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CONTENTS.

Export Trade.

It will be seen from the [illegible] that the export trade for the past year has been highly satisfactory in regard to all branches of manufacture, and shows an increase that was hardly to be expected. In fact, setting aside iron and steel, in which there is a small decline, simply because there is not enough to go around to meet all the domestic and foreign demand, it appears that in the eleven months ending with May, other manufactured exports increased $11,817,[illegible]. In other words, foreign [illegible] of American goods and apparatus is maintained. As to the outlook, it is excellent if alone for the reason that our sorely tried English cousins can now look forward to some relief from the burdens that have hampered but not injured their unflagging energies, and they will now resume the tasks of peace—which means the cultivation of the arts of the economical creation and distribution of wealth and comforts the world over. It will be noted from our Commercial Intelligence that one of the English financial organs echoes our opinions as to the prospect of a large electrical demand in South Africa. In Asia, again, with more settled conditions, the second half of the year opens with brighter prospects, and the fact that we mention as to the construction of the biggest freight steamers in the world for American-Pacific trade, carries with it a significance that can hardly be exaggerated.

Hand Versus Machine Telegraphy.

Elsewhere we print a reply by Mr. J. C. Barclay, electrical engineer of the Western Union Telegraph Company, to the communications which have recently appeared in our columns criticizing—directly or by implication—the technical policy of that company. Mr. Barclay states the case strongly for his company, and even those who will not accept the arguments he advances will doubtless feel that in its new technical head the Western Union Company has a man of force and ability. We very much fear, however, that the rejoinder of Mr. Barclay will not be accepted as conclusive with respect to the criticisms which have been advanced. The two sides to the controversy take diametrically opposite views, both highly colored by prejudice, and on which argument can have little effect. On the one hand partisans of machine methods are upheld by the belief, whether justifiable or not, that while in all other branches of the electrical art progress has been so rapid that every decade has marked a revolution, telegraphy has remained an exception. In accounting for this condition, the requirements of the service receive secondary consideration, the belief being widely held that it is to be ascribed to the conservatism of the two great organizations which control the situation. In these companies they see large and unwieldy organizations perfectly satisfied with the status that from year to year brings forth satisfactory dividends, and which, unmenaced by aggressive competition, naturally oppose resistance to changes which may lead they know not where. They believe that new systems are viewed with a hostile feeling and that unbiased tests are not to be expected at the hands of telegraphers deemed to be uncompromisingly wedded to a system in which they have been trained and which they consider as having reached perfection; in other words, that in their technical personnel the companies are held to the key and Morse, this personnel, unlike that of almost every other branch of modern art, not having opened its ranks to the scientifically trained technician.

On the other hand, Mr. Barclay vigorously maintains that his company seeks every means of improving its apparatus and service, and

he appears to see in his critics merely interested parties disappointed in their hopes of drawing upon the revenues of the company. In intimate touch with a tremendous system that requires a perfect adjustment and most skillful management to keep in a state of efficiency, he naturally resents implications of incompetency and dry-rot. In short, his position is similar to that which would be assumed toward criticism directed at, say, the higher problems in practical alternating-current engineering by one whose acquaintance with electricity does not extend beyond that acquired from academic knowledge of the subject. In this connection we believe due weight has not been given to the fact that while some of those who have taken part in the controversy have not had a training at the key, yet as men of scientific and technical training who have given close thought to the art, their knowledge of the technical side is, to say the least, sufficient to qualify them to discuss the art as practiced by the present companies. In passing, we may say that while we thoroughly agree with Mr. Barclay as to the efficiency of the American systems as contrasted with those of European countries, we cannot see that such a comparison carries much weight in view of the fact that abroad the telegraphs are controlled by the state and therefore almost necessarily kept in the rear of progress. Moreover, the comparison given as to the cheapness of American rates is not happily chosen, for the cheap American message is sent over the wires of one company in the same country, while the European message is subjected to the jurisdiction of several state telegraphs, besides passing through a submarine cable in its course. While in his communication Mr. Barclay may hold out little encouragement to those who would revolutionize the present telegraphic methods of this country, we are optimistic enough to believe that under his technical direction the Western Union Company will not turn a deaf ear to inventors who would submit systems that contain, beside technical merit, promise of commercial applicability.

Electrical Freaks and Fancies.

Sir Thomas Browne, of delightful memory, wrote among other and more serious works, a treatise in Confutation of Vulgar Errors. Therein with a seriousness that now seems fairly whimsical, he combats strange popular superstitions, and holds up to gentle contempt the vagaries of mediæval gentlemen with cerebral "wheels." Were the learned and genial knight now alive and alert to the queer obsessions that beset our own century, he would have new food for thought and fresh material for his pen. It is most marvellous how persistently certain weird inventions crop out year after year and refuse to be put down. Electrical science has long been a sort of culture medium for the bacilli of mild paranoia, and every season the same queer delusions break out, first here, then there, and disappear only to pop up again elsewhere. Some ex-examiner in the electrical division of the Patent Office could collate a most precious collection of examples that would read like a bulletin from Bloomingdale. The perpetual motion crank who once haunted the mechanical field has long since come over to electricity, and instead of the usual automatically, self-unbalancing flywheel, puts up a set of self-energized magnets which lift themselves up by their boot straps in the same engaging old manner. Drawing a limitless supply of "juice" from the earth or air has been a favorite device for a decade past, and like a very short period comet it whisks an elusive tail across the firmament of newspapers on an average of about once a year.

Another old and valued friend, almost as venerable as the mother-in-law joke, is the solenoidal projectile. Sometimes it rises to the magnitude of a railway train like the Portelectric road of a dozen years ago, and again it dwindles to an electromagnetic rifle actuated by storage batteries in the stock, but it is the same dear old plausible freak first and last and all the time. It bobbed up again quite recently in the alluring form of a rifled cannon that spat out an endless stream of armor-piercing projectiles that would range thirty miles and make a Krupp steel plate look like an old-fashioned doughnut. This is interesting, but it is coming the game a bit strong. We would suggest to the next editor who feels tempted to use his long scissors on this particular item that he sits solemnly down in the privacy of his sanctum, send the office boy out for an old arithmetic and figure out the output required for the generating station of an electromagnetic fort. It would make the Niagara station look like a liqueur glass alongside of a beer tun, and Ananias like an irresponsible amateur. Even the lamented Professor Keeley never had a happier inspiration. Yet another worthy competitor for immortality is the dynamo that lights the universe without any output to speak of by shifting circuits so rapidly that the eye does not know it is cheated. We would not dare to say how many times within our memory this simple and beautiful scheme has been dragged out of retirement to browse upon the greenbacks of the unwary.

And many others there are, easily to be found if one takes electrical clippings from a press bureau, and altogether delectable. But their recurrence suggests that the inspiring Muses are on strike, and we pine for something new and original. These old timers are all very well in their way, like the use of electric light carbon stubs as a cure for rheumatism, but an overjaded palate demands something of a richer and more pungent flavor.

The Northwestern Electrical Convention.

To say that the Northwestern Electrical Association held a convention at Waupaca last week would be in accord with the accuracy of statement expected of a technical journal. This summer meeting of the Association was (as was intended and contemplated) more an outing than a convention, all of which is perfectly proper, provided the affair is called by its right name. It has been more evident each year for three years past that if these summer meetings continue to be held they should be designated by some title which would not mislead any supply or manufacturing company to send representatives with any expectations of securing greater prominence or acquaintance among central station men, because the central station men have been conspicuously absent in spite of the fact that they vote to hold these summer meetings in expectation of attending. It appears always to happen, however, that the central station men have urgent business at home about the time of the summer meeting. We would not for a moment be understood as having anything to say against the northwestern supply men getting together to renew acquaintance and enjoy a brief outing every summer. Let the practice be kept up as long as those who wish to attend will go to such gatherings in sufficient numbers to make them worth while. But the name "Convention" should be dropped, for it is deception to the uninitiated, and might lead to the expectation of meeting central station men and a discussion of technical and business matters, which programme is foreign to the recent summer gatherings of the supply men of the Northwestern Electrical Association.

Alternator Regulation.

Some interesting questions have recently arisen in connection with the determination of the regulation of alternators, and the final solution of these questions has not yet been reached. When a small alternator is tested at the factory—that is an alternator of, say, not more than 50-kw capacity—it is not difficult to provide a testing load of adjustable power-factor, and to determine, by direct observation, the inherent regulation of the machine. As, however, the size of the alternating-current generator increases, it becomes more and more difficult to provide a load for the test, and so to measure

the regulation of the machine, while with large alternators, it is practically impossible to make the test under factory conditions. Consequently, when an inherent regulation on non-inductive load of, say, 7 per cent. is specified, it becomes practically impossible to determine experimentally whether the specification is complied with, while the machine is in the factory. Possibly a year must elapse from the date of completion of building, before the full load of the machine can be applied to it under service conditions in the power-house, and even then, since the load is rarely non-inductive, the regulation observed is usually worse than the specified regulation, so that some computation is necessary to refer the observed regulation under a measured power-factor to the deduced regulation under full non-inductive load. It becomes, therefore, of considerable importance to have a satisfactory working theory of regulation whereby such tests may be conveniently applied to an alternator on completion, as will enable its ultimate performance to be deduced. Moreover, the more complete and reliable the theory of the subject, the more closely will designers be enabled to compute the regulation beforehand of machines to be constructed under definite specifications. Such improvements have been made in this direction within the last few years, that whereas the regulation on the 5,000-hp Niagara alternators of 1895 was about 30 per cent., the regulation on recent similar machines of the same size is stated to be about 10 per cent.

The drop of pressure in an alternator armature under load is due to two causes combined, namely, armature impedance and armature reaction. These two elements are similar in some respects, while in other respects they differ materially. The impedance drop is the drop which occurs in the armature coils owing to their resistance and reactance. So far as the resistance is concerned, the armature wire might just as well be removed from the machine, for this component of drop is entirely independent of the excitation. On the other hand, the reactance drop is not only a function of the strength of armature current, in so far as this tends to saturate the armature core magnetically; but it is also a function of the field excitation, and of the shape of the polar surfaces, since the reactance varies cyclically with the rotation of moving parts. Consequently the reactive component of the impedance drop is complicated by the field excitation, and by the lag of the armature current. The armature reaction drop is principally due to the demagnetizing effect of the m. m. f. of the armature upon the magnetic circuit supplied by the field windings; whereby the lag of current in the armature brings their m. m. f. more nearly into opposition to the m. m. f. of the field-coils, and so reduces the resultant m. m. f., and the useful flux cutting the armature wires. This effect is complicated by the degree of magnetic saturation in the iron forming the magnetic circuit.

The total drop is, therefore, essentially a complex phenomenon involving the magnetic behavior of iron, both as to reactance, and as to reactive m. m. f. Any formula which is sufficiently simple to be practically available, must probably be only approximative. The first approximation is to treat the reaction as an extra reactance, as it tends to become, when the iron is well below saturation, and when the polar surfaces are in constant magnetic relation with constant armature reluctance in all angular positions. This is the principle of "synchronous reactance." The armature is driven on short circuit at full rated speed, and the field excitation which will produce full-load current in its circuit or circuits is noted. From this observed excitation the e. m. f. of the armature is obtainable, and thence the apparent impedance of the armature windings, including the effects of both reactance and reaction. This synchronous impedance enables the regulation of the generator to be computed at any load, inductive or non-inductive, on the principle of the ordinary choking coil. This method, however, is subject to several errors. In the first place, the field excitation which will send full-load current through the short-circuited armature is only a small fraction of the full-load field excitation, and consequently effects a much lower degree of magnetic saturation than is met with in the normal operation of the machine. An improvement is, therefore, effected in the test by taking the synchronous impedance at or near full-load excitation, the short-circuited armature circuits then temporarily carrying three or four times the normal strength of current.

An excellent paper on "The Determination of Alternator Characteristics," by Mr. L. A. Herdt, read at the recent A. I. E. E. convention, points out that the regulation computed from full-excitation synchronous impedance is rather low. In a particular 15-kw inductor alternator of 33 per cent. regulation, as observed at full non-inductive load, the regulation computed in this manner was about 43 per cent. Of course, this was a very ill-regulating machine from the station manager's view-point. With a low-excitation synchronous impedance, the error in the method of calculation appears to have been greatly increased, the computed regulation being about 70 per cent. These errors become exaggerated in a machine of this particular type. In the case of a small alternator of the revolving-field type, the observed regulation was 10 per cent. at full non-inductive load, while the computed regulation was 17 per cent. It is generally admitted that the full-excitation synchronous impedance method of computing regulation makes an alternator's regulation appear worse than it really is. On the other hand, if the machine is working near magnetic saturation, the armature reaction tends to act by virtue of opposing m. m. f. rather than as a choking coil. Consequently, it is more nearly correct in such a case to compound the m. m. f. of the armature vectorially with the m. m. f. of field excitation, and attribute the actual internal e. m. f. to the resultant m. m. f. according to the curve of excitation. This is virtually the recommendation appearing under section 71 of the new A. I. E. E. standardization committee's report. This method virtually treats the armature reactance as an armature reaction; or deals with the total drop on the reaction theory. It is generally considered that it tends to the opposite error or to make the computed regulation of an alternator a little better than it really is. Mr. Herdt gives a computed regulation of about 21 per cent., by an essentially similar method, for the 15-kw inductor alternator tested by him, as against 33 per cent. actually observed. He also found about 7 per cent. computed against 10 per cent. observed with the revolving-field alternator.

Mr. Herdt recommends a more refined method following Blondel, which he calls a "two-reactance method." He clamps the armature in two different positions relatively to the field, but in magnetic quadrature to each other, and measures the armature reactance under these conditions, to an externally delivered alternating current while maintaining full-field excitation. This is virtually equivalent to regarding the synchronous reactance as a periodic complex quantity instead of as a constant quantity. By this refinement Mr. Herdt claims a very close approximation between the computed and measured values of inherent voltage regulation. It is, perhaps, doubtful whether the additional complication of measuring the armature reactance in different positions is worth the improvement in accuracy. This can only be determined satisfactorily by accumulating observations on alternators of as many sizes and types as possible. Meanwhile the A. I. E. E. rule may tend to give inductor alternators a slight advantage over revolving-field alternators; but otherwise it seems to give a simple method of arriving at a fairly close computation.

Decision in Transformer Litigation.

Jugde Colt filed an opinion in Boston, July 1, denying a motion for an injunction against the Stanley Electric Manufacturing Company, in a suit for infringement of a patent on transformers, brought by the Westinghouse Electric & Manufacturing Company in the United States Circuit Court, District of Massachusetts. The opinion is reported to be very clear to the effect that there was no infringement, but no copy was obtainable at the time of going to press.

Pacific Cable Offer.

A conference was held at the Navy Department, on June 28, at which Secretary Moody, Rear-Admiral Bradford, and Senator ator Perkins, of California, a member of the Committee of Naval Affairs, were present. A proposition of the Eastern Extension Telegraph Company, acting, it is understood, through the Commercial Pacific Cable Company, has been made by which the company would agree to finish its work of laying a cable across the Pacific Ocean a year earlier than was contemplated, and give this Government the benefit of reduced rates in exchange for the information developed in the surveys made by the United States steamer "Nero," in 1899, for a practical submarine cable route across the ocean.

Organization of Western Independent Telephone Companies.

About forty telephone men, representatives of twenty-four independent telephone exchanges in Eastern Illinois and Western Indiana, held a meeting in Terre Haute, Ind., June 19, for the purpose of arranging a uniform schedule of rates for long-distance business, and to adopt rules for the interchange of business among the various companies. Those in attendance represented exchanges having a total of 7,805 telephones in actual use and $516,400 capital invested. A permanent organization was effected, to be known as the Eastern Illinois and Western Indiana Telephone Association, and the following officers elected: President, Charles Duffin, Terre Haute; vice-president, Dr. J. A. Baughman, Neoga, Ill.; Secretary, C. W. Shimil, Casey, Ill.

Grounding Secondary Distributing Circuits.

BY S. BINGHAM HOOD.

It is with considerable surprise that I notice in recent issues of your journal that the question of the advisability of grounding secondary distributing systems is again before the electrical public. When, after endless and varied disputes, the consent of the National Board of Underwriters was obtained, it was to be supposed that the matter had been decided beyond a doubt.

From my personal experience with a system of distribution having a connected load of over 40,000 lamps, I have reached the conclusion that a grounded secondary is absolutely necessary for the safety and reliability of the system; and, further, that a station superintendent who permits his system to remain ungrounded should be held not only civilly, but criminally liable for any personal or real damage which may result.

In a secondary system ungrounded there is to all intent and purposes a three-gap arrester permanently connected to the circuit: First, that between the primary and secondary of the transformer; second, between the circuit wires in the fixture and the stem; and, last, between the plates of the insulating joints. These gaps are little if any longer than those of any good lightning arrester, and equally liable to destruction.

Any one of these are apt to become unknowingly short-circuited, increasing the danger of a high-tension discharge. Does it not then become necessary to eliminate the gaps that most nearly affect the safety of your consumers? Most assuredly, yes. The only way to do this is to permanently and effectively ground the secondary circuit. The question is now narrowed down to the gap between the coils of the transformer. If the factor of safety in the system is so low that the change from a possible ground to an actual ground will endanger the apparatus, then such appliances should be ungrudgingly consigned to the scrap heap. With the old type of air-insulated transformers these "possible" grounds undoubtingly were responsible for the inglorious interment of many of them in the electrical grave yard.

The entry of the oil insulated type, together with a better understanding of the conditions to be dealt with, has largely removed the dangers from the last gap in a safe and reliable system. With oil insulation the punctures probably do frequently occur, but any arc is immediately smothered by the oil, and an insulation again establish, practically as good as at first; the only indication of trouble having existed being a primary fuse blown from no apparent cause.

It is not only possible, but entirely practical, to eliminate this last gap by grounding the primary distributing system. With a three-phase, four-wire system, grounded at the middle of the star, or a two-phase, two-wire distribution, grounded on the B-wire, it is far easier to keep the system free of accidental grounds than that of one presumably clear, but probably covered with high-resistance grounds, paving the road to innumerable petty troubles which are the station man's bore.

True, the danger of handling a permanently grounded primary system is greater than that of a clear network, but it is far easier to avoid a known danger than one not known, which becomes a veritable death trap. The greatest problem to solve is what constitutes a "permanent and effective" ground. The writer's experience has been that a driven pipe in ordinary soil is practically useless, the resistance of a 1 inch galvanized pipe driven 6 feet, varying anywhere from 20 to 80 ohms, depending on the condition of the weather and nature of the soil. Further tests show that pipes of this size, after having been driven about five or six years have increased in resistance to as high as 200 ohms. A copper plate or coil of wire, buried in coke or charcoal, placed in the bottom of a hole, before a pole is set, is about as good a ground as can be obtained, unless connection can be made directly with a water or metallic drain pipe. The resistance of such a ground seldom is over 10 ohms.

An accidental ground on a consumer's premises seldom occurs, except on a branch circuit, which is presumably protected by not over a 10-ampere fuse. An effective ground, therefore, must be of such low resistance as will instantly blow this fuse, should the ground occur on an opposite leg from that permanently grounded. Assuming the ground connections of the system to have an average resistance of 10 ohms, it is then necessary to have at least two plates in good condition on each network, and possibly double this number, to allow for unexpected increase of resistance of either the permanent or accidental grounds. The best policy is to ground the system at every possible chance, as each ground becomes an additional ounce of prevention.

To successfully carry out this idea, it is necessary to have the transformer secondaries interconnected wherever possible. The writer's idea is to carry from the station a primary circuit of about 100 kw per phase, feeding a secondary system of the same capacity, entirely interconnected; making, as it were, two parallel planes, one above the other. There will, of course, be locations where this secondary cannot profitably be extended to the outlying scattered points, but to offset this there will be places where the secondary may be extended slightly beyond the primary network.

A necessary adjunct of a system of this kind is a low-potential cut-out on the ungrounded legs of each transformer, and at main distributing points. These fuses are considerably heavier than necessary for the normal current they are supposed to carry, as they are only supposed to blow in an extreme emergency; in which case they have the entire capacity of the balance of the system to help them do their work.

The objection is raised by some engineers that in a system thus interconnected, there is no way in which to tell when a fuse is out on either side of a transformer. This is very true, but, strange as it may seem, it is very rare that a fuse does blow on these networks; even in severe lightning storms, where individual transformers have the fuses repeatedly blown, seldom is one blown on the large networks. A systematic inspection with a lamp can be made of each transformer at frequent intervals, at a cost of almost nothing compared with the other advantages of a carefully laid out network.

To make a success of these systems, it is necessary to have all the lines, both primary and secondary, in first-class condition, and above all, kept that way. Many plants have made a success of these widely distributed networks, and I think I can unreservedly say, they can point with pride to their outside constructions, either overhead or underground.

To those who have met with failures, let me say in conclusion, look to your lines and your lamps will take care of themselves.

Electricity at Manaos, Brazil.

BY CHAS. S. SEIBERT.

WITH the exception of Sao Paulo, there is probably no city in South America where a greater amount of money has been invested and more activity displayed in electrical matters than in Manaos. This city, which is situated on the Rio Negro, ten miles from the Amazon, has the largest trade of any city in Brazil, except, perhaps, Santos, with New York, and yet it is but little known, owing to its peculiarly isolated position. It is a city in the wilderness, surrounded by hundreds of miles of trackless forest; communication with the outside world being by means of steamers only, although the Amazon River Telegraph Company, which is building a land line from Manaos to Para, is at present making heroic efforts to maintain communication with Para, for the time being, with a submarine cable. The strong current, the shift-

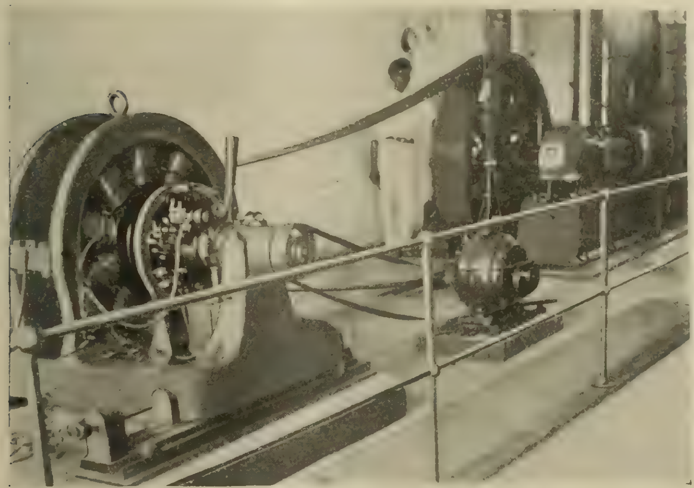


FIG. 1.—VIEW OF POWER PLANT.

ing river bed, ships' anchors and the immense amount of water-logged timber in the river interrupt this service continually.

This is a great hardship for the business people of the city, as Manaos ships by far the largest part of the Amazon rubber, and a cable breakage means ignorance of the selling price of rubber in New York and Liverpool. In order to fully realize the importance of the rubber trade, it may be well to state that during 1901 Manaos shipped 8,736,268 kilos of rubber to Europe and 8,089,516 kilos to New York, and that there are twenty business houses in the city acting as exporters of this product. There is but one steamship line from New York to Manaos; the freight rates on rubber are about $10 per ton, and steamers sometimes leave Manaos with as much as 800 tons of rubber aboard. A very large amount of other freight is carried between New York and Manaos.

About six years ago a New York rubber importer secured a contract for building an electric light station for Manaos; the plant at first consisting of three combination fire and water-tube boilers, one tandem-compound 150-hp McIntosh & Seymour, automatic, high-speed engine and two 125-light Brush arc machines belted thereto. Upon the completion of the plant the operation of the same was turned over to the contractor, the city paying seven mil reis, or about $1.60, per night for each arc lamp, and no fines being imposed unless the plant should be inoperative for more than one hundred hours each month. Soon after the contractors increased the plant, so at present, in addition to the above mentioned machinery, it contains two Babcock & Wilcox water-tube boilers, a similar engine to the first, a 50-light Brush arc machine and an 80-kw single-phase General Electric alternator; also a feed water heater and a jet condenser. In addition to supplying light for the city streets this plant operates about seven or eight hundred incandescent lamps, giving an all-night service.

This being the first electric station to be erected in Amazonas, some serious errors were made in the selection of materials and in installation. The circuits are carried on iron poles, four inches in diameter, and nearly all of these poles are so eaten and corroded where they enter the ground that they very often fall down, causing annoying interruptions. The operation of the station is also often necessarily intrusted to native labor, with the result that there are frequent shut-downs, the causes running from hot crank-pins to failures of boiler feed pumps and [illegible] armature coils. While these things occur frequently, it is [illegible] any reflection on the builders of the machinery, but rather a misfortune for the station management that their machinery contains too many refinements to be intrusted to ignorant labor.

In strong contrast to the results of the municipal station are those obtained by the Manaos Railway Company, which operates 15 miles of single track road in the city. This station consists of a hollow brick and skeleton steel structure, divided into engine and boiler room, and a separate car-shed and repair-shop. The boiler room contains four Aultman & Taylor water-tube boilers, served by a substantial steel stack and a duplicate set of boiler feed pumps. From the boilers bent risers drop to an underground main, from which risers pass up through the floor of the engine room, and with a sweep of large radius enter the engines from the top.

The engine room is spanned by a hand-operated traveling crane, and contains the regulation street railway switchboard and three direct-connected generating sets, each of 200 kw. The engines are of Payne manufacture, tandem-compound, center-crank, operating at 225 r. p. m. They are equipped with the regular Payne gravity system of lubrication. They are run condensing, when the river is high enough for sufficient water to be obtained, a jet condenser being used. The dynamos are of Walker manufacture. Only two generators are run at one time, the other being held in reserve.

The car-shed contains storage tracks for about 30 cars, several motor pits and the repair-shop. Several electrically-driven machine tools are used, the company making its own motor and engine repair parts. The number of cars operated is in the neighborhood of 20, the fare being about five cents for two miles.

Five different routes are covered, one line running out into the forest for six miles. The track is narrow-gauge, laid on steel ties, and for the most part is in excellent condition. The company is subsidized by the State of Amazonas, and has an exclusive right to all freight and passenger traffic for 30 years.

The third electric company operating in the city is that of the Empreza Ventiladeros Electricos. This station furnishes electricity

FIG. 2.—VIEW OF DYNAMO AND SWITCHBOARD.

for general use, and at present operates some one hundred or more electric fans, 40 enclosed arc lamps, electric motors applied to various machines, such as coffee mills, sewing machines and printing presses, electric irons, etc. Between 300 and 400 incandescents also are operated. The company is at present installing electric power in the State printing office, which will drive presses, rolls, paper cutters and folders. Single-phase Wagner motors are being used, belted to the presses and other machines, through countershafts. In the case of the larger presses, Evans friction cones are used for speed regulation.

This company's station is not at present complete, it being neces-

sary to proceed slowly, as electric power is a complete innovation. Therefore the company decided at first to install only the machinery necessary for actual operation.

The station consists of a brick building 45 ft. x 35 ft., divided into an engine and boiler room. The boiler at present in use is of the internally-fired, marine type, 7 ft. diam. by 14 ft. long, with a 40-in. corrugated Morrison fire-box and 101 3-in. tubes. It has 750 square feet of heating surface, and it is served by a steel stack 70 ft. high. Water from the city mains is used for boiler feed, and there is both a pump and an injector provided for boiler feeding. The engine is a Harrisburg Standard, compound, 9½ in. and 15½ in. by 11 in. stroke, taking steam at 120 lbs. gauge pressure, and operating at 282 r. p. m. Its rated horse-power is 100; its flywheel, 6 ft. diameter, and it is equipped with the Ideal self-oiling system, which has proved truly ideal for cases where the engine oiler is more often found asleep than awake. The engine is run high-pressure, no condenser being used.

The dynamo is a single-phase, 1,100-volt, revolving-armature alternator of General Electric manufacture. The switchboard is of gray Tennessee marble, and consists of a standard General Electric single-phase alternator panel and a feeder panel equipped for three feeder circuits. The overhead line construction of this concern is first-class, the poles being of pitch pine, octagonal, creosoted and asphalted, and all wires are supported by pitch pine cross-arms and Imperial porcelain insulators. It is interesting to note that the poles which have been up for nearly a year show not the slightest indication of decay at their bases, while iron poles begin to rust immediately, and in two years are unfit for use.

This company has had its plant in operation from 10 A. M. to 10 P. M., since November, 1901, and up to the present time the only interruption of current has been on the sub-feeders, and has happened twice, both times being caused by employes of the telephone company short-circuiting the lines, once by deliberately twisting the wires together and the other time allowing a heavy iron pole to fall across the lines of this company, the electric light company and the telegraph company.

No description of electrical development in this section would be complete without mentioning the work of the Amazon Telegraph Company. As before mentioned, it is of the utmost necessity for Manaos to have telegraphic communication with New York and Liverpool, and for this reason it is not surprising that the telegraph people are going to immense expense to maintain communication. A cable ship, the "Viking," of about 3,000 tons, is constantly moving up and down the river, with a trained corps of engineers aboard, proceeding instantly to the scene of a located or expected trouble; but in spite of this the cable is sometimes interrupted for 20 days at a time. The strong river current, the shifting bed, immense water-logged tree trunks rolling along the bed of the river and ships' anchors all combine to break the cable, and a land line through the impenetrable forest is a gigantic task. This, however, is being slowly constructed, and is put to good use when a break in the submarine line occurs, steam launches piecing out the parts of the route which the lines do not cover.

It would certainly seem, however, that here is a place where the wireless telegraph could be put to good use. Stations could easily be located wherever necessary, and the writer sees absolutely no difficulty in the way, provided the governments of the States of Amazonas and Para raise no objections. This matter is certainly one which it would be worth the while of some go-ahead American capitalist or promoter to investigate, as uninterrupted communication would be cheerfully well paid for by Manaos business interests.

Postal Telegraph Extensions.

It is stated that the Postal Telegraph Company will extend its lines over the whole of Long Island. At the present time the company only has isolated stations at the summer resorts. The contract of Long Island Railroad with the Western Union has still some time to run, but it is stated that it will not be renewed, and that the Postal will be installed on the lines when the present contract expires. The Postal Telegraph Company is already installed on Staten Island, at Quarantine, Atlantic Highlands and the Jersey coast. It is said that the Pennsylvania Railroad has also notified the Western Union that the contract on the lines west of Pittsburg will not be renewed. These contracts, which have some time to run, cover the Baltimore & Ohio, Western New York & Penna., Pittsburg, Fort Wayne & Chicago, Panhandle and Pennsylvania railroads.

Long-Distance Wireless Telegraphy and Hertzian Waves.

By Lee De Forest.

SINCE the advent of wireless telegraphy so much loose terminology has crept into the popular literature on the subject by writers partially informed that it is not strange to note the confusion of ideas indicated in the article of Mr. E. P. Thompson, appearing in your issue of June 14.

For a correct definition of the term "Hertzian waves," nothing better can be recommended than a careful study of Hertz's work. While true that the German physicist's most startling demonstration was that of the existence of free electromagnetic waves in the ether, as called for by Maxwell's theory, identical save in frequency with polarized light waves, yet it was only by "electrical oscillations" in conductors that these Hertzian waves were generated, and only again by the electrical oscillations induced in his resonators by the free ether waves that the existence of these latter was demonstrated. Hertz was first to show that these very high frequency oscillations traveled along conductors, that they existed in the skin of the metal only, that they were reflected, formed standing waves with nodes and loops, that their energy was in turn electromagnetic and electrostatic, that in the limiting case of an infinitely thin wire of perfect conductivity the pure etheric wave of transverse electrical displacement, with a velocity of propagation equal to that of light, was obtained.

By common consent, then, such vibrations detached or traveling over a conducting surface have most appropriately been styled Hertzian waves. Most certainly also they are "oscillating currents" when traversing conductors. This was Hertz's demonstration. Oscillations from a Leyden jar discharge, of frequency much less than those from Hertz's radiator, are sometimes called Federsen oscillations. Obviously the border line cannot be defined. But when an electrical system discharges, having so small a time constant that the pulsations occur at a rate of millions per second, we have very different conditions from those ordinarily classed with alternating or oscillatory currents. A large portion of the energy is electrostatic, and the force there involved may be conceived as lines of electric displacement perpendicular to the conducting surface, traveling along it away from the source of energy, following any zig-zag path, rounding corners, reflected wholly or in part at all such sudden changes in shape or nature of the conductor.

If near the end of a wire conducting these electrical waves a second wire parallel to the first be placed, the wave train will be in whole or in part transferred to the second wire, and will run along that unchanged in phase. If the second wire or a metallic sheet be near the first and *perpendicular* thereto, the electrostatic line of the wave cutting into this obstruction will excite therein oscillatory currents or waves of like frequency, which will in turn traverse the length and breadth of this second conductor.

These peculiarities, which may be briefly described as the "skin effect," due to the high frequency of the oscillations, should amply distinguish from the alternating currents of ordinary engineering parlance.

Aside from simplest theoretical reasoning, the period of discharge of a vertical conductor to earth has been actually measured and found to be such as to make its height measure, approximately, one-quarter of the wave length of that oscillation. For a vertical wire of 50 meters, this means a frequency of 1,500,000 per second, assuming a velocity of propagation nearly that of light. In the laboratory with such frequencies we find all the wave phenomena and skin effect described above. Why not then in wireless telegraphy? We have a conducting plane surface, the sea, perpendicular to the oscillator at its base. Our lines of electrostatic displacement cannot penetrate this conductor; they must travel over it, be its contour what it will. By virtue of the tall oscillator, the crests or loops of these displacement lines have been first well elevated (if the expression may be allowed). A hundred or a thousand miles distant is a second elevated conductor, say at an angle of 90 degrees to the first, perhaps at an angle of 45 degrees with the sea surface. Nevertheless, it has a vertical component, such as must cut out a shadow in the advancing vertical lines of force. Oscillatory currents or Hertzian waves are excited in this conductor by the cutting into it of these static lines, positive and negative; and a sensitive detector inserted in this conductor, whether it lead to

earth, capacity or to a symmetrical oscillator system, will be affected by the passage of the wave.

In speaking of oscillating currents carried by the conducting salt water, it may be well to remember that with such frequencies as we have here, our "conductor" has been well proven completely opaque, and that only by such phenomena as the above can transmission occur.

The New Generating Plants of the Niagara Falls Power Company.* —I.

By H. W. Buck.

The growth of the applications of Niagara Falls power has been so rapid since the starting up of the first power house in 1895 that the entire 50,000 hp of the first plant has been taken up to its limit. This growth was anticipated by the company three years ago, when the hydraulic development of a second plant was started under way. This plant is nearly completed, and within a few months the first generator of its equipment will be performing useful work.

This power house, from a popular standpoint, may be considered a duplicate of the old one, with which every engineer is familiar, and differs only in some of its technical details. It is located on the opposite side of the intake canal, and nearer to the river, and has its water-wheels placed at the bottom of its own separate wheel pit. Discharge water is led out from this pit by a branch tunnel, which after leading independently for about 600 feet, joins the main tunnel, which, as is known, has a capacity of 100,000 hp. The new turbines are somewhat different from those in power house No. 1, being of the internal discharge type, and having the discharge water carried off through draught tubes, which add about 10 per cent. to the effective head. This increase in efficiency gives 10 per cent. more power for the same amount of water used in power house No. 1, and in consequence the plant is laid out for 11 units of 5,000 hp each, instead of 10. The turbines were designed by Escher, Wyss & Co., of Zurich, and were built by the I. P. Morris Company, of Philadelphia. The governors were also designed by Escher, Wyss & Co., and are being built by A. Falkenau, of Philadelphia. They are of the oil-pump operated type, and give a maximum variation of speed of about 5 per cent., with 100 per cent. load variation, and for fractional changes in load the regulation obtained is about the same as that of a good steam engine.

The electrical equipment is furnished throughout by the General Electric Company. In general, its characteristics are the same as in the apparatus in power house No. 1. The generators are of 5,000 hp each (3,750 kw), wound for 2,300 volts, two-phase, 25 cycles at 250 r. p. m. This type was decided upon on account of its exact interchangeability with power house No. 1. It was considered that the advantages which might result from winding the new generators for a higher voltage would be more than offset by the lack of interchangeability between two power houses located so near together as to be governed by the same conditions.

Electro-technically, power house No. 2 differs in several essential details from the installation in the old plant, the differences being due largely to the advance of the art since the time when the first power house was equipped. The main points of difference are:

1. Closer generator regulation, the regulation on the new machines being 10 per cent., and on the old ones about 30 per cent.

2. The entire plant will be operated from a single switchboard instead of two.

3. The feeders will be protected with automatic oil circuit breakers.

GENERATORS.

The first six generators to be installed will be similar in outline to those in the first plant, being of the external field type, with the nickel-steel revolving magnet ring. This machine is shown in assembly in Fig. 2. In appearance the most striking difference is in the omission of the iron bridges over the machines. This omission results from the collector rings being placed at the bottom of the dynamo shaft instead of the top.

As stated above, the principal difference in these new generators is in the matter of regulation, the regulation being nearly three times as close. This closer regulation was adopted in order to insure constancy of voltage on the system with variations in loads and also to reduce to a minimum the unbalancing of the voltages on the different phases caused by difference in loads upon them. These points are of great importance on such a system as that of the Niagara Falls Power Company. Many electrical distribution systems are made up of a very large number of small consumers of power, and the actions of any one customer have little effect upon the voltage of the system; consequently, in such cases regulation is not of such vital importance. But the Niagara Falls system is made up of a comparatively small number of very large consumers of power, any one of whom can, by a change in his load, cause a serious disturbance on the circuits. Furthermore, it is unique in one of its charac-

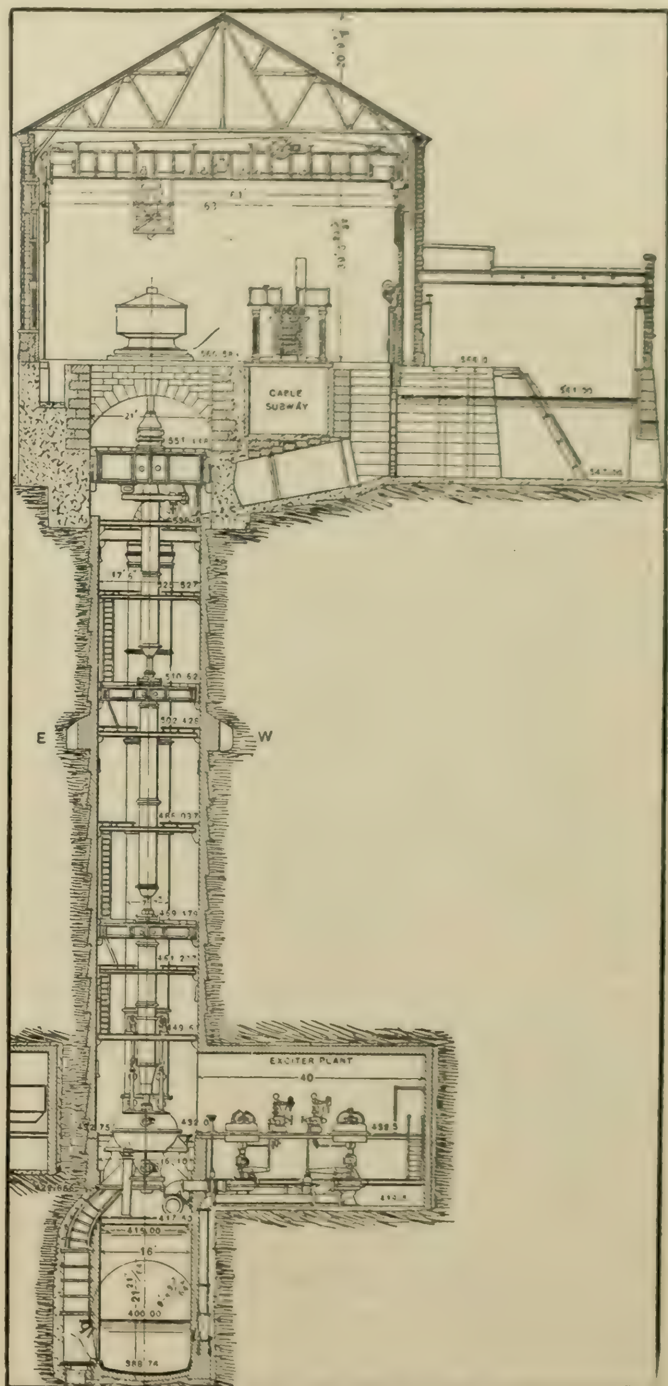


FIG. 1.—SECTION OF POWER HOUSE NO. 2.

teristics in that much of the power is used on large single-phase electric furnaces, which take their power from one phase only. Since it is impossible to control these furnaces so that at all times the same number shall be in operation from each of the two phases, inequality of load on the phases results, and the voltages are unbalanced. This unbalancing is disastrous to polyphase synchronous and induction motors on the system, for the high voltage phase tends to carry all the load, and the windings on this phase are overloaded. These results can be rendered inappreciable only by the use of generators of close regulation.

The armature winding is a two-circuit series closed winding, and

*A paper presented at the Great Barrington Convention of the American Institute of Electrical Engineers.

consists of formed one-turn coils placed in open slots, with two coils to a slot. The conductor is made up of standard cable pressed into rectangular shapes. This stranding of the conductor reduces eddy current losses in the armature conductor itself, which exist in the case of a large solid bar, as used in the old machines. The open slot is also considered an advantage in a machine of such great length of armature core, for in the closed slot it is necessary to drive the armature bar with its insulation on throughout the length of the slot in order to put it in place. The system used in the new machines of interlacing the end windings gives strong construction to withstand the displacement strains caused by short circuits.

The system of ventilation is radically different in the new machines. Referring to Fig. 2, a baffle plate will be seen between the

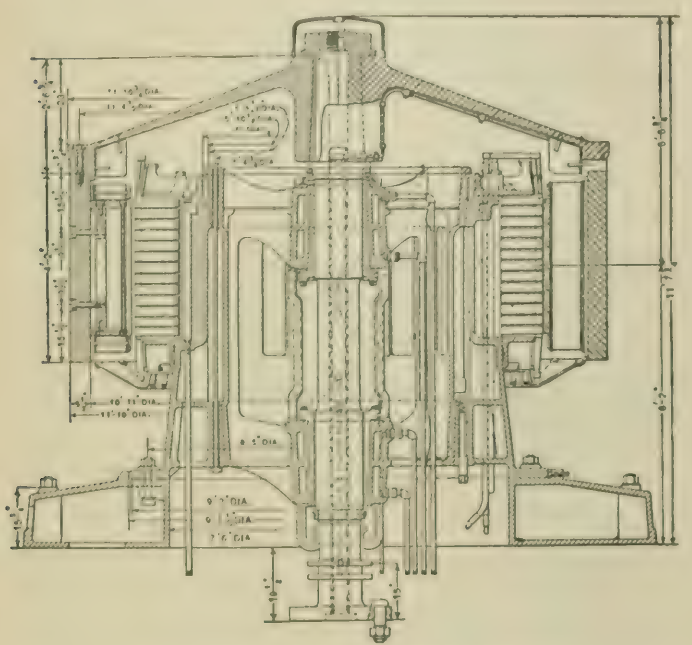


FIG. 2.—EXTERNAL FIELD OF 5,000-HP GENERATOR.

bottom of the armature winding and the bottom of the revolving field. This forces all the air which is actuated by centrifugal pressure to enter the machine at the bottom inside of the armature shell. From here the air passes outward through the air ducts in the armature core, cooling the iron and the winding. It then con-

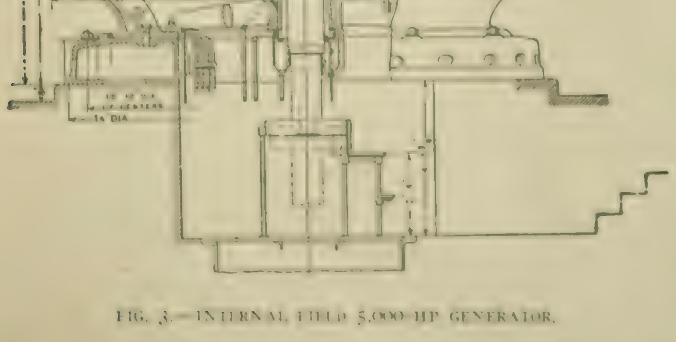


FIG. 3.—INTERNAL FIELD 5,000-HP GENERATOR.

tinues outward radially between the layers of the field winding into an annular space at the back of the field coils, and thence outward through holes in the magnet ring, which are bored in line with the pole piece bolts. The action is that of a centrifugal blower caused by the rotation of the field poles and ring. Some of the air also passes outward at the top of the ring through ventilating holes provided for the purpose. The operation of the air system is very satisfactory, and the blast of air secured is tremendous. From tests which have thus far been made, it is believed that these machines will run from 10 deg. to 15 deg. cooler than the old ones. These improvements in design were introduced by Mr. W. L. R. Emmet, of the General Electric Company, with the co-operation of Mr. H. G. Reist.

The generator equipment in this power house is completed with five 5,000-hp machines of the internal revolving field type, shown in Fig. 3. It was decided that the last five machines of the installation should be of this type on account of the much lower cost of building, simplicity of handling and accessibility to the various parts as compared with the external field design. These machines are also wound for 2,300 volts, 25 cycles, two-phase, and operate at a speed of 250 r. p. m.

These machines will have the same regulation as the first six installed, and in other respects the electrical constants will be the same. From the drawing in Fig. 3, the construction may be clearly seen. It is similar to the standard horizontal shaft engine-driven alternators of well-known types, and its method of ventilation is the same. Recent improvements in mechanical construction of generators have made this type possible at the high speed of 250 r. p. m., and improvements in water-wheel governors have made permissible the lower flywheel effect incident to this design, and the consequent omission of the nickel-steel ring of the first machines.

In the two power houses, then, there will be three types of generator, but no trouble is expected in operating all the machines in parallel. As is well known, when two alternators of different regulation operate in parallel, the resultant regulation is the mean between the two. Idle current between the two types may be prevented by careful adjustment of the field currents.

The guaranteed efficiency of the external field generators was:

Full load	98 per cent.
Three-quarter load	97.3 "
One-half load	96 "

From actual test, the full load efficiency has come out 98.15 per cent, which is probably the highest ever attained in an electrical generator.

Export of American Manufactures.

It appears from the statistics just issued by the U. S. Treasury that the exportation of manufactures during the eleven months ending with May, 1902, is greater than that of any preceding year, except in iron and steel. The total exports of manufactures for the eleven months ending with May amount to $371,647,609, against $378,533,496 in the eleven months of 1901, or $6,885,887 less than those of last year. The exports of iron and steel manufactures for the eleven months are $90,780,571, against $109,483,827 in the corresponding months of last year, a reduction of $18,703,256. From this it would appear that the exports of manufactures other than iron and steel are $11,817,369 greater than in the corresponding months of the preceding year. The exports of manufactures other than iron and steel are, for the eleven months ending with May, 1902, $280,867,038. For the eleven months ending with May, 1901, they were $269,040,669. For the eleven months ending with May, 1900, they were $283,050,704, but when it is remembered that these figures include the exports to Porto Rico and Hawaii, which are not included in those of 1901 and 1902, it becomes apparent that the exports of manufactures other than iron and steel in the eleven months of the present fiscal year are greater than those for the same period in any preceding year in this history of our commerce.

Products of	1902.	1901.
Agriculture	$805,622,656	$884,424,015
Manufactures	371,647,600	378,533,496
Mining	36,190,756	35,626,488
Forests	43,330,716	49,472,249
Fisheries	7,440,629	7,454,347
Miscellaneous	5,069,192	4,447,939
Total domestic	$1,269,310,568	$1,350,959,435

The above table shows the exports by principal classes during the eleven months ending with May, 1901 and 1902, respectively.

The Wolverhampton Exhibition.

By Cesare Pio.

The Wolverhampton Exhibition of Arts and Industries, though formally opened on May 1st by the Duke and Duchess of Connaught, for some time later was in an incomplete state, most of the exhibitors being engaged in placing their apparatus in the machinery hall, where a crowd of wiremen, fitters, etc., have been engaged in laying cables and putting together parts of dynamos and engines.

The machinery hall measures 350 ft. x 130 ft., and is of rather heavy design, wood being mostly used on its construction. Here are exhibited the latest products of English electrical manufacturers, there being few or no foreign machines or apparatus. Some of the large firms, such as the British Thomson-Houston and the British Westinghouse Company, are also not represented by exhibits. A feature of the exhibition is that the committee would not accept any proposal that would not give all exhibitors an equal opportunity of showing their generators in operation, and thus there is no large central operating plant.

While the distributing circuit for power and light is a single one, and has been laid by the British Insulated Wire Company in triple concentric cable, the firms whose generators are going to feed the same in turn are up to the present time eight, and all the necessary changes of connections as well as the regulations of generator is controlled by an up-to-date switchboard installed by the Ferranti Limited. For the distribution of light and power the three-wire underground system direct-current system with the neutral grounded has been adopted. The voltage used is 500 between the outer cables. Here it should also be noted that the committee did not give the contract for the laying of cables and for the wiring of buildings to a single firm. The British Insulated Wire Company installed the triple concentric cables. The wire for the arc light circuits inside the buildings has been supplied by Messrs. Isidor Frankenburg, Limited, and that for the circuits in the grounds of the exhibition, which are run overhead, is composed of a single strand of bare aluminum wire installed by the British Aluminum Company. The indications point toward aluminum being applied on a large scale in Great Britain. Power is supplied free of cost to all exhibitors.

The exhibits show a marked tendency toward high speed and vertical engines, the engines being in all cases of the enclosed type. This is the general tendency all over the United Kingdom, as has been shown in the plants installed by English manufacturers at other exhibits of the past few years, and, notably, at the Glasgow exhibition last year. It may be noted that this feature is in contrast to what may be seen at the exhibition now being held in Germany, at Dusseldorf, where the most of the engines used, according to the general practice followed on all plants in Germany, are of the horizontal slow-speed type of from 100 to 80 revolutions.

All parts of the engines exhibited are thoroughly enclosed, and a complete system of forced lubrication is applied to all moving parts. The advantages of this enclosed type of high-speed engines now generally used in Great Britain include reliability of working and avoidance of the element of danger involved through an engineer in reducing the cost of oil to a minimum; it also excludes entirely the possibility of oil thrown on the dynamos from the draught caused by the dynamos themselves. On all the sets exhibited the high finish of all the different parts of the machinery is notable. This is striking to engineers used to American practice, which gives finish only where it is really necessary. But, perhaps, in this country it is found that well finished machinery gets well looked after by the attendants, who take more interest in an engine and dynamo that looks well when it is clean than when of roughly finished work that barely shows whether it is clean or not.

Though, as above stated, the alternating current does not play a leading role, note should be made of a three-phase rotary converter of 100 kw, exhibited by the Electric Construction Company, in addition to several direct-current machines and some small transformers. This converter is, perhaps, one of the first built in England by English manufacturers, and looks very neat and well ventilated. Instead of copper bridges, only copper strips, bolted between the pole pieces, are used to prevent hunting. Unfortunately, it is not in operation, so that nothing can be said of its running qualities. The Electric Construction Company has a machine of the same design in full operation at its works in Bushbury, and the company has extended invitations to all especially interested to visit its shops, and also see this rotary in operation.

The English Electric Manufacturing Company exhibits a compound-wound generator, developing [illegible] volts at [illegible] volts. The general lines are evidently those of the Walker generator. It may be mentioned that Prof. S. H. Short is the chief engineer and designer of this company.

A series of very well ventilated three-phase motors of light design is exhibited by D. Bruce Peebles & Co., of Edinburgh. One of these motors drives a Barclay pump, and it is worth mentioning that the friction of the different parts of the motor and gears is almost negligible. This firm has the past four years been building direct-current machines of a finish and accurate construction to compete wth the largest manufacturers of the Kingdom, and a striking instance is a 300-hp direct-current motor geared to a shaft intended to operate all the tools of a big shop. A novel feature of the same exhibitors is their alternating-current, high-tension standard panel. Everything is on the back of the marble plate except the levers which operate the quick-break switches secured on the girders on the back. The measuring instruments are so located that only the dial is at a level with the front of the panel. The general arrangements gives a very neat and simple appearance.

The switchgear and the switchboards exhibited by the different manufacturers show a tendency, (1) to simplify the complicated boards of the former years; (2) to follow the American practice of low panels easily put together, taken apart and shipped; (3) a general use of the quick break spring switch. In many cases, however, switches and apparatus are mounted on a small slate or marble panel, which is then bolted to the main panel of the board, instead of having the switches and other apparatus directly bolted to the main panel. This seems to one an extra expense and does not improve the appearance of the panel.

A conspicuous and interesting object to electrical visitors is the switchboard located on the center of the hall, from which all the power and light of the exhibition is controlled. This switchboard, installed by Ferranti, is of an entirely original design, and its features are quite different from those met on the usual system of switchboards. The switchboard is so constructed that fire risks are minimized by avoiding the use of inflammable materials and by the provision of an improved arrangement of connections. In all possible cases the number of connections are reduced by carefully fixing the positions of the various apparatus used on the board; cross connections and long leads are also similarly avoided. All the different apparatus, fuses, etc., are separated from each other by slates so that the formation of an arc between two leads is impossible. One is surprised in approaching such a switchboard, which at first seems complicated, to note the real simplicity, and particularly the advantage of seeing at a glance all the connections. The fuses are of the oil spring type and are easily replaced. Light feeder-panels are on the extreme right of the switchboard, each three-wire feeder panel consisting of two ammeters, two single-pole switches and two sets of fuses.

The switchgear for the balancer is mounted to the left between feeders and dynamo panels. The balancer starting switch is located in front of the board. On the left-hand are situated eight generator panels which can be distinguished by the two different types of switches used; the positive side being arranged with an automatic attachment, the negative having fuses. Each of these generator panels contains an ammeter and a quick-break switch, which is operated by an automatic device (designed to open the machine circuit on reversal of the current), which is fixed in a recess under the switch, with a fuse with duplicate contacts. Edgewise voltmeters are mounted on the top slate for paralleling and for reading plus bar volts. The regulating table in the front contains a switch in the field circuit of the dynamos, and a hand-wheel for regulating the pressure across the terminals of the machine.

This type of switchboard is now standardized by Ferranti, and besides minimizing fire risks such a construction gives greater security to the operators and less chance of dangerous shocks and burns. This firm exhibits also much other apparatus, including wattmeters and transformers.

One of the really good features of the exhibition is the surface contact railway, equipped on the Lorain Steel Company's system, which was opened to the public traffic on the day of the inauguration of the exhibition. The cars are running smoothly and satisfactorily, and no accidents of any kind due to live studs have happened; the

sparking between collecting bar and studs is reduced to a minimum, and leakage is not perceptible. The only trouble will probably be the cost of maintenance, due to replacing studs and collecting bars, which seem to wear rapidly. On the system installed here in Wolverhampton, Mr. Kingsland added an improvement, by which the stud is put into a special concrete block, and there are special facilities for taking out the steel or wearing portion and replacing it in a very few minutes.

Marconi on Wireless Telegraphy.—I.

On June 13, Mr. Marconi delivered an address before the Royal Institution, London, on "The Progress of Electric Space Telegraphy," in which he reviewed the art from the commencement, and with particular reference to his own work. After referring in general terms to the subject of signalling through space, he said that the mathematical and experimental proof by Clerk Maxwell and Heinrich Hertz of the identity of light and electricity and the knowledge of how to produce and detect certain previously unknown ether waves, made wireless telegraphy possible. But the importance of the discoveries of Maxwell and Hertz was realized by very few, and even perhaps so recently as a year ago a great number of scientific men would have hardly foreseen the advances which have been made in so brief a time in the art of space telegraphy.

Mr. Marconi then briefly described his system, as used in the early experiments of six years ago, and afterwards explained the various improvements and modifications which have since been introduced into it.

The transmitter consists of a modified form of Hertzian oscillator, the main feature of which is in having one sphere of the spark discharger earthed and the other connected to an elevated capacity area or to a comparatively vertical wire. The two spheres are also connected to the ends of the secondary winding of an induction coil or transformer. When the key is pressed, the current of the battery is allowed to actuate the spark coil, which charges the spheres and the vertical wire, which when discharging causes a rapid succession of sparks to pass across the spark gap.

The sudden release caused by the spark discharge of the electrical strain or displacement created along certain lines of electric force, through space by the charged wire causes some of the electrical energy to be thrown off in the form of a displacement wave in the ether, and as a consequence the vertical wire becomes a radiator of electric waves.

Lord Kelvin showed mathematically more than 40 years ago the precise conditions under which such a discharge as here considered would be oscillatory. It is easy to understand how by pressing the key for longer or shorter intervals it is possible to emit a long or short succession of impulses or waves, which when they influence a suitable receiver, reproduce on it a long or short effect according to their duration, in this way reproducing the Morse or other signals transmitted from the sending station.

The receiver consists of a coherer, placed in a circuit containing a local cell and a sensitive telegraph relay acuating another circuit which works a trembler or decoherer and a recording instrument. In its normal condition the resistance of the coherer is infinite, or at least very great, and the current of the battery cannot pass through it to actuate the instruments; but when influenced by electric waves, the coherer becomes a comparatively good conductor, its resistance falling to between 100 and 500 ohms. This allows the current from the local cell to actuate the relay, which in turn causes another stronger current to work the recording instrument and also the tapper or decoherer, which is so arranged as to tap or shake the coherer, and in this way restore its sensitiveness. The practical result is that the circuit of the recording instrument is closed for a time equal to that during which the key is pressed at the transmitting station, and in this way it is possible to obtain a graphic, acoustic, or optical reproduction of the movements of the key at the sending station. One end of the tube or coherer is connected to earth and the other to an isulated conductor, preferably terminating in a capacity area similar in every respect to the one employed at the transmitting station.

Mr. Marconi said he noticed that by employing similar vertical rods at both stations it was possible to detect the effects of electric waves, and in that way convey the intelligible alphabetical signals over distances far greater than had previously been believed possible, and by means of similar arrangements distances of transmission up to about 100 miles were obtained.

It was soon, however, realized that so long as it was possible to work only two installations within what may be called their sphere of influence, a very important limit to the practical utilization of the system was imposed. Without some practical method of tuning the stations it would have been impossible to work a number in the vicinity of each other at the same time without interference caused by the mixing of messages.

The new methods of connection adopted in 1898, *i. e.*, connecting the receiving vertical wire or aerial directly to earth instead of to the coherer, and by the introduction of a proper form of oscillation transformer in conjunction with a condenser so as to form a resonator tuned to respond best to waves given out by a given length of aerial wire, were important steps in the right direction.

After giving some mechanical illustrations of resonance, Mr. Marconi said that it is very important to take into consideration the one essential condition which must be obtained in order that a well-marked tuning or electrical resonance may take place. Electrical resonance like mechanical resonance essentially depends upon the accumulated effect of a large number of small impulses properly tuned. Tuning can only be obtained if a sufficient number of these timed electrical impulses reach the receiver. As Prof. Fleming so graphically puts it in one of his lectures on electrical oscillations, to "set a pendulum in vibration by puffs of air we must not only time the puffs properly but keep on puffing for a considerable period."

It is, therefore, clear that a dead beat radiator, *i. e.*, one that does not give a train or succession of electrical oscillations is not suitable for tuned or syntonic space telegraphy. A transmitter consisting of a vertical wire discharging through a spark gap is not a persistent oscillator. Its electrical capacity is comparatively so small and its capability of radiating waves so great that the oscillations which take place in it must be considerably damped. In this case receivers or resonators of a considerably different period or pitch will respond and be affected by it.

Early in 1900 good results were obtained with another arrangement, in which the radiating and resonating conductors each take the form of two concentric cylinders, the internal cylinder being earthed. By using zinc cylinders only 7 meters high and 1.5 meters in diameter, good signals could easily be obtained between St. Catherine's Point, Isle of Wight, and Poole, over a distance of 30 miles, these signals not being interfered with or read by other wireless telegraph installations worked by his assistants or by the Admiralty in the immediate vicinity.

The capacity of the transmitter due to the internal conductor is so large that the energy set in motion by the spark discharge cannot all radiate in one or two oscillations, but forms a train of slowly damped oscillations, which is just what is required. A simple vertical wire may be compared with an empty teapot, which after being heated would cool very rapidly, and the concentric cylinder system with the same teapot filled with hot water, which would take a very much longer time to cool.

In the receiver the closely adjacent cylinders which give it large electrical capacity cause it to be a resonator possessing a very decided period of its own, and it becomes no longer apt to respond to frequencies which differ from its own particular period of electrical oscillations, nor to be interfered with by stray ether waves which are sometimes caused by atmospheric disturbances, and which occasionally prove troublesome during the summer.

Another successful system of tuning or syntonizing the apparatus was the outcome of a series of experiments carried out with the discharge of condenser or Leyden-jar circuits. An experiment was made, to set up the required number of oscillations in the radiator, by associating with the radiating wire or capacity, a condensing circuit, which is known to be a persistent oscillator. An arrangement consisting of a circuit containing a condenser and a spark gap, constitutes a very persistent oscillator. Prof. Lodge has shown us how, by placing it near another similar circuit, it is possible to demonstrate interesting effects of resonance by the experiment usually referred to as that of Lodge's syntonic jars.

But, as Lodge points out, "A closed circuit, such as this, is a feeble radiator and a feeble absorber, so that it is not adapted for action at a distance." Mr. Marconi doubts if it would be possible to affect an ordinary receiver at even a few hundred yards.

It is, however, interesting to notice how easy it is to cause the energy contained in the circuits of this arrangement to radiate into space. It is sufficient to place near one of its sides a straight metal rod or good electrical radiator, the only other condition necessary

for long-distance transmission being that the period of oscillation of the wire or rod should be equal to that of the nearly closed circuit. Stronger effects of radiation are obtained if the radiating conductor is partly bent round the circuit containing the condenser (so as to resemble the circuits of a transformer).

The first trials with this system were not successful, in consequence of the necessity not being recognized of attempting to tune to the same period of electrical oscillation (or octaves) the two electrical circuits of the transmitting arrangement, these circuits being the circuit consisting of the condenser and primary of the transformer, and the aerial or radiating conductor and secondary of the transformer. Unless this condition is fulfilled, the different periods of the two conductors create oscillations of a different frequency and phase in each circuit, with the result that the effects obtained are feeble and unsatisfactory on a tuned receiver. The syntonized transmitter is shown in Fig. 1. The period of oscillation of the vertical conductor, *A*, can be increased by introducing turns of wire, or decreased by diminishing their number, or by introducing a condenser in series with it. The condenser in the primary circuit is constructed in such a manner as to render it possible to vary its electrical capacity.

The receiving station arrangements are shown in Fig. 2. Here we have a vertical conductor connected to earth through the primary of a transformer, the secondary circuit of which is joined to the coherer or detector. In order to make the tuning more marked, an adjustable condenser is placed across the coherer in Fig. 3. Now, in order to obtain best results, it is necessary that the free period of electrical oscillation of the vertical wire primary of transformer and earth connection should be in electrical resonance with the second circuit of the transformer, which includes the condenser. It has been stated that in order to make the tuning more marked, a condenser is placed across the coherer. This condenser increases the capacity of the secondary resonating circuit of the transformer, and in the case of a large series of comparatively feeble but properly tuned electrical oscillations being received, the effect of the same is summed up until the e. m. f. at the terminals of the coherer is sufficient to break down its insulation and cause a signal to be recorded.

In order that the two systems, transmitter and receiver, should be in tune, it is necessary (if we assume the resistance to be very small or negligible) that the product of the capacity and inductance in all four circuits should be equal.

It is easy to understand that if we have several stations, each tuned to a different period of electrical vibration, and of which the corresponding inductance and capacity at the transmitting station are known, it will not be difficult to transmit to any one of them, without danger of the message being picked up by the other stations for which it is not intended. But better than this, we can connect to the same vertical sending wire, through connections of different inductance, several differently tuned transmitters, and to the receiving vertical wire a number of corresponding receivers.

Different messages can be sent by each transmitter connected to the same radiating wire simultaneously, and received equally simultaneously by the vertical wire connected to differently tuned receivers. Mr. Marconi said that this result, which was quite novel at the time, was shown to several friends, including Dr. J. A. Fleming, F. R. S., nearly two years ago. Dr. Fleming made mention of the results he had seen in a letter to the London *Times*, dated 4th of October, 1900.

It was further noticed that the tuning can be further improved by the combination of the two systems described. In this case the cylinders are connected to the secondary of the transmitting transformer, and the receiver to a properly tuned induction coil, and all circuits must be tuned to the same period as already described. This arrangement is going to be further tested in long-distance experiments, shortly to be undertaken between England and Canada.

The syntonic systems have not been applied generally to ships, as it has always been considered an advantage that each ship should be able, especially in case of distress, to call up any other ship or ships which may happen to be at the time within the range of its transmitter, but in the case of land stations the syntonic method has been applied in several instances where necessity demanded it. Thus, at the testing stations which maintain communication between St. Catherine's, Isle of Wight, and Poole, in Dorset, when electric waves of a certain frequency are used, no interference whatever can be caused by the working of the Admiralty installations in the vicinity. The long-distance station at Poldhu, Cornwall, is able to transmit signals decipherable on a tuned receiver on a ship at over 1,000 miles distance, whilst the Lloyd's Wireless Station, at the Lizard, only seven miles away, is not affected by the powerful waves radiated from Poldhu, if tuned to a different frequency.

Mr. Marconi said he was not at all prepared to say, that under no possible circumstances could a wireless message transmitted between syntonic instruments be tapped or interfered with, but he wished to point out that it is now possible to work a considerable number of wireless telegraph stations simultaneously in the vicinity of each other without the messages suffering from any interference. Of course, if a powerful transmitter, giving off waves of different frequncies, is actuated near one of the receiving stations, it may prevent the reception of messages, but the ordinary systems of communication through wires may be likewise affected.

Professor O. J. Lodge, in a report of his experiments, in magnetic space telegraphy, mentions that he was able to interfere with the working of the ordinary wire telephone system in the city of Liverpool. Sir. W. H. Preece has also published results, which go to show that it is possible to pick up at a distance on another circuit

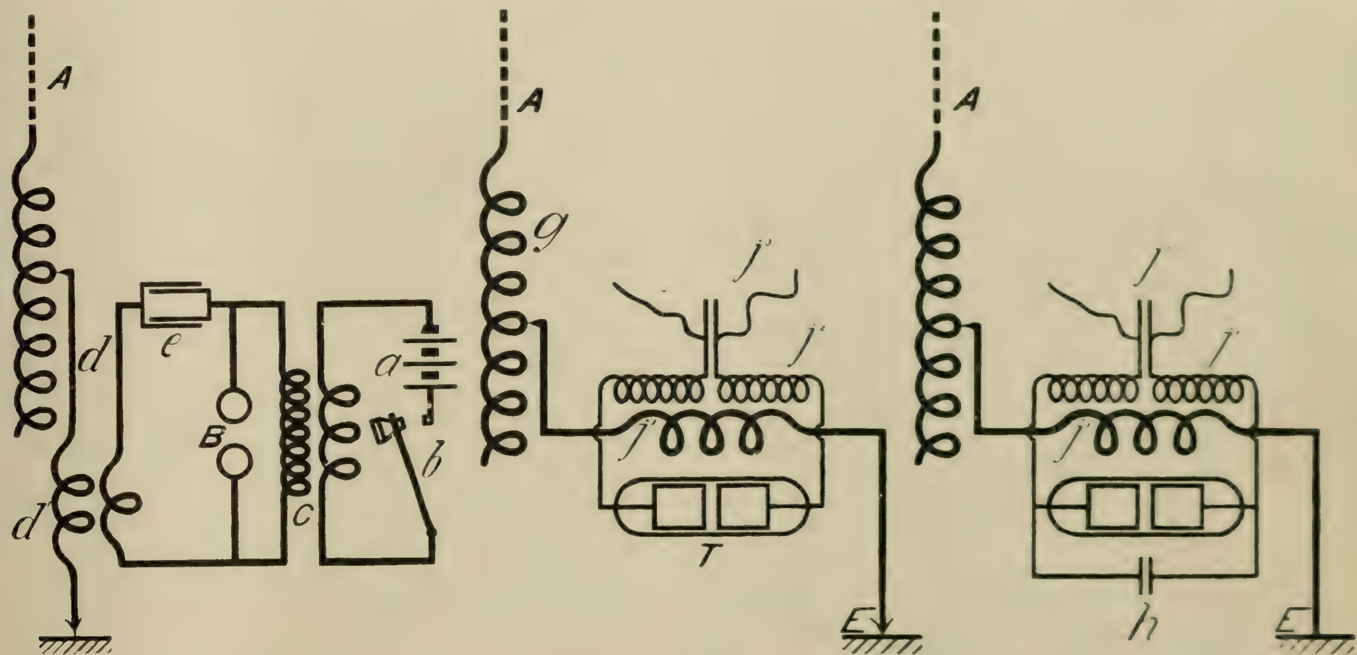


FIG. 1.—SYNTONIZED TRANSMITTER. FIG. 2.—RECEIVING STATION ARRANGEMENT. FIG. 3.—TUNING ARRANGEMENT.

the conversation which may be passing through a telephone wire. About two years ago, at Cape Town, it was found impossible to work the cables landing there during certain hours when the electric tramways of the town were running, and the matter became subsequently the subject of litigation between the companies concerned.

Prof. Fleming, who has witnessed the working of a great number of syntonic wireless telegraph stations, was sufficiently impressed by what he saw to make the following statement in his Cantor Lectures, on "Electrical Oscillations and Electric Waves," delivered before the Society of Arts in December, 1900. "The objections as to interference of stations, which imperfctly informed persons are in the habit of raising with regard to Mr. Marconi's system of wireless telegraphy, as a matter of fact no longer exist."

Summer Convention of the Northwestern Electrical Association.

THE summer convention of the Northwestern Electrical Association was held at Grand View Hotel, Chain o' Lakes, near Waupaca, Wis., une 25, 26, and 27, 1901. The Wisconsin Independent Telephone Association held its convention at the same time and place, but the sessions were at different hours.

The first session of the Northwestern Electrical Association was called to order June 25, at 10:45 A. M., by President I. P. Lord, of Waupaca, who appeared in the double role of host and president. In his short address he spoke of the prosperity of the smaller central stations today as compared to a few years ago, and welcomed the convention to the Chain o' Lakes and to Waupaca.

After the president's address G. H. Atkin, of Chicago, and the Shelby Electric Company were elected to membership.

A paper on "Small Motors" was then presented by Mr. S. F. Dibble, of the General Electric Company, Chicago. Mr. Dibble first called attention to the different methods of handling the small-motor business by central station companies at various stages in the history of the business. At first central stations to encourage the use of current, became supply dealers in all current-consuming devices calculated to increase their business. Later, as the drawbacks of carrying on a mercantile business in connection with a central station became apparent, this supply business was discontinued and the consumers were left to deal with outside concerns. The manufacturer of cheap apparatus was not slow to avail himself of the opportunities, and circuits became loaded with inferior apparatus sold to customers who looked simply at first cost and had no knowledge with which to discriminate between good and bad motors. With the old custom of charging a flat rate the burden of supplying current to inefficient apparatus came on the central station company, but later, when meters were adopted this burden was transferred to the customer. For a time the central station manager regarded this as an entirely satisfactory condition, for if a consumer was so unwise as to install a device that consumed more current than it ought it meant a larger revenue to the station. It soon developed, however, that this was not as satisfactory a condition as it had at first appeared. The service was unsatisfactory because of these inferior devices and the cost to the consumer was too great. The more progressive stations soon realized that their position was untenable and set about to remedy it in the only logical way, viz.: to regard all current consuming devices on their circuits as part of their equipment for transforming energy. The central station began by purchasing good lamps and furnishing them to the consumers at prices so low that the cheap competition was driven out. The service improved rapidly, the cost decreased and lighting has now reached a point which a few years ago was not dreamed of. This result has been attained because central stations have realized that the wise policy is to give the consumer for his dollar, not necessarily the most current, but the greatest amount of *useful energy* consistent with a fair profit on the investment. The customer must be as far as possible protected from inferior apparatus.

A specific example was figured out, in which a difference in efficiency of four per cent. on a 5-hp motor run at full load five hours per day with current at seven cents per kw-hour would amount to $18 in cost of current in a year, or five per cent. on $360. The station managers who were first to see the wisdom of furnishing their consumers with good lamps now realize the equal importance of protecting their consumers from these poorly designed motors, and have adopted substantially the same plan; they have selected some make of motor that possesses sturdy construction and good efficiency, and have made arrangements whereby they can furnish it on terms that will appeal to the consumer and at the same time be profitable to the station. They have had, and will have, competition; if it is honest competition, selling a good article, so much the better for all concerned; if it is the competition of the unscrupulous dealer or manufacturer, it should be and can be crushed. The recommendation of the central station always carries far greater weight with the consumer than the argument of any outsider, for the purchaser can readily see that while the dealer's incentive is the immediate profit on the sale, the central station is desirous of having a satisfied customer, whose influence will be for, rather than against electric service, and will, therefore, naturally recommend a first-class motor.

A very large number of central stations are now vigorously pushing the sale of good motors, and they have found that they now have satisfied consumers whose influence is constantly an aid in securing other consumers, and that their power service is therefore increasing; and also that the direct result of personally soliciting motor business has been to reveal possibilities that they were previously unaware of.

It is natural that the large user of power should be eagerly sought, and it is also natural, though not at all logical, that the small user should be neglected. The few large units of power which it is possible for a station to secure are, as a rule, though not always, valuable, but a large number of small units is far more desirable, for the rate is higher, the demand for current is more uniform, and there is not the constant threat of establishing an isolated plant in order to secure a lower rate. But the desirable small consumers must be sought, and sought constantly and systematically. No first step in this direction can equal intelligent newspaper advertising. Advertise one or two current-consuming devices at a time. It is a mistake to divide attention by putting everything in one advertisement. Advertising of itself is insufficient, but must be followed up by solicitation. The solicitor must be thoroughly posted as to the technical requirements, to be able to look over the ground and tell the customer what he needs. Some one person should be held responsible for the growth of the power business. Meter readers can aid the solicitor by giving pointers as to customers' changes and needs. A few motors on hand ready for immediate installation will often secure a customer whose engine has broken down and who will take electric service if he can get it at once.

Another short meeting was held Thursday afternoon, but Prof. J. W. Schuster, of the University of Wisconsin, who was to have read a paper, was unable to be present and the convention adjourned *sine die*.

The convention was mainly in the nature of an electrical supply men's outing, for which the natural advantages of the Chain o' Lakes offered exceptionally pleasant advantages. There are few more beautiful spots on the face of the globe than are to be found there, and save for the unseasonably cold weather, the convention as an outing was a great success.

The following were in attendance, not including delegates to the Wisconsin Independent Telephone Association: Ex-Gov. W. H. Upham, Marshfield, Wis.; I. P. Lord, Waupaca; Harold Almert, Oak Park, Ill.; Sinclair Mainland and wife, Green Bay, Wis.; R. F. Kountz, Neillsville, Wis.; W. D. Kurtz, Appleton, Wis.; C. A. Kuhlman, Chicago; W. W. Geisse, Chicago; M. B. Kitt, Minneapolis; J. B. McMullin, Chicago; Geo C. Bailey, Chicago; A. Meinema, Chicago; Thos. Ferris, wife and daughter, Milwaukee; F. J. Alderson, New York; H. S. Conner, Shelby, O.; W. W. Smyth, Jr.; W. W. Low, Chicago; Thos G. Grier, Chicago; L. K. Cushing, Chicago; W. D. Packard, Warren, O.; H. J. Way, Chicago; Wm. Smith, Chicago; V. W. Bergenthal, Chicago; L. W. Burch, Madison; C. L. Currie, Jr., Chicago; W. N. Matthews, St. Louis; J. H. Montague, Chicago; C. L. Hibbard, Chicago; S. A. Dinsmore and wife, Chicago; Geo Cutter and wife, Chicago; A. Smith, wife and sister, Milwaukee; Chas. Messer, Chicago; O. B. Williams, Whitewater, Wis.; W. R. Pinckard and wife, Chicago; Geo. W. Conover and wife, Chicago; C. A. Kenworthy, Chicago; Otto E. Osthoff, Chicago; J. Scribner, Chi-

cago; W. H. Colman, Chicago; D. T. Wallace, Chicago; C. Knight, Chicago; J. C. Schmidtbauer, Milwaukee; R. B. Abbott, Chicago; W. H. Slingluff, Chicago; J. R. Cravath, Chicago; W. P. Upham, Chicago; J. B. Darragh, Chicago; S. F. Dibble, Chicago; E. A. Forbes, Rhinelander, Wis.; John Rice, Chicago; G. L. Ainsworth, Chicago; John Schnabel, Grand Rapids, Wis.; P. L. Utley, Grand Rapids; W. F. Collins, Chicago; Chas F. French, Chicago; Frank J. Binney, Madison, Wis.; J. B. Coale, Minneapolis, Minn.; Harry Byrne and wife, Milwaukee; M. B. Austin and wife, Chicago; C. W. Welkins, Cleveland; A. O. Kuehmsted; J. C. Finch, Chicago; Geo. B. Foster, Chicago; D. M. Fulmer, Florence; H. F. Hamack, Sturgeon Bay.

The following companies and supply firms had one or more representatives at the convention: New York Insulated Wire Company, Fort Wayne Electric Works, Electric Appliance Company, Illinois Electric Company, M. B. Austin & Co., Keelyn & Smith, American Circular Loom Company, W. H. Schott, Central Electric Company, American Electric Telephone Company, Westinghouse Electric & Manufacturing Company, New York & Ohio Company, General Electric Company, J. Andrae & Sons, John A. Roebling's Sons' Company, Monarch Electric Company, Ericcson Telephone Company, Kellogg Switchboard & Supply Company, Wagner Electric Manufacturing Company, Gregory Electric Company, Western Electric Company, Dearborn Electric Company, Electric Supply Company of Madison, American Credit Indemnity Company, Geo. W. Conover, Geo. Cutter Company, Wm. Matthews, Columbia Incandescent Lamp Company, Shelby Lamp Company, H. T. Paiste Company, Kuhlman Electric Company, ELECTRICAL WORLD AND ENGINEER, American Electrician, Electrical eview, Western Electrician.

Convention of the Wisconsin Independent Telephone Association.

THE Wisconsin Independent Telephone Association held its summer convention at Grand View Hotel, Chain o' Lakes, near Waupaca, Wis., June 25, 26 and 27, 1902. The Northwestern Electrical Association had its summer convention at the same time and place, but the sessions were held at different hours of the day.

The first session was called to order at 3.15 p. m., June 25, by President R. Valentine, of Janesville. In his introductory remarks he spoke of the remarkably rapid growth of the independent telephone business recently, and quoted figures from the Secretary of State to the effect that 29 new telephone companies had been chartered in Wisconsin since January 1, 1902, with a capitalization of $570,640.

Mr. J. H. Montague, of the Ericsson Telephone Company, spoke a few words upon request, as to the practicability of using ordinary telegraph lines for both telephoning and and telegraphing at the same time, and referred especially to some tests made on the Illinois Central Railroad.

Mr. L. W. Burch, of Madison, called attention to the desirability of adopting some kind of an attractive trade mark or sign for inde pendent telephone station. Several members expressed the opinion that the independent companies were lax as regards the display of signs and advertising.

Mr. A. W. Bryant mentioned as a remarkable example worthy of imitation an exchange in a town of 200 population in Indiana which had 400 telephones connected, most of them farmers' lines. The company builds the lines and the farmers purchase the instruments. The farmers pay a rental of so much per month per mile of line required to reach their particular houses.

Mr. A. J. Perkins, of Medford, Wis., was called upon to give his experience with the automatic telephone exchange there. They have had a 100-subscriber automatic (National System) exchange in operation nearly two years, and are much pleased with it. The attention required and maintenance is very small, amounting to about 2 per cent. of the income.

The Mt. Vernon Independent Telephone Company and the Dane County Rural Telephone Company were admitted to membership.

The second session of the convention was held Thursday morning, June 26, when a paper was read by H. C. Winter, of Madison, Wis., on "Toll Rates." Mr. Winter called attention to the fact that although the adjustment and uniformity of toll rates was one of the main objects for which the Wisconsin Independent Telephone Association was started two years ago, that as yet no agreement had been reached although it had resolved and re-resolved at its various conventions and committee reports had been made. The object of his paper was to start a discussion which should crystallize into something definite. He said there are two distinct parts to the [illegible]: the fixing of the toll and the division of the toll among the different companies handling the message. The first question is whether the [illegible] pole line or air line distance should be the basis. Operating expense in the main does not vary with the distance. It varies with the distance only so far as the additional distance involves handling a message through different offices and circuits. The construction expenses connected with the transmission of a message vary directly with the distance. So the total cost of transmitting a message depends on two differentiating factors.

Next considering the question of an air line vs. pole line distance as a basis of charging, Mr. Winter considered the air line the logical basis, though he discussed various phases of the question.

The prime consideration in fixing toll rates is to fix them to give the maximum net return. No one will dispute that a reduction in the toll means an increase in the number of messages. But as a business proposition 5 messages a month between 2 stations at 20 cents each is better than 10 messages at 10 cents each. Unless such lower rate has increased the mesages more than two-fold the reduction in charges has been made at a net loss. Each message has a cost, and in addition it should be remembered that the transmitting capacity of the circuit is necessarily limited, and when a circuit is worked up to its limit or nearly so, it means that there is much inconvenience and waiting all along the line. It will not be found profitable in the long run to keep the line busy with cheap messages. The most feasible and logical plan for regulating rates that has yet been suggested is the zone system in which each distance is figured solely on the air-line basis. This system has been adopted generally by the companies in Michigan.

The plan suggested by Mr. Winter was to make the first or 10 cent toll circle with a 5 mile radius. To get the second or 15 cent zone add 5 + 1 miles to the radius; to get the third or 20 cent zone, add 5 + 2 miles, and so on, making the zone radii 5, 11, 18, 26, 35, 45, 56, 68, 81, etc.

In this discussion Mr. Winter took it for granted that there was no competition to be met with the Bell Company or between independents. The competition of the Bell Company he considered really very limited as from 60 to 70 per cent. of the independent toll stations are not reached at all by Bell lines. In over 100 towns in the State there are exclusive independent exchanges. As to the simpler, though no less important question of toll division, the prevailing practice is for each company to keep what it takes in. This inequity of division is a most prolific source of friction between companies. He recommended the following rule for toll division:

Combination tolls should be divided among the various companies transmitting the message in accordance with the air line distance between the receiving and transmitting points of the company transmitting such message and all exchanges except originating exchanges that necessarily handle such message, be figured as 5 miles of air line; and originating exchanges to receive 5 per cent. and originating toll stations 15 per cent. of the toll. As the toll is based on the air line distance the division should also be as no premium should be placed on circuitous routes. In order to stimulate copper toll line construction it may be advisable to place a premium upon such service in the schedule of rates in the future.

Following the reading of Mr. Williams' paper the committee on joint toll rates, by its chairman, H. G. Slaten of Waupaca, recommended the following schedule for toll rates, which was adopted after some discussion:

Taking each station as a center, radii are to be obtained by drawing circles of different diameters; that is, take any station that is doing toll business, and draw a circle from that as a center, each circle represents a different rate.

The first circle is to be 7 miles in radius, and the rate 10 cents; 7 to 15 miles, 15 cents; 15 to 24, 20 cents; 24 to 32, 25 cents; 32 to 40, 30 cents; 40 to 48, 35 cents; 48 to 56, 40 cents, etc.

Where a station lies within two miles of a zone it may take the rate of either zone; that is, if the zone is within two miles of the circumference, it is optional with the company whether they charge for the second zone or the first one in the division of combination toll rates.

Air line distances shall be the method of measuring toll lines from originating stations to switching and receiving points.

Originating exchange stations shall receive 25 per cent. of the toll rate; originating toll stations 15 per cent. of the tolls.

In exchange switching or terminating, a message shall be allowed a credit of 5 miles of its toll lines in the division of its tolls.

The question of making special rates in case of competition was left to the committee on rates which was continued until the next annual meeting with those duties.

The secretary was instructed to notify all the companies in the State of the action taken and that the rates specified for joint business go into effect on Aug. 1, 1902.

The report, of course, covers only joint business. It does not specify anything in regard to night rates and other matters which will probably come up at later meetings, as there was an informal discussion of some of those points.

Mr. A. L. Hutchinson, of Weyauwega, took up the subject of a telephone clearing house, in which he first called attention to the great amount of labor necessary between companies in settling toll accounts with each other because of the great number of companies (over 200 in Wisconsin) and great number of messages.

Having adopted a schedule of rates between existing companies the question of checking messages, toll charges, messenger fees and other extra charges, and settling balances between connecting companies becomes one of great moment to every company. If each company were to check up and settle its business with every other company in the state over whose lines there has been transmitted through messages, each company would have a herculean task to perform.

There is but one correct way of checking messages and settling accounts between various companies, and that is the method adopted by banks in settling their balances with each other.

The business between the stations of a single company is settled through the principal office of that company, but to settle the business between the various companies there must be a central office to which each company shall report, and which central office shall have authority to settle and adjust all joint business for the various companies.

Realizing the urgent necessity of a central office for checking messages, adjusting and settling balances between companies, he had anticipated the wants of the companies, and had incorporated under the laws of the State of Wisconsin a company known as the State Telephone Clearing Company, whose functions are to receive reports of all business between connecting companies, ascertain their correctness, and adjust and settle the balances at stated periods.

Although a complex undertaking for each company to attempt to check and settle its business with every other company, it is but a simple proposition when done through a central clearing company. The *modus operandi* is given as follows: The clearing company furnishes each company at cost with two forms of message slips, one form for messages received, the other form for messages sent. The two forms are exactly alike, except that one is on yellow paper and the fees are entered under the word "Charged;" the other on green paper, and fees entered under the word "Collected." All entries are to be the same. At the end of each week each station transmits to the clearing company all message slips of all messages passing between it and the stations of stations of connecting companies. The clearing company then brings the sending and receiving slip for each message together, and if correct the fees are apportioned to the several companies over whose lines the message has passed and each company credited with its proper amount; if there is a discrepancy in the fees collected and charged, the error is corrected and the station whose slip is wrong is notified to make the correction. The station at the end of the month is then able to send its own company a correct statement of all joint business. At the end of the month the clearing company strikes a balance between the various companies reporting to it, sends each a copy of the balance sheet, and draws a sight draft in favor of the company having a balance due it against the company having a balance owing. No money passes through the clearing company, but its drafts in favor of creditor companies must be honored by debtor companies.

It is possible, through the simplicity of the clearing office scheme, to settle the balances between a dozen companies by a single draft. Not only will each company have its toll business more carefully looked after, but it will also know that it receives every cent that it advances for messenger or other extra services. Not only does the clearing company make the work absolutely simple, but it can do the work at a trifling cost, compared with the expense incurred by each company attempting to adjust and settle its own business with that of every other company.

The fees fixed by the State Telephone Clearing Company are one cent for each message to each company sharing in the toll charge for such message.

The meeting then passed resolutions thanking the Waupaca Electric Railway & Light Company for its courtesies extended to the convention, and adjourned.

The delegates present at the convention were as follows: R. Valentine, Janesville, Wis.; H. C. Winter, Madison; A. J. Perkins, Medford; H. E. Kepler, Sun Prairie; H. G. Slater, Waupaca; Chas. Schenneker, Sun Prairie; A. L. Hutchinson, Weyauwega; A. W. Bryant, Chicago; J. M. Baer, Appleton; M. T. Patchin, Weyauwega.

Small exhibits were made by the American Electric Telephone Company, the Kellogg Switchboard & Supply Company and the Ericson Telephone Company.

The Edison Storage Battery.

Mr. Thomas A. Edison contributes an article to the July issue of the *North American Review,* entitled "The Storage Battery and the Motor Car," in which further information is given as to the new type of storage battery upon which he is working. It is stated that the battery has sustained and overcome the four thorough tests applied to it, and it is now undergoing the fifth, and last, with every prospect of the same result. These four tests and the fifth, now in progress, point to the new nickel-iron battery as being in fact the only real storage battery known. Mr. Edison says that the attempts to compare its performance with those of the lead storage batteries, so called, now in use in automobiles and elsewhere for lack of something better, make it not improper to declare the facts. A real storage battery must be reversible, like a dynamo, which converts power into electricity and *vice versa.* A storage battery, to deserve the name, should be a perfectly reversible instrument, receiving and giving out power like a dynamo motor, without any deterioration of the mechanism of conversion. The present lead battery in an automobile, he alleges, does not meet this condition. It gradually becomes less and less efficient, and in a few months wholly inoperative. The acid environment prevents a proper mechanical construction, its chemical reactions are of the most capricious character; it must be watched and treated with great care—so great care, indeed, as to make it impracticable for general use. It can be made, as far as mere weight is concerned, of sufficient lightness to meet all the wants of commerce and pleasure; but, if made light, it rapidly becomes useless.

On the other hand, the nickel-iron storage cell has an ideal environment. Being in an alkaline solution, none of the ingredients is attacked by the solution in any degree. The chemical reactions are also of the most simple and stable character. The conditions permit of a perfect mechanical construction, and, finally, it remains uninjured under any condition which one could imagine, when in the hands of an inexpert. The weight can be made to meet every exigency of commercial vehicle traction, and up to the present time there are no signs of chemical deterioration, even in a battery which has been charged and discharged over 700 times.

Mr. Edison says he has been working for a number of years on the problem of a true storage battery. The experiments have been continuous for the past three years. The above may be considered the first stage. Tests on the battery have been going on for over a year and a half; this was the second stage. The construction of chemical works and a manufacturing plant for the cells was the third stage. The manufacture of standard cells from the tools is the fourth stage.

Twenty-one cells made in the factories, weighing 332 pounds, were placed in a Baker automobile, the total weight with two men in the vehicle being 1,075 pounds. The vehicle made a run, on one charge, of sixty-two miles over country roads, containing many grades, some as steep as twelve feet in a hundred. At the end of this run the vehicle was making 83 per cent. of the original speed. The average speed over the entire distance was 11.2 miles per

hour. On a comparatively level country road a little heavy from recent rain, the same vehicle on one charge came to a stop at the eighty-fifth mile.

The fifth endurance test of the nickel-iron battery, which is demonstrating that the storage battery is indeed an accomplished fact, is now being made with five different models of automobiles, in each of which the new cells have been installed. They are of various weights and construction, and each of them is being run 5,000 miles over country roads, at an average distance of 100 miles per day. If these tests shall show no loss of capacity and no mechanical defect in the battery, and that it is in all respects exactly the same at the end as at the commencement, we can be reasonably assured that at last we have a real storage battery.

Mr. Edison expresses the conviction that the storage battery carriage, by the aid of the new battery, will come ultimately within the reach of the man of moderate means. Driving through the many miles of streets in the suburbs of New York, he has been impressed with the fact that something like eighty per cent. of the residences have no carriage houses. The storage battery carriage, with the new battery, should enable the owners of forty per cent. of these residences to have a serviceable pleasure vehicle at their beck and call, without hiring a coachman to keep it clean and run it, with no horses to eat their heads off, and no oats and hay to buy. With an initial outlay of from $700 and upwards, the storage battery automobile can be used once a week at the cost of a fifty-cent charge, or twice for a dollar, and so on, the cost of use being met as it is incurred, and so ceasing to be the bugbear that fixed charges must always be to the householder of moderate income. For safe and successful use, the automobile must, however, be made with heavier running-gear, on the lines of the later French automobiles. Especially should stability be secured in the wheels and frame; the superstructure may be made gauzy. It seems likely that two general types of electric carriage will be developed, a light buggy type and a heavier touring carriage, the battery varying accordingly. The question of types of automobiles is further discussed, and the conclusion arrived at that the electric carriage of the future, and of the near future, will not only supersede other types of automobiles, but it will be built and run on such practical lines that accidents will soon become things of the past.

Long-Distance Power Transmission in England.

The Yorkshire Electric Power Company are fixing up their financial arrangements with a view to starting on the works at an early date. The company have four sites scheduled for their generating stations. These are located at Thornhill, Methley, Wath and Bingley. It is proposed to start by putting down a plant of 10,000 kilowatts on the Thornhill site, and after a time other stations will be erected on the other three sites as the business grows. In the meantime all customers within the area of the Yorkshire Power scheme will be entitled to a supply of power. It is anticipated that the capacity of the plant on each of these four sites will amount to 100,000 kilowatts at no distant date.

The company will be in a position to supply either continuous current or alternating currents, as may be required. Power will be generated at a potential of 10,000 volts. The first plant will consist of four 1250-kw units and two 2500-kw units. As soon as the demand reaches the present capacity of 10,000 kw extensioons will be carried out with 5000-kw units.

Of the first instalment of plant there will be a supply of 5000-kw direct current for use within a radius of three miles of the power station. The remainder of the plant will be of the three-phase type, the currents being generated at a pressure of 10,000 volts, and with a periodicity of 40 cycles per second. This limit has been fixed upon for the reason that it is high enough to give satisfactory lighting on the alternating side if required, and is also suitable for conversion from alternating current to direct current. A secondary battery is also provided.

There will be two main types of substations, one in which the alternating current is transformed from high pressure to low pressure suitable for distribution, and another in which the currents are transformed from high pressure to low pressure and further converted to continuous current. Low tension networks will be laid out from these centers and consumers supplied with three-phase currents at about 300 volts, or single-phase currents at 300 volts, or, if the user finds it more convenient, he can transform the three-phase to quarter phase. A continuous-current illuminating system will also be provided at a pressure of from [illegible] to [illegible] volts, this being a standard pressure for tramway and railway working, and is being extensively adopted for lighting and general purposes by companies and municipalities.

A great many power users prefer the use of three-phase motors of the induction type for running their factories. These users are provided for as already indicated. In fact, every possible class of consumer is catered for. The prices have already been decided upon, and are fixed at such a point as to give a clear inducement to the users however extended or economical their business may be. As a comparison, the rate charged is about 2od. (40 cents) for supply under conditions such as exist in ordinary electricity supply undertakings by local authorities and companies The price of factory supply under normal working conditions of a 52½-hour week, averages about 2½ cents. For supply under usual working conditions of an electric tramway the price charged will be under two cents.

As a result of a careful inquiry into the whole circumstances of supply and nature of the demand by Mr. H. F. Parshall, consulting engineer for the company, it is stated that the return, after paying all working costs, renewals, maintenance, and after providing also for depreciation of plant shows a clear initial profit of from 5 per cent. to 9 per cent., according to the capacity and size of the undertaking. As the advantages of the company are derived from saving in working costs due to the magnitude of the undertaking, the profit will be greater as the output grows. A great many applications have already been received from local authorities, railways, tramways, factories and collieries, and it is expected that the company will be in a position to supply power in about 20 months' time.

National Electric Light Association Membership.

At the recent Cincinnati Convention of the National Electric Light Association an amendment to the constitution was adopted whereby after January 1, 1903, all new members shall pay an entrance fee of $25. The annual dues of active members in cities or towns of less than 20,000 population was fixed at ten dollars; the dues of members in cities or towns of from 20,000 to 300,000 population at twenty-five dollars, and the dues of members in cities or towns of over 300,000 population shall be fifty dollars. For the remainder of 1902, new active members from towns of less than 20,000 population will be received in full membership upon payment of ten dollars dues. The following companies have joined the Association since the above provision went into effect: Altoona, The Edison Electric Illuminating Company, of Altoona; Atlantic City, N. J., Atlantic Electric Light & Power Company; Auburn, N. Y., Auburn Light, Heat & Power Company; Bloomington, Ill., Bloomington & Normal Railway, Electric and Heating Company; Covington, Ky., Union Light, Heat & Power Company; Clinton, Ill., Clinton Gas Company; Edwardsville, Ill., Edwardsville Electric Light & Power Company; Evansville, Ill., Evansville Gas & Electric Light Company; Elizabeth City, N. C., Electric Light Company; Fishkill-on-Hudson N. Y., Citizens' Railroad, Light & Power Company; Fulton, N. Y., Fulton Light, Heat & Power Company; Jackson, Mich., Jackson Light & Power Company; Lead, S. D., Belt Light & Power Company; Macon, Mo., Northwestern Electric Heat & Power Company; Manheim, Pa.; Lancaster Valley Electric Light Company; Muscatine, Iowa, Citizens' Railway & Light Company; Plymouth, Mass., The Plymouth Electric Light Company; Red Oak Iowa, Red Oak Electric Company; Rockford, Ill., Rockford Edison Company; Scranton, Pa.; Scranton Illuminating, Heat & Power Company; Wheeling W. Va., Wheeling Electrical Company; Zanesville, Ohio, Zanesville Electric Light Company; Columbus, Ga., Columbus Railway Company; Clay Center, Kan., F. L. Williamson & Co.

A Large London Contract.

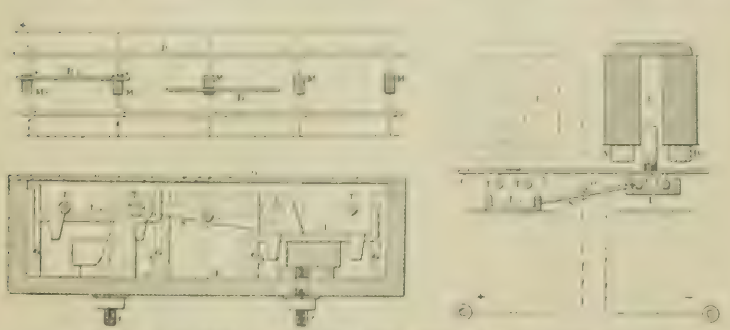
London cables state that the value of the contracts secured by the British Westinghouse Company for the Metropolitan District Railway power house, at Chelsea, is said to be $5,000,000.

Cruvellier Surface Contact Electric Railway System.

A new surface contact electric railway system has recently been installed on a car track at Neuilly, France, near Paris, one of the main features of which is that the main track does not form a part of the conducting system, the car current connection being with plus and minus surface contacts.

Referring to Fig. 1, *B*, *B*, are the car contact-makers, and *M* the surface contacts, which become alternately plus and minus. Normally the surface contacts are neutral, but become negative when under the forward contact maker, and positive when under the rear contact maker.

Fig. 3 shows the manner in which this is done. The top, *C*, of the surface contact is connected with either of two horizontal bars T_1 and T''_1. Two other bars, T_2 and T'_2 are connected, one with the positive feeder and the other with the negative feeder. By means of *L*, *L*, which are connected to the lever *S*, the top *C* may be connected with the negative or positive feeder connection as indicated in the cut. The lever *S* is pivoted at *A*, to prevent the two parts, *L*, *L*, from being raised at the same time, the effect of which would be to cause a short-circuit. A series of electromagnets, *E*, mounted in the front part of the carriage, determines the attraction of minus *L*, and a second series of electromagnets, *E'*, mounted in the rear



FIGS. 1, 2 AND 3.—CRUVELLIER SURFACE CONTACT SYSTEM.

of the car, acts on *L*. These two sets of electromagnets, as may be seen in Fig. 1, are not in line with each other with respect to the car longitudinally. Thus when the forward part of the car is over a contact, the part *L* plus is raised and connects with T'_1, the cover *C* then becoming negative. As the car proceeds, the part *L* minus falls when the polar projections *AB* have passed over the cover, and then the electromagnets *E'* come into play, which causes the raising of *L* plus, rendering the corresponding contact cover positive.

The two series of electromagnets *E*, *E'* may be installed either on the same car or on different cars. Fig. 2 shows the actual contact boxes. Owing to the small extent of contact at the conducting bars, when a circuit is made, there is apt to be a slight soldering to the bar. To provide for this case the movable part of the contact arrangement is in two parts, one consisting of a movable non-magnetic portion with lugs, as shown in Fig. 2, on which the contact is made. Should this stick, it will be left behind when the lower part drops away, until near the end of the motion of the latter, when a projection thereupon serves to release it. The car contact consists of a metal ribbon passing over two pulleys, the lower surface of the ribbon rubbing on the tops of the contact boxes.

Caustic Soda by the Diaphragm Process.

By Clinton Paul Townsend

The history of recent success in the production of alkali by the electrolysis of sodium chloride solutions in cells provided with a diaphragm is quite largely the history of the "unsubmerged cathode." The undoubted promise of the Hargreaves installations, operating with high-current efficiency, albeit with the production of rather weak and carbonated lyes, has shown that the mere fact of using a diaphragm is not of itself sufficient to condemn an electrolytic method. The cell of Moore and Allen is the most recent of the constructions operating with an unsubmerged cathode, and differs from that of Hargreaves, and certain still earlier forms, mainly in that the cathode is formed of several conducting layers, capable of retaining by capillarity a considerable amount of the electrolyte, and technically called a "sponge."

The idea that a cell could be operated without a catholyte filling the compartment in which the cathode is placed, seems to be due to Camille Alphonse Faure (British patent, No. 1,742, of 1872). His cathode, and, indeed, anode also, took the form of a hollow rectangular casing, projecting upward from the bottom of an electrolytic tank, faced with perforated metal on the side nearest the opposing electrode, and provided below with a free outlet for the liquid product. A diaphragm of canvas covered the perforated cathode plate, and through this diaphragm and cathode the electrolyte was permitted to filter, the metallic action being oxidized by the liquid of the undecomposed solution. Faure provided a vent pipe, extending above the solution line, for the escape of liberated hydrogen. He mounted many of these electrodes filtering-frames in a single tank, but seems to have missed, or perhaps avoided, the

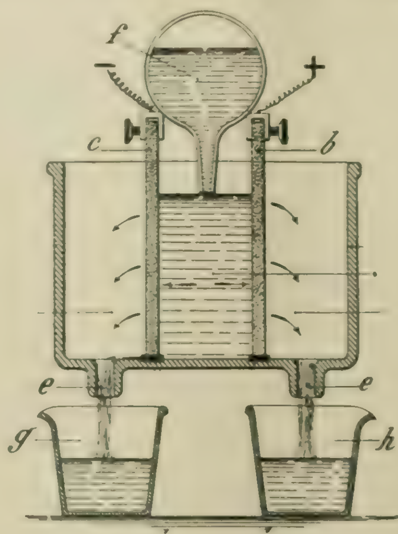


FIG. 1.—HULIN CELL.

construction of multiple tanks with unsubmerged permeable electrode walls.

Such a construction was reserved for Leon Paul Hulin (U. S. patent No. 586,236). Hulin seems to have dispensed with the diaphragm, relying upon the spongy character of his electrodes to restrain the flow of the electrolyte to an amount commensurate with the current employed. One of his constructions, indicated in Fig. 1, is almost self-explanatory. The walls *b*, *c*, of metallic sponge or porous carbon, for filtering electrodes, through which the liberated ions, or the products of their secondary action upon the electrolyte, pass through orifices *e* into collecting vessels *g*, *h*. A simple constant level device is indicated at *f*.

The spongy cathode, faced with a non-conducting diaphragm, had indeed been previously used by Le Sueur as a closure for an anode bell; but Le Sueur seems always to have operated with a definite, though reduced, head of electrolyte in the cathode chamber. Le

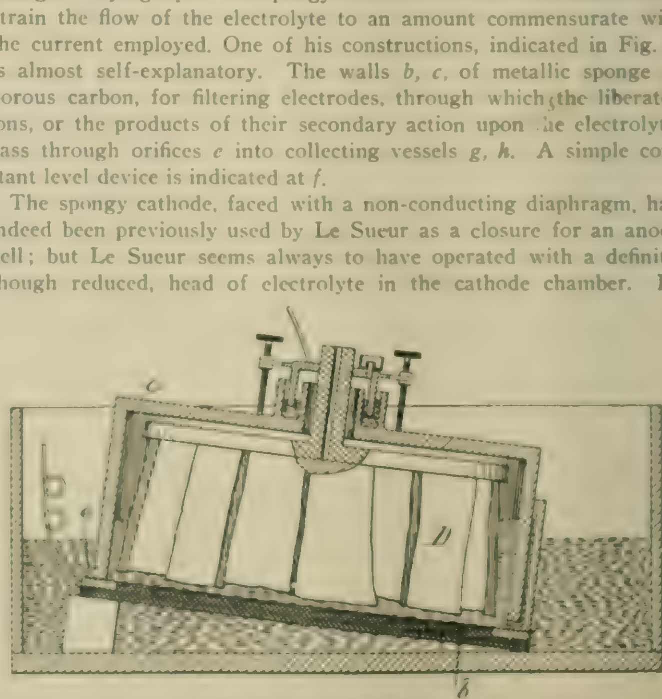


FIG. 2.—LE SUEUR'S CELL.

Sueur's patented cell, which differs greatly from that in actual use, is shown in Fig. 2, *e* representing a diaphragm and *b* a spongy cathode, which together close the mouth of an anode bell, *c*, bearing an anode, *D*.

The third step was due to James Hargreaves, who combined in a cell of this type the permeable non-conducting walls and the external unsubmerged cathode. His construction is diagrammatically shown in Fig. 3, while Fig. 4 indicates the combined cathode and diaphragm upon a larger scale. This cell comprises an anode, *e*,

in a chamber, *g*, filled with sodium chloride solution; diaphragms *d*, and cathode *c*, external thereto and unsubmerged, retain the electrolyte; the cathode products are collected by the trough *k'* and pipes *k* from the lateral compartments *f*, formed by the side walls, *a*, With Hargreaves, the filtering effect of the diaphragm, though present, becomes of secondary importance; and a jet of steam or

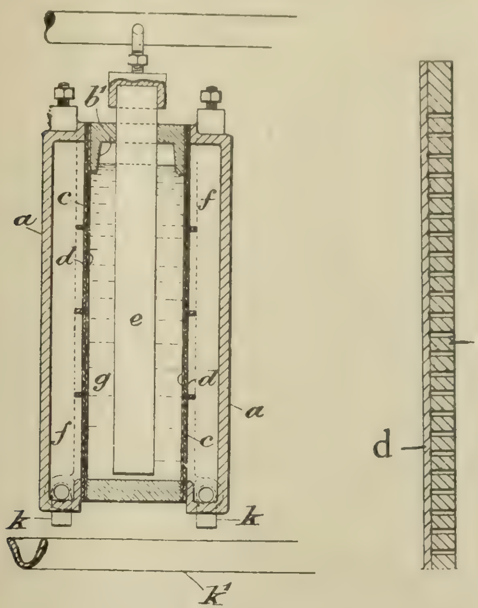


FIG. 3 AND 4.—DIAGRAM OF HARGREAVES CELL.

of mingled steam and carbon dioxide is employed as an auxiliary agent for cleaning the cathodes.

The Moore and Allen cell is shown in Fig. 5, as composed of a

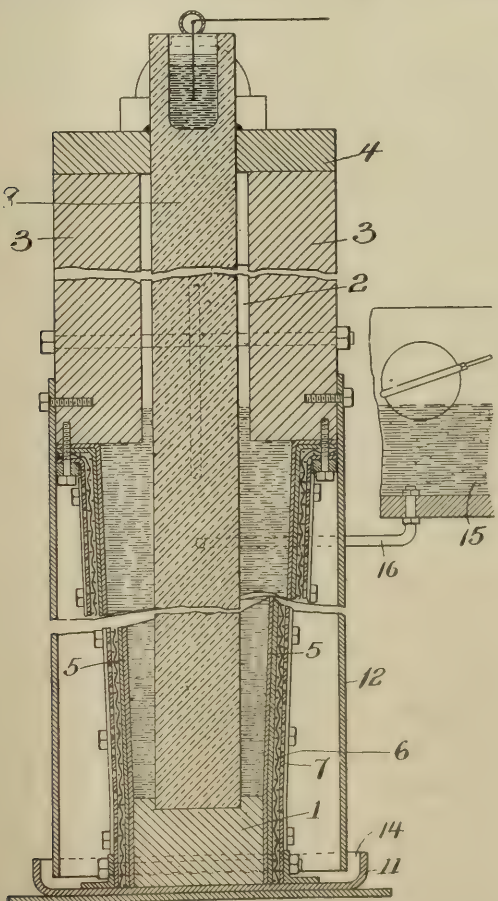


FIG. 5.—MOORE AND ALLEN CELL.

base, 1, end walls, 2, sills, 3, and a cover, 4, of slate or equivalent resistant material. The lower portion of the cell is closed by the combined diaphragm and cathode, the former, 5, consisting of a number of layers of asbestos paper, and the latter of a combination of wire gauze, 6, and perforated metal, 7. The anode 8 is centrally mounted, and electrical connection therewith is indicated as made by means of a mercury cup. An automatic constant [illegible] drain, 16, is provided, and the outflowing cathode products escape through a seal, 14, formed between the base plate, 11, and the bell or [illegible], 12; the function of the latter is to prevent evaporation in the cathode by holding against it a "bath" of hydrogen gas.

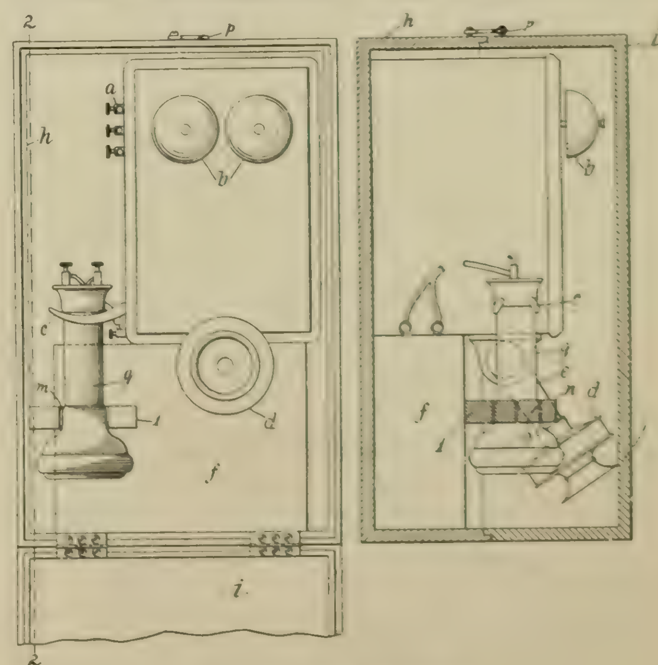
Regarded from a purely functional point of view, this is the cell of Faure, or of Hargreaves, with a spongy cathode; or that of Hulin, with a nonconducting diaphragm; or that of Le Sueur, with a void cathode tank. Regarded, however, as a means for carrying out an electrolytic method, the cell is said to possess some advantage due to the combination, not before employed, of an unsubmerged spongy cathode and a nonconducting diaphragm.

Treatment of Tin Scrap.—Mr. Thomas [illegible], of [illegible], England, offers in a recent patent the following method for the separation of tin from iron. Finely divided carbon is stirred into a strong solution of sodium chloride to form a paste, into which the cuttings or scrap are dipped, emerging with an adherent film of the mixture. After exposure to the air for an hour the tin is found to be oxidized, and may be removed by washing. The action is accelerated by dusting the plates with fine dry carbon after removal from the bath. The process is plainly electrolytic, the film upon the plate comprising an electrolyte, and a conductor electro-negative to tin, the latter metal acting as the oxidizable anode of a short-circuited voltaic couple. This problem is two-fold, looking to the recovery of the coated metal and the coating. Hence a disclosure, which deals with one aspect only of the question, stripping the tin but relying upon metallurgical methods for its recovery, can scarcely be considered satisfactory. Aside from the fine division of the carbon, the method is the same as that patented in England to Gould, in 1900.

New Telephone Patents.

Again the weekly issue of the Patent Office has but one telephone patent, the inventor being Mr. Lambert Schmidt, of Weehawken, N. J., and the invention a field telephone set which shall be self contained and self containing, independent of extraneous packing and so constructed that when the case is closed the switch hook is locked down to prevent exhaustion of the batteries, and the receiver and transmitter are held securely free from risk of damage.

Referring to the accompanying drawings, the transmitter, *d*, bat-



SCHMIDT FIELD TELEPHONE.

tery box, *f*, bell, *b*, and receiver *g*, are mounted in a case, *h*, having hinged cover, *i*. To the side of *h* is fixed a block, 1 having a recessed part, *m*, adapted to receive the lower part of the receiver when it is in place on the switch hook. Attached to the door, *i*, is a similar block, *m*, recessed at *o* in the same form as block, *1*. When the door is closed, the transmitter being folded down and the receiver in place

on the hook, the two blocks come together, gripping the receiver and holding it down firmly on the hook. As long as the cover is kept closed the receiver is securely held no matter what movement be given to the box; thus the batteries cannot become exhausted nor the parts of the instrument be damaged in transit. Mr. Schmidt's device is simple, but ingenious and effective and should be useful for military and other field telephones.

Speed Changes of Rotary Converters.

In a patent granted June 10 to C. P. Steinmetz, on an automatic cut-out, for use with rotary converters, a concise and lucid account is given of the causes which give rise to changes in speed of rotary converters. If the machine is used in the ordinary manner, with alternating current supplied thereto, and direct currents taken from the direct-current end, the machine will run in synchronism with the frequency of the alternating current supplied, and its speed will change only with changes in frequency of the alternating current. It sometime happens, however, that the generators supplying the alternating current speed up abnormally, thus requiring some safety device in connection with the rotary converters or other machines driven therefrom, in order to prevent too great rise in speed and consequent destruction of the machines by the action of centrifugal force.

It also sometimes happens that the alternating supply mains of a rotary converter are interrupted. If the direct-current end of the rotary converter is connected to an independent circuit, no harm will result. If, however, the direct-current end of the rotary converter be connected with the direct-current end of the rotary converters or, indeed, with any other source of direct current, the immediate result is a reversal of current in the direct-current side of the rotary converter, which thereupon runs as a direct-current motor. If the machine is provided with a series field winding, as usual, the field strength is reduced by reversal of current through this winding, and the machine therefore speeds up.

If, on the other hand, the function of the rotary converter is inverted by normally supplying the same with direct current, and deriving alternating currents therefrom, the speed of the machine is varied not only by changes in electromotive force of the direct current supplied, but also by changes in the character of the load on the alternating-current end of the machine. Thus, if an inductive load is fed from the alternating mains, the lagging currents produced thereby react upon the field magnets of the rotary converter and cause a weakening of the same, the immediate result of which is a speeding up of the rotary converter, such as would take place in a direct-current motor if the field were weakened. On the other hand, if leading currents flow in the alternating mains, the effect of the same is to strengthen the field of the rotary converter and to correspondingly decrease its speed. This has been a serious, and in some cases, a prohibitive difficulty in the employment of inverted rotary converters.

In order to provide a speed limiting mechanism suitable for employment in the cases above mentioned, and in fact in connection with any dynamo-electric machine generating alternating current, or to which alternating currents are supplied, the inventor proposes a circuit connected across the alternating mains and responsive to the frequency of the e. m. f. impressed thereon. This circuit is arranged to actuate automatically or to control suitable devices for cutting the machine or machines out of circuit or for otherwise reducing their speed when the frequency of the alternating e. m. f. reaches a predetermined abnormal value. In an arrangement specifically described, a capacity and reactance are employed of such a value as to bring the circuit into resonance at that frequency of e. m. f. at which it is desired to cut out the rotary converter or other machine. When this condition is reached, the current in the tuned circuit increases very greatly, and this increase of current is sufficient to act upon a circuit-breaking device.

Wireless Telegraphy in Hawaii.

It is reported that Mr. John D. Spreckels, who is largely interested in Hawaiian industries, contemplates establishing a wireless telegraph system between the islands and San Francisco. This project, however, is dependent upon the success of the system being installed between Los Angeles and Catalina Island, 40 miles off the coast

Recent Telephonic Development in Canada.

An interesting development in the direction of municipal telephony has first been made in Canada, where by almost unanimous vote the citizens of Port Arthur and Fort Williams, Ontario, have decided to install public telephone systems. These two small cities are about five miles apart at the head of Thunder Bay, on the north of Lake Superior, where they are quite isolated from other communities. Being without capitalists, they have been led to establish public utilities and have already public lighting plants and street railway systems.

The people placed the matter in the hands of the city councils, and it was referred to a joint committee from the two cities, to act as a body to proceed with the work with a view of establishing the most modern, efficient and durable system possible. Tenders were received from the foreign and the various independent manufacturers in the United States and the orders were placed in Chicago with the International Telephone Manufacturing Company, for a central energy lamp signal switchboard and telephones embodying all the latest improvements and new features recently evolved by them.

The central office at Port Arthur is to be located in a special building, to be built on part of the grounds of the government post-office or with the Carnegie Library Building. The Fort Williams exchange will be located in the city hall. The outside construction work has already been started. The exchanges are built with a capacity of over 500 lines in each system, and it is contemplated to extend the plant, entirely surrounding Thunder Bay and through the Lake Superior region.

The Pennsylvania Railroad Telegraphs.

Mr. W. H. Baker, vice-president and general manager of the Postal Telegraph-Cable Company, confirms the announcement made by First Vice-President John P. Green, of the Pennsylvania Railroad Company, of the contract made between the two companies to operate the telegraph lines on the 4,745 miles of the Pennsylvania Railroad Company's system, to take effect July 1. This system in its entirety consists of 10,000 miles of road, and present contracts between the Pennsylvania Company and the Western Union Telegraph Company as they expire will be transferred to the Postal Telegraph-Cable Company on substantially the basis of the contract which has been made for the 4,745 miles. The Pennsylvania Railroad's telegraph system has been under the control of the Western Union Telegraph Company for twenty-five years. It is considered the heart of the telegraph business east of the Ohio River. It includes 3,000 offices, and the total amount of telegraph business is estimated at not less than three-quarters of a million dollars. The contract between the Postal Telegraph-Cable Company and the Pennsylvania Railroad Company is for a term of fifteen years. About 3,000 employees are affected by this deal, and it is believed that nearly all of those at present in the Western Union service in these offices will be employed by the Postal Telegraph-Cable Company. The Postal Company is to pay a yearly rental of $70,000 and 50 per cent. of the cash receipts from commercial business. The railroad will be entitled to free telegraph service amounting to $100,000 a year, but is to furnish the poles.

Pacific Coast Electric Transmission Association.

The Pacific Coast Electric Transmission Association opened its sixth annual session on June 17, in the Maple Room of the Palace Hotel, in San Francisco.

The officers elected were: E. J. de Sabla, Jr., president; H. H. Noble, vice-president; Wm. Angus, treasurer; Geo. P. Low, secretary. The executive committee will consist of C. O. Poole and C. W. Hutton. There are now about sixty-seven members, and there was a fair attendance at the sessions of the association.

The papers and addresses were as follows: Opening address by Dr. Charles Van Norden, the retiring president; "The Economy of Electric Power in Quartz Mining," by C. O. Poole; "The Application of Electric Power in the Comstock Lode," by Leon M. Hall; "Electric Pumping from the 1300-foot level," by Donald H. Fry; "Cloud versus Coal," by Alexander G. McAdie; "The Hydraulic End of Power Transmissions," by John S. Eastwood; "The Law of Electricity," by Frank P. Medina; "Surges in Transmission Circuits," by F. G. Baum; "A Proposed System for the Electrical Operation of Stock Wells," by A. J. Bowie, Jr., and "Wrinkles," by C. W. Hutton.

On the 18th the convention adjourned for one year and in the afternoon the plant of the Oakland Gas, Light & Heat Company and the sub-stations of the Bay Counties Power Company and of the Standard Electric Company were visited by the members of the association.

CURRENT NEWS AND NOTES.

MEXICAN TELEGRAPHS.—The Mexican government reports for the last fiscal period that 218 kilometers of line have been constructed; that 185 kilometers of iron wire have been replaced by bronze wire, and that the installation of Federal wires in the streets of the capital has been renewed, besides which the entire system is now under repair, for which purpose about 27 tons of iron wire, and over 10 tons of bronze wire, have been employed.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION will hold its twelfth annual meeting, at the Kaaterskill, Catskill Mountains, N. Y., on Tuesday, Wednesday and Thursday, September 2d, 3d and 4th, 1902. The officers are: President, Dr. Fred H. Morse, Melrose, Mass.; secretary, Dr. George E. Bill, Harrisburg, Pa.; treasurer, Dr. R. J. Nunn, Savannah, Ga. Further particulars may be obtained from Dr. Robt. Newman, 101 West Eightieth Street, New York, chairman of Executive Council.

MODEL ENCYCLOPÆDIAS.—It was stated last week that a set of rules regarding the employes to be engaged hereafter by the Manhattan Railway Company, which have been put into effect recently, will be enforced strictly when the entire system is run by electrictiy. The rules provide that each new employe must be 5 feet 8 inches tall, and must know the places of interest in the city, the streets, the routes of the surface car lines, and the terminals of the street car and ferry lines.

INSTITUTION OF ELECTRICAL ENGINEERS.—The English Institution finding that its work needs more funds has raised the annual fees as follows: Members, 3½ guineas; associate members, 2½ guineas, foreign members, 2 guineas, and associates, 2 guineas. This doubles the foreign subscription. There is no increase in the student's fee. The lowest cost of running the Institution on its present basis is £1 10s. per member, while the civil engineers spend about £2 17s., and the mechanicals, £2 14s. The Institution has accumulated a building fund of £10,000.

ELECTRIC PLANT IN AMSTERDAM.—Under date of June 2, 1902, Consul F. D. Hill writes from Amsterdam: The city council has voted a loan of 6,500,000 florins ($2,613,000) and a second one of 2,900,000 florins ($1,165,800) for building a plant to furnish electricity for lighting and motive power and for changing the street railway to electric traction. The contract for the building of the plant has as yet not been made. The steam engines, dynamos and the installation will be furnished by German and Dutch manufacturers. Particulars of the cables will be published on July 1; bids are to be delivered Sept. 1, 1902.

WHY AN A. M. ONLY?—The following is from the New York *Sun*: "Charles Proteus Steinmetz, the foremost expert in applied electricity of this country, and, therefore, of the world.—*President* ELIOT, *conferring the degree of A. M.*—Good. Mr. Steinmetz was on the *Sun's* list of the hundred Captains of Industry, whose great place in their respective callings entitled them to be present at the memorable luncheon to Prince Henry of Prussia. The Committee of Invitation thought so, too. Mr. Steinmetz's services to the General Electric Company prove him to be what President Eliot describes him. But why, then, make him merely an A. M.?"

EXPORT CLUB OF AMERICA.—This body has recently been formed with headquarters on the ground floor of the Tontine Building, Wall and Water Streets, New York City. The charter membership, limited to 500, has nearly been attained. Mr. H. S. Salt, of the Western Electric Company, is one of the vice-presidents. Among the companies in membership are the Electric Storage Battery Company, John A. Roebling's Sons Company, Milliken Bros. & Co. The dues are $10 per year, and the initiation fee, $25. The chief object of the club is to act as an export board of trade or exchange with committees for different branches of trade, including the electrical.

MOTOR SPEED REGULATION.—The speed regulation of electric motors is the subject of a patent granted June 17 to B. G. Lamme, consisting in the employment of an exciter on the motor shaft. The field magnet of the exciter under normal conditions is worked well below saturation; consequently, any change in the speed of rotation of its armature by reason of change in the e.m.f. supplied to the motor will build up or cut down the field magnetization of the generator to a greater degree than would be the case if the exciter field magnet were saturated. The exciter will, therefore, vary the excitation of the field magnet of the motor to a corresponding degree, and thus serve to maintain the speed approximately constant.

TURBINE DYNAMO.—A patent granted June 17 to B. G. Lamme describes the construction of a generator of high speed. for use in connection with steam turbines, the machine being of the revolving-field type. The field consists of two end blocks with two intervening blocks, the several sections of the core being fastened together against independent movement, by means of dowel pins near the periphery. The winding, which is all in parallel planes, is laid in deep slots continuous over the two ends of the armature. By means of a system of longitudinally bored holes and spaces between the blocks ventilation is maintained. Each section of the core is exactly balanced independently as it is placed in position on the shaft, and the entire structure is also balanced by means of screws inserted in the ends, the number and position of the screws being regulated to secure the adjustment desired.

ELECTROLYTIC CONDUCTORS.—A patent was granted June 10 to C. P. Steinmetz, which describes details of a glower of the Nernst lamp type. It is stated that as customarily made, such glowers have terminals consisting of fine platinum leading-in wires, and that after the lamp has been running awhile, the contact between these wires and the glower becomes greatly impaired, the end of the glower becoming smaller where the wires are wrapped around it, thereby loosening the latter. The inventor has found that by inclosing the wire-wound ends of the glower in magnetite and then fusing the latter, the wasting away of the glower end is prevented, and the ends run much cooler than those of the ordinary lamp of this type. In practice, the magnetite in powdered form is sprinkled upon the platinum wires where they are wound around the ends of the glower; these ends are then heated for a moment, preferably in a small electric arc between carbon points, to melt the magnetite about the wire This material has the advantage of being conductive at all temperatures—slightly so when cold, but increasing rapidly with the rising temperature. Moreover, it can be fused to make a firm compact mass at the joint between the wire and the glower, and will successfully withstand the heat at which the glower becomes incandescent.

PAN-BERLIN AUTOMOBILE EXPOSITION.—At the annual Pan-German Motor Carriage Exposition, which was held in Berlin, May 15 to 26, the list of 105 exhibitors included but one American firm, which firm showed a composition polish for metals. Consul-General Mason reports that but few electric automobiles were exhibited, and these so unchanged from the type of three years ago, that they did not form much of a feature of the Exposition. He states that the whole subject of electrical igniters for gas and spirit motors has made great progress in Germany during recent years. The Exposition included several kinds which furnished an effective and reliable spark with the minimum consumption of current. Some of these are fed from storage batteries, and in other cases a primary battery and Ruhmkorff coil is used, or current is furnished from a small dynamo driven from the axle. As to the general subject of automobilism in Germany, he says that steam carriages are not yet permitted to be used on public streets in Prussia, and hydrocarbon motors now appear to have the field to themselves. Throughout Prussia the rate of speed within municipal limits is limited to 7.45 miles an hour, and if this rate is exceeded there is inevitably a policeman in sight to halt the offender and bring him to justice. It is added that the result of the Paris and Berlin race, of last year, was to deepen and confirm the conviction of municipal monopolies that the automobile is an intruder to be handled with firmness and discretion.

CELLULOSE INSULATION.—A patent granted June 24 to Isidor Kitsee describes a method of insulating wire with cellulose, which is claimed to obviate the objections that have heretofore applied to this type of insulation. The inventor states he has found that if finely-divided sulphur, such as flour of sulphur, is intermixed with dissolved cellulose and then subjected to heat, preferably with the aid of pressure, the resistance value of the material insulated is more than double, and any degree of flexibility may be reached. Moreover, the degree of flexibility can be regulated in accordance with the percentage of sulphur added, and the sulphur adds the valuable property of a greater degree of resistance to the action of acids or of moisture.

SYNCHRONIZING ALTERNATORS.—A simple means of synchronizing alternators is the subject of a patent issued June 10 to R. E. Huthsteiner. The connections of a local circuit are such that in the case of two alternators; for example, the two machines are connected in opposition in the local circuit, this circuit containing two reactances of high value in order to reduce the current. Across this circuit and between the two reactances is connected a synchronizing arrangement, which may consist of an incandescent lamp. So long as the machines are out of phase the lamp produces a series of flashes while the machines are starting up, and then glows with gradually increasing luminosity, burning at full brilliancy when the machines are at exact step. As the circuit controlling the phase-indicating device is connected across the bus-bars, when the machines are paralleled to the two reactances above referred to, it will reduce the current in the synchronizing circuit to a minimum.

ELECTRICITY IN SEOUL.—The U. S. Department has received from Minister Allen, of Seoul, under date of May 1, 1902, extracts from a report published in a Japanese newspaper, in which very favorable mention is made of the plant of the Seoul Electric Company. The plant in question was built for the Korean company by an American firm—Collbran & Bostwick—who hold the property under mortgage. The company operates an overhead-trolley road of some 12 miles, and, with the same power, furnishes incandescent and arc lights for the city. The generating machinery consists of two 120-kw generators from the Westinghouse Manufacturing Company. The boilers are of the Babcock & Wilcox type. The dynamos furnish direct current at 550 volts for use of the cars, and at the same time alternating current at 385 volts for the electric lighting. There are something over 1,400 incandescent lights besides the arc lights in use. The consulting engineer is a Japanese, a graduate of the Massachusetts Institute of Technology. The road is being well patronized by the natives.

ASBESTOS INSULATED WIRE.—Six patents granted June 24 to J. A. Heany relate to a means for using asbestos for the insulation of wire. In one process the bare wire is first covered with a paste consisting of fish glue combined with lime, or a solution consisting of sulphate of ammonia, boracic acid, sulphate of soda, chloride of ammonia, chloride of soda and water. After either the first composition or the second solution has been applied to the wire, the asbestos is first treated with the second solution above mentioned, and is then dried, picked into flaky or fibrous form and then applied to the metallic surface. The covering thus applied is then coated with a paste containing the first mentioned composition. The wire before it is covered with the first composition or the second solution may be immersed in a bath of zinc chloride, and then allowed to dry before the first composition combined with the solution of chemical salts is applied. The zinc chloride not only serves to clean the wire, but when the latter is subjected to extreme heat after the insulation has been applied, chlorine is driven off and metallic zinc remaining, chemically combined with the metal surface and with certain of the ingredients of the paste. One of the patents describes a water, acid and fireproof composition for use on asbestos insulated wires or metallic surfaces, the compound readily adhering to and penetrating the asbestos. The compound is made by heating linseed oil to the boiling point and then adding litharge and red lead. After the mixture has boiled an hour, copal gum may then be added. This mixture is then again boiled until the mass becomes thick and black, at which point all or nearly all the free or volatile linic acid has been driven off, the stable linic or other acid combining with the metallic oxides to form a metallic compound. This compound is applied to the substance to be coated in a heated condition. Another of the patents describes a method of applying the asbestos. The wire is first drawn through a bath consisting essentially of sodium, silica and manganese oxide, in proportions sufficient to make a paste more or less viscous, after which asbestos is dusted or blown upon the cement. This furry covering is next subjected to heat and pressure until the asbestos is thoroughly correlated with the adhesive mixture. When thoroughly dry, this covering of asbestos and cement will firmly cling and will not crack or peel off if the wire is twisted or bent. One of the patents gives details of a machine for carrying out the above-mentioned process.

Letters to the Editors.

Hand vs. Machine Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs.—My "strongly expressed views on automatic telegraphy," to which Mr. Delany takes particular exception in your issue of May 31st, are more than fully justified by the long and costly experience of the Western Union and other telegraph organizations in connection with the operation of such systems.

It is not an uncommon, and, perhaps, not an unnatural tendency on the part of those with "axes to grind," to cavil at, and criticise the policy, or action, of any company that appears to be inimical to the adoption of such invention, system, or scheme in which they are directly interested. This particularly applies to the advocates and adherents of chemical automatic systems, who invariably raise the cry of antediluvianism against any position or attitude which may happen to be at variance with their own notions concerning so-called, up-to-date methods of telegraphy.

To such, it matters not that the objections offered are based upon past experiences showing conclusively that these systems possess neither the accuracy, reliability, efficiency nor economy of prevailing methods. Nor does it count for anything that the needs or requirements of the telegraph service do not, in point of fact, call for the employment of these alleged superior systems, whose defects and shortcomings of the past have yet to be satisfactorily demonstrated as having been practically overcome.

I know of but one really practicable high-speed automatic system in use to-day (the Wheatstone) that has stood the test of time, and even that can only be utilized to advantage as an auxiliary to the Morse system. The introduction of the Wheatstone into the Western Union service was attended with considerable difficulties in adapting it to the requirements of that service. Only after long and costly experimenting was this found possible, despite the fact that quite a number of expert Wheatstone operators were imported for that especial purpose.

It is obvious that when a system possessing features and properties of a much more practical character than those of any known chemical system cannot be worked satisfactorily without so much time and money being spent in bringing it up to the requisite standard, the chances of establishing and successfully operating less highly developed, and more uncertain systems at much higher rtaes of speed, must be very remote indeed.

College professors, interested inventors, promoters and other advocates of the fast method of transmission may figure it out theoretically, and say what they please regarding quicker service, cheaper rates or other alleged benefits to be derived by the public from the adoption of automatic methods of working, but 20 years of actual experience with the *best* of these methods have emphatically demonstrated the utter fallacy of such reasoning and conclusions.

One phase of the question that has seemingly been entirely overlooked by those who urge the adoption of improved methods of high-speed communications, is the fact that whatever necessity may have originally existed for the use of automatic systems passed away with the multiplication of wire facilities.

The business of the company, as intimated in a previous communication can be, and is now being handled to better advantage, and with greater despatch, accuracy and economy by "Morsing" the numerous wires at the company's disposal: the Wheatstone finding its sphere of usefulness as an adjunct, and a very valuable one in emergencies as in case of breakdown, etc. This course, it may be remarked, has also been adopted in the British telegraph service—the very home of fast speed telegraphy—and for reasons precisely similar to those above mentioned.

The argument advanced by Professor Crehore in favor of the

Craig idea of distributing perforating machines among business houses, with the view of relieving telegraph companies from all other functions except that of actually transmitting the messages from the slips prepared for that purpose, are not in the least convincing. This plan would not only involve the employment of more or less costly machinery, the maintenance of an expert force for the preparation and transcription of slips, but it would also lead to endless trouble and confusion in locating errors, and in placing the responsibility therefor. There are, indeed, so many disadvantages, dangers and difficulties to be apprehended from a practical point of view, and there is withal so little actual necessity for the adoption of such a scheme, that its acceptance cannot be regarded as a serious business proposition.

While the attitude of the Western Union is entirely friendly towards those who possess inventions or devices of any real merit or promise, it is not to be expected that it can seriously regard the extravagant claims, or entertain the absurd proposals of every Tom, Dick or Harry, with an invention of the gold-brick variety to dispose of, the sterling value of which is, as a rule, apparent only to the parties immediately concerned.

Nor can this company be justly accused of indifference to the "ideas of those who stand for developments in telegraphy commensurate with the advancement of recent years," inasmuch as it is continually experimenting with the latest and most promising appliances, and is keeping in close touch with any practical device or innovation calculated to expedite and cheapen the present telegraph service.

The "trial of the foreign automatic system" made by the writer, and so sneeringly alluded to by Mr. Delany, was in itself a clear indication of the disposition on the part of the company to grant facilities for putting to a practical test a new and much exploited system of the most rapid type of automatic telegraphy. The way in which this action has been misconstrued by Mr. Delany only goes to show that, by a certain class of disappointed inventors, the Western Union at least is bound to be "damned if it does, and damned if it don't" afford the desired opportunities for testing the feasibility of "up-to-date" schemes.

All statements to the contrary notwithstanding, the Western Union has ever shown a highly progressive spirit in matters affecting the best interests of the telegraph service, and has only frowned upon what was regarded as impracticable schemes, or revolutionary ideas, having for their object the demoralization or destruction of those well tried methods of working that have proved the mainstay of industrial telegraphy in the country.

The charge that it has been slow to accept improvements adopted by other companies is one that can only be justly applied to systems or appliances of dubious merit or character, and but poorly adapted to the lines, requirements or necessities of the Western Union service. In this category may be included the chemical system, for which, for reasons already specified, this company has no use whatever; the costly and complicated synchronous multiplex system, that can only be worked satisfactorily over limited distances; and the porcelain insulator, which, owing to climatic conditions alone, is employed to better advantage in England than could the more hygroscopic, but less expensive glass insulator used in the United States.

With regard to certain of the other matters mentioned by Mr. Delany, it is only necessary to say that just as soon as the Western Union became convinced of the superior advantages of sound reading, copper conductors, storage batteries, dynamotors, etc., it lost no time in adopting these improvements. The very success of the company, in the face of active competition, depends indeed upon its quickness to perceive the importance and desirability of methods calculated to increase the efficiency of its service.

This consideration has necessarily induced the company to investigate and promptly inaugurate such changes and improvements as could be safely, appropriately and beneficially applied to its lines. For proof of this, one has but to look at the number of different systems in operation, the wide range and variety of its machinery, embracing as it does all kinds of new and novel appliances of the most modern description, to say nothing of the thousand and one schemes and devices that have been tried and found wanting.

Many of the principal standard methods of working in use to-day have, as a matter of fact, been either largely or wholly developed by the Western Union. The quadruplex, for instance, was in but a partial stage of development when that company took hold of the system, and it was only through the energy and painstaking efforts of such men as Mr. F. W. Jones [illegible] was the first to make it a really practical working [illegible] Mr. [illegible] and other officials of the company, that its present state of efficiency was [illegible] reached.

It would occupy too much space to refer in detail to what has been accomplished in this particular direction, but enough, perhaps, has been said to show that the Western Union, far from being the slow-going, antiquated organization that certain persons would have the public believe, has in reality done more to foster, develop and render telegraphy commercially practicable than any other telegraph organization in existence.

Touching now upon Mr. Delany's criticism, "that with the speed ranging from 10 to 60 words per minute, and 30 cents for 10 words, it is no wonder that the number of messages falls below one per head." It should be remembered that the 66,000,000 messages to which this criticism refers represents the number handled by the Western Union alone during the past year. If to this number be added those sent over the Postal, Associated Press and railroad wires, as well as over the various bankers', brokers' and newspaper lines, controlling as they do a multiplicity of leased circuits, the grand total would amount to not less than 200,000,000 messages per year.

The charge is everlastingly made that the telegraph tolls in this country compare unfavorably with those of foreign countries. What are the facts in the case? Take Great Britain for example. There the charge to any part of the Kingdom is twelve cents for as many words, *including the address and signature*. The address and signature will certainly, as a rule, contain not less than six words, so that the rate may be said to be *two cents per word for the body of the message*, one cent per additional word being charged when the number exceeds the minimum of twelve words.

Now a message containing ten body-words may be sent from New York to Philadelphia for twenty cents, or two cents per word; the sender having the privilege of making the address and signature of any desired length without additional cost. And it may interest, if it does not surprise the reader to learn, that, with the address and signature counted, the total number of words in these so-called "ten-word" messages averages about thirty.

For twenty-five cents a message of twenty-five words may be sent between any two points in England, but the twenty-five cent rate in this country covers a very much larger area. When, however, it comes to a question of greater distances than those possible in England, we find that the difference is all in favor of the American tariff. The rate, for instance, from New York to Chicago (984 miles) is forty cents for ten body-words, with no charge for address and signature, whereas between London and Vienna (980 miles) the rate would be nine cents per word, or ninety cents for the text of the message alone. A 10-word text message, New York to Milwaukee, costs fifty cents, address and signature being free. The same message between London and Madrid, a corresponding distance, would cost $1.30 for the text, and thirteen cents for each word contained in the address and signature. For one dollar, a 10-word message, exclusive of address and signature, can be sent from New York to San Francisco. To send a telegram from any point in England a similar distance on the Continent would cost probably not less than three or four dollars.

It would appear, then, all things considered, that while for short distances the rates here are no higher than in England, the long-distance rates on the Continent and between England and the Continent are much higher than those for similar distances in the United States.

It has been said that Europe is at least ahead of America with regard to its telegraph equipment and service. As far as the writer knows, the United States is the only country in which telegraph lines are operated direct from dynamo current. Representative electricians from nearly all parts of the globe who came to visit the World's Fair, in Chicago, and who inspected the Western Union office and system there, stated distinctly that the progress of telegraphy in the United States was very far in advance of what it was in Europe, and there is no reason to believe that the case is any different now from what it was in 1892.

To quote a recent utterance of a high authority in this country, "the active competition between our two great telegraph companies has been not only of economic advantage to our people, but it has assured them of the highest condition of efficiency. Every new labor-saving and time-saving device is promptly adopted, until we have admittedly to-day the finest and most expeditious electrical service in the world. The service in England is almost proverbial

for its slowness and lack of mechanical facilities, and she has so far operated her lines at a loss."

In the latter connection, it may be of some interest to state that the official annual reports of the British Postmaster General show that there has been a large deficit every year since the government purchased the lines in 1869. The average shortage for the past nine years amounts to $2,423,555.

In conclusion I would add, that while it has been generally conceded that the business demands of commercial telegraphy in this country have been satisfactorily met, the Western Union Telegraph Company recognizes the possibility of a better and more liberal service, and is ready to welcome any effort for its provision.

NEW YORK. J. C. BARCLAY.

Electrical Engineer, Western Union Telegraph Company.

Self-Exciting Asynchronous Alternators.

To the Editors of Electrical World and Engineer:

Sirs.—As a result of certain claims of M. Marius Latour, which have appeared in your columns, several letters and inquiries on the relation between M. Latour's claims and my system of compensated motors and generators have been sent to me from your country.

First of all, I may say in reference to M. Latour's claim for the invention "Exciting a constant field by commutated polyphase current," that he was anticipated by Prof. Görges in 1891, who described a similar arrangement, consisting of a polyphase motor with commutator armature, and having three brushes either in parallel or in series with the terminals of the motor. In connection with this arrangement, Prof. Görges says (*Electrotechnische Zeitschrift*, 1891, page 701): "At synchronism this e. m. f. (of the rotor) will be equal to zero. The rotating ring is thus magnetized similarly to the field magnets of a series direct-current machine, while the e. m. f. produced by rotation only occurs in the stator, etc."

On the other hand, M. Latour's arrangement has nothing to do at all with the system of asynchronous motors and generators described by me, but relates to quite a different matter. To relieve any doubts in this direction, I give below the main points of a letter to a French journal, which forms the end of a long discussion commenced by M. Latour.

1. M. Latour has maintained and continues to maintain that the connections between the segments of the commutator do not present a closed circuit to the induced currents; that the rotor would be dead short-circuited by the brushes, and that less than 1 per cent. of the current would go through the connections between the segments. I have demonstrated by trials that practically all of the induced current passes through these connections, and that current from the brushes (exciting current) remains practically constant at all loads.

2. M. Latour maintains that the effect of these connections would be disastrous with respect to efficiency. I have shown by experiments that the efficiency remains good, and that a 5-hp Schuckert motor showed a slip of 5 per cent., 2 per cent. of current being taken for excitation. I can now add that a Brown-Boveri 100-hp motor has shown a slip of 2 per cent., with ½ per cent. of energy taken for excitation.

3. M. Latour maintains that my motors run above synchronous speed. I have proved that the slip of my motors is the same as that of ordinary induction motors, and rises in ratio to the load from zero at no load to 5 per cent. at full load for small motors, and 2 per cent. for large motors.

4. M. Latour maintains that the closed circuit of the rotor of my machines serves only to obviate sparking and to suppress harmonics; that is, he confounds it with the amortisseur of M. Leblanc. I have shown in what precedes that this closed circuit serves the purpose of the squirrel-cage of non-synchronous motors; that is to say, to produce by slip a couple between the stator and rotor, while M. Leblanc has defined his amortisseur as being intended for machines the field of which has a constant direction.

It is evident, and according to his original patent, undeniable, that M. Latour has striven to produce in his machines a field of constant direction caused by a synchronous commutation of polyphase currents; but after learning of my work with respect to non-synchronous machines, he changed his plan. My French patent does not prevent him from making a non-synchronous machine with a slip below or above synchronism; but a trial will show him the modification introduced by the squirrel-cage. This arrangement is covered by my French patent. If the object is not explained in the title of the patent, as M. Latour has observed, it is certainly explained in the text, which suffices from the legal standpoint. I will remark that my German and American applications are more detailed.

The object of this arrangement has been demonstrated by the results obtained. It is new, an indication of which is that at first sight it appears inoperative; in fact, up to the present it has been held to be impossible, and this by electrical engineers of reputation. A singular error, resulting from the theories which have confused the two systems, is with respect to the manner in which all of these theories treat the question of commutation in the machines of M. Latour. It is astonishing to find M. Poincairé considering as the important point in commutation the fact that the total field of the rotor remains constant during commutation. According to modern theories, the periodicity of the fields scarcely enters, but it is the reactance of the commutated coil which gives to the machines of to-day the "vertus modernes" of which M. Latour speaks. The effect of this reactance during the time that a brush passes from one segment to the other remains evidently the same, and all the current in the coil between two segments should be commutated from plus to minus, whether the current is continuous or alternating. This should make clear to M. Latour that the brush short-circuit is not so absolute as he thinks, and also why the induced currents in the rotor prefer to pass through the connections or the coils in the short-circuit. If then, M. Latour wishes to give to his machines this "vertu moderne," namely, that the reactance of the coil between two segments shall not exceed the value generally found in direct-current modern machines, he will have the condition of non-sparking whether his brushes are regulated or not. The number of segments will become sufficiently large to suppress harmonics without the need of a squirrel-cage.

M. Latour also disapproves of my machines on the ground that the cost of copper for the rotor is greater than that for the stator. In point of fact, this difference should not increase at a greater ratio than the exciting current. Generally, for certain reasons, I use more copper, and manufacturers are not sorry when the results show them that the ratio of the power of the machine to the cost of material increases in greater proportion than the cost of material.

M. Latour announces that he has claimed, in a new patent, the excitation of a machine by simple alternating current. This claim should convince him of the profound difference between our two systems, for this method of excitation is necessarily involved in my machine. In my system, as I have explained, I introduce the magnetizing current into the rotor instead of into the stator. The ordinary induction motors are single or polyphase, and up to the present I have not seem a single-phase motor excited by a polyphase current. The drawings of my French patent show for the general case, two brushes. The excitation of my motors has been described as being by a single-phase current, and a machine on my system, which I saw in operation at Vienna, Nov. 18, was excited by single-phase current. As to single-phase excitation, I naturally had no need to claim it.

BRUSSELS, BELGIUM. ALEXANDER HEYLAND.

A Photographic Phenomenon.

To the Editors of Electrical World and Engineer:

Sirs.—The following phenomena were observed last January while the writer was attempting to get an effect upon a photographic plate from the waves surging through an ordinary magnetic field produced with an alternating current. A pair of electromagnets about 3 inches long and 2 inches in diameter, wound with No. 24 wire, was placed behind a double plate-holder containing a 4-in. x 5-in. Cramer "Crown" plate, thus bringing the film within one-half inch of the two pole faces. In front, and as a support for the plate-holder, were placed two upright brass posts. An alternating current of 60 cycles was switched on and off several times, and then left on about three minutes. When the plate was developed a faint image was observed, the exact size of the two pole faces, and, stranger yet, the two brass posts were shown, the images thus having been produced through the hard rubber slide of the plate-holder. The same experiment under the same conditions, as nearly as possible, has been repeated a number times since, but without success. The writer would be glad to know why such long waves as those acting excited chemical

action upon the plate where ordinarily it requires an extreme frequency? Also why the image or shadow of the brass standards, which were on the opposite side of the plate from the magnet, appeared?

Manhattan, Kan. Geo. T. Fielding, Jr.

Government Supervision and Municipal Ownership in Great Britain.

To the Editors of Electrical World and Engineer:

Sirs.—In the otherwise accurate report in your issue of the 24th ultimo of the work of the Legislation Committee of our Institution of Electrical Engineers, there is a typographical error, which perhaps you will be good enough to correct by the insertion of this letter. I was a member of this committee and acted as its reporter [illegible]. The chairman at the greater number of the meetings was our respected president, Mr. W. E. Langdon, whose term of office has just expired.

Perhaps I might be permitted to add that it is generally felt on this side that Mr. Langdon's year has been the most momentous in the history of the institution, which has now inaugurated the policy of taking an active part in furthering not only the purely scientific but also the practical needs of the industry.

London, England. Wm. L. Madgen.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Heyland Motor.—Heyland, Latour, Picou, Osnos, Feldmann, Boy de la Tour.—The discussion of the Heyland and of the Latour machines is continuing in the German and French journals. Picou contributes an article, illustrated by diagrams, in which he endeavors to explain in a simple way the relations between the two machines. He starts with the Latour machine; then he adds resistances as connections between the segments of the commutator, and thus passes over to the Heyland machine. The currents induced in the rotor can now pass both through these connections or over the brushes. He calculates that only one thousandth part would pass through those connections, so that these connections would not make the Heyland motor comparable to a short-circuited armature induction motor. He thinks the differences in the conceptions of Heyland and Latour come from the different points of view from which they have started in developing their inventions. He seems to assume that Heyland's and Latour's machines are identical wtih the single exception that the connections between the segments in Heyland's machine are favorable for suppressing sparks at the collector.—*L'Ind. Elec.*, May 10.

Osnos gives a French article, the contents of which are largely identical with those given by him recently in the German journal *Elec. Zeit.*, which was duly noticed in the Digest. In his present article he formulates his conclusions as follows: "In 1891 Georges invented an induction motor of practical applicability without phase difference. We are indebted to Heyland and Latour for having drawn this motor out of oblivion." He is not sure whether the induction motor with a power factor equal to unity will be able to compete successfully with induction motors without a commutator. This question can be settled in the practice only. He fears that the efficiency and the overload capacity will be low in the Heyland motor, which has, moreover, the disadvantages of being complicated and expensive.—*L'Eclairage Elec.*, May 24.

Latour answers Osnos, and denies that Georges has anticipated him. He seems to agree in general with Picou (see above). He says "Mr. Heyland makes the same motor as I do. There is no Heyland motor. Heyland has simply invented a device for avoiding the sparks at the commutator of a shunt dynamo."—*L'Eclairage Elec.*, June 7.

Feldmann says there are the following distinct and essential differences between Heyland's and Latour's inventions. Heyland has a generator which always runs non-synchronously, and which excites itself and remains excited, with a fixed position of the brushes between no-load and full-load, the exciting current being constant and compensating the magnetizing current. Latour has a generator which always runs non-synchronously and which, to remain constantly excited, needs a varying position of the brushes and a varying current through the brushes, when the load is varied, as the current which passes to the rotor through the brushes is not only the magnetizing current but also the energy component of the current corresponding to the load. He says Latour now wants to read into his patents more than it contains.—*Elek. Zeit.*, June 12.

Boy de la Tour discusses the Heyland machine theoretically by means of diagrams; he seems somewhat sceptical as to the practical usefulness of the machine.—*L'Ind. Elec.*, June 10.

The polemics between Heyland and Latour themselves continues largely on the patent question and on the similarity between Latour's and Heyland's inventions. There is much repetition in their discussions. Latour's point of view has been stated above. Heyland claims his motor is a true induction motor because the rotor is short-circuited and the motor has all the characteristic features of an induction motor: slip equal to zero at no-load and 4 to 5 per cent. at full-load, etc.; this has been found to be so whether the brushes are on or not; when the brushes are connected, the only result is that the power factor becomes unity and that the overload capacity increases by 50 per cent. He points out that experimental evidence has refuted Latour's statement that only 1 per cent. of the induced current would pass through the connections between the segments (or only one-thousandth, according to Picou); he says that experiments have shown that "practically the whole induced currents pass through the connections between the segments." It has also been found that the efficiency remains good; for instance, a small 5-hp motor has 5 per cent. slip and 2 per cent. excitation loss; a larger motor of 100-hp has 2 per cent. slip and 0.5 per cent. excitation loss. The connections between the segments are not simply for the purpose of suppressing sparks at the commutator, but on their account the motor is really a short-circuited armature induction motor.—Latour in *L'Ind. Eelc.*, May 25, and *L'Eclairage Elec.*, June 7; Heyland in *L'Ind. Elec.*, May 10, 25, June 12, and in *Elek. Zeit.*, May 29, June 5, 12.

Parallel Operation of Alternators.—Tingley.—A paper read before the Engine Builders' Association, at Pittsburg. He gives the principal clauses of a specification in use by the Westinghouse Electric Company, covering the matter of characteristics of engines driving direct-coupled alternators intended for parallel operation. The requirements are explained, and some comment on them is added. Additional flywheel effect in the rotating parts usually decreases the tendency to pumping; it is only when additional flywheel capacity increases the resonant effect that the additional flywheel is objectionable. To get successful parallel running, it is now usual to apply dampers to the poles of the generators and rotary convertors and synchronous motors; but experience shows that dampers do not ensure parallel running, nor are they absolutely necessary. The specification mentioned above requires that the variation of the rotating part of the generator through one revolution, at any constant load not exceeding 25 per cent. overload, should not exceed 1-60 of the pitch angle between two consecutive poles from the position it would have if the motion were absolutely uniform at the same mean velocity. The maximum allowable variation, which is the amount the rotating part forges ahead plus the amount which it lags behind the position of uniform rotation, is, therefore, 1-30 of the pitch angle between two poles; generally this is obtained by the use of a heavy playwheel. The angular variation from uniform velocity is thus limited in order to limit the cross currents between generators and rotary converters to what is considered a reasonable amount. Adjustable governors are recommended in the specification for the purpose of transferring the load from one generator to the other, in order that the load may

be readily cared for at the switchboard, or reduced so that the generator switches may be opened without injurious arcing. Usually the engine governors will vary in their own adjustment, and it becomes necessary to correct this from time to time in order to divide the load properly, since all the governors may not regulate the same throughout the total range of load. Adjustable governors also enable an unloaded engine to be synchronized with a loaded engine.—*Eng. News,* June 19. (See full report ELECTRICAL WORLD AND ENGINEER, May 31, 1902.

LONGWELL.—Another paper, read before the same association, and discussing the problem from the view of the engine builders. He says that the problem of paralleling alternators is now, and will be for some time to come, complicated with additional and, perhaps, equally difficult problems of "paralleling brains." The electrical and dynamic features in the case are so interrelated that real knowledge can come only when the electrical engineer and the mechanical engineer drop all petty differences and co-operate with each other in the most frank and hearty manner. As long as one is expected to blindly and unquestionably follow the dictates of the other, successful paralleling will be by accident rather than design. The whole matter is one of compromise. The irregularities in the action of the engines do set up electrical disturbances. The reciprocity engine must always have an irregularity in angular speed, and consequently electrical disturbances are inevitable. The engine builder can control the amount of this irregularity to a certain extent, but he is barred by continual and commercial limits from reaching absolute perfection. On the other hand, the electrical disturbances react on the engine, augmenting the inherent irregularities in the latter, and the intensity of this reaction is, within certain limits, under the control of the electrical engineer. He attacks certain requirements usually given in specifications of electrical engineers. He dwells at length on the proof of the statement that "in every practical case the effect of the synchronizing force of the alternators is to increase the irregularity of the angular speed of the engine instead of to diminish it." Synchronizing force cannot pull two generators into phase and hold them there any more than the force of gravity can pull an ordinary pendulum to the vertical position and hold it there. The effect of the synchronizing force between alternators is analogous to that of a spring capable of both extension and compression, and considered apart from all other forces, will produce an oscillation of the rotating masses, the period of which oscillation depends on the intensity of the synchronizing force and the magnitude of the masses. The period of this oscillation has a very important bearing on the amount the angular displacement is augumented by the syncronizing force. With a period which he believes corresponds with the time of one revolution of the engine, the angular displacement seems to be increased indefinitely. As this natural period of oscillation is increased or decreased from the critical period, the effect of the synchronizing force on the displacement seems to decrease.—*Eng. News,* June 19.

REFERENCE.

Voltage Drop of Alternators.—BACH, ROTHERT.—Two further communications in which they continue their polemics on this subject.—*Elek. Zeit.,* May 8, 29.

Thury System of Direct-current Transmission between Saint Maurice and Lausanne.—SOULIER.—A very long illustrated description of this high-tension, direct-current power transmission plant. In 1898 the city of Lausanne had acquired a water-power of 14,000 hp, at Saint Maurice, at a distance of 56 km. The plans of transmission were submitted to a committee of experts, which decided in favor of the direct-current series system of Thury, because this allowed a saving of nearly $150,000, the cost of the three-phase transmission and of the direct-current series system being $1,621,000 and $1,473,000, respectively. There has been erected up to the present 18 installations of this Thury system. The plant was started without difficulties; the connection of the machines in series is simple, and is done in a few minutes; variations of load, although important, have not changed the regulation in any way. In the city of Lausanne the direct current motors, which are supplied from the transmission line, drive three-phase alternators which supply the city with lighting current; this peculiar reversion of general practice is not the one originally suggested, as it had originally been proposed to use direct-current distribution with storage batteries as reserve, which would have been charged during the day. It is said that the three-phase system was adopted for distribution in that city " for political reasons." The hydraulic plant is described: the power house contains 10 direct-current generators, a pair of each being driven by the same turbine, connected to it by an elastic insulating coupling. Each of these machines produces a direct current of 156 amperes at 2,230 volts, at a speed of 300 revolutions. The automatic regulation of the installation for constant current is obtained by variations of the speed, by means of a special motor operating the turbine sluice. The power house has no switchboard in the proper sense, the only switching apparatus is a short-circuiting switch located in a column; to start a machine, the dynamo is short-circuited and the turbine is gradually started; as soon as the ammeter shows that the current has risen to 150 amperes, the machine is switched into the circuit, which is done easily without sparks, and the load divides automatically between the different sets in service. The transmission line is 56 km. long; on the way it makes a loop of 2 km. in order to supply a 300-kw motor in a cement factory. In the substation in Lausanne there are five motors in series, each of 300 kw, and taking an e. m. f. of 2,150 volts at 150 amperes. They drive three-phase alternators which supply the city network. Experiments have been made to determine whether, in a case of emergency, it would be possible to work with one single conductor and earth return; it was found it would be possible to work with an earth return for 150 amperes. At Lausanne the earth is represented by the water-pipe system, which has been connected to the negative side of the system to avoid electrolysis. At Saint Maurice an artificial earth has been made. The machines operated successfully, but while the earth at Lausanne was perfect, there was a notable drop at Saint Maurice, probably on account of the rocky ground. These experiments have not been made with a view of constantly using one wire only and an earth return, but to ascertain whether this would be possible in case of one wire breaking down. The Lausanne substation contains an interesting machine, which is used for testing the insulation of the line. It is a 25-kw direct-current dynamo, producing directly 25,000 volts.—*L'Ind. Elec.,* May 25.

REFERENCES.

A Novel Elevator and Transfer Table.—The apparatus described is of a new type and design; it combines an electric transfer table with an elevator, so that either story of a finishing shop may be served by a single device. The motor not only moves the structure along the pit but also operates the elevator, and by means of a cable draws the cars on and off.—*St. R'y Jour.,* June 7, and *Int. Ed.,* June.

Refuse Destruction.—BROADBENT.—The first part of an article on "refuse destruction, its sanitary and its steam raising aspects." He points out that refuse destruction is primarily a sanitary problem, and that the only sanitary method of disposing of refuse is by burning. He discusses briefly some early types of refuse destructors.—Lond. *Elec. Rev.,* May 30.

Electric Traction in Italy.—CARUS-WILSON.—An illustrated abstract of a paper read before the (Brit.) Inst. Elec. Eng., on "electric traction on steam railways in Italy." For a long time past the Italian railways have been suffering from the competition of tramways, and have thus come to the conclusion that the remedy lies in providing, by means of electricity, a service of short trains running frequently at high speeds. The Adriatic R'y Co. has already equipped electrically that portion of its system running from Lecco to Colico, and thence to Sondrio and to Chiavenna. The total distance at present electrified is 66 miles, all of single track. In the hydraulic power house with turbines of 6,000 hp. three-phase currents are generated at 22,000 volts and transmitted to nine transformer substations, where the three-phase currents are reduced in voltage to 3,000, to be supplied then to the two trolley wires, the rail forming the third conductor and thence direct to polyphase motors on the cars. Each car is provided with two high-speed motors of 150-hp, and two low-speed motors of 75-hp each, weighing 3.8 tons, and driving direct without gearing. Full speed is 37 miles an hour. The four motors are used in cascade connection at starting; at half speed the two low-speed motors are switched out, and the car is driven by the two high-speed motors alone at full speed. On all grades over 1 per cent., the motors are connected in cascade. The goods traffic is to be hauled by electric locomotives. The Mediterranean R'y Co. is equipped electrically the whole of the line from Milan to Gallarate and thence to Varese, Porto Ceresio, Laveno and Arora; the total length is 81 miles. Three-phase currents at 12,000 volts are transmitted to seven converter substations along the line, where the current is changed to 650 volts direct current. He gives numerous statistical tables concerning the operating expenses, receipts, etc., in comparison with

steam traction, and also in comparison with English lines. He concludes that the full advantages of electric traction cannot be obtained without an increase in the total running expenses, and this increase can only be met by a corresponding increase in the passenger traffic, so that the change from steam to electricity should not be made unless the increase in traffic may be reasonably expected at least to cover the increased cost of running and the interest on the capital expenditure. It is not by reducing expenses that electriciy is going to help the railways, but by enabling them to offer greatly increased traveling facilities to the public at a figure impossible with steam traction, and thus to meet the growing competition of the tramways.—Lond. *Elec. Rev.*, May 30. A reprint of the paper in full in Lond. *Elec.*, June 6, 13.

An editorial on Carus-Wilson's paper, and a brief abstract of the discussion which followed, and which turned largely on the financial inducements to British railway companies to convert their lines. Steel, formerly general manager of the Great Northern Railway, denied in unqualified terms that there was any substantial inducement. Sayers retorted that if such was to be the policy of railway companies, they would soon be left to their goods and mineral traffic. Langdon could not accept the author's conclusions, and he doubted whether it would pay British railway companies to convert their lines. Editorially, the opinion is expressed that the conversion of British steam railways will take place, not through any studious contemplation or forethought of railway authorities, but through the irresistible compulsion arising from the competition of rival electric lines.—Lond. *Elec.*, June 13.

REFERENCE.

South African Tramway.—An illustrated description of the Camp's Bay, Cape Town and Sea Point tramways. The trolley system is used with a voltage of 500. The power house contains two 400-kw generating sets.—Lond. *Elec. Rev.*, May 30.

Installations. Systems and Appliances.

Buenos Ayres.—Baehcker.—An illustrated description of a combined lighting and traction station, built by a German company in Buenos Ayres. There are seven steam-driven 672-kw dynamos, giving direct current at 440 to 550 volts. For traction this voltage is used directly, while for lighting the dynamos are provided with a device (probably Dobrowolski's), by which a three-wire system can be directly supplied from a single dynamo.—*Elek. Zeit.*, May 8.

REFERENCE.

Street Lighting by Meter.—Allin.—A brief paper, read before the League of California municipalities. He suggests applying the meter to street lighting. This is done in Utica, N. Y., and the results are satisfactory.—*Jour. of Elec.*, May.

Wires, Wiring and Conduits.

Current Density in Nickeline Resistance Wires.—Erlacker.—An article on the current density which may be allowed in nickeline wires, used for resistance wires. The rule is sometimes given that 5 to 10 amperes per square millimeter are permissible, but such a general rule is not consistent. He applies to nickeline wires the formula which has been used for copper wires. It states that the current to be allowed is equal to the square root of the third power of the diameter, multiplied with a constant which depends upon the rise of temperature permitted. The following rise of temperatures may be permitted: 450 degrees for single starters, wound on porcelain; 300 degrees for spirals; 300 to 200 degrees for reversing starters and speed regulators in the main circuit; 100 degrees for shunt regulators, feeder regulators and lamp regulators. For nickeline wire, the constant in the formula mentioned above, is, for good regulation, 6.4, 9.05, 11.1, 13.6 for a temperature rise of 100, 200, 300, 450 degrees, respectively; for bad regulation it is 5.7, 8.06, 9.88, 12.1. Porcelain, although it is a poor conductor for heat, absorbs much of the generated heat, which is of advantage for intermittent service. By winding resistance wires on porcelain cylinders, a considerable saving of resistance material may be obtained, as the volume of the wire is inversely proportioned to the third root of the eighth power of the temperature constant.—*Elek. Zeit.*, May 8.

Electro-Physics and Magnetism.

Wave Shape.—Russell.—An article in which he investigates mathematically how the shape of an alternating-current wave depends on the resistance in circuit, and how its effective value depends on the shape of the e. m. f. wave. He describes the following experiment, illustrating the kind of effect [illegible] by electricians, which is due to change of shape of the current wave. The primary circuit of a small 100 to 200-volt transformer was [illegible] to the 100-volt mains of a supply company. Across the [illegible] terminals was placed a condenser, whose capacity was 2 m[illegible] in series with an adjustable resistance. On increasing this resistance it was expected that the primary current would first increase and then diminish. It was found, however, that when the adjustable resistance was zero, the current in the primary was 0.67 ampere. As the resistance increased the primary current diminished, attaining a minimum value of 0.62 ampere when the resistance was 35 ohms; it then increased to a maximum value when the resistance was 1,500 ohms, and finally diminished to 0.74 ampere, its value on open circuit when the resistance was infinitely larger. The secondary current, of course, continually diminished when the resistance was increased. The alteration of the shape of the current wave was proved by the ratio of the volts at the condenser terminals to the secondary current continually increasing as the resistance in the circuit was increased.—Lond. *Elec. Rev.*, May 30.

Electric Waves and the Human Brain.—Collins.—An illustrated account of experiments concerning the effect of electric waves upon the human brain, which show that cohesion of the brain cells in "mammals" after death and in life, and also in "man" after death, takes place under the action of electric waves. From facts in which nervous poeple were affected in a certain way by thunderstorms, he concludes that cohesion of the brain cells in man in life also takes place under the action of electric waves.—Lond. *Elec. Rev.*, May 23.

REFERENCES.

Radioactivity of Matter.—Becquerel.—A reprint of a discourse delivered before the Royal Institute, and in which he gives a review of the experimental and theoretical researches, by various investigations, of Becquerel and similar rays.—*Sc. Am. Sup.*, June 7.

Coherer.—Del Mar.—An illustrated article in which he describes how to make a modern coherer, and gives a brief review of its history and theory.—*Sc. Am. Sup.*, June 21.

Electro-Chemistry and Batteries.

Electro-Zincing.—Cowper-Coles.—An illustrated article giving some notes on electro-galvanizing. This has been in extensive use in ship-building yards for coating steel plates and boiler tubes for the last seven years, and the results obtained have been highly satisfactory when the work has been electrozinced under proper supervision in a plant capable of fiulfilling the conditions necessary to obtain an adhesive coating of zinc free from perforations. On the other hand, work to be galvanized cold may be placed in the bath for an hour or more, and be withdrawn with practically no zinc on it, due to a bad electric connection, or to the bath being too acid, or to the dynamo having too small a capacity for the size of work under treatment. He gives an illustrated description of a regenerative electrogalvanizing plant, which he has recently erected for the Vulcan Shipbuilding Company, in Stettin, Germany, for the coating of boiler tubes for water-tube boilers and general shipyard work. The electrolyte contains 35 ozs. of crystallized zinc sulphate to the gallon of water. In practice, it is found very important to keep the zincing solution slightly acid, otherwise the zinc coating will not be adhesive and will have a tendency to blister. The best proportion of free sulphuric acid is about 0.1 oz. to every gallon of water. The amount of free acid in solution is quickly determined by using capsules of gelatine containing known quantities of alkali. A small proportion of lacnoid solution is then added, and if a pink color is obtained it indicates the presence of more than 0.1 oz. per gallon of free acid. If a violet color is obtained, the solution contains less than 0.1 oz. of free acid per gallon.—Lond. *Elec. Rev.*, May 23.

Aluminum Alloys.—An article giving notes on some new aluminum alloys. Guillet has investigated a binary alloy of aluminum and tungsten, prepared by the Goldschmidt process; he has also investigated the binary alloys of aluminum with molybdenum, preparing them by reducing molybdic acid with an excess of aluminum in the same way as he did with the tungsten alloys. Lippman has examined the alloy of aluminum and antimony, having the composition Al Sb; it melts at 1,080° C., while its constituents melt at 660 and 630 degrees, respectively; it is, therefore, an exception to the rule that alloys generally are more fusible than their ingredients separately. Lippmann also found the sp. gr. to be 4.22, the sp. gr. of aluminum and antimony being 2.67 and 6.72, respectively; by calculation it should have had a density of 5.22, so that a consider-

able increase in volume must occur during its production, and it forms an exception to Matthiessen's law. Both Wright and Roche state that Al Sb disintegrates in moist air, and liberates hydrogen from water; in fact, none of the aluminum antimony alloys appear to be permanent. Boudouard has determined the melting points of a long series of aluminum magnesium alloys, of which magnalium is the best known type. Kaempfer states that magnalium turns well, can be drilled or milled readily, and does not clog the finest files. It is harder than pure aluminum, and cannot be cut with a knife. Its tensile strength is from 13 to 15 tons per sq. in. It takes and retains a high polish. Its sp. gr. is 2.52, 0.03. Its fracture has a fine grain, like that of steel. Siemens and Halske, of Berlin, are reported to use it in the manufacture of armatures and for motor-car parts; otherwise it seems to have been taken up mainly by opticians.—Lond. *Elec. Rev.*, May 30.

Aluminum Rectifiers.—Koenig.—An account of an experimental investigation. An aluminum cell behaves like a condenser in parallel with a high resistance and in series with a low resistance. Using four cells, in the arrangement of Graetz, for the conversion of an alternating current into a pulsating direct current, he found that the maximum efficiency increases up to a certain point with increasing voltage. In the alternating-current circuit there is a phase difference between current and voltage which is greatest at zero load on the direct-current circuit, and decreases when the load on the latter is increased. He observed that all cells after a while show a growth of cylindrical rods of alumina about 7 mm. long and 1 mm. thick after prolonged use, which limits their life.—*Elek. Zeit.*, May 29; abstracted in Lond. *Elec.*, June 13.

REFERENCES.

Development of Electrochemistry.—Johnson.—An article in which, after a brief discussion of the modern theories of electrochemistry, he discusses the industrial development of electroplating and electrotyping, metal refining, reduction of ores and production of copper, gold, lead, aluminum and sodium, and the manufacture of caustic soda, hypochlorites and chlorates.—*School of Mines Quart.*, April.

Industrial Electrolysis of Water.—Engelhardt.—A long and well illustrated paper, in which he gives a review of the different types of apparatus for the industrial electrolysis of water, with comparative tables of cost. He also discusses the different industrial applications of the gases produced.—*Zeit. Oest. Ing. u Arch. Ver.*, May 9.

Theory of Electrolytic Dissociation.—Wiechmann.—An article giving a rather full and concise review of the principles of the theory of electrolytic dissociation.—*School of Mines Quart.*, April.

Units, Measurements and Instruments.

Capillary Electrometer.—Burch.—An account of a long series of experiments concerning the insulation resistance of the capillary electrometer. In many capillary electrometers, if an excursion of the meniscus is produced by touching the terminals with a source of e. m. f. and then removing it, leaving the circuit open, the meniscus returns in a comparatively short time to the position it would occupy if the instrument were short-circuited. In other words, the charge which is contained in the instrument as long as the meniscus is deflected from its zero position, gradually leaks away. The question arises whether this leakage is accidental, like that of the gold-leaf electroscope, or essential, in the sense that some small current may be necessary to maintain a deflection. His experiments appear to show that the latter is not the case. The cause of the leakage is two-fold. Part of it is external, as is evident from the marked influence of the weather on the insulation resistance; the capillary electrometer is necessarily a difficult instrument to insulate. The other part of the leakage is internal, due to the fact that the acid wets the glass and the mercury does not; there is, therefore, a tendency for the acid to creep up between the mercury and the walls of the capillary tube. He prefers to have a depth of 8 or 10 cm. of mercury in the capillary tube, and 5 cm. in the U-tube type. The internal leakage is least when the electrometer is new. He is of the opinion that there is no electrolysis, properly so called, in the well-made electrometer. Incidentally, he mentions the following method of guarding against false readings due to a sticky tube: When an electrified ebonite tube is waved to and fro near one of the terminals of the instrument at open circuit the meniscus in the capillary tube must move up and down by induction, and then return to its original position; if it does so freely, the tube is not sticky. In his instrument the minimum quantity of electric charge required to cause a visible movement of the meniscus he found to be 0.01 electrostatic unit.—Lond. *Elec.*, May 30.

Units of Electromagnetism.—Giorgi.—An abstract of a (Brit.) Phys. Soc. paper, on a system of "rational units of electromagnetism," somewhat similar to that proposed by Fessenden. He starts with a set of three equations, which contain explicitly the four concrete units of e. m. f., m. m. f., electric current and "magnetic current," together with that of "activity," and considers them as fundamental in electromagnetism. Two fundamental units are required to express these quantities, and their product must reproduce the mechanical unit of activity. If the watt is assumed as unit of activity, there are two existing units, the volt and the ampere, which satisfy the condition, and may be considered fundamental. All concrete units in electricity and magnetism can be expressed in terms of these and the second as unit of time. In order to complete the system, a unit of length is required. The meter and kilogram are consistent with the watt, and putting them together with the units enumerated in the paper, he has built up an absolute meter—kilogram—second system, which comprises electric, magnetic and mechanical measures in a consistent way. In the discussions, Swinburne remarked that most physicists who love simplicity would be glad to get rid of 4π, but schemes for suppressing it generally moved it somewhere else. If a change in units were to be made, it would be an advantage to get rid of the terms e. m. f. and m. m. f. Everett gave some mathematical explanations of the paper.—Lond. *Elec.*, May 30.

REFERENCES.

Ballistic Measurement of Hysteresis.—Searle.—A long illustrated and chiefly mathematical paper. In a former paper he described a method by which the energy lost through magnetic hysteresis, for a given range of the magnetic force, can be measured by the throw of a ballistic electrodynamometer as rapidly as changes of magnetic induction can be measured by the throws of a ballistic galvanometer. He now works out all the details and gives the complete mathematical theory of the method.—Lond. *Elec.*, May 9. 23.

Insulation Measurements.—Claude.—An article in which he explains an older mathematical theory of the late Hess on the constitution and behavior of the dielectric in a cable, with some conclusions concerning the measurement of insulation. He illustrates Hess' theory by a mechanical model, which is based upon the hydraulic analogy of a condenser.—*L'Ind. Elec.*, March 25.

Meters.—An illustrated description of the latest improved type of Ferranti direct-current meter.—Lond. *Elec.*, May 30.

Telegraphy Telephony and Signals.

Telephone and Telegraph Circuits on the Same Pole Line.—Kinsey.—An abstract of and comments on his paper, read before the Dublin section of the (Brit.) Inst. Elec. Eng., on "railway blocks and telegraphs; recent practice." In this paper he describes the following method of combining telephone and telegraph circuits which run on the same pole line, so as to obviate inductive disturbance of the former, without more wires than would be required for a single-wire circuit for each. The arrangement is shown in the adjoining diagram. The two line wires are joined at each end

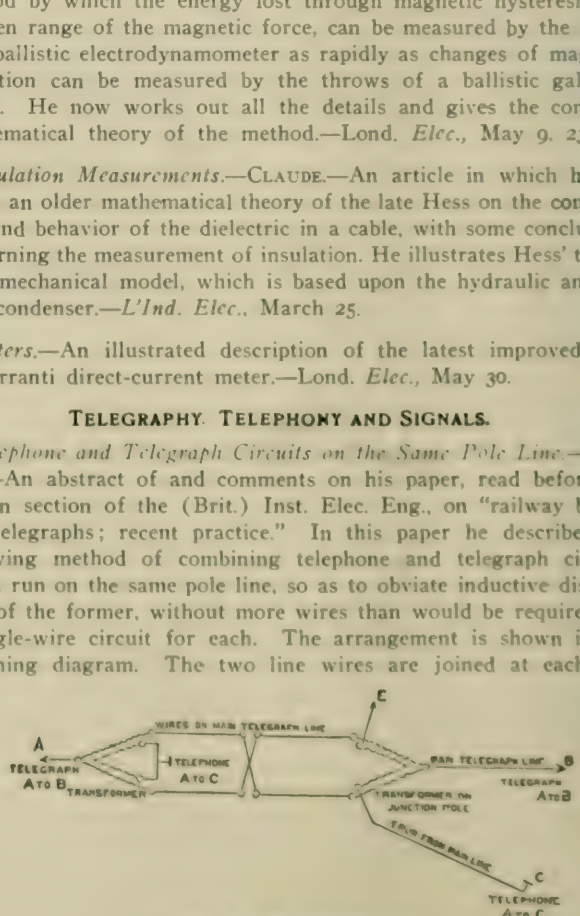


DIAGRAM OF CONNECTIONS.

through similar windings of the transformers, and the telegraph line is connected to the centers of the same winding at each end The telephone sets are connected in the other windings of the respective transformers. If the telephone line wire is led off the line of poles carrying the telegraph wire, the transformer is placed at the junction pole, and one end of the winding connected with the telephone is earthed there, the other end being connected to the

continuation of the telephone line wire, and earthed through the telephone set as usual. The two line wires are in parallel so far as the telegraph currents are concerned, and the differential action of the transformer windings to these currents prevents disturbance to the telephone, which has a metallic circuit up to the transformer at the far end. Disturbance from other wires is prevented by crossing the line wires in the usual way. Obviously, the two line wires must have the same resistance in order to prevent disturbance of the telephone by the telegraph currents.—Lond. *Elec. Rev.*, May 23.

Coherer for Wireless Telegraph.—BRANLY.—A description of a new type of coherer, consisting of a steel tripod with slightly ozidized feet, standing on a plate of polished steel. The oxidation is carried out at a fixed temperature, and remains in the same state for months. The receiving circuit contains this tripod coherer, and operates a Claude relay, which brings an accumulator circuit into action. The Morse connections are so arranged that, after the signal has been recorded, the recorder, in returning to its normal position, communicates a slight shock to the tripod, which decoheres it and makes it ready to receive the next signal. The tapping device used by Marconi is thus rendered superfluous. The feebleness of the shock required renders it possible to increase the speed of transmission. The coherer is shielded from the influence of the sparks of its own transmitter by the attraction of an auxiliary electromagnet, which serves to lift the tripod very slightly off the steel plate while signals are being sent out. He claims that the new coherer is more regular in function than any other coherer, and that it has the same sensitiveness as any other coherer used for Morse signalling.—*Comptes Rendus,* May 26; abstracted in Lond. *Elec.*, June 13.

Automatic Telephone Exchanges.—DOMMERQUE.—An article in which he discusses in detail the claim that low telephone rates could be obtained by using automatic exchanges, as the expense for operators is done away with. He denies this, and raises the following fundamental objections to automatic exchanges. The subscriber has to do his own operating, which is not to his liking. The central office mechanism is extremely complicated. Local battery is used for transmission instead of central energy, while the whole tendency of modern telephone engineering is towards centralization of mechanism and energy, instead of subdivision, as occurs in the automatic system. The Western Electric Company is said to have experimented with all forms of automatic exchanges, and to have today better automatic systems than other companies, but after extensive experiments it was decided that it would be impossible to manufacture and maintain automatic exchanges and give proper service.—*Tel. Mag.*, May.

REFERENCE.

American Institute.—An article giving brief biographical sketches of the organizers of the Am. Inst. Elec. Eng.—*Elec. Rev.*, June 14.

New Books.

DIE ELEKTRISCHEN EINRICHTUNGEN DER EISENBAHNEN. By R. Bauer, A. Prasch and O. Wehr. Vienna: A. Hartleben. 431 pages, 318 illustrations. Price, 6 marks.

The authors have prepared this volume with special reference to the requirements of the signallers and telegraphists employed on the German and Austrian railways. No attempt is made to develop the theory of the apparatus described, beyond the necessities of apprehension. In fact, the theory of magnetism, so far as it is developed, is archaic, and such as existed in books on physics thirty years ago. The practical descriptions of the apparatus are excellent and lucid, the diagrams of connections simple and clear, and the classification orderly and convenient. No other book that we have seen gives so clear and comprehensive a description of the various signalling, automatic and semi-automatic railroad telegraph systems of German-speaking countries.

The first section of 67 pages is devoted to outlines of electric and magnetic theory. The second section of 72 pages deals with railroad telegraphy. The third section of 170 pages treats of the various electric block and signal systems. The fourth section of 34 pages covers telephony, while the fifth and last section of 47 pages is devoted to the treatment, care and operation of railroad electric apparatus in general. For the particular purpose to which the book is devoted, it is invaluable.

HAND BOOK FOR STREET RAILWAY ENGINEERS. By H. B. Andrews. New York: John Wiley & Sons. 202 pages, 41 illustrations. Price, morocco, $1.25.

This little book is a convenient size to go in the pocket and contains 14 chapters comprising the following information.

Chapter I is devoted to mensuration, and covers such mathematical computations as are likely to be used in railway work. It gives the formulæ briefly, and presupposes a knowledge of mathematics. Chapter II is devoted to circular curves which are used in track laying, and Chapter III to compound transition curves. These curves are illustrated, and methods and formulæ are submitted for obtaining the lengths of chords and arcs. Chapter IV carries this matter up still further, having particular reference to track curves, elevation of rails, and the method of laying out such curves from a practical standpoint. Chapter V contains miscellaneous information with reference to track construction, tables, specifications for rail, cost of track construction, and similar data.

Chapter VI is devoted in the first part to well-known formulæ in applied mechanics, which are important in car construction and truck design. It closes with a diagram showing standard weights for street railway cars, giving truck spacing. Chapter VII is devoted to the strength of materials used in street railway work, but curiously enough nothing is said about concrete, which is such an important material in power-house and track construction. This is an evident oversight, as it should have been given several pages. Chapter VIII is devoted to data for estimating, and includes a few pages relating to the determination of the necessary work for various kinds of track construction. It does not comprise any commercial figures. This is also an opportunity lost for making the book particularly valuable. The engineer is often required to give rough estimates at short notice, and commercial data for this purpose is difficult to obtain.

Chapter IX is devoted to electrical information, and is prefaced by a definition and review of the common electrical terms, and followed by copper wire tables and the method of calculating feeders. There is also included a system for computing the horse-power necessary for propelling railway cars. The author devotes several pages to the subject of aluminum for electrical conductors, which is important information not generally to be found in hand-books of this character. This latter feature comprises Chapter X. Chapter XI is devoted to railway storage batteries, and is quite complete as far as the small number of pages allotted to this subject can make it so. Chapter XII is devoted to tables relating to rail curvatures, length of circular arcs and chords, decimal equivalents in feet per fractional part of inches, and a five-place table of natural sines, cosines and tangents for every degree and minute of the quadrant.

Chapter XIII treats of percentage between expenditures and gross receipts of street railways in Massachusetts apparently compiled from State reports. Chapter XIV is a buyers' directory, which is very limited, comprising only 21 names. This does not even cover the different supplies to be had in the railway field, and less than onetenth of one per cent of those in the railway supply business. It can hardly be seriously considered.

Taking the book as a whole, it may be said that the writer gives much valuable information, but he has tried to cover too much in an extremely limited compass, with the result that some of the important subjects taken up are considered in the merest outline. The most valuable features are the chapters relating to curves, and there are also some useful tables and tabulated information. The remainder of the book is devoted to data which is to be found in almost any electrical or mechanical band-book.

Directory of Electrical Societies, Etc.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Next meeting, Pittsburg, June 28 to July 3, 1902.

AMERICAN ELECTOCHEMICAL SOCIETY. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Next meeting, September, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Toronto, Ont., 1903.

Electrical Contractor's Association of New York. Semi-Annual meeting, Hotel Ten Eyck, Albany, N. Y., July 15, 1902.

National Electrical Contractors' Association. Annual meeting, Hotel Walton, Philadelphia, July 16, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Electric Light Association. Next meeting, Chicago, May, 1903.

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Old-Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Salt Lake City, Utah, September, 1902.

Society for Promotion of Engineering Education. Next meeting, Pittsburg, June 28 to July 3, 1902.

The American Electro-Therapeutic Association. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

Lozier Lunch at the Lawyers' Club.

Mr. Robert T. Lozier, who for some years past has been managing with great success the business of the Bullock Electric Manufacturing Company at its New York offices, and has pushed its trade vigorously at home and abroad, has been called to the Cincinnati headquarters by Mr. Bullock to take entire charge of the sales department. He left on Saturday to assume his new duties, and in order to wish him prosperity in his larger sphere of responsibility, some 25 or 30 of his more intimate friends gathered at 1 p. m., at the Lawyers' Club for lunch, in one of the private dining-rooms, which certainly was never filled by a more enthusiastic party. Among those assembled to express their sentiments toward this talented and amiable young New Yorker, who in addition to his business work, has done admirable service for the American Institute of Electrical Engineers, as a member of various committees, were Messrs. W. E. Baker, the well known electric railway engineer; G. U. G. Holman, of the Quebec Electric Companies; P. Torchio and H. Stephenson, of the New York Edison Company; E. S. Keefer, of the Western Electric Company; H. B. Coho, of the Electric Storage Battery Company; Capt. D. S. Hough; J. L. Hall, F. Saxelby and W. T. Spellmire, of the Bullock Company; A. K. Warren, of the Brooklyn Rapid Transit Company; E. R. Knowles and H. Alexander, the electrical engineers; T. C. Martin, Electrical World and Engineer; and Messrs. H. D. Babbitt, S. H. Evins, H. W. Doubrava, C. D. Zabriskie, C. E. Pickett, B. W. Payne, N. B. Payne, L. Comstock, C. V. Edwards, H. C. Cushing, Jr., H. H. Pennock, H. T. Maury, etc., etc.

Among the speakers were Messrs. Holman, Hough, Alexander, Martin, Spellmire, Coho, Warren, Zabriskie, Pennock and Hall. and their emphatic remarks had the effect of making Mr. Lozier's cheeks assume the color of his necktie. In response to all the kind things said about him, Mr. Lozier spoke of the pride he had always felt in electrical work ever since he had managed Mr. Edison as his office boy; and in outlining electrical engineering development even during his own short term of activity, he expressed strong belief in its opportunities as a career for every hard worker. During the lunch, Mr. Lozier received a set of silver-backed hair brushes from his colleagues in the New York office; and it was not till 4 p. m. that the gathering broke up with three ringing cheers for the new Cincinnatian.

The New Telephone Exchange at Saratoga, N. Y.

The independent telephone exchange recently installed at Saratoga, N. Y., is one of the most interesting complete equipments evolved of late. While it differs to no great extent in its main principle or working from other like successful systems, it embodies, however, in the construction of its parts, an unusual number of new features that are of importance to the durability and efficiency of a telephone system. The equipment is manufactured and installed by the International Telephone Manufacturing Company, Chicago.

The main switchboard, shown in Fig. 1, is a full central energy lamp signal multiple board with double supervisory clearing out

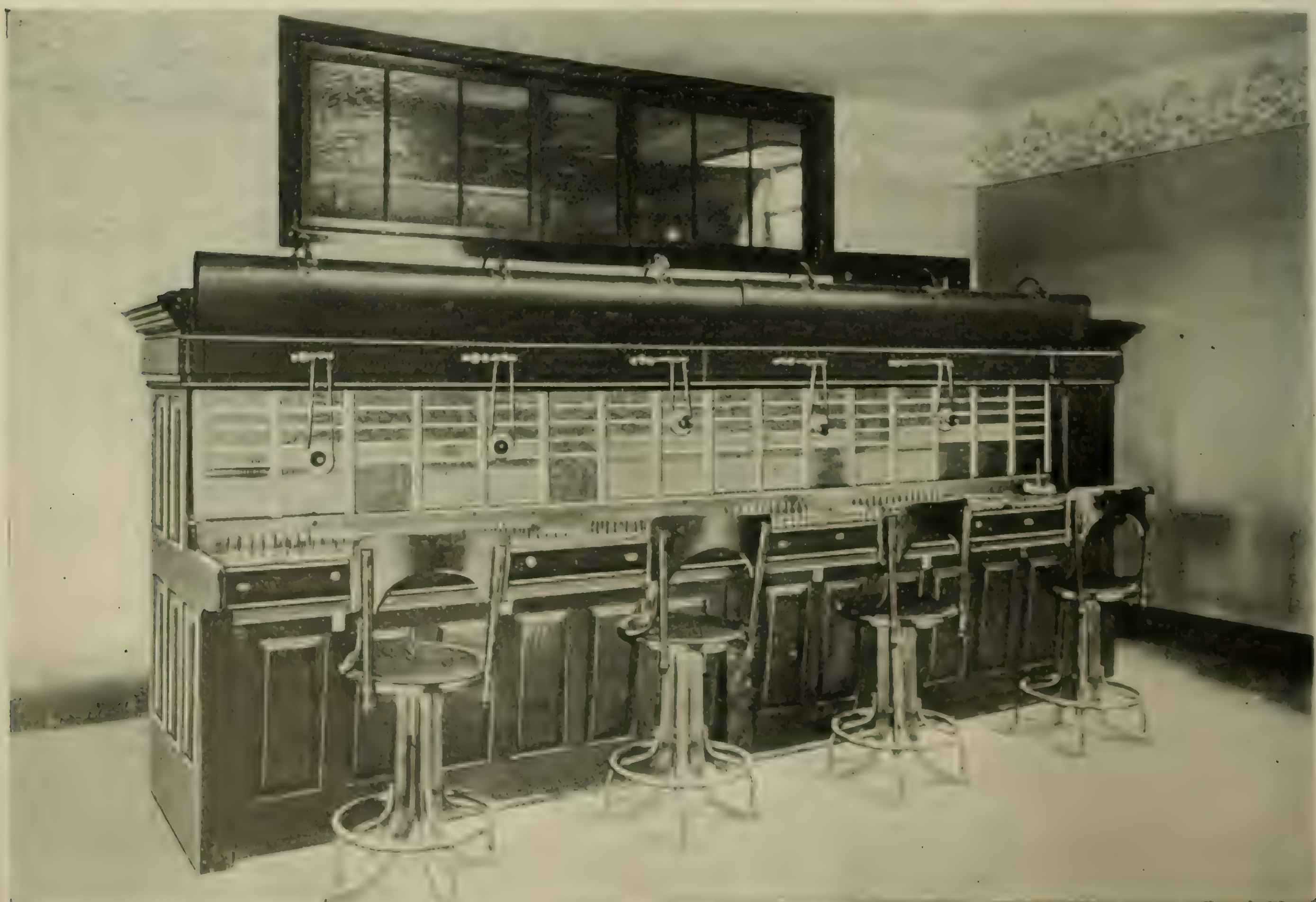


Fig. 1.—Central Energy Multiple Switchboard, Saratoga Telephone Company.

lamps. It is built with a frame capacity for 2400 lines, with a present equipment for 500 subscribers' lines. The frames are eight-panel iron sections arranged for three operators' positions. They are constructed of angle-iron well braced, to make them strong and rigid. The sections are so arranged that when joined they have the appearance of one solid frame. All parts of the front and side, other than

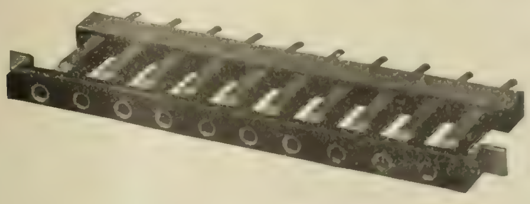


FIG. 2.—ANSWERING JACK.

the space for the jacks and signals, are covered with highly polished dark-finish solid mahogany cabinet work. The back of each section is provided with a dust-proof roller curtain of heavy canvas covered with dark red felt.

The plug board and the panel back of the plugs, which contains the pilot lamps, are covered with mahogany-stained leather belting. At the top, in front of each section, is mounted an Acme trough reflector

[illegible] the panels and firmly clamp[illegible] are easily removed and replaced.

The base of the bank of jacks and signals, by which each [illegible] clamped to the iron frame, is of one piece of [illegible] brass, properly formed and extending through the [illegible] the strip. In the jacks this bar base is provided with [illegible] size to receive a hard rubber bushing, with its inner diameter of the same size as the holes in the front and back hard rubber strip, through which are placed the jack ferrules. The ferrules are screwed into the bottom connection spring, firmly holding the springs and clamping the three parts of the front piece.

The ringing and listening keys are set on the key-shelf with all their contact points toward the front, and the one key cable which connects all the terminals along the bottom, when the shelf is raised for inspecting the working parts, as shown in Fig. 4. In ea[illegible] are also placed a pair of circuit-changing keys for four-par[illegible] ringing line use, for which the entire board is equipped.

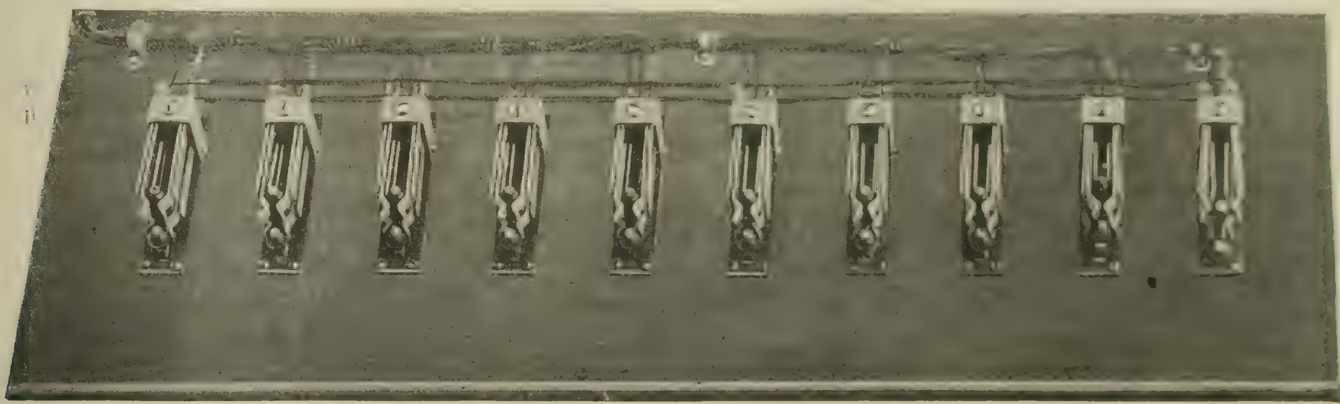


FIG. 4.—RINGING AND LISTENING KEYS.

with incandescent lamps. These reflectors are adjusted so that the light may be thrown properly on the front of the board. The transmitters are mounted on a nickel-plated brass octagon-shaped adjustable arm, provided in front with nickel-plated cord pulleys set in oxidized hangings. The arm passes through an oxidized plate, which forms also an escutecheon on each side for the transmitter cords. The arm is guided and held in proper position by an angle arm fastened in the rear of the board. Each operator's position is provided with three pilot lamps, one to indicate when a call is received, one when a disconnect signal is given, and one when an operator rings a subscriber.

The key-shelves are made of five layers of wood, two layers with their grain running crosswise, and the remaining three lengthwise. The shelves are hinged so that they may be raised for inspecting and testing the keys and wiring. The key-shelves are provided with a spring lock for fastening and are opened with a key. The plugs and double supervisory clearing out lamps are mounted on the mahogany-stained leather-covered board, back of the key-shelves.

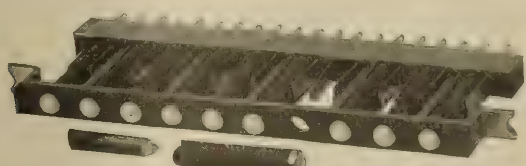


FIG. 3.—LAMP LINE SIGNALS.

In the front of the trough of the board under the key-shelf, in each position, are mounted a pair of spring jacks, for operator's receiver connecting jacks. The answering jacks and lamp line signals (shown in Figs. 2 and 3) are placed alternately in strips of ten, with 100 to the position. They are arranged in columns of five strips, or 100 signals in two panels, leaving one vacant panel between the operators

The supervisory signal lamps are mounted similarly to the line signals. The lamps are placed in a fibre tube, which is provided at its top with a collared setting holding the opalescent jewel. The glass jewel is protected from impact with the plugs by an arched wire fastened to the collar of the setting. This arched wire protector also

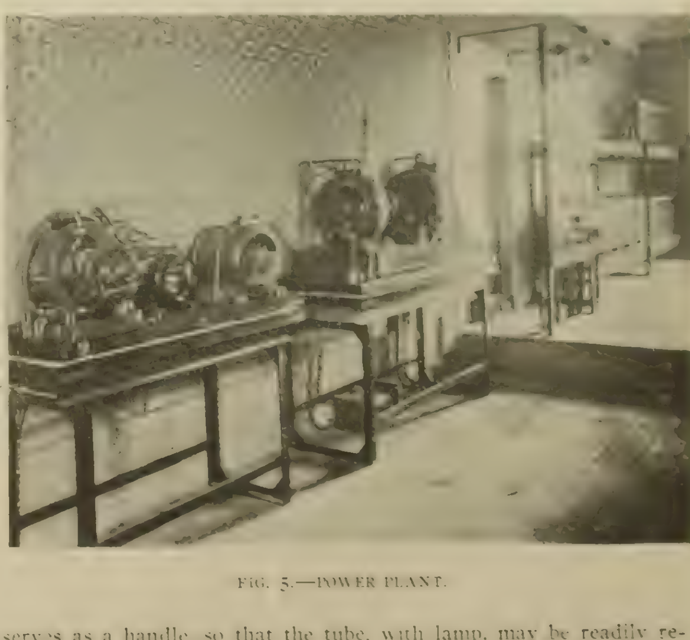


FIG. 5.—POWER PLANT.

serves as a handle, so that the tube, with lamp, may be readily removed and replaced at any time, from the top of the board. This form of construction leaves the glass jewel flush with the top of the board, and absolutely avoids any accumulation of dust in these

parts. The bottom of the lamp-holding tube is slotted to form a guide and leave openings for the lamp jack contact points.

The supervisory lamp jacks are permanently mounted and wired on the bottom of the board. All line relays, cord relays and operator's set relays are mounted on the relay rack. In the back of the main switchboard, no relays, condensers or coils of any kind can be seen. All like apparatus is placed together.

Fig. 5 shows the complete power plant for the exchange. The battery plant consists of a set of chloride accumulators with cells of lead-lined wooden tanks. The battery rack is constructed of heavy angle iron and channel iron, well braced to make it strong and rigid. The batteries are set on shelves of heavy slate slabs, supported on the angle iron crossbars of the rack. The power switchboard shown in front of the battery rack is constructed of a heavy marble slab containing the switches and instruments and mounted on a stand built of heavy angle iron, all suitably braced.

At the top of the board are mounted two Weston ammeters and one volt meter. Immediately below the reading instruments is mounted a voltmeter switch. In this switch the contact points of opposite polarity are mounted on separate slabs of slate, which are fastened

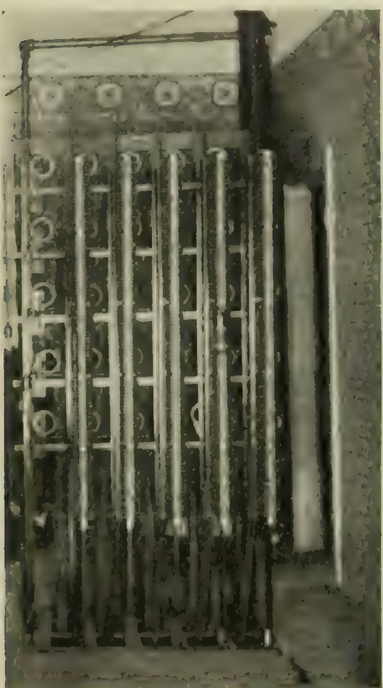


FIG. 6.—MAIN AND INTERMEDIATE RACK.

FIG. 8.—WALL INSTRUMENT.

on the back of the switchboard. The switch is controlled from the face of the board by a hand wheel and index plate. This switch gives a positive knife-switch connection, and does not depend on the uncertain pressure of small springs for the contacts. On the center of the board are mounted necessary knife switches for controlling the entire system. At the bottom of the power board are mounted the bus bars and D. & W. lightning arresters. Immediately above the bus bars in the center is mounted a circuit breaker. Between the circuit breaker and the knife switches are mounted the rheostats, which are provided, on the face of the board, with a small hand wheel and dial plate similar to the voltmeter switch. All metal parts on the face of the power board are copper-plated and highly polished. The power equipment consists of a 2-hp Wagner motor, directly connected to a 2-hp Roth charging dynamo, for the charging set. For the ringing set is furnished one Roth combination generator, and a half-hp Wagner motor. The combination generator may be operated from the motor or from the storage battery set. The power machine tables are constructed of heavy angle iron and channel iron, strongly braced, on which is mounted a heavy wood frame supporting the base of the machines on heavy solid rubber balls.

Fig. 6 shows the combination main and intermediate rack, with heat coil protectors. The desk telephone, as shown in Fig. 7, is constructed with all of its metal parts of heavily nickel-plated, highly polished cast brass. The switch is mounted in the head of the pedestal with all its contact springs, for both sides of the circuits, mounted in hard rubber, perfectly insulating the circuit from the pedestal and hook, and avoiding the use of any of the exposed metal parts for any part of the circuit at any time. The contact springs are of the best German silver and are provided with platinum contacts. The springs and contacts are so arranged that they form a positive sliding connection at all times. The hook-restoring spring is of heavy German silver sheet, and is formed to pass around the pedestal on two sides. This construction gives a double spring and furnishes a restorer three inches in length, making a very live and durable switch, and avoiding the use of a small exposed spiral spring under the switch hook. The switch springs and the restoring springs are covered with a brass tube cap to completely conceal the working parts, together with all connecting cords and wires.

The pedestal is provided with an adjustable head for the transmitter, so it may be raised up and down. This adjustable head is provided with a concealed stop for allowing its adjustment the proper distance only. The transmitter cords taken directly from the front and back electrodes, pass through the head and the pedestal into its base, and terminating in properly mounted binding posts. The induction coil is mounted on a neatly constructed, heavily japanned metal base. The cord terminals are supported on a fibre insulated bar mounted on the induction coil base.

The wall instrument shown in Fig. 8 is constructed with the usual backboard with shelf. The induction coil is mounted in the base of

FIG. 7.—DESK TELEPHONE.

the arm. The coil box is provided with a false bottom, to which it is hinged and locked. The false bottom is permanently fastened to the backboard and can be conveniently opened for inspecting and testing the working parts. All wire terminals and connecting wires are mounted in the coil box, and are fully concealed when the box is closed. On this instrument, as well as on the desk set, there are no exposed metal parts, binding posts, screws or connecting wires that form any part of the circuit at any time.

Telephone Switchboard Manufacturing in New England.

The Couch & Seeley Company, of Boston, Mass., in its factory of 30,000 feet of floor space devotes an entire floor, or 10,000 square feet, wholly to switchboard work. Its switchboard line includes both central energy and magneto-call types for both transfer and multiple systems, toll line boards, hotel and small private plant apparatus, with complete facilities for building equipment to any specifications. Another department is occupied wholly in making central energy and magneto-call types of telephones, with a capacity for producing 100 complete instruments per day. Another department is given over entirely to "interior" apparatus, of which the company makes a large line, including automatic intercommunicating systems and similar types for every conceivable purpose. The personnel of this company is composed of the following: Francis H. Whitman, president; Raymond L. Whitman, treasurer, Elisha B. Seeley, general manager.

Mordey-Fricker Electricity Meter.

At the Royal Society Conversazione, on May 14, there was shown a new and very simple electricity meter differing in principle and mode of action from other types of meters in use. The meter is the invention of Mr. W. M. Mordey and Mr. G. C. Fricker, and is suitable for either direct or alternating current. It may be described as a combination of an ordinary clock with a galvanometer coil surrounding a soft iron needle. Its construction will be readily understood from the illustrations in connection with the following description:

Fig. 1 shows the meter complete in its case. Figs. 2 and 3 are back and front views with the cover removed. Fig. 4 shows one coil of the winding removed, revealing the "armature." Two examples were shown at the Conversazione, a 20-light and a 10-light meter. The illustrations are from photographs of the former.

The meter consists of a clock deprived of its hair-spring and carrying on its balance-wheel shaft a disc of slate on which a few pieces of iron wire or iron strip are fixed in the manner of a compass card. This disc is surrounded by a fixed coil of wire, conveying the current to be metered. The disc acts as a variable hairspring. The iron which it carries is magnetized more or less strongly by the current, a directive action being exerted in an opposite sense to that acting on a galvanometer needle, that is to say, tending to bring the iron needle to a central or axial position in the coil. This action, in conjunction with the ordinary action of the driving spring of the clock, causes the disc to oscillate at a rate proportional to the current. The meter does not go at all when no current is passing; there then being no directive action on the iron, the disc comes to rest at one or the other extreme of its arc of oscillation.

The balance-wheel shaft is carried on a footstep jewel, but in order to relieve that jewel of pressure and prevent risk of injury to it, a torsionless silk fibre suspension is used attached to the shaft by a bent wire spring; thus practically the whole weight of the shaft and disc is taken off the jewel. This suspension is not essential. The meter works quite well without it. It is used simply as a safeguard against damage to the jewel and consequent interference with the running of the meter, such as might otherwise result from long-continued use.

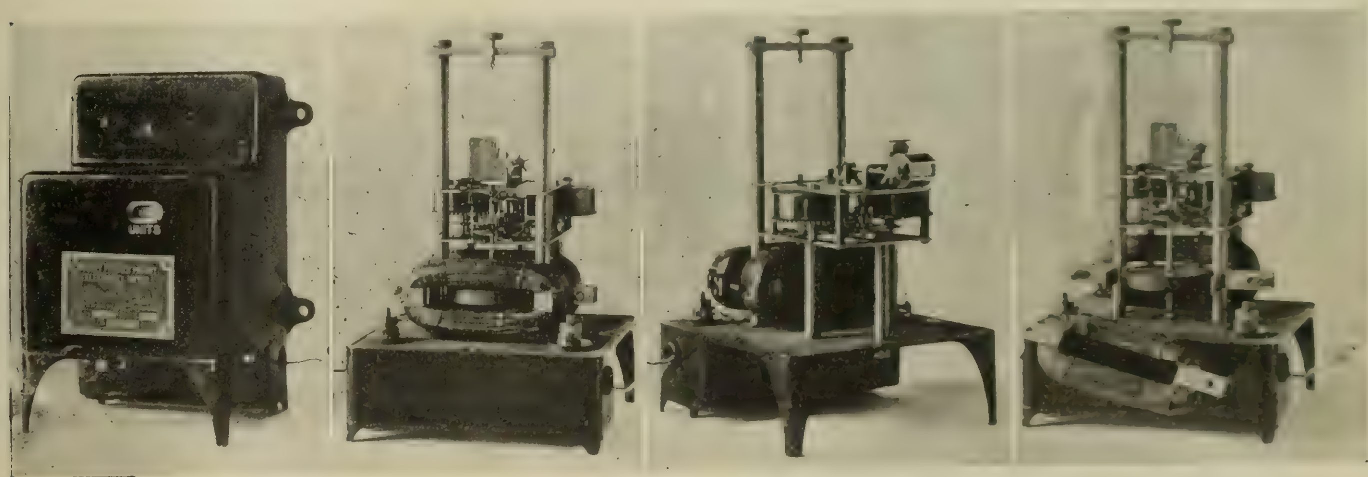
The meter is an ampere-hour meter, but for use on constant-pressure circuits the counter, which is geared to the clock, is arranged to indicate the consumption directly in kilowatt-hours. The base of the instrument is provided on one side with a sealing chamber to which access is obtained by a movable plate at the bottom, the wires passing through holes at the sides.

These meters are suitable for either direct or alternate current. They may be wound for any pressure. An important feature is that with alternate currents there is no "frequency error," the constant being the same for all practical frequencies. As it is found in practice that on many installations a considerable loss to the central station results from inaccurate records of very small and long-continued loads, these meters are made to record the smallest loads met with in practice, such as one 5-cp; or one 8-cp lamp. The pressure drop due to the resistance of the coil is about 0.7 per cent on full load.

The winding-up of the clockwork is a very simple matter, as one winding is enough to last for about three months on installations of the kind for which the instrument is intended. As the clock does not go at all when no current is passing, the running-down of the spring is very slow. For this reason it has not been thought necessary to introduce the complication of an automatic self-winding gear. As it is the practice for meter inspectors to visit all meters at least once a quarter, and as the operation of winding up takes the inspector only a few seconds and will not necessitate any extra visits on his part, it will probably be admitted that there is no practical objection on this score. The question of the life of the clockwork is of some importance. An ordinary eight-day clock movement is used, but as at the average speed of the meters, the clock for each wind-up runs for about three months, it will be evident that the life will be much greater than that of an ordinary clock.

These instruments are intended especially for small installations of lamps which now in many places form a large proportion of the new work that is coming on central stations, installations, say, of twelve to thirty lamps. So long as the same range is used they may, however, be equally used for much larger loads, such as, for example, motors of 10 to 20-hp, on which the minimum load is not less than one hp. For such cases as they are readily calibrated to read directly in units, they are likely to be of use for power purposes.

It will be seen that this meter is not of a type similar to any meters in use. Meters may be divided into a number of classes, such as commutator motor meters, induction motor meters, mercury meters, electrolytic meters, differential clock meters and periodic integrating clock meters each class having several representatives; but the present meter is the first practical example of a type consisting of a single simple clock which does not go at all when there is no current, and when there is current, goes at a speed proportional to that current. The meter is being made by the British Insulated Wire Company for the Mordey-Fricker Electricity Meter Company, Ltd., of Grosvenor Mansions, Victoria Street, S. W.



FIGS. 1, 2, 3 AND 4.—MORDEY-FRICKER ELECTRICITY METER.

Illuminations in a Canadian Hotel.

In connection with the recent meeting, at Quebec, of the Canadian Electrical Association, the headquarters were established at the beautiful Hotel Frontenac, and the occasion was seized for some very effective special lighting, both inside and outside the building. The work was done by the National Electric Improvement Company, of New York City, through Mr. Russell Spaulding, who installed no fewer than 4,500 lights with the "Elblight" system.

The interior of the Chateau Frontenac was decorated with green Elblight cable and about 2,500 lights. Various electrical lighting boards bearing the insignia of the association were distributed in the lobbies of the hotel. Hearts, circles and other designs, made of Elblight strips, and boards bearing various ornamental designs,

such as bunches of grapes, shields and emblems, illuminated by the system were disposed effectively. The banquet of the association was profusely decorated with Elblight cable and miniature lamps, which were so well appreciated that about fifty per cent. of them were taken away by the guests as souvenirs.

In addition to this, the Dufferin Terrace, one-third of a mile long, was festooned from end to end with Elblight cable and 2,000

FIG. 1.—ILLUMINATIONS IN CHATEAU FRONTENAC.

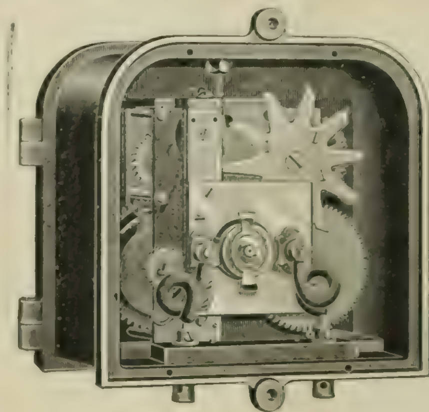
lamps, blue, white and red, the French national colors. The sight was a beautiful one, and the view from Point Levis, across the St. Lawrence River, was one to be long remembered, but very difficult to photograph successfully.

FIG. 2.—ILLUMINATIONS IN CHATEAU FRONTENAC.

The entire lot of Elblight material taken to Quebec was bought by enterprising residents of Quebec, who intend to use it for decorations during the important festivities which will be held there this summer. The system was generally accepted with much favor by experts and engineers attending the convention.

Acme Time Switches.

Attention has been paid in these pages to the development of automatic controllers of electric lighting circuits, etc., by the Acme Switch Company, of Hartford, Conn. There exist many places and installations of lights and motors where it is desirable or necessary to cut the apparatus in or out at a given time, and when contracts are made on a time schedule, a switch that will "call time" is requisite. We have already illustrated the earlier types perfected by the company, and now show the single-pole rotary switch form, designed for outdoor work, and intended to meet the requirements of



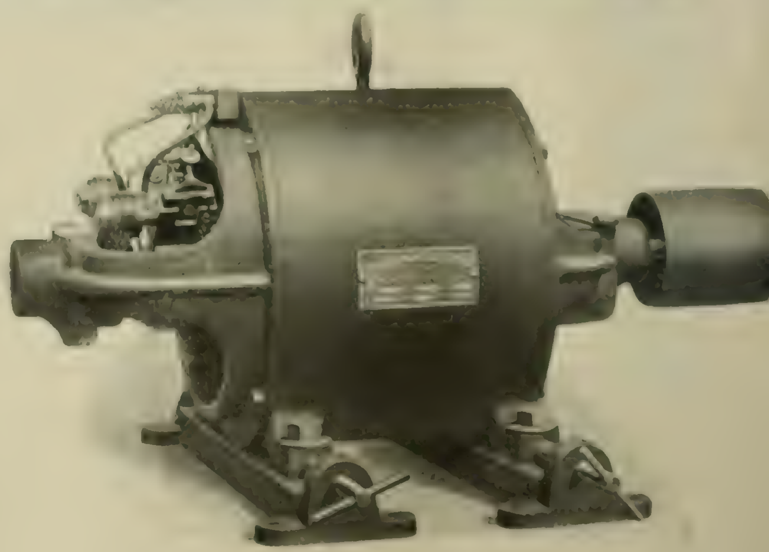
TIME SWITCH.

any central station or consumer wishing to control one or two arc lights. It has a snap-switch movement, and is made at present in 15 and 25-amp. sizes. As a less exacting demand is made upon the clockwork in this style of switch, it is and remains in better condition to withstand the variations of heat and cold, such as are encountered in exterior use of such apparatus. Each switch and clock movement is enclosed in a dust-proof iron case, and the door of each is provided with lock and key to prevent illegitimate interference.

Protected Multipolar Type Motor.

The Quaker City Electric Company, of Philadelphia, is placing on the market a direct-current type of electric motor for general use and also for application in cases where a dust and moisture-proof machine is necessary. The motor may be installed in any position—on the wall, ceiling and floor—and in any position be belted, geared or direct-connected to the load.

The field magnet is of one piece of open-hearth steel, and the



ELECTRIC MOTOR.

field coils are form-wound and interchangeable. The brush holders are of a special design; they are radial in action, self-adjusting and self-feeding. The bearings are of an improved self-oiling type of large surface and having the feed-rings and reservoir immediately accessible without the removal of bolts or screws. The armature is of the iron-clad laminated type, the coils being secured in slots. The machines are wound for 110, 220 or 500 volts, with shunt series or compound fields.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was freely offered, the closing rates being 4¼@4½ per cent. for 60 to 90 days, and 4½ @ 4¾ per cent for four to six months. In the stock market there was limited activity, yet the tone was strong, with advances throughout the railway list. The United States Steel stocks tended somewhat to recover, although the uncertainty as to the outcome of the injunction case was adverse to activity in them. Industrials were irregular and traction properties were dull. Brooklyn Rapid Transit closed at 67⅝, being a net gain of 1⅛ points, the sales aggregating 15,565 shares. Metropolitan Street Railway closed at 148½, ex-div., a net loss of ¼-point, the total number of shares sold being 4700. In the electric list there was comparatively little business, the sales of the General Electric aggregating 2010 shares, the closing quotation being 305, ex-div., a net gain of 1 point. This stock moved between 304 and 309 during the week. Westinghouse Electric, common, was quite steady as to price, the closing quotation being 210, which was the highest figure of the week and 209 the lowest; the closing price represents a net loss of 1 point. Western Union was weak, closing at 89¼, being a net loss of 1¼ points. American Telephone & Telegraph made a net gain of 1¾ points, closing at 179, which was the highest figure of the week. American District Telegraph made a net gain of ½ point, closing at 36½ after reaching 38. In Boston dullness prevailed, General Electric closing at ½ point lower, and American Telephone & Telegraph ⅜ of a point higher. Following are the quotations of July 2:

NEW YORK

	June 24.	July 1.		June 24.	July 1.
American Tel. & Cable..	87	—	Gen. Carriage (n. st'k)..	5¼	—
American Tel. & Tel....	175	163	Hudson River Tel......	—	—
American Dist. Tel......	35	38	Metropolitan St. Ry....	148	148⅜
Brooklyn Rapid Transit.	66⅝	67⅝	N. E. Elec. Veh. Trns..	—	¾
Commercial Cable	—	—	N. Y. E. V. T. Co......	13	12½
Electric Boat..........	28	28	N. Y. & N. J. Tel......	—	—
Electric Boat pfd........	40	40	Tel. & Tel. Co. of Am..	—	—
Electric Lead Reduc'n..	3	2¾	Western Union Tel.....	89⅞	87
Electric Vehicle	7½	6	West. E. & M. Co......	210	—
Electric Vehicle pfd.....	15½	14	West. E. & M. C. pfd.	206	—
General Electric	305	—			

BOSTON

	June 24.	July 1.		June 24.	July 1.
American Tel. & Tel ...	175¼	163	Mexican Telephone.....	2¼	2¼
Cumberland Telephone..	—	—	New Eng. Telephone....	146	146
Edison Elec. Illum.....	—	280	Westinghouse Elec.	—	—
Erie Telephone.........	—	—	Westinghouse Elec. pfd.	—	—
General Electric pfd....	—	—			

PHILADELPHIA

	June 24.	July 1.		June 24.	July 1.
American Railways.....	45½	45¾	Phila. Traction	98½	98¾
Elec. Storage Battery...	88	90	Phil. Electric	5⅛	—
Elec. Storage Bat'y pfd.	88	90	Pa. Elec. Vehicle......	1	—
Elec. Co. of America....	7¼	5⅞	Pa. Elec. Vehicle pfd...	3	—

CHICAGO

	June 24.	July 1.		June 24.	July 1.
Central Union Tel.....	—	—	National Carbon pfd...	96½	97¾
Chicago Edison	180*	—	Northwest Elev. com...	34	—
Chicago City Ry.......	205	205	Union Traction	17½	16⅞
Chicago Teleph. Co....	160	—	Union Traction pfd.....	—	—
National Carbon........	22¾	23			

* Asked.

CHICAGO ELECTRIC ELEVATED.—The committee on local transportation has agreed to recommend that an ordinance be granted permitting the Metropolitan West Side Elevated Company to build an extension from Market Street to Fifth Avenue between Van Buren and Jackson Streets. The ordinance will also provide for connection with the loop, but officials of the company say the new piece of track will be operated as a sub-terminal exclusively. They contend that the plan is to give the patrons of the wholesale district room to get in the cars, which under present conditions are packed to their full capacity by the time they get around the loop during busy hours. It is estimated that fully 20,000 passengers are forced to take the surface lines because of these conditions. The company has prepared for the financing of the construction work. About $1,500,000 will be spent, and the work is expected to be finished before the year's end. Thirty-seven-year four per cent. gold bonds, under a mortgage already executed by the company, are to secure the loan. The First National Bank has agreed to take the bonds at private terms and pay over the money to the company as the construction work necessitates.

WESTERN UNION AND POSTAL.—It is said that the Postal Telegraph-Cable Company earned 8 per cent upon its [illegible] of stock last year. [illegible] treasury of the Commercial Cable Company, [illegible] 1897 issued [illegible] of debenture [illegible] per cent. bonds [illegible] [illegible] were issued to be exchanged for Postal Company [illegible] at par. Five million dollars' worth of bonds [illegible] reserved for extensions of the Postal lines which now [illegible] about 200,000 miles. The Western Union has abou[illegible] miles of wire. It has a capital stock of [illegible] and a [illegible] debt of $19,660,000, a total capital of $117 [illegible] against a capitalization of $100 per mile by the Postal Co. [illegible] Western Union earned [illegible] per cent upon its [illegible] against 8 per cent by the Postal Company. The Western [illegible] Company operates [illegible] telegraph offices and [illegible] line, "two star" and telephone stations, ag[illegible] offices and 10,724 "other" line, "two star" and [illegible] operated by the Postal Companies.

WESTERN UNION is having trouble with its operat[illegible] Chicago, and some loose "strike" talk is heard. Mea[illegible] improvements are going on. In addition to placing eigh[illegible] new lines between New York City and Chicago the mana[illegible] ment intends to do away with the Wheatstone system w[illegible] has been in use on some of the existing lines between the [illegible] cities, and it is not unlikely, as a result of the change, that [illegible] operators may be discharged. This may add to the fee[illegible] insecurity among the company's employes, and further [illegible] sentiment in favor of the formation of a union. The cost of [illegible] new lines would appear to be provided for in the $3,000[illegible] additional bonds which were listed April 9, of which $2,000[illegible] were to be used solely for or in case of purchase of impr[illegible] ments, betterments or extensions of the property and the [illegible] velopment and enlargement of the business.

CONSOLIDATION AT PROVIDENCE.—The Rhode Is[illegible] Company has acquired the property of the Union Traction C[illegible] pany, of Providence, the Pawtucket Street Railway Company, an[illegible] Rhode Island Suburban Railway Company, for a period of [illegible] years. The Rhode Island Company has been controlled by [illegible] United Gas Improvement Company, of Philadelphia. The [illegible] lowing officers were chosen: President, Marsden J. Perry, P[illegible] idence; vice-presidents, S. P. Colt, Providence; Randall Mo[illegible] and Walton Clark, Philadelphia; secretary and treasurer, L[illegible] Little, Philadelphia; general manager, A. T. Potter Pr[illegible] dence.

VIRGINIA PASSENGER & POWER COMPANY.—[illegible] street railway, lighting and power companies of Richmond, [illegible] have been consolidated. The merger embraces the Virginia E[illegible] trical Railway & Development Company, the Richmond T[illegible] tion Company, and West Hampton Park Railway Comp[illegible] Major James D. Patton has been elected president. Stockhol[illegible] of the Richmond Traction Company received $50 per share [illegible] their stock, and the Virginia Electrical Railway & Develop[illegible] Company gets $50 per share—the par being $100. About $1,[illegible] 000 will be paid in connection with the deal.

MASSACHUSETTS GAS COMPANIES.—In discussing [illegible] Boston Gas situation, the *United States Investor* says: "In [illegible] reorganization which is to be effected the Massachusetts [illegible] Companies, it is believed, will form the parent company, an[illegible] the course of time it is felt that the securities of the latter wi[illegible] actively traded in and will constitute one of the features o[illegible] Boston stock market. Ultimately, also, it is expected that [illegible] local electric light companies will be included in the great[illegible] combination."

DIVIDENDS.—Directors of Consolidated Traction [illegible] New Jersey have declared a dividend of 1¼ per cent, pay[illegible] July 15. The directors of Electric Storage Battery have [illegible] clared the regular quarterly dividends of 1¼ per cent on [illegible] the common and preferred stock, payable July 1.

MONTGOMERY, ALA., LIGHTING.—The Montgo[illegible] Light & Power Co., for the year ending February 28, shows g[illegible] $173,323, and net, $92,943, with a surplus over all charges of [illegible] 880. The gross in 1901 was $154,880, and in 1899 was $136,[illegible]

INDIANAPOLIS TROLLEYS.—The United Gas Imp[illegible] ment Company, of Philadelphia, has taken over the Indiana[illegible] Street Railway Company, of Indianapolis. Its trackage is [illegible] miles; capital, $5,000,000, and bonded indebtedness, $9,500,0[illegible]

TOLEDO RAILWAYS AND LIGHTING.—Application [illegible] been made to the committee on stock list, New York Stock Exch[illegible]

t the Toledo Railways & Light Company, $12,000,000 capital

ONE & WEBSTER, of Boston, are reported to have acd the Jacksonville, Fla., Street Railway properties.

W HAMPSHIRE TROLLEYS.—It is stated that Thomp-Tenny & Crawford, of No. 25 Broad street, New York City, rranging an important consolidation of street railroads in Hampshire, and it is announced that the underwriting of the is now in progress. The proposed company will be known e New Hampshire Traction Company. Charles S. Fair-former Secretary of the Treasury, will be president. The York Security and Trust Company will act as trustee of the .

Commercial Intelligence.

E WEEK IN TRADE.—The unseasonably cool weather g the past week has had some effect on retail trade distri-n. Confidence in the outlook, however, is evidenced by the ued heavy buying for fall delivery noted in the great grain-ing sections of the West. This is reflected in the large in-e in railway earnings, except where in the case of the coal distribution is paralyzed by the general shut-down of pro-n and consumption. Aside from this single exception, how-the general industrial situation has rather improved. Quiet-in the lumber trade is noted at the principal centers, but ills are firm as to prices and stocks are badly broken. There much demand as ever for the cruder forms of iron and steel. s, bars and structural material are active and the latter is d far ahead. Foreign iron and steel are being bought freely ld material is being carefully looked after. Other metals ull and lower, copper and tin being especially very much r. The business failures for the week, as reported by *treet's* numbered 153 as against 177 the week previous and e same week last year.

WLING & HARNISCHFEGER, Milwaukee, Wis., state emand for electric cranes and hoists remains highly satis-y. The present booking of orders is on the average of one per day, which fully equals their capacity. There is a no-le broadening of inquiries, particularly from the Central Western States, and the prospect for sales in these sections very good. The foreign demand is better, judging by the ies within the last month. Prominent among the recent asers of cranes and hoists are as follows: Pennsylvania ad Company, West Philadelphia, one 6-ton trolley; Grand ng Track Company, Chicago, one 75-ton ladle crane with auxiliary trolley; Stanley Electric Manufacturing Com-Pittsfield, Mass., for Michigan-Lake Superior Power Com-Sault Ste. Marie, Mich., two 15-ton cranes; S. Morgan Company, York, Pa., one 10-ton crane; Pressed Steel Car ny, Allegheny, Pa., one 5-ton special hoist; The Westing-Machine Company, East Pittsburg, one 10-ton crane; Pitts-Plate Glass Company, Ford City, Pa., one 3-ton crane; hem Steel Company, South Bethlehem, Pa., one 30-ton with 10-ton auxiliary trolley, three 2-ton chain block cranes; . & F. Brown Company, Elizabethport, N. J., one 15-ton with 3½-ton auxiliary hoist; Jas. B. Clow & Sons, Newcom-n, O., one 5-ton hoist; American Foundry & Construction Hazlewood, Pa., one 5-ton special hoist. Buffalo Foundry uffalo N. Y., two 30-ton cranes with 5-ton auxiliary hoist, o-ton cranes; Ball Engine Company, Erie, Pa., one 25-ton with 5-ton auxiliary hoist.

CENT WESTINGHOUSE ORDERS.—A steam railway les long, the Cincinnati, Georgetown & Portsmouth Rail-is shortly to be converted from steam to electric traction. Tennis Railway Equipment Company, which has the contract, cently purchased from the Westinghouse Electric & Manu-ing Company two 600-kw alternating current generators number of 300-kw rotary converters for supplying current line. The Coke Oven Blowers in the Buffalo plant of the wanna Iron & Steel Company are to be operated by direct-cted electric motors. Ten induction motors of 75-hp each recently been purchased by the above named company for urpose from the Westinghouse Electric & Manufacturing any. Four induction motors of 100-hp each will be used for ing the gas cleaning plant, and the machine shop will like-be driven by induction motors. This company has lately t in all 151 Westinghouse induction motors of from 1 to each. The Fayette Manufacturing Company will use elec-power transmission for driving its new plant for the manu-e of refractory brick at Chester, Pa. The entire power for xing and grinding of the ingredients and for conveying the o and from the various machines and finally pressing them into shape will be furnished by induction motors. The Fayette Company has recently purchased from the Westinghouse Company a 3-phase equipment, including an engine-type alternator, exciter, switchboard, and alternating-current motors aggregating 290-hp.

FOREIGN CONTRACTS FOR PELTON OUTFITS.—The Pelton Water Wheel Company has secured a contract through the Allis-Chalmers Company calling for a 2000-hp. hydraulic plant, which is to be constructed near Barcelona, Spain, by the Crisna Company, for the purpose of operating a Portland cement factory about to be built there with American equipment. There will be nine Pelton waterwheels, varying from 24 inches to 94 in. in diameter. Three miles (some 1,200 tons) of steel riveted pipe will also be utilized. The pipe will be of three sizes—25 in., 28 in., and 31 in. Shipment will be made inside of sixty days. The Pelton people, through their New York office, have also received an order for a 250-hp. outfit, including 1,500 feet of 24-in. pipe for the San Juan Cotton Mills of Puebla, Mexico. Two 100-hp. wheels have been requisitioned for by the company's Paris agents for the purpose of driving electric light dynamos in France and a 200-hp. water-wheel is to be forwarded to Bologna, Italy, for a similar purpose. A smaller outfit is to be shipped to Dominica, West Indies, for use on a sugar plantation.

BREWERY EQUIPMENT.—H. Steinmann, the brewery architect, New York, is about to be in the market for the complete electric euipment—both for lighting and power purposes —for the $250,000 brewery and distillery, which he is designing for erection at Durban, Natal, South Africa, by the Durban Breweries and Distilleries, Limited. The establishment will have an initial capacity for turning out 30,000 barrels of lager and the same quantity of ale. Everything other than the bricks and the mortar will be shipped from the United States. In addition to operating the entire machinery in the brewery the electric plant, it is intended, will be utilized to furnish energy to light part of Durban and the immediate vicinity of that city. The brewery and distillery plants, it is expected, will be in active operation inside of six months.

WESTINGHOUSE AFTER SHANGHAI TRACTION CONTRACT.—The Westinghouse Electric & Manufacturing Company is after the contract for the construction of the electric traction system it is proposed to build in the foreign settlement of the city of Shanghai, China. The lines will be about 23 miles in length. There promises to be very keen competition regarding the contract as according to private cable advices received this week from the Far East prominent British, German and other European manufacturers have already sent in bids. The last day for receiving tenders is June 30. It will probably be ten days later than that date before any decision is arrived at by the Shanghai municipality regarding the matter.

RAILS FOR NEW ZEALAND AND LONDON.—The electrical engineering and contracting firm of J. G. White & Company, of 29 Broadway, which concern, through its London interests, recently secured the contract for the construction of the electric traction system at the City of Auckland, New Zealand, is about to make a substantial shipment of steel rails for that road. The rails have been manufactured by the Lorain Steel Company Next week the J. G. White people will forward several carloads of Lorain special track work for the London County Council Tramway, South London

WATERPOWER PLANT FOR LYNCHBURG, VA.—J. J. Kennedy, consulting engineer, 52 Broadway, New York, is about to issue specifications for a waterpower plant to be built on the James River about four miles from Lynchburg, for lighting and traction use in that city. The plant will be a 3500-hp one, but in the meantime it is proposed to utilize only 2000-hp. There will be three 750-hp turbines and the same number of 500-kw generators. The plant will be constructed by the Lynchburg Water Power Company, of which Mr. R. D. Apperson, of Lynchburg, is president.

ELECTRIC LIGHT PLANT FOR CUBAN PLANTATION —O. B. Stillman, No. 80 William Street, New York, has been awarded the contract for the construction of the $800,000 sugar factory, to be erected by the Cape Cruz Construction Company near Manzanillo, located on the southern side of Cuba. He will be in the market almost immediately for a complete electric lighting plant for installation on the plantation.

AUTOMOBILES FOR THE FAR EAST.—The export house of Bruhl Brothers, 54 Maiden Lane, is about to place soome substantial conracts for automobiles, which are to be shipped principally to Shanghai and Yokohama.

ELECTRIC POWER IN RAILWAY SHOPS.—The Central Railroad of New Jersey is erecting a large repair shop at Elizabethport, N. J., which will be equipped with an extensive electrical plant.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ending June 28: Antwerp—34 pkgs. material, $841. Brussels—3 pkgs. material, $270. Brazil—14 pkgs. machinery, $222; 7 pkgs. material, $456; 5 pkgs electrical machinery, 88; 17 pkgs material, $887. British East Indies—7 pkgs material, $725; 3 pkgs. machinery, $110. British Guiana—13 pkgs material, $389; 1 pkg. machinery, $90. Barcelona—2 pkgs. materia' $50. Bremen—6 pkgs. material, $88; 1 pkg. machinery, $65. British Possessions in Africa—90 pkgs. machinery, $1,476; 38 pkgs material, $2,525. British West Indies—69 pkgs. material, $1,281. China—19 pkgs. material, $359. Central America—78 pkgs. material, $2,967. Chili—23 pkgs. material, $779. Cuba—26 pkgs. machinery, $7,928; 126 pkgs. material, $3,569. Genoa—35 pkgs. machinery, $2,397; 7 pkgs. material $236. Gibraltar—1 pkg. machinery, $75. Glasgow—14 pkgs. material, $758; 20 pkgs. machinery, $1,860; 44 pkgs. cable, $17,497. Hamburg—8 pkgs. machinery, $329; 9 pkgs. material, $300. Havre—11 pkgs. material, $500; 19 pkgs. machinery, $2,094. Hull—18 pkgs. machinery, $1,025. Japan—85 pkgs. material, $6,361; 21 pkgs. machinery, $3,352. London—6 pkgs. meters, $5,225; 187 pkgs. machinery, $9,779; 255 pkgs. material, $3,566. Mexico—90 pkgs. material, $2,258; 7 pkgs. machinery, $501. Manchester—1 pkg. material, $18; 47 pkgs. machinery, $3,705. Marseilles—11 pkgs. material, $530. New Zealand—8 pkgs. material, $1,926. Naples—3 pkgs. machinery, $250. Peru—2 pkgs. machinery, $20. Philippines—25 pkgs. material, $931. Rome—5 pkgs. material, $100. Rotterdam—17 pkgs. machinery, $321. St. Petersburg—8 pkgs. material, $459. San Domingo—9 pkgs. material, $157. Siam—8 pkgs. material, $880; 7 pkgs. machinery, $1,442. Southampton—4 pkgs. material, $1,625. United States of Colombia—6 pkgs. material, $80; 43 pkgs. cable, $377. Venezuela—1 pkg. machinery, $50; 139 pkgs. material, $467.

DEMAND FROM SOUTH AFRICA.—The London *Daily Market Review* has this to say of the Transvaal's approaching demand for new appliances, especially electrical: "One of the earliest results will be the restarting of industrial works in South Africa. English manufacturers will profit to a large degree, and not the least benefit, we trust, will accrue to the makers of electrical appliances. When we think of the already vast and continually increasing number of uses to which electricity may be put, we are perforce led to the conclusion that, when the civil and commercial life of the Transvaal is once more in full swing, there will be a strong and urgent demand for not only dynamos and motors, but all the thousand and one articles that go to make up a modern electrical plant. In the mines, in the streets, and in the public and private buildings the current will be needed, both for motive power and for lighting, and if English manufacturers are sufficiently awake to seize the opportunity, they may very probably have their hands full of orders by the autumn. . . . The only thing open to doubt is whether the English manufacturer will take advantage of what will be practically the opening up of a new field, or whether he will allow the Yankee and the German to step in before him and sop up all the good things."

MORE RAPID TRANSIT SUBWAY CONTRACTS.—The Rapid Transit Subway Construction Company, Park Row Building, has just placed a contract with Westinghouse, Church, Kerr & Co., for three 1250-kw turbo-generator sets, which are to be installed in the power station now under construction between Fifty-eighth and Fifty-ninth streets, on Eleventh avenue. The equipment will be utilized for the purpose of lighting the power station and subway. The specifications for the machinery were drawn up conjointly by Mr. L. B. Stillwell, the electrical director, and Mr. J. Van Vleck, the mechanical engineer of the Rapid Transit Company. Contracts have also been placed within the last few days with the Henry R. Worthington branch of the International Pump Company for nine large boiler-feed pumps, and with the Wheeler Condenser & Engineering Company for a smaller number of feed-water heaters, each having 500 square feet of heating surface. These pumps and heaters are also to be installed in the Eleventh avenue power house.

EXPORTS TO BRITISH AFRICA.—The expected increase in the exports to Africa has already begun. The exports from the United States to Africa in April, the latest month for which the details have yet been received by the Treasury Bureau of Statistics, were greater than those to all South America, and were more than 50 per cent. greater than those of April in the preceding year. For the ten months ending with April, 1902, they amounted to $28,956,179, against $22,070,133 in the corresponding ten months of the fiscal year 1901, and $15,858,286 in the corresponding months of 1900. The chief increase, of course, is to British Africa, which takes about 85 per cent. of our exports to Africa. To British Africa alone our exports during the month of April, 1902, were $2,763,833, against $1,817,101 in April, 1901; and for the ten months ending with April, 1902, were $24,708,612, against $18,537,315 in ten months of 1901, and $13,168,062 in ten months of 1900.

POWER FOR BIG COTTON MILL.—One of the largest cotton mills in the world is to be built within twenty miles of Kansas City. [illegible] 75,000,000 pounds of finished cloth. The val[illegible] will, it is estimated, amount to $12,750,000. [illegible] as the motive power, and several new devices will be installed. There [illegible] ground.

SOME WESTINGHOUSE ORDERS.—Westinghouse, Church, Kerr & Company have secured a contract from the Stanley Rule & Level Company, of New Britain, Conn, for a 500-hp vertical cross compound Westinghouse engine, to be direct-connected to a marine-type Westinghouse generator of 375-kw, 500 volts. This equipment will be used for general power purposes in an extension of the Stanley Company's plant. The Trumbull Street pumping station at Washington, D. C., has ordered a 150-kw Westinghouse generator for direct connection to a 14-inch Westinghouse compound engine. The Norfolk Electric Light Company, of Norfolk, Conn., has requisitioned for a 50-hp Westinghouse gasoline engine to be belted to an alternating-current Westinghouse generator.

CARS, ETC., FOR DURBAN, SOUTH AFRICA.—The British electrical engineering and contracting firm of Macartney, McElroy & Company, whose New York offices have been removed to the second floor of the Havemeyer Building, has just made a considerable shipment of various equipment for the city of Durban electric traction system, S. A. The shipment included eight car bodies and trucks manufactured by the J. G. Brill Company, of Philadelphia. The motor equipments were double ones of G. E. 58 type. An order has been given the McGuire Manufacturing Company, of Chicago, by the British concern for two electric sprinkling cars for the same South African road.

ELECTRIC FANS FOR ABROAD.—The Shedd Electric & Manufacturing Company, of 136 Liberty street, New York, has recently received orders for "Comfort" oscillating electric fans through Arnhold, Karberg & Company, of No. 50 Wall street, for shipment to China; from Tata & Company, whose offices have been removed to the Tontine Building, Wall and Water streets, New York, for export to London on order from Drake & Gorham, Ltd., of London, for the British market; and from Juan Salero, of Manila, Philippine Islands.

POWER FOR STEAMSHIPS.—Several new ocean steamers are being built by the Great Northern Steamship Company to ply between Seattle and Asia. They are to carry twice as much freight as any others now afloat, and will handle their cargo by electric power. All the auxiliaries of the vessels will be run by motor. The vessels will each be 630 feet long, 73½ feet extreme beam, 55 feet six inches in depth; have a gross tonnage of about 21,000 and an extreme load displacement of about 38,000 tons.

FIBRE PAPER MILL FOR G. E.—It s stated that the General Electric Company is negotiating for the purchase of the plant of the Middleton Paper Company, of Middleton, Mass., now in the hands of a receiver. A large amount of paper is used by the General Electric Company in its factories, and the fibre paper used for insulation, etc., is sometimes difficult to secure, or is of an inferior quality. The company proposes to manufacture its own paper to suit the needs of its business. The mills are said to be worth $170.000.

MONTE VIDEO ELECTRIC TRACTION PROJECT.—An Anglo-Argentine syndicate is reported to be seeking to construct an extensive electric traction system in the city and immediate surroundings of Monte Video, Republic of Uruguay. J. Sacarello and E. E. Sanchez, both of that South American city, are interested in the project.

DYNAMOS FOR MAGDALENA RIVER.—Pedro del Ospino, representing a large transportation company of the United States of Colombia, is reported to have placed a contract with the Triumph Electric Company, of Cincinnati, Ohio, for a large number of dynamos, to be utilized for the electric lighting of steamboats, which are to be built in the United States for the Magdelena River trade.

BALL ENGINE ORDERS.—The San Bernardino Gas & Electric Company, San Bernardino, Cal., has recently purchased additional power from the Ball Engine Company, Erie, Pa. Stearns & Foster, cotton manufacturers, Lockland, Cincinnati, are installing an electric plant to consist of Bullock generator direct-connected to a Ball engine.

PHOENIX IRON WORKS, of Meadville, Pa., report in connection with the Westinghouse plant for the Farmers' Deposit Building, at Pittsburgh, that the order they have received is for three compound engines of 240-hp each and one simple engine of 120-hp.

Special Correspondence.

SPANISH NOTES.

(From our Special Correspondent.)

SEVILLE, MAY 18, 1902.

GIBRALTAR.—The electric lighting plant at Gibraltar is in the hands of the Sanitary Commissioners of which board Mr. W. Wallace Copland, A. M. I. C. E., is secretary and engineer. All the plant is of English make. Mr. James A. Daguino, Waterport street, owns and operates the Gibraltar telephone system.

LIGHTING AT RONDA.—The ancient Moorish city of Ronda, in the Province of Malaga, has a lighting plant which was operated a few years ago by a German company. It was, however, taken over and the system is now operated by Senor Camilo Granados, under the title of Empresa Luiz Electrica, Ronda. This gentleman is said to be extremely rich, but has not apparently spent much on extending the plant.

LIGHTING IN MOROCCO.—In the whole of Morocco there is only one electric lighting plant, that at Tangiers, known as the Compania Transatlantic. Mr. A. Ortenbach is the local "acting agent." The light is very poor. The plant was installed some time ago by Germans. Owing to the price of coal rates were recently advanced. At 10 o'clock the street lights are turned off. In 1900 there were imported into Tangiers candles worth $38,400 and petroleum worth about $6000.

ELECTRICITY IN SEVILLE.—The company known as the Compania Sevillana de Electricidad owns and operates the electric power plant, supplies the city with light and sells current to the electric tramway company. Mr. Otto Engelhardt is director, and Mr. Mariano Vasquez, chief engineer; while Mr. Paulo Callam is manager of the tramway system. Everything is German; the plant having been supplied by the Allgemeine Elektricitats Gesellschaft, of Berlin, which concern practically controls electrical work in Seville. Mr. Martin Marten, the leading importer of machinery in Seville, would, however, like to hear from American manufacturers of electrical machinery, telephone supplies, electroliers, glassware, etc. There is a fine opportunity in some respects for American tools. The shops of the Sociedad Talles de Portilla, where some 250 hands make engines and boilers, are using a steam hammer built at Glasgow in 1862.

DEVELOPMENTS AT HUELVA.—The famous Rio Tinto Copper Mining Co., of which Mr. A. W. Carlyle is the director, has its own electric light and power plant, furnished by Siemens Bros., of London. Mr. Alfred Attwood, the chief engineer, would be glad to receive prices and catalogues as to electrical supplies of all kinds, machine tools, etc. Mr. Matias Lopez, the most important private machinist, employing 250 men, imports chiefly from England considerable quantities of steam fittings. Huelva, itself a city of 22,000 inhabitants, has a poor electric light plant, of which Mr. R. N. Wilson is the director. It is known as the Fabrica Del Gas Y Electricidad. There is a telephone system of German and English make, furnished by Riley & Co., of Madrid. The telephone system will soon be connected with all the mines in the Huelva district, creating a new demand for material and supplies. The system, which is owned and operated by Rodriguez Suarez Y Ca., Calle Carmen, has 194 subscribers. The principal wholesale dealers in electrical supplies, fittings, etc., are Carlos Diaz y Diaz, who at present are getting almost everything from England and Germany.

General News.

THE TELEPHONE.

OAKLAND, CALIF.—The Independent Telephone & Telegraph Company, which was recently incorporated in Oakland by H. C. Stilwell, A. P. Holland and others with a capital stock of $500,000 is actively preparing for business in Oakland and other places.

DOVER, DEL.—The National Telephone Company, of New York City, has been incorporated here by John H. Lewis, William E. Milne, New York City; James G. Gregg, Morristown, N. J. The capital stock is $3,000,000.

WASHINGTON, D. C.—American Telephone Company will erect a fine building on Twelfth St. at a cost of $100,000.

COEUR D' ALENE, IDAHO.—A local telephone exchange is being established here. It has started with about 40 subscribers.

STEELE, IDAHO.—The Nez Perce Co-operative Telephone Company, Ltd., has been incorporated by J. M. McGee, H. L. Stanley and others with a capital stock of $1,300. The principal office is in Steele.

LEWISTON, IDAHO.—A franchise has been granted in Nehart to the Great Falls & Lewiston Telephone & Telegraph Company, of Lewiston. The company will extend this line to White Sulphur Springs and connect with the line to Lewiston.

CAMP POINT, ILL.—The Camp Point telephone exchange was recently burned with total loss.

CHICAGO, ILL.—Telephone bills for large users of the wires will be increased in the new ordinance to be submitted to the City Council by the special committee. The rates to the ordinary users, who form the bulk of the telephone company's list of patrons, will be largely decreased. Toll service within the city limits will be entirely abolished and the company's territorial bounds will be made co-extensive with the city's. Payment will be by the message and not by an arbitrary rate. The committee met with the telephone company's officers and practically completed their work. City Electrician Ellicott is on the committee.

GREENWOOD, IND.—The Greenwood Telephone Company has increased its capital stock from $5,000 to $6,000 to provide for improvements.

ELKHART, IND.—The Chicago Telephone Supply Company, owned by G. A. Briggs and A. J. Briggs & Son, will remove from Chicago to this place by Sept. 1. The company employs 250 men.

WINCHESTER, IND.—The Eastern Indiana Telephone Company, with headquarters in this city, has increased its capital stock from $5000 to $20,000. Preparations are being made to erect a number of new lines.

INDIANAPOLIS, IND.—The McCarter Telephone Company of Hancock and Shelby Counties has been incorporated with $900 capital stock by Wm. Boring, J. W. Boring, C. L. McNamara, and Dugald McDonald.

ELLIOTT, IA.—The Elliott Mutual Northwestern Telephone Company has been incorporated.

MOVILLE, IA.—The Arlington Telephone Company has been organized with a capital of $5,000.

DES MOINES, IA.—The Maple Valley Telephone Company, of Mapleton, has been organized. President, C. I. Whiting; vice-president, W. H. Leeth; secretary, C. H. Smith; treasurer, F. B. Lutz.

VICTOR, IA.—The Victor Mutual Telephone Company has been incorporated with a capital of $2,000. T. T. McMillan of Durham is president; J. B. Lyman, secretary, and R. G. Emmel, treasurer.

DES MOINES, IA.—Seventy exchange operators in the two exchanges in this city struck work June 21 for higher wages. The Iowa and Mutual lines were tied up in consequence. The strikers demanded $30 per month and a nine-hour day. At last reports the service on both systems was demoralized.

WESTBROOK, ME.—The Westbrook Telephone Company has been organized at Westbrook. Capital stock $10,000.

BOSTON, MASS.—The Western (Bell) Telephone & Telegraph Co. is making its normal gain in new subscribers. On May 31 it had 170,630 subscribers, a gain since January 1 of 9,222. This gain was largest in the northwestern and southwestern territory.

DETROIT, MICH.—The annual meeting of the stockholders of the Michigan Telephone Company was held in this city on June 23. No financial statement was given out. The following directors were elected: F. P. Fish, Philip Dexter, W. F. Hutchinson, H. J. Pettengill and Thomas Sherwin, of Boston, Hugh McMillan, of Detroit and Dudley E. Waters, of Grand Rapids.

BUCKNER, MO.—The Jackson County Telephone Compony, has been incoporated with a capital stock of $5,000, one-fourth paid. The incorporators are N. D. Ravenscroft, Ed. C. Roth, J. G. Burnley, G. M. Chiles, A. B. Frazier and others.

LINCOLN, NEB.—The Central Telephone Company of Broken Bow has been incorporated with a capital stock of $35,000.

BUFFALO, N. Y.—The Consolidated Telephone Company has removed its offices from Cleveland, Ohio, to this city. This move was made on account of a recent financial deal with Buffalo capitalists who have become heavily interested in the company. Mr. B. G. Hubbell is president and R. M. Parmely second vice-president. It is stated that the Century Telephone Manufacturing & Construction Company will also be moved to Buffalo from Cleveland.

NEW PHILADELPHIA, OHIO.—The Tuscarawas Telephone Company which has its headquarters in this city is meeting with much success. The company operates six exchanges in this vicinity and has 2,035 telephones in operation, an increase of over 800 telephones in less than a year. It has $200,000 capital stock and bond issue of the same amount. Besides paying its interest it is earning four per cent. on the stock. At present the company is using its earnings for improvements.

LORAIN, OHIO.—The Black River Telephone Company which serves a considerable territory in this vicinity, is spending $65,000 in improvements. The company has 720 telephones in operation and finds its switchboard facilities wholly inadequate. Work has been started on the installation of a board with a total capacity of 4,000 lines. Considerable underground cable is being laid and much other work is being done. E. M. Pierce is president and L. A. Faurber, secretary of the company.

CLEVELAND, OHIO.—It develops that Edward J. Barber, president of the Central Construction Company, and George J. Hoffman, who is identified with strong independent interests in central Ohio, are at the head of the syndicate which has secured an option on 12,000 shares of the stock of the United States Telephone Company. These gentlemen are very enthusiastic over the prospects of the United States Company and they predict that the receipts will increase as rapidly during the next two years as they have during the past year.

SPARTANSBURG, S. C.—The Citizens' Telephone Company of this city was sold at public auction June 23. This company was organized about four years ago and for a while was thought to be doing well. The sale was to satisfy a mortgage said to be for $30,000. The property was knocked down to L. W. Floyd, of Newberry, S. C., at $[illegible].

AUSTIN, TEX.—The Ellis County Independent Telephone Company of Waxahachie, capital stock $100,000, has been incorporated by A. E. Schaeffer, J. B. Earle and Tony Schaffer.

SALT LAKE CITY, UTAH.—The West Gallatin (Mont.) Telephone Company has decided to rent instruments of the Rocky Mountain Bell Telephone Company. There was some talk of starting an independent telephone exchange in West Gallatin, but it was finally determined that the best policy for the company was to adopt the course above outlined.

ST. ALBANS, VT.—The New England Telephone Company will install a new switchboard in the St. Albans Exchange.

GLENDIVE, WASH.—The new telephone system at Glendive will be in operation by July 5.

FOND DU LAC, WIS.—The Little Wolf River Telephone Company contemplates establishing an exchange at North Fond Du Lac.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Pacific Light & Power Company will erect a new building 150 feet square, in which to house its electric generating plant. The boiler capacity will be 2,500-hp. The structure will be used as a reserve station.

SAN FRANCISCO, CALIF.—It is reported that a 5,000-hp electric power plant will be installed at Coulterville, Calif., for the purpose of supplying power for the mines near Coulterville and in the northern part of Mariposa County. A 9-mile flume will be required. A masonry dam will be constructed on the Merced River near McCabe's Flat. The available head of water is 300 feet.

SAN FRANCISCO, CALIF.—The Riverside Power Company, W. E. Pedley, secretary, has closed a contract with the General Electric Company for two 250-kw, 3-phase generators. These will be installed in a water power electric station from which 10,000 volt current will be supplied for the city of Riverside, Calif. The water of the Santa Ana River will be utilized. W. E. Pedley has contracted to construct a canal for the company that will carry 7,000 inches of water and will be completed by Jan. 1.

SACRAMENTO, CALIF.—General Manager A. M. Hunt, of the Independent Electric Light & Power Company, San Francisco, recently submitted a proposition to the Board of Supervisors of this city. It is proposed to furnish a water supply for that city, the pipe line being 21½ miles in length. This would extend to a subsidiary reservoir, which would be placed at an elevation that would produce the required pressure. Beyond this a main reservoir would furnish a head of 1,200 feet of water. It is estimated that 20,000 hp could be developed for electric power purposes for transmission to Sacramento and elsewhere. The South Fork at the American River will supply the water.

DENVER, COLO.—The Western Packing Company has let the contract for a complete electrical power plant to be installed in the packing house now in course of construction at the Denver stock yards. The equipment will include Ball engines and Crocker-Wheeler generators of 550-kw. capacity.

MICHIGAN CITY, IND.—The Michigan City Electric Light Company has been incorporated with $50,000 capital stock by Russell B. Harrison, Indianapolis, George J. M. Porter and Frank Reidel, Michigan City.

BALTIMORE, MD.—The City Arc Light and Power Company has been formed here. The new corporation proposes to compete at once for city and private contracts. The capital is $50,000 and the officers are: President, L. M. Hartman; vice-president, J. P. Julius; treasurer, R. H. Shindel; secretary, Granville Hartman, Jr.; directors, J. Herbert Thomas and W. T. Gerber.

TRENTON, N. J.—The Granite City & Venice Light & Power Company, with headquarters at Jersey City, has been incorporated; capital, $160,000. Incorporators: Frank L. Arnold, Granville A. Harker and Carol Wight.

CHATEAUGAY, N. Y.—A corporation has been formed at this place known as the Chasm Power Company to utilize the water power of the Chateaugay chasm for light and power. The officers are C. L. Bentley, president; W. B. Ryan, vice-president; A. B. Cooney, secretary, and A. M. Bennet, treasurer. A head of about 85 feet will be obtained.

COLUMBUS GROVE, OHIO, has voted an issue of $15,000 electric light bonds.

SANDUSKY, OHIO.—Trustees of Erie County Children's Home, Sandusky, have had plans prepared for a power house for lighting and heating.

FREMONT, OHIO.—The Home Electric Light & Power Company, organized at Fremont, Ohio, has secured a local franchise and will at once purchase its apparatus.

COLUMBUS, OHIO.—The Eastern Heating & Lighting Company of Columbus will erect a power plant and furnish light, heat and power in the residence portion of the city. Plans have been laid out by Mr. W. T. Mills.

MT. VERNON, OHIO.—The Mt. Vernon Electric Light Company is contemplating building a modern lighting plant. The company has asked the city to annul the present lighting contract and make a new contract for ten years on a basis of $78.35 per year per light.

TOLEDO, OHIO.—The Toledo Railway & Light Co., control of which has been purchased by Mr. R. B. Van Cortlandt and a few personal friends, has increased the number of its directors from five to seven. The new members of the board are: Mr. R. B. Van Cortlandt, of Kean, Van Cortlandt & Co., and Mr. Herbert S. Holt, president of the Montreal Light, Heat & Power Co.

BRADFORD, PA.—The Gray-Blaisdell Company, Bradford, Pa., is about building a foundry 150x100 feet. In it there will be a 20-ton traveling crane, 50 feet span. It will be fitted with electric motors.

M'MINNVILLE, TENN.—The water and power house, which was swept away in the flood of March 28, has been rebuilt, and the town is again enjoying electric lights after nearly three months of darkness.

BRYAN, TEXAS.—The city council has granted Sam M. Winters a franchise to put in an electric light plant.

SALT LAKE CITY, UTAH.—The Tag Horn Mine in Ymir district, Wash., will install an electric light and power plant for the further working of the property.

SALT LAKE CITY, UTAH.—H. W. Ogilvee has formed a company of San Francisco capitalists to build a large power plant, using the waters of Applegate Falls. Power wil be used in Josephine County for mines and mills.

SALT LAKE CITY, UTAH.—A landslide in American Forks Canyon on June 12 tore away about 50 feet of the Utah Light & Power Company's pipe line. As a result the three cities of Lehi, American Fork and Pleasant Grove were in darkness.

SALT CITY, UTAH.—The Park City (Utah) Heat & Power Company has overhauled its entire plant, and a new generator has been added. The company has the contract to furnish light and power for the new zinc plant now in the course of construction, the entire equipment of which is to be run by electric power.

SALT LAKE CITY. UTAH.—The Utah Light & Power Company, of Salt Lake City, [illegible]

[illegible]

THE ELECTRIC RAILWAY.

[illegible] of the company is $25,000. Incorporators, Matt Gaasch, George D. McElroy and John Lorenz, of Vinton, and Arthur R. Jones and Charles S. Jones, of Chicago.

[illegible] town Electric Railway Company have voted to increase the capital stock from $25,000 to $125,000, the additional stock having been subscribed by Boston capitalists. The Company will build and operate a suburban railway.

HOPKINSVILLE, KY.—The Commercial Club is agitating for an electric railway and it is believed that the City Council will grant a franchise on liberal terms. Mr. H. H. Abernathy, secretary of the club, may be addressed.

FRANKFORT, KY.—The Ohio Valley Traction Company, of Carroll County, with $30,000 capital stock has filed incorporation articles. The incorporators are Albert S. Berry, of Newport, and John I. Forbes and M. I. and R. M. Barker, of Carrollton.

BOSTON, MASS.—The Board of Railroad Commissioners has authorized the Morton & Taunton Street Railway Co. to extend its railway into the towns of Rehoboth and Seekonk.

MARSHALL, MICH.—The Jackson & Battle Creek Traction Company has given a mortgage for $750,000 to the Morton Trust Company of New York.

TRENTON, N. J.—The East St. Louis and Suburban Company has filed papers with the Secretary of State increasing its authorized capital from $3,000,000 to $5,000,000. The company was chartered in April last, to acquire and operate trolley lines in and about St. Louis, including the lines of the St. Louis and Illinois Suburban Railway Company.

JEFFERSON, OHIO.—George Chapman, acting for the Conneaut & Southern Railway Company, has applied for a franchise through Jefferson County.

COLUMBUS, OHIO.—Contractor Luchtenburg has secured the contract for building the Urbana, Mechanicsburg & Columbus Railway within the city limits.

FINDLAY, OHIO.—It is announced that the Findlay, McComb & Deshler Railway Company will shortly be incorporated to operate an electric line from Findlay to Deshler.

TOLEDO, OHIO.—The Peoples' Rapid Transit Company of Toledo has been incorporated with $100,000 capital stock by James H. Morgan, Louis J. Weadock, Adam Burber, W. H. Wilhelm, and Albert Merkley, all of Toledo.

CLEVELAND, OHIO.—The Cleveland, Richland & Akron Rapid Transit Company has been organized with H. B. Camp, of Cleveland, president. Others interested are F. W. Inman, Daniel Gindelsperger, G. T. Inman and Fredick W. Green.

CANTON, OHIO.—Directors of the Canton-Massillon Railway Company and the Canton-Akron Railway Company have voted favorably on the proposition to consolidate the properties under the title of the Canton-Akron Railway Company. The capital stock of the company has been increased to $1,600,000 to make the merger.

CLEVELAND, OHIO.—The power house of the Cleveland Electric Railway Company was badly crippled last week through the simultaneous burning out of the armature on the 2,400-kw General Electric unit and the blowing out of the cylinder-head of the engine on the 1,600-kw unit. A tie-up was avoided by the pressing into service of all the old apparatus and the old Canal Street station, the equipment of which was being offered for sale.

CLEVELAND, OHIO.—The Cleveland, Painesville & Ashtabula Railway Company, which was purchasel from Everett-Moore by Messrs. Holcomb and Lattimer, has been fully organized and financed. The company is capitalized at $750,000 and will be bonded for the same amount. Officers are Luther Allen, president; W. J. Hayes, vice-president; Joseph R. Kraus, secretary-treasurer. The road will connect the Cleveland, Painesville & Eastern with the system now being built between Conneaut and Erie, Pa., with projected roads to Buffalo.

OTTAWA, ONT.—The Hull Electric Railway, operating between Ottawa and Aylmer, has passed into the hands of the Ottawa, Northern and Western Railway, or, more properly, of the Canadian Pacific Railway, which recently concluded the purchase of that system. The purchase price is said to have been between $700,000 and $800,000.

GREENSBURG, PA.—The Indian Creek Valley Railroad Company has been chartered. W. A. Kalp of Mount Pleasant is president. The capital stock is $1,500,000.

PIERRE, S. D.—The Sioux Falls & Madison Railway Company, with a capital of $2,600,000 has been incorporated. The directors are George Schlosser, J. F. Sherman, Edward McKim, A. L. Winzer, Lee Frudenfeld. The line is to be fifty miles long and in Minnehaha and Lake Counties.

SALT LAKE CITY, UTAH.—Despite the fact that the municipalities of Salt Lake and Ogden have refused to grant franchises to the Salt Lake & Brigham City Electric Railway Company for the occupancy of streets, the project of building the road has taken a fresh impetus. It is now understood that strips of land will be bought from private parties over the entire proposed line between the two cities.

RICHMOND, VA.—A New York syndicate, headed by the Merchants' Trust Company, has bought the Richmond Traction Co., the Virginia Electrical Railway & Development Co., and the West Hampton Railway & Park Co. for about $4,000,000.

THE AUTOMOBILE.

THE AMERICAN MOTOR CARRIAGE COMPANY, Cleveland, Ohio, has increased its capital stock from $10,000 to $50,000. The company is going into the manufacture of electric vehicles and storage batteries.

A LONG ELECTRIC TRIP.—Two local automobilists recently made a run from New York to Oceanic, N. J., by way of Staten Island and New Brunswick, a distance of sixty-three miles, according to the cyclometer, in an electric phaeton, without being obliged to recharge the batteries, and the current was still strong at the end of the trip.

STOPPING TRIALS.—In some automobile stopping trials at Philadelphia last week, a Columbia electric phaeton run by Mr. Herbert Lloyd, weighing 2,700 pounds, was stopped in 40½ feet when going at a speed of 17¼ miles an hour. An electric runabout handled by Arthur Bloch weighing 1,900 pounds stopped in 30⅓ feet while going 14½ miles an hour. Mr. Lloyd also made a stop in 12½ feet at 12 miles an hour. The ordinance limiting speed to five miles an hour in the city will be changed to eight miles, ten miles in less crowded portions, and twenty miles in the suburbs.

NEW INDUSTRIAL COMPANIES.

THE CITY CONDUIT COMPANY of York, Pa., has been formed under the laws of Delaware, to acquire, construct, and dispose of conduits, telegraph, telephone, and electric light lines; capital, $100,000.

THE AMERICAN UNION ELECTRIC COMPANY filed papers at Trenton increasing its capital stock from $100,000 to $7,000,000. The company was incorporated on June 10 to manufacture electric dynamos.

THE KEARNEY ELECTRIC COMPANY has filed articles of incorporation with the Wayne county clerk, Detroit; capital, $10,000. The stockholders are George F. Kearney, Edwin Leggett, and William J. Brennan, Coldwater.

THE ELECTRO-MAGNETIC RAILWAY CONSTRUCTING COMPANY, capital $1,000,000, has been incorporated at Trenton, N. J. The incorporators are Albert C. Albertson, Christian A. Henricksen and John Allen, of New York.

THE ENGINEERING COMPANY OF AMERICA has been incorporated with an authorized capital stock of $5,000,000, to continue the business of the Cunningham Engineering Company of Boston. The incorporators are Willard W. Baldwin, Albert R. Palmer and Alfred G. Brown.

LEGAL.

PANEL BOADS.—We are advised that the H. Krantz Mfg. Co., of Brooklyn, New York, Crouse-Hinds Electric Co., of Syracuse, N. Y., and Zimdars & Hunt, of New York City, N. Y., have commenced a "trade libel" suit in the New York Supreme Court, on their own behalf and on behalf of other panel-board manufacturers, against Charles L. Eidlitz and T. J. Murphy, as owners of the Murphy panel-board patents. The complaint alleges that the defendants have been issuing circular notices, which the plaintiffs claim contain false statements, and the Court is asked to issue an injunction to stop the circulation of such notices.

OBITUARY.

MR. M. MAREAN.—Morell Marean, for twenty years local manager of the Western Union Telegraph Company, at Washington, D. C., died there on June 22, aged sixty years. Death was very sudden, although Mr. Marean had been unwell for some time, close attention to business bringing on an attack of nervous prostration. He was a native of Montrose, Penn., and leaves a widow and four children. He was well known in electrical circles as a partner of the late Wm. F. Royce, in the business of electrical supplies.

MR. E. H. JENKINS.—The death of Edward H. Jenkins, of San Antonio, Texas, president of the San Antonio Traction Company and the Gas & Electric Company, of that city, occurred Wednesday, June 25, at his hotel in San Antonio. His death was due to blood poisoning, following a surgical operation performed about ten days before. He was born at Indianapolis, Ind., March 4, 18[illegible], a son of A. W. and Caroline Harrison Jenkins. His father was a merchant and of an old American family. He found employment with the Indianapolis Gas Company as timekeeper; rose through the intermediate positions and learned every detail of the business. After nine years of service with this company, he occupied the responsible position of assistant superintendent. In 1878 he was elected superintendent of the Elkhart, Ind., Gas Company, remaining there for four years. In 1882 he was called beyond the boundaries of his state, going to Cedar Rapids, Iowa, to design a new gas plant. The following year he became superintendent of the Columbus, Ga., company and remained in this position for twelve years. He then accepted the position of the Covington, Ky., Gas Company, where he remained until 1898, when he entered the service of the [illegible] Company. He was [illegible] superintendent of the three large plants at Buffalo, N. Y., and in 1899 he was sent to San Antonio to assume charge of both the traction and electric [illegible] the company had purchased. He was given full charge of the reconstruction of these plants and in three years he evolved one of the best street railway systems in the South out of what had been chaos. By reason of his [illegible] he was appointed by Governor Sayer as a member of the Texas World's Fair Commission to the Louisiana Purchase Exposition. He was also second vice-president of the Texas Associated Commercial Clubs, a director of the International Fair Association, also in the Business Men's Club and San Antonio Club. In 1875 Col Jenkins was married to Anna F. Burton, at Indianapolis. He is survived by his widow and two children, one of whom is Albert E. Jenkins, superintendent of the San Antonio Gas Works.

PERSONAL.

MR. L. H. LEWIS.—Cards are out announcing the approaching marriage of Mr. L. H. Lewis of the Lamp and Meter Department in New York City of the General Electric Company.

PROF. BOWMAN, of the Butte, Mont., School of Mines, will go East, spending some time at the Westinghouse Company's works studying the latest developments in electrical mining apparatus.

MR. HARRY B. THAYER, of the Western Electric Company, New York, sailed on June 28 for Europe, where he will visit England, France, etc., and see many old friends and acquaintances.

DR. MAX VON RECKLINGHAUSEN has contributed to the *Elektrotechnische Zeitschrift* of Berlin, an interesting article on the Hewitt mercury vapor lamps, which has just been issued in pamphlet form.

DR. S. S. WHEELER, president of the Crocker-Wheeler Company, who with his wife has been for some time in Europe, has just bought a Panhard-Levassor automobile and will make a trip through France in it before returning home.

MR. FRANK GIBBONS VAUGHAN, of the General Electric Co., Schenectady, was married last month to Alma, daughter of Mr. and Mrs. Demmick, of Lynn, Mass. The happy pair will be at home in Schenectady after August 1.

MESSRS. E. J. HALL and C. H. Wilson, vice-president and general superintendent, respectively, of the American Telephone and Telegraph Company, were in Kansas City recently inspecting the long-distance terminal stations at that point.

MR. E. W. GOLDSCHMIDT, of the Chicago office of the Bullock Elec. Mfg. Co., has been moved to New York to take charge of the sales office there, vice Mr. R. T. Lozier, who has gone to take charge of the general selling organization at Cincinnati.

MR. ISAAC L. RICE, who has long been very prominent in the promotion of electrical enterprises, has been informed by the trustees and regents of the state of Maine that the Bates College, of Lewiston, Me., has conferred upon him the degree of LL.D.

MR. CHAS. M. CLARK.—The United Telpherage Co., of New York, has just issued in separate pamphlet form the interesting and valuable paper on telpherage read by Mr. Clark before the American Institute of Electrical Engineers last April.

MR. GUY M. WALKER.—The offices of the Everett-Moore Syndicate in New York have been closed. Mr. Guy M. Walker, who had charge of the syndicate's affairs in New York, has left for Cleveland. The company still maintains its offices at Boston, Cleveland and Detroit.

MR. JOHN DENHAM, of the electric lighting works of the Cape Government Railways, who was in this country last year, has read a very interesting paper on his American observations and experiences before the Cape Town section of the English Institution of Electrical Engineers.

MR. JOSEPH HOADLEY, of New York, it is reported from Paris, has just purchased for $10,000 a 75-horse power Krieger electric automobile, which recently made the world's record for this class of machine. It is capable of doing fifty miles an hour and is fitted with a new Fulmen battery, of which Mr. Hoadley has purchased the patents for the United States.

MR. FRED. L. BARRETT, at present superintendent of the Peninsula Elec. Lt. & Power Co., Houghton, Mich., will shortly engage in the engineering, contracting and electrical supply business in that city. It is his intention to cover the upper peninsula of Michigan in these lines. He will be glad to have manufacturers send him their catalogues and wholesale prices.

MR. ROBERT McF. DOBLE, who is consulting and supervising engineer for the Guanajuato Power & Electric Co., of Mexico, has gone to New York. He will visit the General Electric Company's works in connection with the details of the generating apparatus aggregating 6,000-hp that has been ordered for the company's 110-mile transmission plant on the Duero River.

MR. GEO. F. PORTER has returned from Alaskan waters, having succeeded in getting the government cable there into successful operation far more quickly than was deemed possible. It had been supposed that ice had something to do with the rupture of the cable, but it is now said to seem more than likely that the cable was cut in order to free from it the anchor of an entangled vessel.

MR. J. P. MORGAN.—A cable dispatch from London of June 28 says J. Pierpont Morgan has decided, it is reported here, to submit himself to Prof. Finsen's electric light cure for a face affection from which he has long been suffering. It seems the strain of his recent labors ran down his health, greatly aggravating this troublesome complaint, and, as he is a warm believer in the therapeutic value of electricity, he decided to take treatment by Finsen's system. The treatment probably will be given in his London house or aboard his yacht.

DR. M. I. PUPIN.—A cable dispatch from Berlin says: The invention of Prof. Michael I. Pupin, of Columbia University in New York, seems destined to revolutionize telephony in Germany. Prof. Pupin, who is here, says that the firm of Siemens & Halske, now experimenting with his underground system between Berlin and Potsdam, is delighted with the results. As the telephone is a government institution in Germany, Prof. Pupin believes that the German government may introduce the system. Prof. Pupin will demonstrate his system to the government patent officials. The firm of Siemens & Halske has secured all of Prof. Pupin's patent rights for Germany. The professor expects to go to Vienna shortly to secure patent rights for Austria and to enter into arrangements with the Austrian government for the introduction of his system in that country, if he can induce the Austrian officials to look upon it favorably. The professor is more than pleased with the favor with which he has been received here. This is not his first visit to Berlin. He studied here in [illegible].

Trade Notes.

THE FOSTORIA INCANDESCENT LAMP COMPANY, Fostoria, Ohio, will enlarge its factory, increasing the output from [illegible] per day.

THE NATIONAL CARBON COMPANY will rebuild the Partridge plant in Sandusky which was badly damaged by fire a short time ago. The capacity of the plant will be increased considerably.

THE BALL ENGINE COMPANY, Erie, Pa., is installing a 400-hp engine in the plant of the Fulton (N. Y.) Light, Heat & Power Company; also a 125-hp engine for direct connection to a Crocker-Wheeler generator in Wm. Borden's building, Chicago.

REYNOLDS ELECTRIC COMPANY, of Chicago, Ill., has just issued a new pamphlet describing its improved Reynolds flasher, telling what a flasher is and what it may be used for. Every central station superintendent and electrical contractor should send for a copy.

PAPER WEIGHT.—The Chicago Fuse Wire & Manufacturing Company has gotten out a neat little paper weight that will be appreciated by those who are fortunate enough to receive one. It consists of a brass disk two in. in diameter, at the center of which is a miniature representation (also of brass) of a spool of tested fused wire. This is intended for a handle to life the weight by.

THE ATLANTIC SUPPLY COMPANY, Atlantic City, which was decreed insolvent last October, requests us, through Albert C. Stephany, receiver, to say that large quantities of circulars and other advertising matter continues to come directed to the company, and as the company is no longer open for business, the senders are thus put to a useless expense, which, by this notice, Mr. Stephany hopes to save them.

MOTOR DRIVEN TOOLS.—The Crocker-Wheeler Company, Ampere, N. J., have just issued in brown burlap cover, bearing their trade mark in colors, a very handsome brochure devoted to the above topic. It is freely illustrated with applications of their motors to a variety of machine tools, and in many cases a brief description is given of the work. The pamphlet is an effective argument for electric power.

NOVELTY SLIDABLE SLEEVES.—With regard to their "Novelty Slidable Sleeves," the New Haven Novelty Machine Co. state that they are willing to send samples, with "Y" branch and pot head for any individual piece, to responsible telephone companies for inspection and approval. After these have been tested they will quote prices and discounts. These goods they will also forward at their own expense.

THE CONSUMERS' CARBON COMPANY, Lancaster, Ohio, has passed into the control of Cleveland parties. Mr. C. S. Britton, of Cleveland, will be president and Mr. B. L. Britton, of Lancaster, will remain secretary and treasurer. Mr. A. M. Britton, of Cleveland, is vice-president. The new company will largely increase the capacity of its plant and the scope of its work, and will manufacture a complete line of carbon specialties in addition to electric light carbons.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is just out with one of the handsomest, most comprehensive and best arranged electrical supply catalogues ever sent to the trade. This is its No. 16 and is accompanied by its up-to-date loose leaf net price list and discount sheet. It is so arranged that as prices change new leaves may be inserted. The compilation is a distinct advance over previous issues and is certain to meet with favor by buyers and users of electrical goods.

LAVITE.—We are advised by the D. M. Steward Manufacturing Company, of Chattanooga, Tenn., that in order to distinguish its "lava" product, it has bought a new name and trade mark. The word is "Lavite," which has been registered by the concern to cover broadly all forms of its lava insulation. It has recently established a permanent branch office at 57 Washington street, Chicago. The experiment was begun last March and the results have been very gratifying. All communications for the territory addressed there will receive prompt attention, and old friends as well as new prospective customers will be welcomed.

"NEVERGUM" is a new commutator compound made by the Commutator Compound Co., Ltd., Battle Creek, Mich. It is the invention of Mr. F. C. Hayes, who has become the general manager of the company. "Nevergum" is put up in stick form (⅞x4 in.); it flows readily at about 105 degrees and it is stated will not gum under any known conditions. It should be used sparingly.

[illegible]

MANHATTAN [illegible] TELEPHONE SERVICE.—[illegible] Lambert Schmidt Company's [illegible]

HOLTZER-CABOT APPARATUS.—[illegible] in the advertisement of the Holtzer-Cabot Electric Co. an error was made in the designation of apparatus. The Holtzer-Cabot Electric Co. called particular attention to the [illegible] delphia and in the Battersea Exchange at London, England. An illustration of each installation was shown in the [illegible] caption for No. 1 should say that the generators there shown were installed in Philadelphia, as they are, but through an inadvertence, the word "London" appeared as part of the title.

WOODWARD GOVERNOR COMPANY.—[illegible] held on June [illegible], Mr. A. W. [illegible] Mr. E. E. Woodward, vice-president and general manager, and Mr. J. Chas. Young, secretary and treasurer. The company expects to get out after the business of friction water-wheel governors, and to increase the large territory now covered with its goods, including the United States, Canada, South America and Europe. The president and general manager have been conducting the business for the last 25 or 30 years as a partnership, but its growth has now resulted in the incorporation. Mr. Young, who was formerly superintendent of the People's Power Company, of Moline, Ill., will have as his principal duty the selling and outside engineering.

NALDER BROS. & THOMPSON, LTD., of London, have just issued an interesting price list and catalogue which deals with electro-magnetic ammeters and voltmeters of their own manufacture besides their special electrostatic voltmeters. The book is well illustrated showing their various designs of these instruments besides giving some detail of their intruments and samples in full size of the scales which are used with their instruments. The catalogue concludes with a few views of their workshops which are specially adapted for the manufacture of electric material of this kind. Messrs. Nalder & Thompson also promise that they will soon bring out another section of their catalogue which will deal with moving coil ammeters and voltmeters; a third section which will treat of recording instruments and a fourth section which will treat entirely of automatic circuit breakers which they also manufacture.

MASURITE.—A month or two ago some interesting details were given in these pages as to the striking results with the new explosive "Masurite." Subjected to all manner of tests by concussion, fire, friction, electricity, detonation, etc., it would not go off except under the predetermined methods of firing by electricity or by tape fuse. For ourselves, we think the magneto the preferable way. The Masurite Explosive Co., 50 Broadway, New York City, is now doing a large business, especially in the mining field, and is building itself a large factory and model village in the vicinity of Sharon, Pa., according to general plans prepared by President Fred L. M. Masury. In this plant electric power will be used largely in different departments. It may be mentioned that the existing factory at Sand's Point, Long Island, stands only a few hundred feet from the Masury country residence, an emphatic demonstration of faith in its safety.

STEAM TURBINES.—The Chase-Shawmut Company, Boston, manufacturer of electrical specialties, has entirely reconstructed its factory since the recent fire, on a greatly enlarged scale, and with over double the number of [illegible] Among the many [illegible] is the installation of a De Laval [illegible] for the generation of both power and lighting for its factory. This steam [illegible] for which this company is New England agent, is attracting great [illegible] the part of those interested in the economic questions of power and lighting. It is no new experiment, the De Laval turbine having for many years been in successful operation in Europe. It is only recently, however, that the De Laval Company has entered this country, but its extensive works at Trenton, N. J., are already overtaxed to meet its orders. The Chase-Shawmut Company invites inspection of its turbine, which is in constant and very efficient operation in its factory, [illegible] avenue, Boston.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 24, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

702,938. TROLLEY FOR ELECTRIC RAILWAYS; F. W. Garrett, Johnstown, Pa. App. filed, Sept. 10, 1901. In order to take up wear in the wheel bearing, a movable part of a bushing is constantly forced outward by a spring located in a groove in a fixed axle.

702,981. CONTROL OF ELECTRIC MOTORS; F. A. Merrick and E. W. Stull, Johnstown, Pa. App. filed Sept. 10, 1901. The object is to dispense with the use of master controllers and pilot motors and control the train directly by manually operated controllers mounted on the car platform. The system includes a number of train wires to which the motors are connected, one or more controllers on each car, connected to each wire, the corresponding contacts on the several controllers being connected to different wires.

702,986. ELECTRIC THIRD RAIL; P. E. McIntosh, New York, N. Y. App. filed Dec. 2, 1900. A construction of chair for the third rail.

702,989. ELECTRICAL FLUSH SWITCH; W. J. Newton, New York, N. Y. App. filed July 26, 1900. Details.

703,004. FIELD TELEPHONE SET; L. Schmidt, Weehawken, N. J. App. filed Aug. 8, 1901. (See page 17.)

703,022. CIRCUIT CONTROLLER; E. W. Vogel, Chicago, Ill. App. filed July 23, 1901. A lever which [illegible] tion to do its work when the sagging portion of the trolley wire is lifted by the trolley wheel.

703,033. ELECTRIC TIME SWITCH; E. H. Wright, Chicago, Ill. App. filed April 11, 1898. (See Current News and Notes.)

703,037. STREET RAILWAY SWITCH; W. J. Bell, Los Angeles, Calif. App. filed March 25, 1902. The flange of the car wheel ordinarily overcomes a yielding connection between the switch point and a switch-throwing device, to allow the car to continue on the main track; but to turn out on to a branch, the motorman closes a circuit through an electromagnet which holds the yielding connection rigid and prevents the movement of the switch point.

703,051. ELECTRIC METER; T. A. Edison, Llewellyn Park, N. J. App. filed Oct. 15, 1900. (See Current News and Notes.)

703,091. ELECTRIC BELL; A. F. Spencer, Ansonia, Conn. App. filed Feb. 21, 1902. A contact spring is inserted between the end of the adjusting screw and the armature spring to avoid the necessity of inserting a contact point in the end of the adjusting screw, it then being possible to use an ordinary commercial screw.

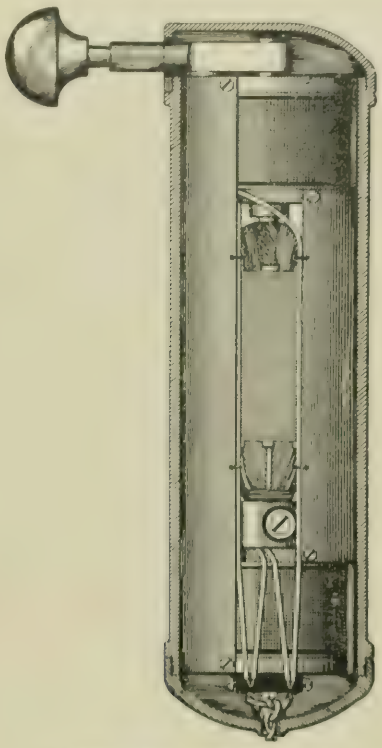
703,100. MASSAGING IMPLEMENT; J. B. Wantz, Chicago, Ill. App. filed March 10, 1902. A handle containing an electric motor arranged to vibrate a hammer for the purpose of delivering rapid blows.

703,135. INSULATING ELECTRIC CONDUCTORS; I. Kitsee, Philadelphia, Pa. App. filed April 17, 1902. (See Current News and Notes.)

703,144. ELECTRIC MOTOR; J. H. Mason, Brooklyn, N. Y. App. filed Nov. 23, 1900. The armature is in two sections having separate windings and an iron sleeve joining them, whereby the armature virtually consists of horseshoe magnets with outwardly turned poles and neutral points in the sleeve.

703,145. ELECTRIC RAILWAY SIGNAL; F. C. Muller, Brooklyn, N. Y. App. filed March 10, 1902. A striking device in the track which operates a tappet on the locomotive to mechanically control an electric switch in the cab of the engine.

703,153. PROTECTING APPARATUS FOR ELECTRICAL MACHINES AND PLANTS; P. Rudhardt, Geneva, Switzerland. App. filed July 23, 1901. Details of a lightning arrester.



703,100.—Massaging Implement.

703,176. ELECTRIC METER; F. A. Brocq and A. Blanchet, Paris, France. App. filed March 27, 1902. The commutator and brushes project into a supplemental casing so that they can be inspected without giving the inspector an opportunity to tamper with the remaining parts of the meter.

703,196. INSULATED WIRE; J. A. Heany, Philadelphia, Pa. App. filed Feb. 14, 1901. Renewed Nov. 21, 1901. (See Current News and Notes.)

703,197. MANUFACTURE OF INSULATED WIRE; J. A. Heany, Philadelphia, Pa. App. filed Nov. 9, 1901. Renewed Nov. 21, 1901. (See Current News and Notes.)

703,198. INSULATING METALLIC SURFACES OR WIRES; J. A. Heany, Philadelphia, Pa. App. filed Nov. 9, 1901. Renewed Nov. 21, 1901. (See Current News and Notes.)

703,199. WATER, ACID AND FIRE PROOF COMPOSITION; J. A. Heany, Philadelphia, Pa. App. filed Nov. 11, 1901. (See Current News and Notes.)

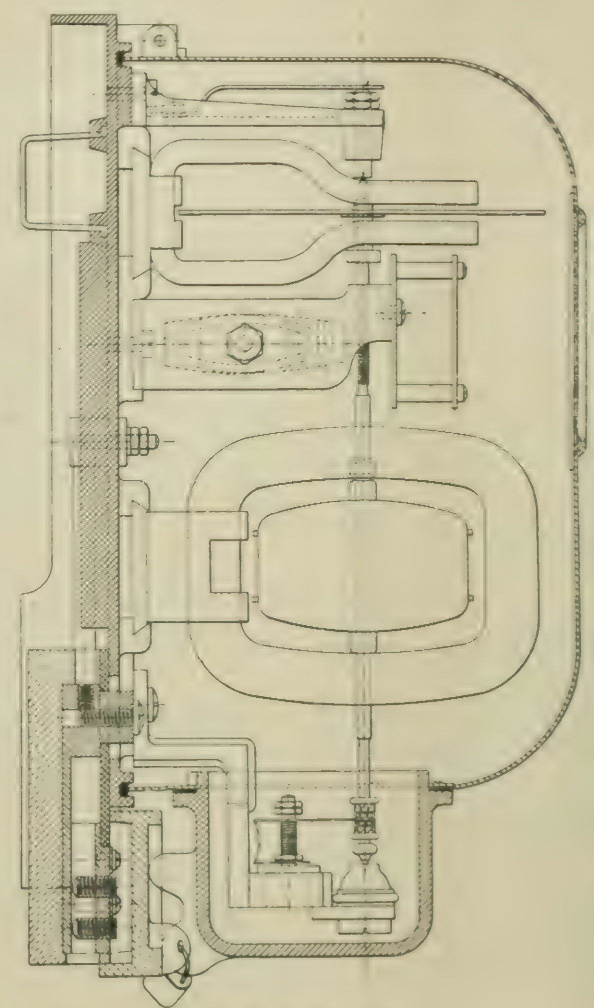
703,200. METHOD OF PREPARING ASBESTOS FOR USE AS AN INSULATION FOR METALLIC SURFACES; J. A. Heany,. Philadelphia, Pa. App. filed Nov. 9, 1901; divided and filed Jan. 8, 1902. (See Current News and Notes.)

703,201. METHOD OF INSULATING METALLIC SURFACES WITH ASBESTOS; J. A. Heany, Philadelphia, Pa. App. filed Nov. 9. 1901; divided and filed Jan. 9, 1902. (See Curent News and Notes.)

703,225. POLE CHANGER; J. M. G. Beard, Fruita, Colo. App. filed Feb. 12, 1902. A pole changer for currents of high potential, comprising a base, a vertical insulating standard mounted thereon, radially movable metallic arms pivoted upon the standard and provided with knobs, insulating handles connected with said arms for moving the same and means for connecting the arms with an electrical supply.

703,234. ELECTRIC CONTROLLER; J. W. Brown, Jr., Philadelphia, Pa. App. filed March 7, 1902. Details.

703,274. RAIL BOND; J. E. Jones, Hazelton, Pa. App. filed May 1, 1902.

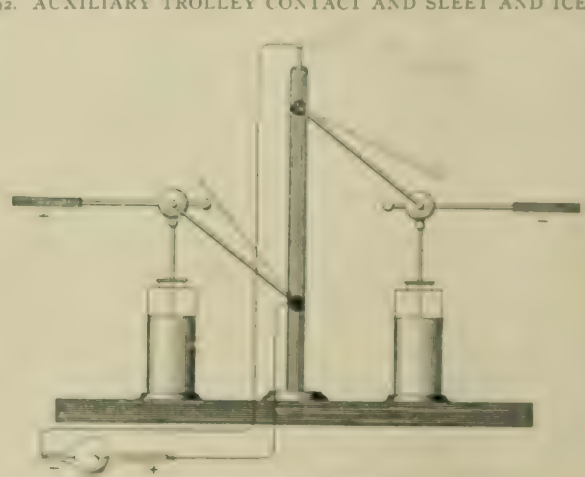


703,176.—Electric Meter.

The rail-ends have their webs cut away to form a chamber for the bond; it is held in place by screws and covered by the fish-plates.

703,289. PROCESS OF PRODUCING CAUSTIC; H. K. Moore, Lynn, Mass. App. filed April 30, 1900. (See page 16.)

703,292. AUXILIARY TROLLEY CONTACT AND SLEET AND ICE CUT-



703,225.—Pole Changer.

TING DEVICE; W. H. [illegible], Mount Holly, N. J. App. filed Sept. 13, 1901. An ice-breaking wheel precedes the trolley wheel.

703,329. MAGNETIC SEPARATOR; J. C. Winder, Eastport, Ga. App. filed March 25, 1902. Details.

703,340. ELECTRIC CONTROLLER; E. C. Fellows, Philadelphia, Pa. App. filed April [illegible], 1902. An overload and an underload switch can be operated by the controller arm, the former when moving in one direction, and the latter when moving in the other direction.

703,361. THIRD RAIL SYSTEM OR MAGNETO-ELECTRIC RAILWAY; W. H. Wright, Buffalo, N. Y. App. filed Aug. 19, 1901. Pivoted levers in a conduit are caused to establish connection between a bare conductor in the conduit and a third rail, by an energized magnet carried by the car

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CONTENTS.

THE INDEX SUPPLEMENT.

With this issue we present the Index to Volume [illegible], in the preparation of which unusual care has been taken, while, as will be seen, it occupies no fewer than twelve closely printed pages, owing to the thorough system of cross reference. The growing number of subjects of a scientific and industrial nature brought within the sphere of electricity, as well as the steady addition to the number of pages, renders the compilation of such an index as this increasingly more difficult, as it is always desirable to render consultation of it direct and easy. Aside from these considerations, an index is a pretty good indication of the drift of things, and the waxing and waning of interest in different topics. We may point out that as an auxiliary to this regular index of the volume, we are now printing every week a catalogue card index of the leading contents of the previous week, convenient for inclusion in a card index.

A. A. A. S. PITTSBURG MEETING.

Elsewhere we print an account of the recent Pittsburg meeting of the American Association for the Advancement of Science, which meeting undoubtedly ranks as one of the most successful in the history of the body, both with respect to the character of the attendance and the value of the papers presented. Very much of this success has been due to the excellent work of the local committee and its efficient secretary, Mr. Geo. A. Wardlaw, whose efforts were seconded by a large sum contributed by public-spirited citizens of Pittsburg. Moreover, a real effort was made to aid the press in giving proper publicity to the proceedings, and we are consequently enabled to print in our columns a fuller account of the meeting of the Association than has been possible any time in the past. This matter of publicity also received attention on the part of the governing body, and we are glad to know that by unanimous vote a press secretary was provided for each section, whose duty will be to obtain in advance of reading, papers or abstracts thereof for purposes of publicity. The real necessity which led to this measure is obvious when it is considered that the various sections meet during the same hours, and that very many papers are read only by title. Consequently, to obtain a satisfactory report of the proceedings from notes taken during sessions has been impossible, and the attempt has rarely been made. The unfortunate result has been that most of the papers contributed to the A. A. A. S. might as well never have been written so far as concerns the dissemination of the knowledge contained. The section on physics anticipated action on this point, and it is through its press secretary, Mr. Geo. F. Stradling, that we are enabled to present a full account of all the more important papers on electrical and cognate subjects read in that section.

In considering the subject of press secretaries, the governing body might well have gone a step further and provided for a general office or routine secretary, to care for the interests of the association between meetings. Abundant occupation should be found for such an officer in the publication of the *Transactions*, enlarging the membership by solicitation through proper channels, co-operating with the section press secretaries and local committees, and, above all, in keeping the association before the public through press notices, particularly during the several months preceding a meeting. The secretary of the local committee appears to have performed this work admirably for the Pittsburg meeting, so far as the opportunity would permit, but this important duty, as well as many other

matters that in the past have not received adequate attention, require the services of a permanent official corresponding to the office secretary of the various professional bodies of the country. In other words, there is a crying need for a business and routine secretary, all of whose time should be devoted exclusively to the interest of the Association. It is undeniable that up to the present the American Association for the Advancement of Science has in prestige lagged far behind the corresponding British body. This we firmly believe to be due, not to innate inferiority, but to defects in organization and administration, the correction of which we hope will soon be seriously undertaken by the governing body.

Marconi on Wireless Telegraphy.

In this issue we print the concluding portion of Mr. Marconi's lecture before the Royal Institution of London, in which are set forth the more recent developments of his system of wireless telegraphy. The new form of wave detector described involves a very interesting principle. In the coherer, the electric resistance of the gap is in a semi-unstable condition. A small variation in the physical condition of the surfaces of adjacent filings in the gap is destined to produce large changes in electrical resistance. From this point of view the coherer is a sensitive conductor in electric instability, and operates by virtue of the changes in electric condition consequent on the passage of electric impulses. The new instrument may be described as a magnetically unstable magnetic circuit, in which small changes of magnetizing force, effected by the influence of received electric impulses, can produce a considerable change in magnetic flux. The permeability curve is artificially steepened in the iron subjected to the magnetizing influence of the received electric waves. Henry showed that electric wireless impulses, traversing small solenoids, were capable of magnetizing steel needles acting as cores, and the new apparatus described is a development of that principle. A special form of induction coil has its primary winding in circuit with the receiving vertical antenna. The secondary winding is in circuit with a telephone. The iron-wire core is subjected to slow cyclic variations of magnetic intensity, but rotating a permanent magnet in the neighborhood of one extremity. During the descent and ascent of the cycle HB curve of the hysteresis loop, and particularly during ascent, the iron is in a critical or unstable magnetic condition, such that a small magnetizing impulse in the primary winding, due to the electrically-received impulse, will develop a relatively large secondary induced current through the telephone.

In order to avoid the presence of insensitive intervals occurring cyclically at the points of the hysteresis loop, the plan has been adopted of making the core in the form of an endless band of iron wires threading through the induction coil, and moving this band steadily past fixed magnets, by clockwork, in such a manner as to bring the part of the band within the coil into the unstable magnetic condition. The iron core of the coil is thus constantly sensitive, and has its youthful sensitiveness perpetually renewed by clockwork. No decohering mechanism is needed, and the speed of operation between the Poldhu (Cornwall) and Poole (Isle of Wight) stations, using this apparatus, is described as being 30 words a minute. Curiously enough, Gramme essayed many years ago to develop a commercial form of continuous-current dynamos, consisting of fixed coils of insulated wire through which an endless band of iron was steadily moved by power. The band was subjected to magnetizing forces during its cyclic path in such a way that the hysteretically varying magnetic flux might constantly cut the coils. Only a feeble e. m. f. was, however, in this way obtainable.

It transpired in the course of the lecture that, from long-distance observations conducted on the Atlantic, signals which could be read at a distance of 2,000 miles from Poldhu at night, could only be read at 700 miles from Poldhu by day. The enormous difference of range was attributed to the influence of solar light upon the transmitting radiator, affecting its discharge. Here lies a field for investigation that should produce a rich harvest of interest.

A Method of Measuring Small Inductances.

A convenient method of measuring inductances, within a certain range, is described by Mr. W. M. Varley in a recent technical periodical. He employs the Braun tube, which deserves to be called the Braun galvanometer, owing to the number of galvanometric uses to which it is already applied. The Braun galvanometer has its exciting electromagnets in circuit with a Leyden jar, and with the coil whose inductance is to be measured. The Leyden jar is charged to constant e. m. f. by an induction coil excited from a constant-potential alternating-current circuit. The Leyden jar discharges at rapidly recurring intervals through the inductance coil, and the Braun galvanometer, producing on the fluorescent screen of the latter an observed deflection. Substituting a coil of known inductance for the coil of tested inductance, the discharging current deflections permit the tested inductance to be evaluated. The principal limitation to the use of the method lies in the constant inductance of the coils in the Braun galvanometer itself. The inductance to be measured must not bear too small a ratio to this constant inductance. Consequently, the lower the inductance of the Braun galvanometer, or the more sensitive it can be made, the smaller become the inductances which can be measured in this manner. From one millihenry to one henry is described as the effective range of the instrument.

Report of the Standardizing Committee of the American Institute of Electrical Engineers.

The report of this committee adopted by the Institute at the recent convention, embodies the work of the committee in extension and amendment of its previous report of 1899. Several important additions have made their appearance in the new report. One of these is the section relating to Luminous Sources. The Heffner lamp, under Reichsanstalt standard conditions, is advocated as the standard of reference, and rated at 0.88 British candle for the expression of horizontal intensities in the ordinary commercial unit. The flux of light emitted by a luminous source is duly defined in lumens. The efficiency of an incandescent lamp is defind in terms of its lumens per watt at terminals; while its consumption per horizontal candle-power is defined in watts per candle in accordance with existing usage. Following these recommendations, the watts per candle of an incandescent lamp may be retained under the correct title of consumption; while the efficiency of a lamp will call for a new rating, involving either a measurement of the total flux of light, or the spherical candle-power of the lamp.

The temperature coefficient of copper is also recommended as corresponding to a straight-line law of 0.42 per cent. per degree centigrade, based on copper at zero centigrade. The commercial rating of a railway motor is conventionally defined as the horse-power output, giving 75° C. temperature rise after one hour's continuous operation under standard conditions. But since such a rating is merely for the purposes of classification, the real capacity of railway motors is referred to their temperature elevation under carefully specified conditions, comprising load, speed, stops, acceleration, etc. An important section is devoted to insulation, which occupies nearly two pages. Only a few lines are given to ohmic insulation, the sole meaning usually attached to the term a few years ago. All the remainder refers to volt resistance or dielectric strength. Above 20 kilovolts, rated terminal voltage, the testing voltage is given as 50 per cent. in excess. Below 20 kilovolts the ratio of testing to rated voltage is more severe. Low-pressure apparatus generally is tested at 1,000 volts. The rating of fuses and circuit breakers is

made the normal working current which they can continuously carry, but the strength of current at which they open is also recommended for separate specification. Consequently a ten-ampere fuse would be a fuse which will steadily carry ten amperes. Such a fuse should, however, be rated as a ten-ampere fuse, melting at, say, fifteen amperes.

Standard circuit voltages up to 60 kilovolts now receive recognition for the first time. Standard voltages and frequencies for dynamos and motors are recommended as suitable for various classes of service, and the report will do good work if it aids in maintaining uniformity in the demand for these classes of apparatus. There can be no doubt that, within reasonable limits, the standardization of electric machines, and the selection of a standard size by an engineer, not only enables him to buy that size considerably cheaper than if he had a special size built; but also enables other purchasers to buy that size, or even other sizes, cheaper by the reduction in the cost of production thereby involved. In other words, when an engineer orders a special type of machine in contradistinction to a standard type, he not only has to pay more for that machine, by reason of the extra labor involved in its construction, but he also tends to raise the cost of all other sizes for other purchasers by raising the general average cost of production. It is for this reason in particular that the work of the Standardization Committee of the A. I. E. E. is so important to the industry.

THE NEW NIAGARA PLANT.

One of the most notable papers at the recent Institute meeting was Mr. Buck's most interesting description of the new Niagara power house and its equipment, one portion of which we reprint in this issue. In some very important respects it marks a great advance over the pioneer station, and it makes, too, a notable industrial success. To-day, after the lapse of nearly ten years, one can look back upon the initiation of the Niagara enterprise with something of judicial perspective and measure methods by results. In one very important particular the issue of the Niagara enterprise has justified the wise foresight of its projectors. It was the original purpose to build up at the great cataract an industrial city of the first order of importance, drawing to that spot by the invincible magnetism of cheap power the large power consuming industries. To this end the territory above the Falls was secured and the huge and enormously expensive tunnel was constructed. The erection of this new power house is the final answer to criticism directed at this policy. The fundamental plan called for an industrial city, and an industrial city has risen from the earth. The Niagara plant was not primarily intended to be, has not been, is not, perhaps never will be, fundamentally a transmission plant, but a mammoth central station for power distribution. Half a dozen plants for trivial capacity have done more to advance the art of electrical power transmission, but in its own field Niagara stands unique. The uprising of the city about it is due, of course, primarily to the power plant, but in scarcely less degree to the wonderfully favorable situation as a shipping point for general distribution over the country. We note this lest the unwise should imagine that great industries inevitably cluster around cheap power. We could mention numerous localities in which the enterprise would have been a complete and dismal failure, but the vicinity of Buffalo is almost the most advantageous point in the country in its freight facilities, which are fully as important to cheap manufacture as is cheap power. Even at Niagara it is to be remarked that most of the industries thus far developed are those requiring exceptionally large amounts of power for the area of the works.

In the equipment of the new power house there is general improvement in the apparatus and its arrangement, but in less degree [illegible] equipment to be subordinate to the hydraulic equipment. It forced the electrical designs into unusually close quarters, and the excellent [illegible] of the contractors. The faults of the plant are due to bad advice, happily tempered by good execution. It has alw[illegible] of wonder to us that it was necessary to go abr[illegible] designs, even to so eminent a firm as furnished them, and it is doubly strange that the same policy should be followed now. The new generators are to be of the same capacity, voltage, speed and electrical character as the old ones, and also of the same low frequency. The hydraulic efficiency, due to the use of draft tubes, is raised enough to allow an extra 5,000-hp unit. Here is an example of the timidity to which we refer, for the draft tubes were in use in every American saw mill when the first plant was installed, and their omission is small credit to the hydraulic engineering of that installation. The retention of the old voltage and frequency was, perhaps, wise in view of the local utilization of most of the power, and two-phase dynamos will do the work as well as any others; but larger units would have been preferable if the hydraulic contractors would have stood up to their end of the work, as perhaps they might have. Twenty-one generators for a plant of 100,000 hp is a large number, far larger than seems necessary on the face of the evidence, and larger than would be put in a steam plant of similar capacity at the present time.

A far more important change from the electrical point of view is the improvement in the inherent regulation of the great generators. A regulation of only 30 per cent. was not good, even when the first plant was started, and ought to have been bettered long ago. The reason assigned for the change is, in view of the early history of the plant, rather delectable. If memory serves us aright, the two-phase system was alleged to have been chosen for the initial plant by reason of its superior freedom from unbalancing, which was considered most important in view of the electric lighting which was to be done. In the same breath we were informed that the frequency was put at 25—a periodicity notoriously unsuitable for general electric lighting. It now transpires that the improvement in regulation is rendered necessary by so grave unbalancing as to cause trouble even in motor service. All of which makes it clear enough, as is now perfectly well understood, that any polyphase system is subject to trouble from an unbalanced load, and that bad regulation is an evil first, last and always. We have for years dinned into the ears of our readers this apparently obvious fact, and it is with a real feeling of satisfaction that we gloat over the improved design of the new station. Another original blunder which is at last to be put aside is the weird umbrella design of the first machines, since even at the start there were available governors quite good enough to render the extra flywheel effect needless, and there was not the slightest difficulty in then building internal-pole machines closely similar to those now planned. Of course, the art of design has improved in general, but we think that no electrical engineer worthy the name in 1893 would have adopted the umbrella design unless it had been forced on him by pressure from the hydraulic end of the line. If one is to have a stationary armature, it should be accessible, otherwise it might as well rotate. The final improvement in the new station, and one that has our heartiest approbation, is the introduction of a complete system of feeder protection, and of the latest type of switchboard, which will render the plant singularly safe and easy to operate, even as compared with the old one.

Stanley Transformer Patent Decision.

Judge Colt handed down an important opinion ,July 1, in the Circuit Court of the United States, District of Massachusetts, denying a motion for a preliminary injunction applied for under a recent decision affirming the validity of a certain transformer patent issued to William Stanley, Jr., March 1, 1892, on an application filed August 15, 1888. The decision referred to was rendered in a suit brought against the Saranac Lake Electric Light Company, and its effect was claimed to make the Stanley patent a controlling one in the transformer art.

The court in the Saranac Lake decision laid much stress upon a disclosure in the specifications of the Stanley patent of a method for determining the length of primary wire in a transformer. This disclosure, which in the litigation has been called the "Stanley Rule," is that the proper length of primary coil may be determined by connecting the transformer in circuit with the dynamo with which it is to be used, and then winding on wire until, with the secondary circuit open, the loss indicated by the formula $C^2 R$ equals a certain loss of energy. In the original case the court decided that this rule is "A part of the invention disclosed and claimed in the patent—indeed it would seem to be the main object of that invention—and with the patent thus construed the citations from the prior art show neither anticipation nor lack of invention. The whole argument of the defendants on that branch of the case is so interwoven with the postulate that the Stanley rule is to be eliminated from the patent, that when the postulate is not granted the argument becomes wholly unpersuasive."

Judge Colt, in his opinion, said that in the present case it becomes necessary to determine whether the court in its opinion imposed the limitation of the Stanley rule upon the claims of the patent then in litigation. The points made by the parties in the present case are summarized by the court substantially as follows:

The complainant maintains that the court imposed no such limitation upon the Stanley invention; that the court held that the invention was for a transformer, "which is automatically self-regulating as to a secondary pressure," and "not for a rule"; or for "a transformer having such a length of wire on its primary coils as would make it self-regulating"; or for "a transformer having in its primary coils substantially such a length of wire as was described in the specification, and which would effect the result sought, irrespective of the means or methods employed in arriving at the result"; or for a transformer which has "in its primary coils the proper length of wire to make it self-regulating"—all of which means that the Stanley patent was held to cover the transformer described, irrespective of the Stanley rule, by which the length of wire is obtained, although it was incumbent upon Stanley to point out one method by which the proper length of wire was determined. On the other hand, the contention of the defendant is that it is perfectly plain from the decision of the court that the Stanley rule is inherent in the Stanley invention, and that this limitation is imposed upon the claims.

As to the contention of the complainants, that since the Saranac transformer had been enjoined by the court in the Saranac case, it is the duty of the present court to enjoin the defendant unless it is shown that the transformer now in suit differs essentially from the Saranac transformer, Judge Colt decides that this position is not well taken, but that it is the duty of the complainant under its present bill charging infringement to show first, what the Stanley patent covers as defined by the court in the other case, and, second, to show that the transformer now manufactured by the defendant comes within the Stanley invention as exactly defined.

Concerning the contention of the complainants that the Saranac transformer did not embody the Stanley rule, and that consequently the transformer now alleged to infringe comes within the decision in the other case, Judge Colt holds that in view of the opinion of the court it must be presumed that the Saranac transformer contained the Stanley rule. Any other interpretation, he said, would lead to the following conclusions: "On the question of the validity, the Stanley patent is limited by the Stanley rule, while in the question of infringement there is no such limitation; in other words, a transformer may be outside of the monopoly secured by the patent and still infringe the patent." Judge Colt says there is nothing in the language of the opinion of the Circuit Court of Appeals or of the Circuit Court in the Saranac case which would justify him in holding that any such illogical and inconsistent conclusion was reached. After the Appellate Court in the other case had determined that the Stanley invention for the most part resided in the Stanley rule and that the "rule" must be incorporated into the claims; and after the court said on a petition for re-hearing that, "As to infringement" it "did not deem it necessary to add anything to the opinion below," it is manifest that the Appellate Court did not understand from the opinion of the lower court that the Stanley rule was eliminated from the Saranac transformer.

Judge Colt held that the Stanley "rule" is the main contribution made to the art, and that it constitutes the principal and most essential part of the invention covered by his patent. He disagreed with the complainant's counsel that the court in the former case found the Stanley invention to reside "in a certain length of primary winding," and their argument on this point he considered to be plainly in conflict with the invention as defined by the court. He could find in the opinion nothing to warrant the contention that it was Stanley's discovery of the proper length of wire in the primary which consituted his invention; or that the invention is for a transformer having a proper length of wire; or that the Stanley rule is no part of the invention claimed, but only one method of determining the length of the wire. On the contrary, the court expressly declared that the Stanley rule is the main part of the invention disclosed in the claim. The motion for a preliminary injunction was denied. The parties in the litigation were the Westinghouse Electric and Manufacturing Company and the Stanley Electric Manufacturing Company.

Meetings of Electrical Contractors.

As already noted in these columns, the National Electrical Contractors' Association of the United States will hold its annual meeting next week at the Hotel Walton, Philadelphia, Pa. The board of directors will meet at the hall of the Franklin Institute at 9 A. M., July 16. The first delegates' meeting will be called to order in the same hall at 1:30 P. M., on that date. In the afternoon a special boat will take the delegates and invited guests along the river front to Cramp's Shipyard and to League Island. A dinner for the delegates will be given at 7 P. M. On July 17th the delegates' meeting will be called to order at 2 P. M., on the Steel Pier, Atlantic City N. J. A special train will leave Philadelphia for Atlantic City at 9 A. M., of July 17. The entertainment committee will provide transportation to and from Atlantic City for the delegates. The convention will adjourn on the afternoon of July 17. Mr. Alex Henderson, master of transportation, announces a special train over the Jersey Central, from New York to Philadelphia, leaving on July 16th, at 9:30 A. M.

The semi-annual meeting of the Electrical Contractors' Association of New York will be held at Albany on July 15th, under the auspices of the Eastern New York Electrical Contractors' Association. The headquarters of the association will be at the Hotel Ten Eyck. The directors' meeting will be held at 9 o'clock A. M., July 15th, and will be immediately followed by the meeting of the delegates. At 12 o'clock a trolley ride will be taken to Schenectady and the works of the General Electric Company, and a lunch will be served at that place. At 8 P. M. the delegates will leave Albany by the steamboat "Adirondack," for the trip to New York.

Arrangements have been made to serve a banquet on the boat after leaving Albany. Mr. Charles L. Eidlitz, president of the National Association, will act as toastmaster. It is expected that the directors of the National Association will be among the guests at the State meeting.

A German Commission.

The Imperial German Post Office has just appointed a commission to go to the United States and study American postal, telegraphic and telephone systems. Special attention will be given to the tubular mail service. Germany at present is using only small tubes for individual letters, and contemplates introducing the American system of transmission in bulk by mail to and from the branches of the central post office. The commissioners are Post Councillors Wernecke, of Leipzig, and Braun, of Hamburg. They will be accompanied by a telegraphic engineer and another engineer of Berlin.

The Concord, N. H., Water Power Plant.

FROM the foot of the Franconia Mountains, down through the heart of New Hampshire, past the great Lake Winnipiseogee, the Merrimac River flows two hundred miles to the ocean. Between its sources, more than 2,000 feet above tidewater, and the Atlantic, this river drains an area of 4,553 square miles. At Lawrence, about twenty miles from the ocean, the average yearly discharge of water by this stream is about 6,464 cubic feet per second. Nearly half-way from mountains to seashore, along the course of the river and equidistant between the short coast line of New Hampshire and the Connecticut River, Concord, the capital city, is built on the high west bank of the Merrimac. Compared with Manchester, the industrial center of the State, some seventeen miles down stream, Concord is not a great manufacturing city. Its fame rests rather on its residential attractions, its institutions of learning, its fine public buildings, including the time-worn State House, and on its political importance as the point where legislative functions are exercised.

According to the Federal census of 1900, the population of Concord was only 19,632 persons. In spite of all these facts, tending to lines of development other than technical, the capital city is the site of one of the best examples to be found anywhere of electrical supply operated almost exclusively by transmitted water-power. In 1892 the load of electric lamps in Concord was transferred to a water-power station on the Merrimac by means of a three-phase transmission. This is believed to be one of the earliest, if not the first instance, in which the entire commercial service of a city electric system was derived from a three-phase water-power plant. Prior to the date just mentioned electrical supply in Concord had been carried on from a steam-driven station by the local gas company. About that time the interests of the gas company in the electric lighting system were transferred to the Concord Electric Company, the present owners. At Sewall's Falls, in the Merrimac River, about four miles from the State House in Concord, and nearly north, a stone and timber dam was built in 1892. This dam is about 500 feet long, and gives a fall of sixteen feet for the entire flow of the river. At the water-power thus provided the three-phase generating station of the Concord Electric Company was erected in the year last named. The minimum capacity of this water-power in dry seasons is estimated at 2,500 horse-power and there has always been sufficient water to operate the electric plant. Some trouble with anchor ice has made the use of steam necessary at times in early winter before the river was frozen over, but this has been of short duration.

In 1901 new water-wheels were installed at this electric station, and the three-phase generators of 1892 were replaced by others of later pattern. The new wheels comprise five pairs of horizontal turbines, each pair being 36 inches in diameter and rated at 300 horsepower when operating at 140 revolutions per minute under a head of fifteen feet of water. Each pair of wheels is regulated in speed by a Lombard governor. These wheels were furnished by the Stilwell-Bierce & Smith-Vaile Company.

A three-phase, 60-cycle alternating generator of the revolving magnet type, with capacity of 200 kilowatts at 2,600 volts, is belted to each of the five pairs of turbine wheels just mentioned. The combined capacity of these generators is thus 1,000 kilowatts. All five of these machines were made by the General Electric Company. Current for the magnet windings of the three-phase generators is supplied from one 30-kilowatt, 230-volt exciter, motor driven, and from two bipolar exciters of 15 kilowatts each, driven by belts from the main dynamos. One of the old three-phase generators, displaced by those just described, is now used as a motor of 150-horse-power capacity to drive two direct-current arc dynamos, with capacity of 75 lamps of 1,200 candle-power each at the water-power station. The switchboard at this station is built of wood on the skeleton pattern, and contains five panels for the main generator, one for the exciters, and four for feeders. There is also a board for the arc dynamos.

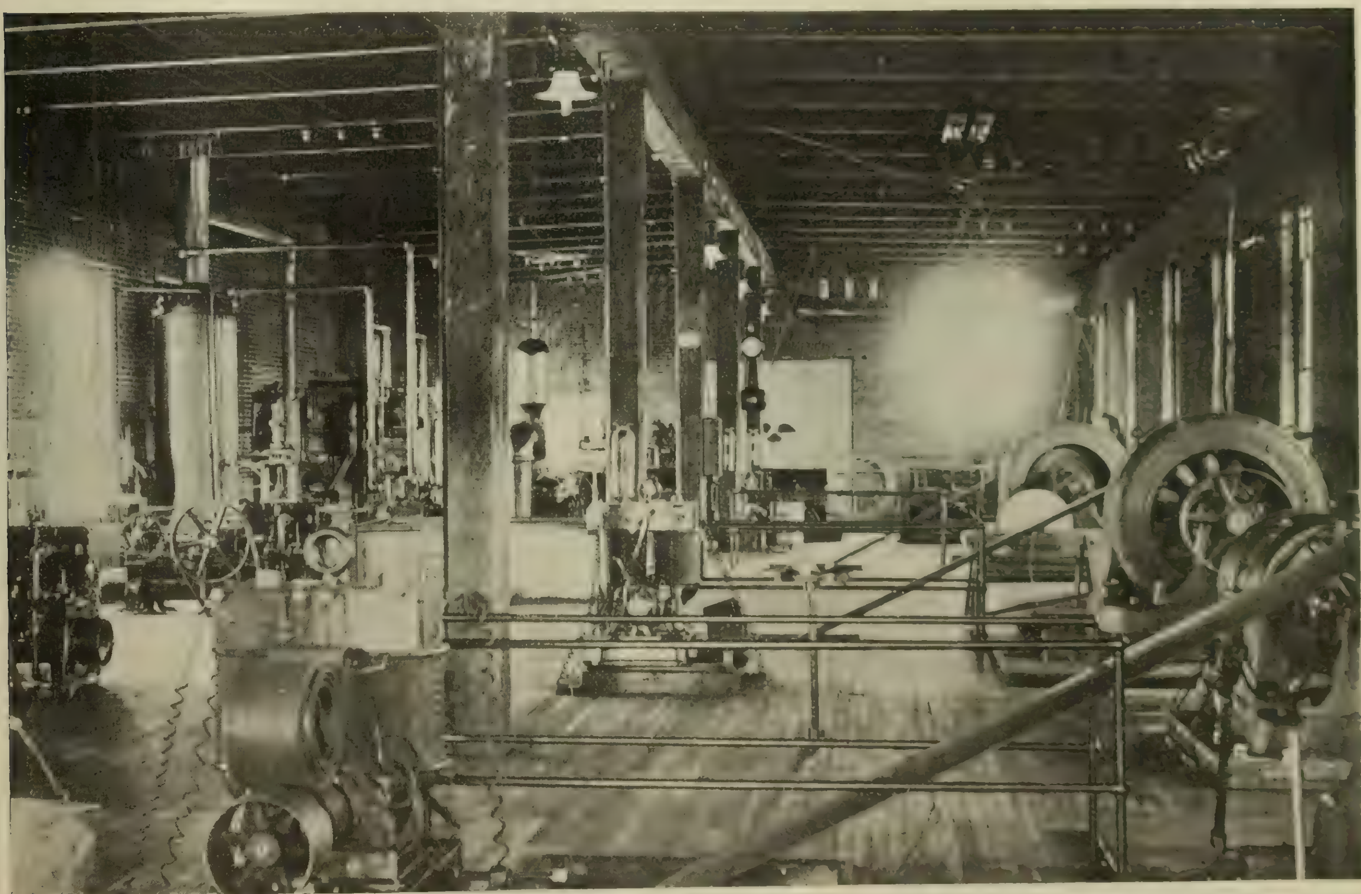


FIG. 1.—INTERIOR VIEW OF CONCORD WATER POWER PLANT.

The five main generators all deliver three-phase current at 60 cycles and 2,500 volts to the switchboard just mentioned. From this board energy goes directly to the motor that drives the two arc dynamos. Three No. 6 wires conduct energy at 2,500 volts from the board to West Concord, a village two miles distant. Three No 00 insulated wires pass from the water-power plant to the sub-station near the business center of Concord, over a pole line about 4.5 miles long, at the pressure of 2,500 volts. Another circuit of three No. 6 bare wires on this same pole line delivers energy at 10,000 volts in the sub-station. This energy is derived from three transformers of 100 kilowatts each that are located in the water-power plant and fed from the switchboard at 2,500 volts. The ratio of transformation

is thus four to one, and the transformers are of the air-blast type. At the sub-station the No. 6 wires just mentioned terminate in three transformers of 100 kilowatts each, that reduce the pressure from 10,000 to 2,500 volts for local distribution. Three transformers, of 150 kilowatts each, located at the main generating plant, take 2,500-volt current from the switchboard and deliver energy at 10,000 volts to three No. 6 bare wires that pass over the pole line previously mentioned and on to the shops of the Boston & Maine Railway, distant 5.5 miles from the water-power. At these shops the three No. 6 wires feed two transformers of 200 kilowatts capacity each, that change the energy from three-phase, 10,000 volts to two-phase at 440 volts. From the foregoing it may be seen that the combined capacity of the six 10,000-volt transformers at the water-power plant is 750 kilowatts, or three-fourths of the total capacity of the main generators there. All 10,000-volt transformers are cooled by air blast. Besides the three circuits already mentioned, two pairs of No. 6 wires from the arc dynamos and a set of No. 6 pressure wires pass from the main station to Concord over the pole line mentioned. These wires cross the Merrimac River by a span seven hundred feet long immediately on leaving the generating station.

The two arc circuits do not enter the sub-station, and are employed in the supply of arc street lamps about Concord. Energy delivered by the three No. 00 wires at a pressure of 2,500 volts in the sub-station is distributed from that point to the local city circuits at the same voltage. Energy derived from the three transformers of 100 kilowatts each at the sub-station is fed into the same circuits that receive current from the three 00 wires. After these 00 wires

FIG. 2.—EXTERIOR OF PLANT, SHOWING WATER GATES.

had been in use some time, the percentage of loss in them grew larger than was desirable; so the 100-kilowatt, 10,000-volt transformers, three at the water-power and three at the sub-station, were installed and connected by the circuit of No. 6 wires, in order to avoid the use of much heavier conductors.

Owing to the troubles with anchor ice at the water-power plant, a steam-power equipment was installed at the sub-station in 1898. The boiler at this sub-station is of the water-tube type, with three drums, rated at 600 horse-power, and was built by the Babcock & Wilcox Company. A Buckeye engine, cross-compound and rated at 500 horse-power on 200 revolutions per minute, is belted to a 450-kilowatt, three-phase, 60-cycle, 2,500-volt generator, made by the General Electric Company. This generator operates at a speed of 257 revolutions per minute, and has 28 poles. When this plant at the sub-station is in use, it delivers energy to the same distribution circuits that receive current from the water-power plant. A 10-kilowatt exciter, belt-driven, is employed with the generator at the sub-station.

All of the commercial electric service in Concord, except that at the Boston & Maine shops, is carried out with the three-phase, 60-cycle current from the sub-station. The 2,500-volt circuits extend generally over the city, and in the business center a closed loop of about one mile total length is run, to avoid the frequent use of small transformers. This loop is composed of three primary and three secondary wires, the latter having a pressure difference between them of 110 volts. From this secondary loop service wires are carried directly into the premises of consumers. Between the primary and secondary wires of this loop transformers are connected at moderate intervals to keep the necessary size of the secondary wires within limits. Twelve banks of transformers are thus connected to the service loop, and have a combined capacity of 262 kilowatts.

The transformers used in the distribution of commercial service are as follows:

Number.	Watt capacity each.	Number.	Watt capacity each.
9	600	7	4,500
2	900	7	5,000
6	1,000	3	6,000
4	1,500	42	7,500
40	2,500	1	10,000
4	4,000	15	15,000
		3	18,000

The total of these numbers is 143 transformers, with a combined capacity of 823.7 kilowatts. In this list the small percentage of total capacity represented in the smaller sizes of transformers is especially notable, and should contribute to high efficiency of operation. No doubt the large average capacity of transformers is due in part to the use of the service loop above mentioned. Adding the 400 kilowatts of transformer capacity at the Boston and Maine shops to the 823.7 kilowatts just found for other service transformers gives a total of 1223.7 kilowatts, or 22 per cent. more than the combined capacity of the main generators at the water-power plant. Of course, there never comes a time when all of these transformers are working at full capacity, especially as those at the Boston and Maine shops supply energy mostly to motors that operate during the hours of daylight.

Most of the commercial service from the Concord electric system is supplied through Thomson recording wattmeters, of which the following numbers and sizes are in use, all on 110-volt circuits:

Ampere Capacity.	*Number.*	*Ampere Capacity.*	*Number.*
5	111	75	3
10	100	100	13
15	76	150	6
25	63	200	1
50	29	300	1
60	2		

The total number of these 110-volt meters is 408, and there are in addition two recording meters at the Boston and Maine shops, each meter having a capacity of 500 amperes at 450 volts.

All clases of commercial service, arc lamps, incandescent lamps and motors are from the same set of distributing lines in the Concord system. Commercial arc lamps are all of the enclosed type, taking about 6.5 amperes, and are connected singly to the 110-volt lines. At present 150 of these lamps are in use. About 10,000 incandescent lamps, mostly of 16 candle-power, are connected to the system. Street arcs to the number of 129 of 1,200 candle-power each are in use for public lighting in Concord. These arc street lamps are operated directly from the water-power plant by the two arc dynamos there located. It is the intention during the present year to substitute enclosed arcs taking 6.5 amperes at 80 volts for the open type of street lamps now in use.

Though Concord is not pre-eminently a city of manufactures, the motor business of the electrical supply system is exceptionally large, compared with that in other lines. The total capacity of motors now connected to the company's lines is 1,144 horse-power. All of these motors are of the induction type, and all save those at the Boston and Maine shops are three-phase at 110 volts. The numbers and capacities of these three-phase, 110-volt motors are as follows:

Horse power.	*Number.*	*Horse power.*	*Number.*
½	9	10	9
1	16	15	11
2	13	20	2
3	10	25	1
5	18	30	2
7½	1		

The motors last named number 91, and their aggregate capacity amounts to 554 horse-power, giving an average of more than 6 horse-power per motor, which is unusually large for motors in general commercial service. At the Boston and Maine shops, where the two transformers of 200 kilowatts each change three-phase energy at 10,000 volts to two-phase energy at 440 volts, only two-phase motors are in use. The numbers and capacities of these motors are as follows:

Horse power.	*Number.*	*Horse power.*	*Number.*
10	1	25	2
15	6	30	6
20	3	40	2
		100	1

These 21 motors have a combined capacity of 590 horse-power, which, added to that of motors on general commercial circuits, gives the total of 1,144 horse-power. Allowing an average efficiency of 74.6 per cent. for all of these motors in actual use, their combined

capacity at full load to draw energy from the lines is 1,144 kilowatts. At 56 watts per lamp, the 10,000 connected incandescent lamps represent a capacity for consumption of 560 kilowatts. The 129 open arcs on direct-current lines, rated at 1,200 candle-power each, require in operation 38.7 kilowatts, on the basis of 300 watts each, and the 150 enclosed arcs, each taking 6.5 amperes at 110 volts, absorb 107.25 kilowatts. The energy rate for all connected lamps is thus 706 kilowatts, and for lamps and motors combined, 1,850 kilowatts. Of this total, the capacity of connected motors amounts to the exceptionally large percentage of 61. The capacity of the connected load exceeds that of the main generators at the water-power plant by 85 per cent.

Records of the station meters show that the week-day output of the Concord system averages about 6,800 kilowatt-hours. This corresponds to an average load of 283 kilowatts during the 24 hours of each day. If the maximum load is three times the average, it amounts to 85 per cent. of the main generator capacity at the water-power.

During 1901 it was necessary to operate the steam plant at the sub-station to a larger extent than common, because of changes in water-wheels and dynamos at the main station. In spite of this fact, the record of the fiscal year ending June 30, 1901, presents the advantages of water-power as a saver of fuel in a strong light. During the year just named about 500 tons of coal were consumed at the sub-station.

FIG. 3.—DAM AT SEWALL'S FALLS.

Considering only the working days of the year as 310, the coal consumption was 1.61 tons per day on an average. At the moderate rate of six pounds of coal burned per kilowatt-hour of output at the station, the 6,800 kilowatt-hours of daily output would require 20.4 short tons. From these results it appears that the consumption of fuel during the year in question was less than 8 per cent. of what it would have been with a fairly efficient steam station giving the entire output. The difference between this computed daily consumption of coal and that actually burned is 18.8 tons. Good steam coal is worth about $5 per ton in Concord, so that the use of water-power saves approximately $94 per day in the cost of fuel.

The engine at the sub-station is now operated non-condensing because of the cost of water, but it is proposed to move the steam plant to the water-power station at an early date, where condensing water can be had free, and the cost of labor for operation reduced.

The marked success of the Concord Electric Company seems to be due in no small measure to its use of water-power. This view is certainly borne out by the fact that the electric system supplies motors of almost 600 horse-power capacity in the shops of the railway that brings all of the coal used in the city. Further illustration of the advantages of water-power is found in the successful competition of the electric system with the local gas company. The nominal price of gas in Concord is $1.50 per 1,000 cubic feet, but it is believed that large consumers get materially lower rates. This gas is reputed to be of good quality, and the price named is certainly moderate for an inland city as small as Concord. The gas company does not court comparison with the electric system, as its officials declined to give any facts as to their output for use in this article. The success of the Concord electric system seems to be due in large measure to the efforts of its efficient superintendent, Mr. George B. Lauder, to whom thanks for these facts are due.

Safety in Elevators.

By [illegible]

Once in a while we still hear about accidents in elevator service. The exact cause is seldom told, and we are simply informed that "the car was equipped with every known safety device—a rigid investigation as to the cause will be made." The frequency of the accidents would seem to indicate that there is something wrong with some safety device, or that some one may be lacking.

In my humble opinion there is in high-speed electric elevators at least one safety device still lacking, and I have reason to believe that this was the direct cause of an accident not very long ago. The safety device which I refer to, is one which should prevent the elevator from attaining excessive speed on "run away" when the motor happens to be driven as generator by the load.

If the motor were a pure shunt motor with no resistance in its armature circuit, this danger would not exist, since its speed, and thus the speed of the car, could not be raised beyond a certain limit. For good reasons, however, the motor of a high-speed elevator is not of such a kind. It is generally a compound-wound motor, and when driven as generator by the load, it will turn into a differentially-wound dynamo with constant torque. Such an arrangement has no fixed speed limit, and cannot exert any checking action on the car, which thus will increase its speed.

The proper remedy to apply for this excessive speed is evidently to remove the cause and change the differentially-wound dynamo to a shunt-wound one; that is, to short-circuit the series winding. This can be done by an apparatus, the action of which depends on the speed of the counter e.m.f. of the motor, so that the desired short-circuit is established when the said e.m.f. exceeds the line voltage by a small amount, and is again removed when the e.m.f. drops below the line voltage. No sparking at contacts would occur in such an apparatus, since it would operate just when the current changed direction, and its strength was almost nil.

As far as I can recollect, there has never in your columns been mentioned any apparatus for such purpose, and I therefore conclude that it has not been applied to elevator service. I believe, however, it has been suggested to establish the short circuit by means of a magnet adjusted so as to operate when the counter e.m.f. of the motor reaches a certain value, in a manner similar to the magnets now used for automatically operating the starting resistance. This, however, would not accomplish the desired result, because the line voltage is not constant, and if the magnet were adjusted to the normal voltage it would act too soon if the line voltage were higher, and it would not act at all, if the line voltage were lower than the normal.

The chances of running away on account of the motor being driven as a differentially-wound dynamo, are greater with elevators operated at high speed than at low speed; and with an over-balanced car, the excessive speed is liable to occur when the car is travelling in either direction—up or down. The question of safety in elevators is indeed one that concerns most all of us, and it would no doubt interest many readers of your paper if those informed on the subject would point out what means are now provided in electric elevators to guard against the danger above referred to.

Important Power Transmission Around Grand Rapids.

Along with the consolidation of all the electric light and power work of Grand Rapids, Mich., under the control of one company, the Grand Rapids Edison Company, some interesting developments in the way of long-distance transmission into Grand Rapids from water power on the Muskegon River are promised. The Newaygo Water Power Company has water rights on the Muskegon River, above the town of Newaygo several miles, and it is proposed to put in a plant with a capacity of about 7,000 hp to generate current for transmission to Grand Rapids and for use on the Grand Rapids Edison Company's system. Plans for a substation in Grand Rapids are being drawn up, which will put a storage battery plant in the basement and rotary converters on the first floor of a building adjoining the present steam plant of the company, on the east side of the Grand River, not far from the center of the business district. The transmission line from the plant on the Muskegon River will be about 36 miles long, and the transmission voltage in the light of present practice is not likely to be less than 40,000 volts. A storage battery of 1,000 ampere-hour capacity, at a 1-hour rate, will soon be put on the three-wire, direct-current network in Grand Rapids.

Electrode Terminology.

By Albert M. Lewers.

It would be interesting to know upon what grounds the common use of the terms "positive" and "negative," as applied to the electrodes or active materials of secondary batteries, is based. Almost without exception American writers designate the peroxide electrode as the "positive" and the spongy lead electrode as the "negative." Theoretically considered, this appears to be an improper designation of the electrodes, and especially of the active materials when considered by themselves, since peroxide of lead is electro-negative to spongy lead. The only reason I have ever seen stated as to why the peroxide electrode should be called positive and the lead negative, is given in the introduction to "The Storage Battery," Treadwell, wherein he quotes the London *Electrician* as stating that "the positive plate of a secondary battery is properly so-called, because it is *plum colored* and peroxidized, while the negative plate is of a neutral color and non-oxidized." The force of this reasoning is difficult to appreciate.

The confusion that has arisen in the terminology of the electrodes of secondary batteries is recognized by most writers, but they usually adopt what seems to be an incorrect nomenclature, giving as their sole reason that it is the one usually employed. For instance, Prof. Marsh, in his recent excellent article on "The Possibilities for a Light Weight Storage Battery," (Electrical World and Engineer, June 7, 1902), refers to the confusion that has arisen in the use of the terms "negative" and "positive," and then proceeds to apply the term "positive" to the more electro-negative materials. A manufacturer of storage batteries may be justified in designating the peroxide plate as the "positive," as its terminal or pole is positive and is so marked. In order to avoid confusing the users of the batteries, who, perhaps, may not know that the positive terminal is on the negative electrode, and *vice versa*, and who are concerned only with the external circuit, the makers of batteries designate the electrodes by the signs of their terminals. This may be all right from a commercial standpoint, but affords no good reason for the same loose use of the terms in the theoretical consideration of secondary batteries.

Faraday, the originator of the term "electrode," defines the electrodes as follows: "The anode is that surface at which the electric current, according to our present expression, enters; it is the negative extremity of the decomposing body; it is where oxygen, chlorine, acids, etc., are evolved, and it is against or opposite the positive electrode. The cathode is that surface at which the current leaves the decomposing body, and is its positive extremity; the combustible bodies, metals, alkalies and bases are evolved there, and it is in contact with the negative electrode (Experimental Researches in Electricity." Faraday. Vol. I. Art. 663).

Following this definition, the electrode at which the current leaves the electrolyte and the one at which metals or bases appear, at which reduction takes place, is the *negative* electrode. In those batteries having oxide depolarizing material, such as the oxides of lead, nickel, silver, copper, etc., the current leaves the electrolyte at the electrode carrying the oxide, which is reduced during the action of the battery, and this electrode, according to Faraday, is the negative and not the positive.

In considering primary batteries, the soluble or oxidizable electrode, for instance, zinc, is commonly referred to as the positive and the other electrode, for instance copper, is called the negative. Why then, when considering secondary batteries, which are but reversible primaries, are the terms used in the opposite sense? In a primary battery having one electrode of copper oxide and the other of zinc, the copper oxide, is called the negative and the zinc the positive electrode; but if the battery is a secondary and has one electrode of lead peroxide and the other of lead, or it may be of zinc, then for some unknown reason the lead peroxide is to be called "positive," and the lead or zinc "negative," though the direction of internal current flow is towards the oxide in each case. It does not seem consistent to call an electrode made of chemically formed peroxide of lead "negative" when used as the depolarizer of a primary cell, and to call an electrode of the same material "positive" when used in a secondary cell. If it is negative in one case, it is in the other. The fact that the peroxide of this secondary cell is formed by passing a current to an anode of a lower oxide or of metallic lead, and that it is capable of regeneration by "charging," should have no bearing upon its sign. It does not seem proper to consider the cell from the standpoint of charging in determining the signs of the electrodes, since during charging it is hardly a battery, as it is not generating energy, but rather is an ordinary electrolytic cell, and the electrodes may be termed anode and cathode, definite terms, in the use of which there is fortunately no confusion.

The confusion in the use of "positive" and "negative" has undoubtedly arisen from the fact that the polarity of the terminal or pole of an electrode is the opposite of that of the electrode itself. Or stated differently, the electrodes when considered from the standpoint of the external circuit have inverse signs from what they have when considered with respect to the internal circuit. As it is usual to take into account only the internal circuit in the theoretical consideration of other forms of electrolytic cells, no reason is apparent why the external circuit instead of the internal circuit should determine the polarity in considering secondary batteries.

As there is apparently some objection to designating the polarity with respect to the internal circuit, especially when viewed from the manufacturer's or user's standpoint, the terms *positive-pole electrode* and *negative-pole electrode* might be used to indicate the peroxide and spongy lead electrodes, respectively, the word "pole" meaning terminal. This terminology, while somewhat cumbersome, is correct, whether referring to the electrodes during charging or during discharging, or with respect to the internal or the external circuit, and is definite and accurate from a commercial standpoint, as well as from that of the electro-chemist. Some writers have adopted the terms "peroxide plate" and "spongy lead plate," notably Fitzgerald in "The Lead Storage Battery," referring to the usual nomenclature as an absurdity; and also Schoop in "Electrische Accumulatoren." These terms, while having the merit of being definite and accurate, are applicable to lead-peroxide of lead batteries only. The terms *positive-pole* and *negative-pole* are of general applicability to all forms of secondary or primary cells, and are the terms now in use in the U. S. Patent Office, besides being in common use in Germany.

But whatever terms may eventually be selected, it is without question very desirable that some definite and accurate system of designating the electrodes of secondary batteries be adopted and an end put to the present annoying confusion in the use of "positive" and "negative."

The Hertzian Theory.

By S. M. Kintner.

The article by Mr. Edward P. Thompson on "Long-Distance Wireless Telegraphy and Hertzian Waves," published in the Electrical World and Engineer, of June 14th, was exceedingly timely. It seems to me that it is time the Hertzian wave idea, as far as the rectilinear propagation is concerned, was abandoned. In a note to this journal about a year ago I called attention to this very point and suggested the theory, proposed by several others previously, of sliding waves over the earth's surface as the best explanation of the transmission of these ether disturbances over great distances. It may be of interest to some to set forth a few of the points tending to show the strength of this theory.

This can best be done by comparing the three theories most commonly advanced, i. e., "Hertzian Waves Rectilinear Propagation," "Sliding Waves over Conducting Surfaces," and "Oscillatory Currents Transmitted Through the Earth as a Conductor," in connection with some of the known facts of wireless telegraphic communication.

For long-distance work all three theories will do fairly well, if allowance is made for the possible reflection of the rectilinear propagation from conducting media above the surface of the earth, such as clouds and rarified air; but if obstacles such as a city intervene and the stations are moved nearer together, it is well known that signals are sent and received only with great difficulty. It seems to me this failure is best explained by the slding wave theory, as the other two should work as well, or nearly as well, under these conditions, as signaling over land with no obstructions like cities or forests intervening. The reflections should be as strong in one case as the other, and while direct radiations would bo cut off by the obstacles, so it would be for long-distance work, due to curvature of the earth, and yet more trouble is experienced with cross-city signaling than with the long-distance work over water. The "Oscillatory Currents" would depend upon conductivity, inductivity and capacity, and the intervention of a city would, it seems to me, change

that but very little, and so good results should be gotten in city work according to that view. The sliding waves moving along and above the surface of the earth as concentric circles from the disturbing center, would come in direct contact with the city buildings, lightning rods and all vertical conductors, and thus be robbed of their energy and these obstructions would cast what might be called electromagnetic shadows. Any apparatus intended to detect the presence of any sliding waves, as in wireless telegraphy, located in this shadow would be more or less completely screened and consequently would fail to respond.

If experiment should show that a tall wire is not necessary and that a wire but a few inches in height, having the same electrical properties as a tall one, works equally well, then one could drop all the theories other than the oscillatory current. As I know of no such experiment on a large scale, having been performed successfully, I am still inclined to stick to the "sliding wave" idea.

Marconi on Wireless Telegraphy—II.

(*Concluded.*)

THE subject was then taken up of the detector of the electric waves. In all wireless telegraph apparatus used up to quite a recent date, a detector, now called a coherer, has been employed. This detector is based on discoveries and observations made by S. A. Varley, Prof. Hughes, Colzecchi, Onesti, and especially Prof. Branly. Prof. O. J. Lodge has made large use of this apparatus, which he first named "coherer," in the very numerous experiments and studies he has carried out on the effects produced by Hertzian waves.

The form of coherer found most trustworthy and reliable for long-distance work consists of a small glass tube about four centimetres long, into which two metal poles pieces are tightly fitted. They are separated from each other by a small gap which is partly filled with a mixture of nickel and silver filings. Provided such a coherer is properly constructed, and the tapper and relay in good adjustment, it proves to be quite reliable when within the range of the transmitting station.

Experiments with syntonic systems have, however, shown that certain kinds of coherers can be far more advantageously employed than others. One apparently all-important condition is that the resistance of the coherer in its sensitive state or after being tapped should appear to be infinite when measured with an e. m. f. of about 1 volt.

If the tapping does not entirely do away with the conductivity of the filings very poor results are obtained, which can be explained as follows: According to the systems above described, electrical syntony between the transmitter and receiver is dependent on the proper electrical resonance of the various circuits of the transformers used in the receivers. The condenser and secondary of the transformer must not be partially short-circuited by the coherer, otherwise the oscillations cannot mount up or sum up their effect, as is essential in order to produce the difference of potential at the ends of the coherer necessary for breaking down its resistance, but the eelctrical oscillations will leak across the conductive coherer without causing it to record any signal. Of course, the condenser is short-circuited when the filings cohere under the influence of the received oscillations, but in this case the signal is already recorded and the tapper at once restores the coherer to its non-conducting condition, and in this way restores its sensitiveness.

By using coherers containing very fine filings, the necessary condition of non-conductivity when in a sensitive state is obtained. Coherers have lately been tried which will work to a certain extent satisfactorily without the necessity of employing any tapper or decoherer in connection with them. Nearly all are dependent on the use of a carbon microphonic contact or contacts, which possess the curious quality of partially reacquiring spontaneously their high resistance condition after the effect of the electrical oscillations has ceased. This enables one to obtain a far greater speed of reception than is possible by means of a mechanically tapped coherer, the inertia of the relay and tapper, which are used in connection with it, being necessarily sluggish in their action.

In all these self-decohering coherers a telephone which is affected by the variations of the electric current, caused by the changes in conductivity of the coherer is used in place of the recording instrument. It has not yet been found possible to actuate a recording instrument or a relay by means of a self-restoring coherer.

The late Prof. Hughes was the first to experiment with and receive signals on one of these coherers associated with a telephone. His experiments were carried out as early as 1879, and Mr. Marconi expressed regret that this pioneer work of his is not more generally known.

Other self-restoring coherers were proposed by Profs. Tommasina, Popoff and others, but one which has given good results when syntonic effects were not aimed at was designed by the technical personnel of the Italian Navy. Mr. Marconi stated that this coherer, at the request of the Italian government, he tested during numerous experiments. It consists of a glass tube containing plugs of carbon or iron with between them a globule of mercury. Mr. Marconi added that Lieutenant Solari, who brought him this coherer, asked him to call it the "Italian Navy Coherer." Recently, however, a technical paper gave out that a signalman in the Italian navy was the inventor of the improved coherer, and Mr. Marconi says he was at once accused in certain quarters of suppressing the alleged inventor's name. He, therefore, wrote to the Italian Minister of Marine, Admiral Morin, asking him to make an authoritative statement, to which he could refer in the course of this address, of the views of the Italian admiralty on the matter. The head of the Italian navy was good enough to reply by a letter, dated the 4th inst., in which he makes the following statement, translated from the original Italian:

"The coherer has been with good reason baptized with the name of "Italian Navy Coherer," as it must be considered fruit of the work of various individuals in the Royal Navy, and not that of one."

These non-tapped coherers have not been found to be sufficiently reliable for regular or commercial work. They have a way of cohering permanently when subjected to the action of strong electrical waves or atmospheric electrical disturbances, and have also an unpleasant tendency towards suspending action in the middle of a message. The fact that their electrical resistance is low and always varying, when in a sensitive state, causes them to be unsatisfactory, for the reasons already enumerated, when worked in connection with the Marconi system of syntonic wireless telegraphy.

These coherers are, however, useful if employed for temporary tests, in which the complete accuracy of messages is not all-important, and when the attainment of syntonic effects is not aimed at. They are especially useful when using receiving vertical wires supported by kites or balloons, the variations of the height of the wires (and, therefore, of their capacity) caused by the wind making it extremely difficult to obtain good results on a syntonic receiver.

Coherers have long been considered as constituting almost the essential basis of electric space telegraphy, and although many other detectors of electric waves existed, none of them possessed a sensitiveness which even approached that of a coherer, and most of them were also unsuitable for the reception of telegraphic messages.

With a view to producing a receiver which could be worked at a much higher speed than a coherer, Mr. Marconi said he was fortunate enough to succeed in constructing a magnetic detector of electric waves, based on a principle essentially different from that of the coherer and which he thinks leaves all coherers far behind in speed, facility of adjustment and efficiency when worked in tuned circuits. This detector, which has just been described in detail before the Royal Society, possesses a sensitiveness which surpasses that of the best coherer.

The magnetization and demagnetization of steel needles by the effect of electrical oscillations has long been known, and was noted especially by Prof. T. Henry, Aloria, Lord Rayleigh and others. Mr. E. Rutherford also has described a magnetic detector of electric waves, based on the partial demagnetization of a small core composed of fine steel needles previously magnetized to saturation. By means of a magnetometer, Mr. Rutherford succeeded, in 1895, in tracing the effects of his electrical radiator up to a distance of three-quarters of a mile across Cambridge.

But Mr. Rutherford's arrangement is not suitable for the reception of telegraphic messages, in consequence of the fact that a careful process of remagnetization, which requires some time to effect, is necessary in order to restore its sensitiveness after the receipt of each impulse. Mr. Rutherford's arrangement is also considerably less sensitive than a coherer.

The detector about to be described is based upon the decrease of magnetic hysterisis, which takes place in iron when under certain conditions it is exposed to the effects of high-frequency oscillations or Hertzian waves. On a core of thin iron or steel, but preferably hard-drawn iron, are wound one or two layers of thin insulated

copper wire. Over this winding, insulating material is placed, and over this again another longer winding of thin copper wire contained in a narrow bobbin. The ends of the winding nearest the iron core are connected, one to earth and the other to an elevated conductor, or they may be connected to the secondary of a suitable receiving transformer or intensifying coil, such as are employed for syntonic wireless telegraphy. The ends of the other winding are connected to the terminals of a telephone or other suitable receiving instrument. Near the ends of the core or in close proximity to it is placed a horse-shoe magnet, which by a clock-work arrangement is so moved or revolved as to cause a slow and constant change or successive reversals in the magnetization of the piece of iron. It has been noticed that if electrical oscillations of suitable period be sent from a transmitter, rapid changes are effected in the magnetization of the iron wires, and these changes necessarily cause induced currents in the windings, which in their turn reproduce on the telephone with great clearness and distinctness the telegraphic signals which may be sent from the transmitting station. Should the magnet be removed or its movement stopped the receiver ceases to be perceptibly affected by the electric waves even when these are generated at very short distances from the radiator.

It has been noticed that the signals audible in the telephone are weakest when the poles of the rotating magnet have just passed the core and are increasing their distance from it, whilst they are strongest when the magnet's poles are approaching the core.

Good results have also been obtained by keeping the magnet fixed and using an endless iron rope or core of thin wires revolving on pulleys (worked by clockwork), which cause the iron to travel through the copper wire windings, in proximity to preferably two horse-shoe magnets, with their poles close to the windings, care being taken that their poles of the same sign are adjacent.

This detector has been successfully employed for some time in the reception of wireless telegraphic messages between St. Catherine's Point, Isle of Wight, and the North Haven, Poole, over a distance of 30 miles; also between Poldhu, in Cornwall, and Poole, in Dorset, over a distance of 152 miles, of which 109 are over sea and 43 over high land.

It would, no doubt, be possible to obtain signals by causing the iron core to act directly on a telephone diaphragm, and in this case the secondary winding could be omitted.

This detector appears to be more sensitive and reliable than a coherer, nor does it require any of the adjustments or precautions which are necessary for the good working of the latter. It possesses a uniform and constant resistance, and as it will work with a much lower e. m. f., the secondaries of the tuning transformers can be made to possess much less inductance, their period of oscillation being regulated by a condenser in circuit with them, which condenser may be much larger (in consequence of the smaller inductance of the circuit) than those used for the same period of oscillation in a coherer circuit, with the result that the receiving circuits can be tuned much more accurately to a particular radiator of fairly persistent electric waves.

As a cell, a coherer in circuit with a relay working a bell can always be used, and if it is found possible to make the magnetic detector record on a registering instrument (as to the possibility of which the results of recent tests have left little doubt), it may be found possible to receive wireless telegraph messages at a speed of several hundred words a minute. At present, by means of this detector, it is possible to read about 30 words per minute. Mr. Marconi gave the following considerations as those which led him to the construction of the above-described detector:

It is a well know fact that after any change has taken place in the magnetic force, acting on a piece of iron, some time elapses before the corresponding change in the magnetic state of the iron is complete. If the applied magnetic force be caused to effect a cyclic variation, the corresponding induced magnetic variation in the iron will lag behind the changes in the applied force. To this tendency to lag behind Professor Ewing has given the name of magnetic hysteresis.

It has been shown also by Profs. Gerosa, Finzi and others that the effect of alternating-currents or high-frequency electrical oscillations acting upon iron is to reduce considerably the effects of magnetic hysterisis, causing the metal to respond readily to any influence which may tend to alter its magnetic condition.

The effect of electrical oscillations probably is to bring about a momentary release of the molecules of iron from the constraint in which they are ordinarily held, diminishing their retentiveness, and consequently decreasing the lag in the magnetic variation taking place in the iron. Mr. Marconi, therefore, anticipated that the group of electrical waves emitted by each spark of a Hertzian radiator would, if caused to act upon a piece of iron which is being subjected at the same time to a slowly varying magnetic force, produce sudden variations in its magnetic hysterisis, which would cause others of a sudden or jerky nature in its magnetic condition. In other words, the magnetization of the iron instead of slowly following the variations of the magnetic force applied gives a sort of jump each time it is affected by the electric waves emitted by each spark of the radiator.

These jerks in the magnetic condition of the iron, it was thought, would cause induced currents in a coil of wire, of strength sufficient to allow the signals transmitted to be detected intelligibly on a telephone, or, perhaps, even read on a mirror galvanometer. The results obtained go to confirm that this detector can be advantageously substituted for the coherer for the purpose of long-distance space telegraphy.

Mr. Marconi then proceeded to sketch the recent developments in the practical applications of his system, which have been exceedingly rapid. The Lloyds have adopted the system exclusively for use at their stations at home and abroad for a period of 14 years, and no less than 17 liners plying across the Atlantic carry permanent installations. In more than one case recorded in the daily papers, the system has been of service to vessels in distress, especially in the English Channel.

No less than 40 land stations (most of which are controlled by the Corporation of Lloyds) are being equipped with the system in Great Britain and Europe, and over 40 vessels in H. M. Navy carry installations. The adoption of the system in the Royal Navy has brought about a certain slight change of appearance in the rig of the ships. Some naval officers believe that this change improves the ships' appearance, others think the contrary.

The Italian Admiralty, after experimenting for some time with the self-decohering coherers referred to above, informed Mr. Marconi officially by a letter dated the 24th of May last, of its decision to equip their war vessels with the same apparatus as has been successfully employed on the transatlantic liners. On these liners, commercial use is made of the system for the convenience of passengers, and as an illustration of its commercial workableness, it was mentioned that lately the "Campania" and "Lucania," of the Cunard Line, have been collecting as much as $300 each trip in receipts derived from passengers' wireless messages.

Nearly two years ago the facility with which communication was possible over distances of nearly 200 miles, and the improvements in syntonic methods introduced, together with the ascertained fact of the non-interference of the curvature of the earth, led Mr. Marconi to decide to recommend the construction of a large power station in Cornwall, and another one at Cape Cod, Mass., U. S. A., in order to test whether by the employment of much greater power it might not be possible to transmit messages across the Atlantic, and establish a transoceanic commercial communication, which the monopoly of the Postmaster General will not apparently permit between two stations if both are situated in Great Britain.

An unfortunate accident to the masts at Cape Cod seemed likely to postpone the experiments for several months, when the conclusion was arrived at that whilst the necessary repairs there were being carried out, a purely temporary installation in Newfoundland should be used for the purpose of a transatlantic experiment, from which, at any rate, it might be judged how far the arrangements in Cornwall had been conducted on right lines. Before describing the results Mr. Marconi gave a brief description of the nature of the apparatus used at the transmitting and receiving stations.

The transmitter at Poldhu was similar in principle to the syntonic one above described, but the elevated conductor at the transmitting station was much larger, and the potential to which it was charged very much in excess of any that had previously been employed, the amount of energy to be used in this transmitting station having been approximately determined prior to its erection.

The transmitting elevated conductor consisted of 50 almost vertical naked copper wires, suspended at the top by a horizontal wire stretched between two poles, each 48 meters high, and placed 60 meters apart. These wires were separated from each other by a space of about one meter at the top, and, after converging together, were all connected to the transmitting instruments at the bottom.

The potential to which these conductors were charged during transmission was sufficient to cause sparking between the top of the said wires and an earthed conductor across a space of 30 centimeters of air.

The general engineering arrangements of the electric power station, erected at Poldhu for the execution of these plans and for creating the electric waves of the desired frequency, were made by Dr. J. A. Fleming, F. R. S., who also devised many of the details of the appliances for producing and controlling the electric oscillations. These, together with devices introduced by Marconi, and his special system of syntonization of inductive circuits, have provided an electric wave generating plant more powerful than any hitherto constructed. Mr. R. N. Vyvyan and Mr. W. S. Entwistle have also greatly assisted in the experiments carried out with the very high-tension electrical apparatus employed.

The first experiments were carried out in Newfoundland last December, and every assistance and encouragement was given by the Newfoundland government. As it was impossible at that time of the year to set up a permanent installation with poles, the experiments were carried out with receivers joined to a vertical wire about 400 feet long, elevated by a kite. This gave a very great deal of trouble, as in consequence of the variations of the wind, constant variations in the electrical capacity of the wire were caused.

The assistants in Cornwall had received instructions to send a success of Ss, followed by a short message at a certain prearranged speed every ten minutes, alternating with five minutes' rest during certain hours every day.

Owing to the constant variations in the capacity of the aerial wire it was soon found out that an ordinary syntonic receiver was not suitable, although a number of doubtful signals were at one time recorded. Various microphonic self-restoring coherers placed in the secondary circuit of a transformer were therefore tried, the signals being read on a telephone. With several of these coherers, signals were distinctly and accurately received, and only at the prearranged times; in many cases a succession of Ss being heard distinctly, although, probably in consequence of the weakness of the signals and the unreliability of the detector, no actual message could be deciphered.

The coherers which gave the signals were: one containing loose carbon filings, another, designed by Marconi himself, containing a mixture of carbon dust and cobalt filings, and, thirdly, the "Italian Navy Coherer," containing a globule of mercury between two plugs.

For the good results obtained, Mr. Marconi expressed his indebtedness to two of his assistants, Mr. G. S. Kemp and Mr. P. W. Paget, who gave very efficient aid during the tests, which the extremely severe weather prevailing in December in Newfoundland made exceedingly difficult to carry out. The result of these tests was sufficient to convince him and his assistants that with permanent stations at both sides of the Atlantic, and by the employment of a little more power, messages could be sent across the ocean with the same facility as across much shorter distances.

The experiments could not be continued or extended in consequence of the action which the Cable Company, which claims all telegraphic rights in Newfoundland, saw fit to take at the time. Having received a most generous invitation from the Government of the Dominion of Canada to continue operations in the Dominion, it was thought undesirable to continue the experiments in Newfoundland, which would probably have resulted in litigation with the telegraph company.

The Canadian Government, on the initiative of Sir Wilfrid Laurier and Mr. Fielding, has shown itself most enterprising in the matter, and not only encouraged the erection of a large station in Nova Scotia, but actually granted a subsidy of £16,000 toward the erection of this transatlantic station, the object of which is to communicate with England from the coast of Nova Scotia. It is anticipated that the Canadian station will be ready for further tests very shortly. Another station for the same purpose is being erected on the United States coast.

Towards the end of February of this year, it was thought desirable to test how far the messages transmitted by the powerful station at Poldhu could be detected on board a ship. The ship selected was the "Philadelphia," of the American Line. The receiving aerial conductor was fixed to the mast, the top of which was about 60 meters above sea level. As the elevated conductor was fixed and not floating about with a kite, as in the case of the Newfoundland experiments, very good results were obtained on an ordinary syntonic receiver, similar to those above described, and the signals were all recorded on tape by the ordinary Morse recorder.

Readable messages on tape were received up to a distance of 1,551 miles from Cornwall, and indications were received as far as 2,099 miles. Most of the messages were received in the presence of the captain or the chief officer of the ship, who were good enough to sign the tapes. Some of the tapes were shown in a frame, and the audience was invited to examine them at the conclusion of the discourse.

It is curious to observe that signals could not be received at over 900 miles by any of the self-restoring coherers. The reason for this lies probably in the fact that the tuned receiver when connected to a fixed aerial is more efficient.

Another result of considerable scientific interest was, that at distances of over 700 miles the signals transmitted during the day failed entirely, while those sent at night remained quite strong up to 1,551 miles, and were even decipherable up to a distance of 2,099 miles. This result may be due to the diselectrification of the very highly charged transmitting elevated conductor, operated by the influence of daylight. Mr. Marconi added, however, that he does not think that the effect of daylight will be to confine the working of transatlantic wireless telegraphy to the hours of darkness, as sufficient sending energy can be used during day time at the transmitting station to make up for loss of range of the signals, and, therefore, this business of communicating across the Atlantic will not be one of those works of darkness, with which some people connected with cable companies would seem disposed to class it.

It is, however, probable that had this effect of light been known at the time of the Newfoundland experiments, and receiving had been tried at night time, the results would have been much better than those that were obtained.

Wireless Telegraphy, an Electrostatic Effect?

By Prof. J. W. Gore.

During the summer of 1900 Prof. W. C. A. Hammel and the writer made some experiments relative to a system of signaling to and from moving trains, when the question arose, How far could a wire the length of a car be placed from a telegraphic circuit, one end being connected with a coherer, so that the inductive effect of the current might still be sufficient to effectively operate the coherer? We tried placing the wire at various angles with the telegraphic circuit and found that the coherer responded even when apparently at right angles to the circuit.

Although my interest was aroused as to the nature of this effect, various other interests prevented further experimenting until the past session, when I directed the attention of some of my laboratory students to the problem. Some of their results, which I have since verified, may be of sufficient interest to note in your columns.

With the battery and coherer used it was necessary to have some inductance in circuit, such as a telegraph sounder or a small induction coil. Due precaution was taken to be assured that the effects were not the result of other than the causes mentioned. The antenna was placed quite accurately at right angles to the circuit. The coherer was effectively operated upon, making and breaking the circuit when the bare end of antenna touched the circuit; when the end of antenna was near or some distance beyond the circuit; when the antenna was doubled around the circuit or doubled back on itself and the end connected with the coherer. The effect is greater when a helix, having a conductor for its axis, is connected to the antenna, either end, the middle or both ends of helix being connected to the antenna.

Very decided effects were obtained in each of the above cases when one end of an open circuit was connected to a terminal of the secondary coil. In but a few of the cases were earth connections necessary, though the effects were increased by earth connections.

The results obtained seem to be due to the same cause that operates the coherer when an insulated conductor, near the end of the antenna has its potential suddenly changed—namely, electrostatic induction.

It may be a hasty, though it seems a legitimate inference from the experiments, that long-distance wireless telegraphy is an electrostatic, rather than a Hertzian wave effect; at any rate, I have

thought for the past few months that this appears to be the more plausible explanation.

An oscillatory electrostatic stress between the conductor (earth) affected ether and the freer ether above the earth, would produce waves that would be propagated around the earth. The better the earth conductor, the greater the electrostatic effect; the smoother the surface of the earth the less the waves would be distorted and deflected. These are conditions which are found favorable for transmission of wireless telegraphic signals.

The New Generating Plants of the Niagara Falls Power Company—II.

By H. W. Buck.

EXCITER PLANT.

The exciter plant in the new power house will be quite different in arrangement from the old one. The installation will be made complete with the exciter switchboard in a compartment recessed into the rock at the bottom of the main wheel pit, as shown in Fig. 1. This portion will eliminate the long shaft necessary with exciters placed on the main dynamo floor and will simplify the operation of the plant. The equipment will consist of four 150-kw compound-wound vertical shaft, 220-volt exciters, each coupled to an independent turbine, placed directly underneath. The speed is 750 r. p. m., and each exciter turbine is controlled by a separate governor. The exciter plant wiring diagram is shown in Fig. 8. It will be seen that the power house lights and auxiliary motors will be operated from this plant. A panel is also provided for interconnection with the exciter plant in power house No. 1. The double set of bus-bars permits of the separation of exciting circuits and lights and motors. The exciter compartment will be directly connected by telephone with the main generator switchboard.

As in all plants, the most important element for successful operation is the layout of the switchboard apparatus. The switchboard in power house No. 2 has been carefully considered, and is believed to be convenient and as simple as it can be made and still accomplish the desired results. There has been a tendency in the design of some of the recent large switchboards toward complexity and the installation of unessential appliances, which by their presence cause more trouble and confusion *per se* than they are intended to prevent. This has been avoided as far as possible in the design of this board.

Fig. 4 shows a plan of the power house floor and the relative positions of generators, switchboard gallery, oil switches and cable subway. Fig. 12 shows a section through the oil switches and cable subway, and indicates the location of the bus-bars placed in fireproof compartments. Fig. 5 shows a front elevation of the main switchboard gallery and controlling panels. The power house is divided in respect to switching into two parts, one of six generators and one of five. Each part has its own group of oil switches and its double set of bus-bars. Fig. 6 shows the relations between the two groups and also the interconnections with power house No. 1. All the switches in the new power house are the General Electric electrically-operated, oil-break type of the well-known design. This switch is shown in Fig. 7. All cables are led through the cable subway. They are heavily insulated with rubber, covered with a fireproof braid, and supported on brackets with porcelain clamp insulators.

The main switchboard consists of a gallery in the center of the building, having mounted on it 36 separate controlling panels: 11 generator, 22 feeder, 2 interconnecting and 1 exciter panel. The relative location of these panels can be seen in Fig. 5, together with their equipment. All the switching is done on these panels by means of relay switches placed in distinctive relation to one another, and in such a relation to imitation bus-bars placed throughout the face of the switchboard that the connections are clearly indicated, and no mistake in switching can easily be made. On the generator panels are two selector relay switches and one generator relay switch; on the feeder panels are two relay selector switches, and on the interconnecting panels are relay interconnecting switches for making the various connections between the two groups in the new power house and between the two power houses. On the sub-bases of the generator panels are dummy exciter bus-bars, with relay double-throw generator field switches. All these relay switches operate electrically the real switches out on the power house floor, and have the exact relation to the dummy bus-bars which the real switches have to the real bus-bars, so that even a green man could hardly make a mistake in throwing a switch. Return indicators are placed adjacent to the relay switches so that the operator may tell at once whether the real switch has responded correctly to the movement of the relay.

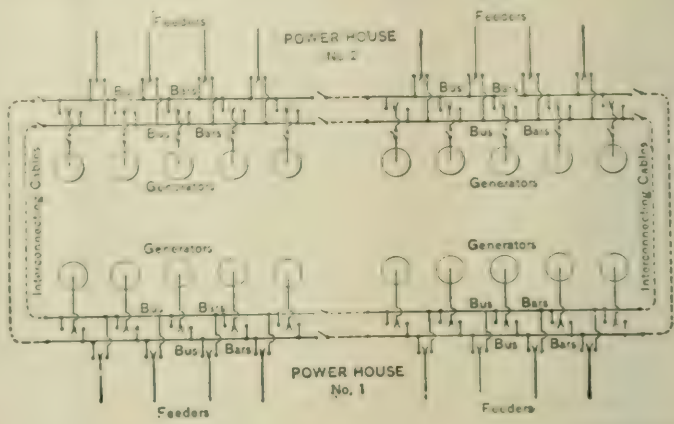
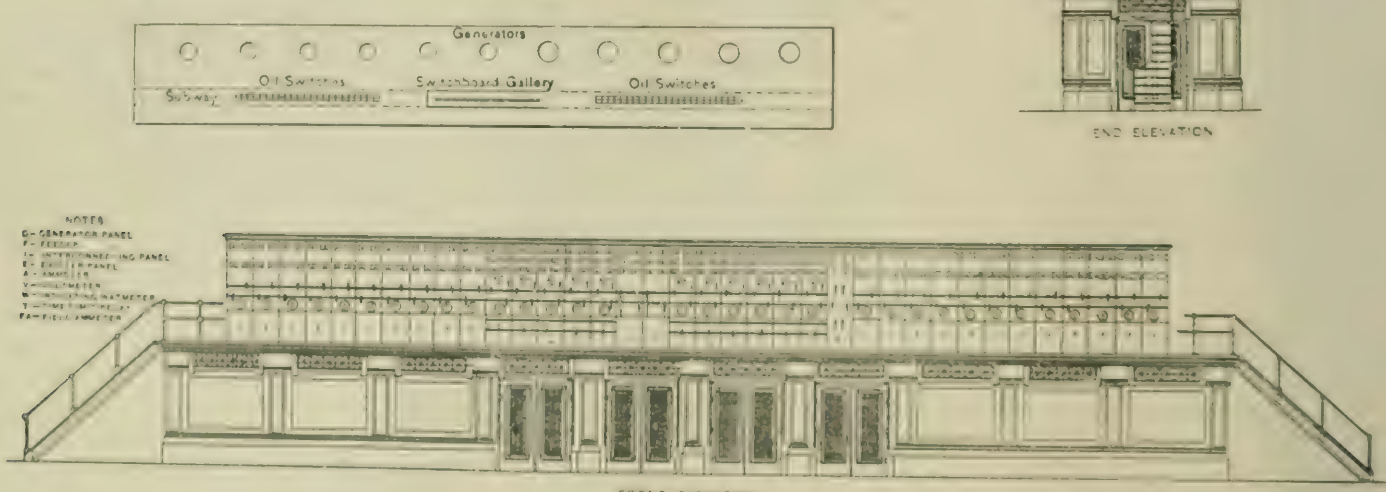


FIG. 6.—INTERCONNECTIONS BETWEEN AMERICAN POWER HOUSES.



Figs. 4, 5 and 5a.—Floor Plan of Power House No. 2 and Front and End Elevations of Main Switchboard.

There has been a considerable craze during the last few years for the operation of switchboard apparatus by bench-board control, but in designing the board for this plant, the bench-board system, although carefully considered, was rejected as inconvenient. In the bench-board system, the operator in switching must first go to the

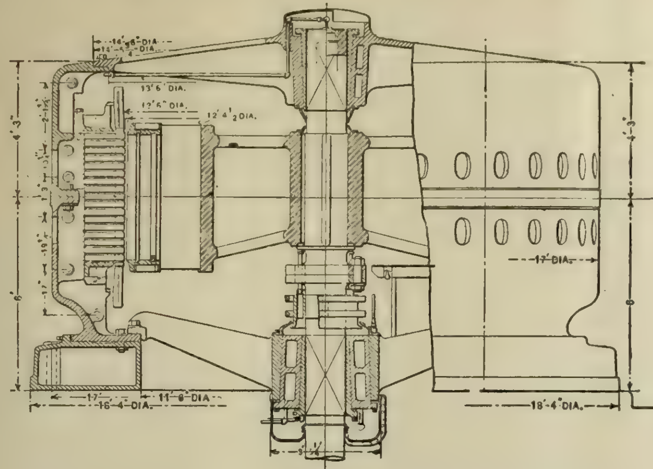


FIG. 9.—10,000-HP, 12,000-VOLT, THREE-PHASE GENERATOR, CANADIAN POWER HOUSE.

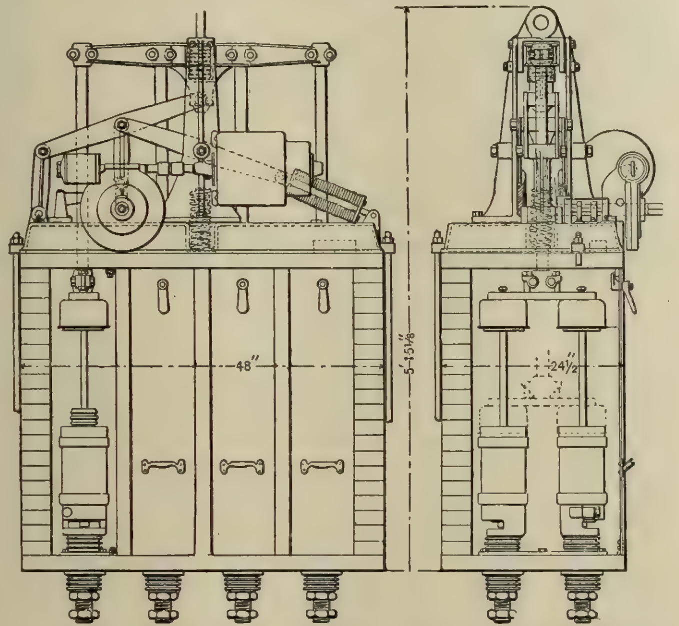


FIG. 7.—2,200-VOLT, TWO-PHASE ELECTRICALLY-OPERATED CIRCUIT BREAKER

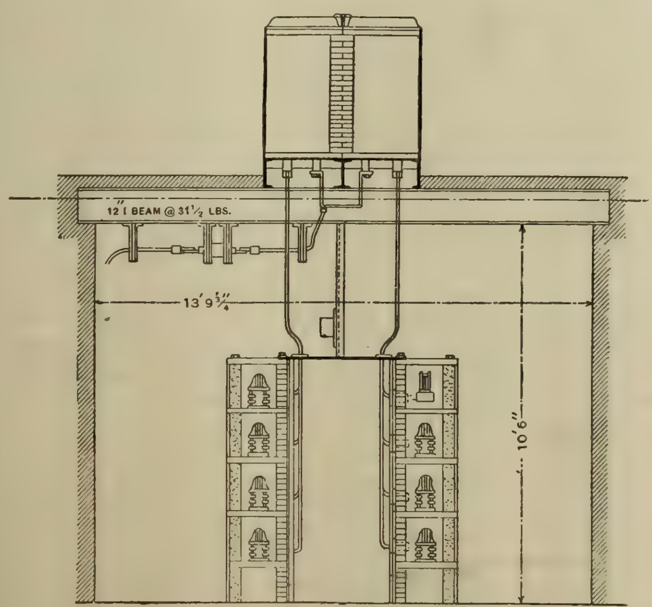


FIG. 10.—SECTION THROUGH CABLE SUBWAY UNDER OIL SWITCHES, SHOWING BUS-BARS, ETC.

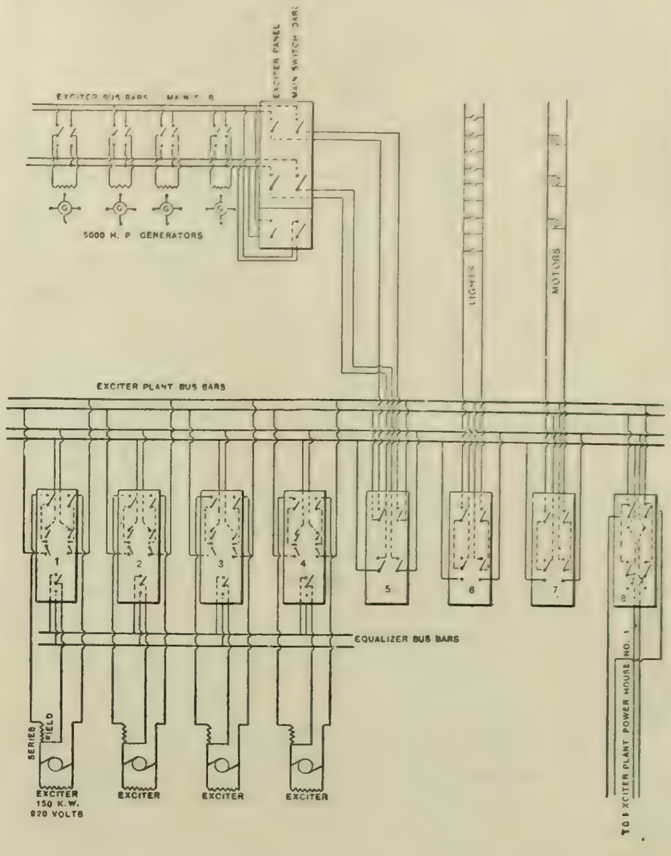


FIG. 8.—WIRING DIAGRAM OF EXCITER PLANT.

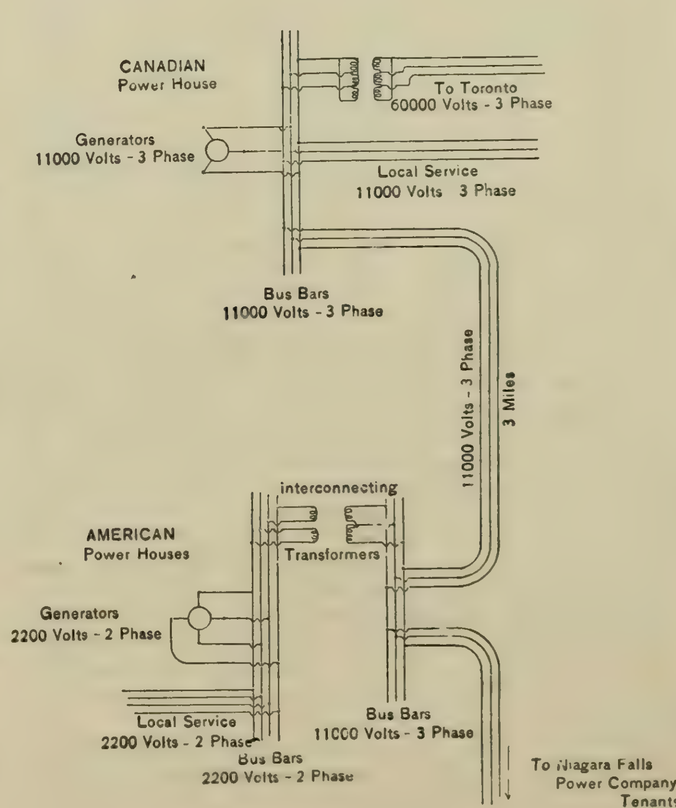


FIG. 11.—METHOD OF INTERCONNECTING AMERICAN AND CANADIAN POWER SYSTEMS.

NEW GENERATING PLANTS OF THE NIAGARA FALLS POWER COMPANY.

bench-board and pick out the relay switch in question, then taking his eye off the switch, he must pick out from a concentrated mass of instruments in front of him on entirely separate panels, the instruments involved in the movement which he is about to make. This is not altogether convenient, and there is always a chance of a mistake. It is believed that the advantages of this bench-board system are more imaginary than real.

In the switchboard installed in this plant, each panel is a complete unit, and comprises all the apparatus, both switches and instruments, which are necessary for any operation which may be made upon it. So that when the operator goes to a feeder or a generator panel he has before him, enclosed within the limits of the particular panel, all the apparatus with which he is concerned at the time. All synchronizing will be done by means of a Lincoln synchronizer placed upon a swivel on the top of the switchboard.

The generator field rheostats and field switches are located under the main switchboard gallery. All feeders are equipped with recording wattmeters installed in the basement of the new office building, through which the feeders pass at the end of the cable subway.

It is the intention to operate the 21 generators normally in four independent groups, but the interconnections are so arranged that they may all be operated in parallel if desired, or any one generator may be thrown on any group. These connections are shown in Fig. 10.

The feeder circuit breakers will be operated by time-limit relays, having an attachment devised by Mr. W. K. Gibboney, of the Power Company. A time-limit relay is a useful device for preventing a circuit breaker from opening unnecessarily at times of momentary overloads, but if a real short circuit occurs, it is objectionable. Experience has shown that on a system like that at Niagara, where there is a large amount of synchronous apparatus in operation, if a short circuit occurs it must be disconnected at once, or else the prolonged drop in voltage will cause all the synchronous apparatus to drop out of step; whereas, if the short circuit can be disconnected instantly, the inertia of the rotating parts of the synchronous apparatus will keep them in step for this short period. For this reason, the ordinary time limit relay is objectionable, since it causes a delay. The device referred to above consists of a dash pot attachment to the tripping plunger of the circuit breaker. This retards the movement of the plunger and consequently the opening of the breaker for ordinary temporary overloads, but if a real short circuit occurs the pull on the plunger is so strong that the dash pot has no effect and the circuit breaker opens instantly.

THE CANADIAN PLANT.

Anticipating still further increase in the use of Niagara power, the Niagara Falls Power Company has, through its allied company, the Canadian Niagara Power Company, started work on its plant on the Canadian side of the Falls. This plant will be located in the Victoria Park, about 1,500 feet above the Horse-Shoe Falls. Its hydraulic feature will be similar to the American plants, with its intake canal, wheel-pit and discharge tunnel leading to the foot of the Horse-Shoe Falls. This power development will be used for the transmission of power to Toronto and other Canadian cities within transmission distance, and for the distribution of power to factories located in Canada in the neighborhood of the power house. It will also be used for the supply of power to the American power system, with which it will be arranged to operate in parallel.

The essential difference embodied in this plant will be in the size of unit and in the electrical arrangements. The unit will be of 10,000-hp capacity (7,500 kw), and the generators will be wound for 12,000 volts, three-phase. The frequency will be retained at 25 cycles for the sake of uniformity with the American plants, so as to permit of parallel operation. In selecting this size of unit, the American and Canadian systems were regarded as one. Since this is likely to reach ultimately an output of several hundred thousand horsepower, a unit of 10,000 hp is not a large proportion of the whole, and is not too large an amount of power to concentrate in one machine from the standpoint of convenience.

The principal advantage in a unit of this size over the smaller one is in the reduction in cost of development per horse-power. This reduction in cost results from:

1. Lower cost of generator per horse-power.
2. Lower cost of turbines per horse-power.
3. A 10,000-hp unit occupies only slightly more space than one of 5,000-hp capacity, which results, for a given plant output, in great reduction in length of wheel-pit, power house and fore-bay, and a consequent reduction in construction.

This generator is shown in assembly in Fig. 9. It is of the internal revolving-field, vertical shaft type. Its revolving field ring is built up of punched laminations, bolted together with joints lapped. This method of construction gives a uniform and definite strength of ring and high magnetic permeability. On account of the high speed, 250 r. p. m., the generator is very small as compared with some of the large engine-driven units, its over-all diameter being only about 19 feet. The weight of the revolving part of the machine is 141,000 lbs., with a flywheel effect at 250 r. p. m. of 2,000,000,000.

The generators are wound directly for 12,000 volts three-phase, instead of 2,300 volts two-phase, as in the American plants. This high voltage was selected, not for long-distance transmission, but for economy in distribution to power users near the power house. In distributing large amounts of power underground from a 2,300-volt, two-phase plant, after a radius of about one mile is exceeded, it becomes cheaper to transform to 12,000 volts, three-phase and distribute at this voltage than to supply power directly at 2,300 volts. From this it becomes evident that great economy results from the direct generation of the higher voltage. For long-distance transmission, step-up transformers will be used to raise the voltage to 22,000, 40,000 or 60,000 volts.

Fig. 11 shows the method which will be adopted for operating in parallel the American and Canadian systems. The connection will be made by triple conductor cables carried across the upper arch bridge over the Niagara Gorge. The paralleling will be done through step-down Scott connected transformers, as shown.

The switchboard and auxiliaries have not yet been decided upon for this power house. It is not expected that it will be in operation for a year or eighteen months.

Pittsburg Meeting of the American Association for the Advancement of Science.

In many respects the Pittsburg meeting of the American Association for the Advancement of Science and Affiliated Societies, from June 27 to July 3, has been one of the most successful which the association has ever had.

While the attendance has not been very large, yet it has been composed of members of the active working class, many of them being Fellows. The registration has shown 435 members of the A. A. A. S. in attendance; in addition to this there were about 200 members of the affiliated societies, bringing the total attendance up to 635.

The geographical distribution of members in attendance is especially interesting, nearly every state in the union being represented by five or more members. It is exceedingly gratifying to note that the attendance of active working members from the south has been double that from the same region at any other meeting.

The papers which have been read before the association proper and in joint session with the more closely affiliated societies have been numerous and of a high order. About 360 papers were presented, which is a large increase over the number read the last meeting of the association. Of the numerous papers read, those presented by Sections B and D—Physics and Mechanical Science and Engineering, respectively—have been of an especially interesting nature.

A number of interesting papers relating to electrical subjects were read before the American Physical Society. Special mention might be made of two papers by L. A. Bauer, of the United States Coast and Geodetic Survey, entitled "Results of Recent Magnetic Investigations," illustrated by charts; and "Some Recent Interesting Magnetic Disturbances Registered at the Coast and Geodetic Survey Magnetic Observatories," illustrated by lantern slides; and another, "On the Action of a Condenser in an Induction Coil," by J. E. Ives, University of Cincinnati.

Mr. George A. Gibson, of the Westinghouse Electrical and Manufacturing Company, read a paper, entitled "The Electrical Industries of Pittsburg and their Economic Influence," in which he showed how greatly modern economic conditions had been influenced by electricity, and particularly through the means it affords for the cheap and efficient transmission and distribution of power. Mr. Gibson stated that the United States generates 69 per cent. of all the electrical energy used in the world, and 76 per cent. of that portion used in electric traction. It has 76½ per cent. of the electric railway mileage and 83½ per cent. of the electric cars.

A number of important measures concerning the future of the

association were considered, and amendments to the constitution of the A. A. A. S. were adopted, which will render the council more permanent in its membership, and undoubtedly more efficient in its work. The matter of giving publicity to the papers read was brought up at the general meeting and was acted upon favorably and unanimously. In the past, the press reports of the various papers read have been handled by the daily newspaper reporters, who invariably picked out what appeared to them to be humorous and eccentric utterances, which resulted in caricaturing rather than in treating seriously the papers and the authors. To prevent this in the future, each section and affiliated society will appoint a press secretary, who will make it his business to see that the proceedings are correctly and interestingly reported from day to day. About 60 new members were elected during the Pittsburg meeting, and 80 members were made Fellows.

A matter of interest to the electrical engineering profession is the election of Mr. George Westinghouse to an honorary Fellowship in the association. This honor was bestowed upon him in recognition of his inventive powers and executive abilities, which have aided so materially the great and substantial progress made in the field of applied science in the past decade, and for his encouragement to the men in his employ in the various Westinghouse industries to lend their talents to the advancement of pure science. This distinction is now shared with only one other living American, namely, Prof. Walcott Gibbs, of Yale University.

Socially, the Pittsburg meeting has been of an exceptional nature, all the educational, religious, business and social organizations in Pittsburg and Allegheny uniting in their efforts to make the meeting an unqualified success. Mrs. Wm. Thaw extended the courtesy of her beautiful home, "Lyndhurst," at Fifth Avenue and Beechwood Boulevard, on Wednesday afternoon. The Engineers' Society of Western Pennsylvania extended every courtesy to the visiting delegates, and the "Smoker" on the steamboat "Annie J. Roberts," on the Monongahela River, on Thursday night, will be long remembered by those that had the good fortune to be present.

Four extremely interesting public lectures were given to the citizens of Pittsburg by the association and affiliated societies, out of appreciation to the many courtesies and hospitalities extended during convention week. Dr. Leonard P. Kinnicutt, of Worcester, Mass., gave an illustrated lecture on the "Prevention of the Pollution of Streams by Modern Methods of Sewage Treatment." Dr. Chas. E. Bessey, of the University of Nebraska, interested his audience with an illustrated lecture, entitled "Evolution Among Microscopic Plants." Capt. Sibert, of the Local U. S. Engineers' Office, gave an illustrated lecture upon his experience in the Philippines in repairing damages to bridges and railroads which were inflicted by retreating insurgents. Robt. T. Hill, of the U. S. Geographical Society, gave a lecture to an audience that crowded the Carnegie Music Hall to the doors on his experience on the Island of Martinique during the recent volcanic eruptions.

President Ira Remsen, of the John Hopkins University, was elected president of the association, and will succeed President Asaph Hall at the next meeting, which will be held at Washington, D. C., from Dec. 28, 1902, to Jan. 3, 1903.

In the section of physics a large number of important papers were read and discussed. Prof. Carhart brought forward some experiments which point very strongly toward a new theory of electrical cells. J. S. Shearer has taken up the study of expansion coefficients between the temperature of melting ice and that of liquid air. This work was called for in order that chemical apparatus for low temperature work may be properly designed.

Prof. Moler, of Cornell, described a very interesting plant in which a potential of 12,000 volts is got by running 24 dynamos of 500 volts each in series.

W. Ambler and F. Allen, after a careful set of experiments in a liquid air machine, find that 116 grains of this substance can be made by 1 hp in one hour, and that only about 2 per cent. of all the energy expended is stored up in the liquid.

Nichols and Hull have revised their determination of the pressure exerted by light, and find that it varies only 4 per cent. from that decuced from theory.

Dr. F. Allen presented some results of important bearing upon the theory of how we see colors.

The section of mechanical engineering and science was favored with an unusually large number of papers, many of them of the highest practical and scientific value.

Prof. R. H. Thurston gave a resumé of "The Trend of Progress in Prime Movers." While immense progress has been made in the efficiency of heat engines very much remains to be done. Steam turbines have become recently very important. But, of course, the efficiency of the turbine and of the ordinary steam engine are tending to the same point.

Mr. Frank H. Cilley, one of the engineers in charge of the construction on the new East River Extension Bridge, gave some interesting examples, showing that ordinary methods of determining the stress upon certain forms of framed structures are at fault—sometimes seriously so—because changes of form due to the act of loading a. different stages of the process are not sufficiently considered. In this line of thought Prof. Thomas Gray, of the Rose Polyetchnic Institute, discussed the "Ratio of the Transverse to the Longitudinal Elastic Strain Produced by Longitudinal Stress." In a following paper, Prof. Gray showed it probable that the effect of hardening upon steel is to diminish its rigidity rather than to increase it, as is the common supposition.

Prof. Mansfield Merriman showed that one additional line of hose of the same size from a hydrant reinforcing a stream already in action increases the nozzle efficiency by about 40 per cent., a third line by about 25 per cent., a fourth by about 10 per cent., while the increase from a fifth or sixth line or more is too small to be of value.

Prof. R. S. Woodward, of Columbia University, entertained the section by a discussion of some of the curious uncertainties still existing in the meaning of the language of engineers. He suggested what he considers necessary reforms in the technical language of engineers. His position, however, aroused a lively controversy, in which the well-known engineer, Mr. Wm. Kent, led the opposition to Dr. Woodward.

Prof. David P. Todd, of Amherst, gave the section some account of a planetary orrery mechanism for showing the motion of the heavenly bodies, now in process of construction at Amherst, and occupying a building of more than 60 feet diameter. He asked the section for some suggestions upon the mechanical arrangements of this very large piece of school apparatus. Prof. J. Burkitt Webb gave a description of an ingenious device, by which with a telephone the strain upon a rotating shaft could be ascertained with great accuracy, also another device for showing the power exerted by floating automobile objects, like self-propelling torpedoes.

Prof. Gray showed that for high pressures, ball bearings become unsuitable and must be replaced by other devices.

An interesting contribution was that of Prof. Calvin M. Woodward, dean of the mechanical department of Washington University, of St. Louis. He is prominent on the committees which are regulating the various competitions to take place at the Louisiana Fair. He published before the section for the first time the rules and regulations which are to govern the contests in air navigation. This paper is of very great interest in describing prizes and methods, and will appear in full in the public prints. With this paper was given the section an account of the excellent scientific investigation in the line of aerodynamics, now being carried on at the University of Georgetown by Professors H. Matullath and A. S. Zahnm.

Professor H. T. Eddy, of Minnesota University, presented a valuable contribution, in which he had worked out to larger degree than heretofore the close analogy between pump action upon water under various conditions, and the action of an alternating electric current. So close is this analogy that the mathematical formulas adapted to deal with problems of water flow are exactly fitted to analogous problems involving the distribution of electricity, with the one modification of a difference in the interpretation of the constants involved.

Prof. J. C. Nagle, of the Texas Technical School, contributed an article upon the "Effect of Weeds and Moss upon the Coefficients of Discharge in Small Irrigating Canals."

Prof. Albert Kingsley gave an interesting paper, fully illustrated by diagrams, showing in original ways how the "Compound Pendulum" can be considered by graphic methods.

Mr. M. M. Kann, of Pittsburg, talked of "Crushed Steel and Steel Emery, an Artificial Abrasive." This is a recently invented form of steel, whose manufacture has grown up in Pittsburg and founded a new industry. The various grades of the product of this new company have replaced sand in rock sawing, emery in steel sawing, diamonds in core drilling of rocks, emery and other substances for

beveling, shaping and polishing various refractory materials, like granite, steel and glass.

Prof. W. T. Magruder illustrated a newly devised and simple method of determining with very small error the coefficient of v in the equation pvn. This is the equation of the curve connected with the indicator diagram, by which the efficiency of various kinds of engines is measured. The special point in Prof. Magruder's paper was the use of the planimeter in the calculation of the important factor n.

Of the 45 papers read, either actually or by title, before Section B, Physics, 17 related to electrical subjects. The following is a summary of their contents:

"Contributions to the Theory of Concentration Cells," by Prof. H. S. Carhart. The paper dealt first with concentration cells of the first class, in which two electrodes of one metal are immersed in a solution of a salt of the same metal, the density of the solution being different at the two electrodes. The Nernst theory requires that the direction of the e. m. f. within the cell be from the dilute to the concentrated solution. The author has discovered a cell in which the e. m. f. is directed the other way, viz., from the concentrated to the diulte solution. It consists of nickel electrodes immersed in solutions of nickel sulphate or nickel chloride.

The explanation given depends on the thermal e. m. fs. at the two electrodes. Curves were given, showing that these e. m. fs. increase with the density of the solution. In most concentration cells the thermal e. m. f. is from the metal to the solution; in nickel cells it is in the other direction. Hence the reverse direction of the e. m. f. of these cells. These new facts were applied to the explanation of the dependency of the e. m. f. of the Daniell cell on the density of the two solutions, and to the reversal of the temperature coefficient of the Daniell cell when the density of the zinc sulphate solution is only slightly over unity.

The paper next took up the other class of concentration cells, in which the two electrodes are amalgams of a metal of different densities, the two amalgams being immersed in a single solution of the same metal. In these the thermal e. m. fs. increase when the density of the amalgam *decreases*. The direction of the e. m. f. within the cell from the concentrated to the dilute amalgam is thus explained.

Further, since the thermal e. m. f. increases with the density of the solution, and decreases with the density of the amalgam, it should be possible to make a concentration cell with the denser amalgam in the denser solution, and the weaker amalgam in the weaker solution, so that the e. m. f. of the cell would be zero. This has been found to be true.

"On the Complex Product of Electromotive Force, Current and Other Vectors," by Prof. Henry T. Eddy, University of Minnesota, Minneapolis. The rules which govern multiplication and the other processes of ordinary algebra are those of mere number in its arithmetical sense. But algebra necessarily admits the use of complex numbers, to which arithmetical processes, such as multiplication, are perfectly applicable. Such complex numbers used as factors are not physical vectors, though they are frequently represented geometrically as quasi vectors.

When a physical vector, such as a force or a velocity, expressed in complex notation is multiplied by a mere numerical complex, the ordinary rules of algebra still hold. But when we multiply together two physical vectors expressed in complex form in order to obtain their product, the result has a physical significance which imposes laws of operation differing from those of ordinary algebra, and the factors are found to be non-commutative. The paper contains a detailed comparison of the nature of the two kinds of complex products, especially directed to the consideration of the product of pairs of alternating vectors of the same frequency to show that the double frequency of such products does not arise in any way from the non-commutative character of the multiplication, as has been sometimes assumed.

"A Set of Direct-Current Dynamos Arranged in Series for High-Tension Work," by Prof. G. S. Moler, Cornell University. To get a direct-current potential of 12,000 volts, 24 separately excited dynamos of 500 volts each are joined in series like battery cells. The full-load current is .22 ampere. The operation of this plant has proved very satisfactory.

"Rayleigh's Alternate-Current Phasemeter," by Prof. E. S. Johonnott, Rose Polytechnic Institute. This instrument consists of a soft-iron needle suspended between two parallel coils at an angle of 45 degrees to the common axis. A study was made of the iron losses in choking coils when the power factor was varied.

"A Radiometric Receiver for Electric Waves," by Prof. G. F. Hull, Dartmouth College. Two silvered strips of glass or mica, of the proper length for the waves used, are marked at their centers by a fine diamond scratch. They are mounted vertically in the focus of a parabolic mirror, with their centers opposite and near two small thin mica vanes which are at the ends of an arm of a torsion balance. The resonators and torsion balance are placed under a bell jar from which the air can be exhausted. The radimetric action due to the heating at the mica scratches or high resistances can be observed by a telescope and scale. The sensitiveness can be made greater than that of the Klemencic thermo-element, and the deflections are quantitative.

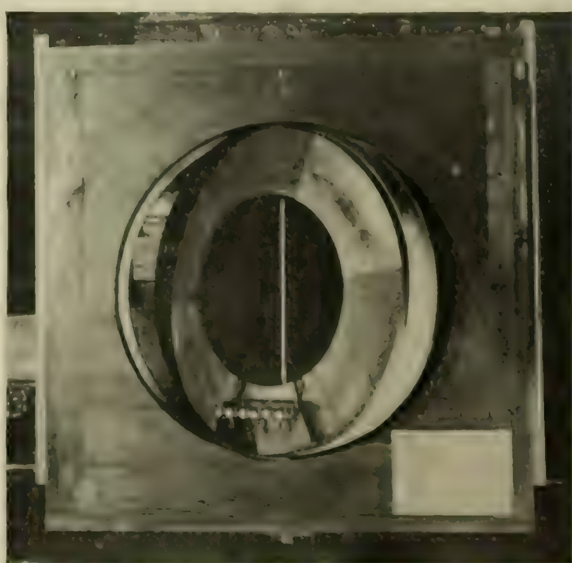
"Preliminary Note on the Effect of Percussion in Increasing Magnetic Intensity," by Prof. G. F. Stradling, University of Pennsylvania. Iron, steel and nickel are magnetized and then demagnetized by reversing the current. Percussion causes a development of poles in the same direction as before demagnetization. These increase in strength with tapping, and then grow weaker.

"The Electrical Conductivity of Saturated Powders," by Ernest Dorsey, Annapolis Junction, Md. The electrical conductivity of non-conducting powders saturated with electrolytic solutions is compared with the conductivity of the supernatant liquor. For coarse-grained powders the two are proportional, but when the powder is fine the conductivity of the saturated powder at first increases more rapidly than that of the supernatant liquor, with the result that for quite dilute solutions the conductivity of the saturated powder, as measured in a cubical cell, a pair of whose opposite sides served as electrodes, may even exceed that of a volume of the supernatant liquor equal to that of the solution in the powder as measured in the same cell.

"On the Conditions Controlling the Drop of Potential at the Electrodes in the Vacuum Tube Discharge," by Prof. C. A. Skinner, University of Nebraska. The drop of potential is explained by the presence of ions which strike the electrodes and rebound perhaps several times before they succeed in getting rid of their charges. Since the negative ions have greater freedom of motion than the positive ones, the accumulation of ions is different at the two ends of the tube, and consequently the fall of potential also differs.

"Some Observations Showing the Oscillatory Character of Lightning," by Prof. A. W. Smith, University of Mississippi. A drop of water falling during a lightning flash had several successive positions. A fence post photographed from a moving carriage gave six partially superimposed images. The period of oscillation was calculated to be from .02 to .03 second.

"A New Variable Ironless Induction Coil for Large Currents," by Prof. F. C. Caldwell, University of Ohio. This coil is interesting be-



INDUCTION COIL FOR LARGE CURRENTS.

cause of its large size. It is made up of two concentric coils, one swinging within the other, and wound on spools with spherical bottoms. The outer coil, which is removable, is mounted inside of a circular frame. In winding the outside coil, brass tubes were included

for the shaft of the inner coil to pass through, brushes carrying the current for the inner coil. Its resistance is 1.4 ohms, and its impedance, with 60-period current about 40 ohms. It is wound with 10 layers of 20 turns No. 8 wire in the outside coil, and 9 layers of 20 turns in the inside layer, about 100 pounds of wire; the outside diameter of inside coil being 20 inches.

"A New Laboratory Switchboard Jack," by Prof. F. C. Caldwell, Ohio State University. A convenient jack and plug of neat appearance were described. The cost of the plug is about 10 cents, and of a complete terminal with two tubes, 26 cents. One hundred amperes flowing for 15 minutes produced a scarcely perceptible rise of temperature in jacks which had been used for several months.

"On the Effect of Electrolytic Condensers in Alternating-Current Circuits," by Profs. A. Trowbridge and E. R. Wolcott, University of Wisconsin. An oscillograph of the Duddell type was used to get current and e. m. f. curves simultaneously. A comparison of these showed that there is a true phase difference. A sine wave is not distorted. Two aluminium electrodes in a solution of $Al_2\ K_2\ So_4$ gave the best results. A set of experiments made with platinum electrodes in sulphuric acid solution lead to these conclusions:

1. The current through the electrolytic cell is not in step with the applied e. m. f.

2. The higher the applied e. m. f., the higher is the value of the capacity.

3. The greater the distance between the electrodes, the less is the capacity, but the capacity is not inversely as the distance.

4. The equivalent resistance of the cell increases when the distance between the plates is increased.

Resonance effects were obtained.

It seems incorrect to regard the electrolytic condenser as two condensers in series, each consisting of an electrode, gas layer and the liquid.

"Photographic Study of the Alternating Arc," by Prof. Geo. A. Hoadley, Swarthmore College. Photographs taken from a rotating mirror mounted with its axis parallel to the line of the two carbons show two luminous intervals each cycle. When one carbon is replaced by zinc there is but one luminous interval each cycle. In this case a direct-current ammeter indicates the passage of 10 or 12 amperes from the zinc to the carbon in the arc.

When a magnet is held near the arc, the photographs, taken now from a mirror with its axis at right angles to the line of carbons, show alternate displacements of the bright band to the right and to the left. If the lower carbon is double, one half the current can be made to go to one part and the remaining half to the other part, thus splitting the alternating current into two intermittent direct currents.

Experiments were made between ordinary carbon points. Between carbon and zinc points, showing that there is an illuminating arc only once per cycle, and that there is a direct current passing from the zinc to the carbon in the arc, that can be read by a direct-current ammeter. Between carbon points in a magnetic field, showing the alternating directions of the current. Between carbon points, the lower of which is double, showing that two direct-current ammeters placed in the two lower branches will show to direct currents if placed in opposite directions.

"The Nernst Lamp," by A. J. Wurts. The substance of this interesting address has already appeared in the technical journals.

"The Electrolytic Rectifier," by Prof. K. E. Guthe, Ph. D. The paper describes the method of investigation, and is illustrated by means of curves showing the relation between the current and the polarization or condensation voltage with different metals and salt solutions. The cause of the effect is located in the gas layer at the anode.

"Model for Showing the Superposition of Two Oppositely Moving Wave-trains," by Prof. W. S. Franklin. This model is designed for class-room demonstration, and it consists of a large number of horizontal bars. One set of ends of these bars rests upon a wave-template and the other set of ends rest upon another wave-template. These two templates move in opposite directions at the same velocity. The middle point of the horizontal bars communicate to a row of points or balls, the resultant motion of the two wave-trains.

"The Emission of a Righi Vibrator and the Measurements of the Length of Electric Waves by the Interferometer," by Prof. H. R. Willard and L. E. Woodman, Hanover, N. H. The paper deals with the radiation emitted with a Righi vibration, which are studied in the first instance by their resonance effects on a receiver, the length of which is varied. The curves bring out the existence of two upper partial vibrations or overtones; in some cases the third overtone also appears. The wave lengths were later measured by the interferometer method.

"Effect of Percussion in Increasing Magnetic Intensity, by George Flowers Stradling, Philadelphia, Pa. When a rod of iron, steel or nickel has been magnetized and then demagnetized by the passage of a current of proper strength through the coil in which the rod is placed, tapping the rod causes the appearance of poles having the same direction as those existing before demagnetization. These poles, as the tapping continues, grow in strength to a maximum, and then decrease. If the demagnetizing current more than overcomes the original magnetism and produces poles in the opposite direction, still the effect of tapping is to make them first approach to those originally existing and then recede. In this case there are three stages produced by percussion. 1. Lessening of pole strength to zero. 2. Growth of pole strength in the direction existing before demagnetization. 3. Decrease of the strength of these newly acquired poles. Whether percussion increases or decreases pole strength depends on the previous magnetic history of the body examined.

"Portable Photometer for Measuring Light Distribution," by Prof. Dayton C. Miller. The arrangement described is a special form of photometer which may be moved in any way, as about a pivot, for quickly measuring with moderate accuracy the relative intensity of light sent out in any direction from a source. A Lummer-Brodhun screen is used to compare the light from the source with that from a standard illumination, the latter being capable of measured regulation from zero intensity to the maximum required. The application of the photometer to the measurement of the distribution of light throughout a room, as by a window prism, is described.

"On the Accuracy of the Zero in a Dynamophone," by Prof. J. Burkitt Webb, Stevens Institute. The dynamophone is a new dynamometer, in which the energy transmitted per revolution is measured by the twist of the shaft transmitting it, said twist being measured while the shaft is in motion by an electrical method in which no contact is made with the shaft. It consists of two armatures or hooked wheels mounted on the shaft at a sufficient distance from each other, each wheel having a telephone magnet with its coil mounted in front of it in such a way that it can be revolved about the shaft. The distance of the telephone magnets from the armatures is also adjustable. These two telephones are connected in series with a receiving telephone, which, when the two telephones are properly adjusted to opposite phases and equal amplitudes, gives no sound, or indicates zero. When the shaft twists under the transmission of a moment the observing telephone must be revolved through the angle of twist to obtain the zero or opposition of phase. As in some cases the observing magnet can be revolved through a small angle without perceptibly altering the zero, it is advisable to discuss the accuracy of the same, regarded as a question of the interference of waves of the same period with slightly different overtones, and to use a method of observation which avoids the difficulty to a great extent.

The retiring address of Vice-President D. B. Brace, of Section "B," physics, was on "The Group-Velocity and the Wave-Velocity of Light." He traced the history of the measurement of the velocity of light from the time of Galileo to the present day, both physical and astronomical methods. The highest accuracy at present attained was one part in five thousand. He showed that no method heretofore used in the laboratory had given the absolute velocity of light. He pointed out further that from astronomical observations light of all colors travel with the same velocity. He showed further that the observations by the American observers were superior to those of foreign observers. He showed further the bearing of electro-dynamic experiments upon the velocity of light. He pointed out the difference between what is called the group-velocity and the wave-velocity, and illustrated it by a group of waves on water, showing that the individual waves move with a different velocity than the average mean of all of them. He pointed out the connection with that of the velocity of light, and showed that no method had yet given the true absolute velocity. He described some new methods for determining each of these velocities, and light moves with a velocity of 185,000 miles per second; these methods could detect that there was such a thing as the velocity

of light in a distance of less than one inch, thus illustrating the extreme refinement of modern methods in research.

In following issues abstracts or reprints will appear of other papers of general interest read before the Association.

Telephone Work in Artillery Practice.

To supplant the wig-wag flag signalling heretofore used for reporting the artillery target practice at State Camp, Peekskill, N. Y., the electricians from the 13th Regiment, heavy artillery, New York, constructed recently, in record-breaking time, a flying telephone line between the gun station and the targets, a distance of nearly three miles, in one hour and a half. The telephone service enabled the gunners to ascertain the exact distance from the target a shot would strike, and corrections in their aim was not only greatly facilitated, but the danger of any men straying near the target at

FIG. 1.—RUNNING OUT THE TELEPHONE LINE.

the time of shooting was eliminated, as timely warning over the telephone was received from the gun station.

Taking with them only their telephone instruments, the detail of six men constructed a reel on an army wagon, and, procuring four miles of wire from the State Camp storekeeper, started off up the mountain, and in the time noted had the line run, instruments connected and communication established.

Just before the wagon started, one end of the line was connected to a telephone located at the gun station, and a ground connection was made to a water tap nearby. Following the wagon, one of the detail made tests along the line, making his temporary ground connections by submerging four ordinary tin wahs basins in brooks and streams crossed by the line, the wash basins being connected together in series, and the wire continued from the basins to the instrument. The country being well supplied with mountain brooks, frequent tests were made possible. At each test the camp was communicated with, and the progress of the constructing party reported, at the same time directions were sent both ways.

The line was kept in service two days, and was taken up by the reel-wagon in a little over an hour. The last night of the 13th men's stay in camp was marked by their work on two impromptu

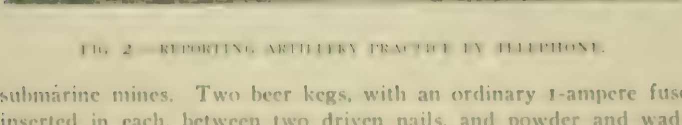


FIG. 2.—REPORTING ARTILLERY PRACTICE BY TELEPHONE.

submarine mines. Two beer kegs, with an ordinary 1-ampere fuse inserted in each, between two driven nails, and powder and wadding tamped in until the kegs were filled, completed the mines. From the nails in each keg, to which the fuse wire was attached, leads were brought to the outside for connection with an external circuit. The mines were removed to the landing at the State Camp, and, after the reels were placed in position on the landing, the first keg was towed out in a skiff and submerged 200 yards off shore. As soon as the boat returned the mine was exploded by passing the electric lighting current, used at the camp, through the mine wires, burning out the 1-ampere fuse, thus igniting the powder. Larger fuses were inserted in the circuit at the dock end to protect the light wires in case of a short circuit through the water due to any possible poor insulation of the mine wires.

The second mine was laid with considerable difficulty. Darkness having set in, accompanied by a driving rain, the men in the boat were quite some time in placing the mine under an old wrecked schooner, some 400 yards off shore. Presently the boat got back to the landing, and the second mine was successfully exploded, in the same manner as the first. Both the telephone work and the laying of the mines were accomplished without a hitch, and the praise received by the men was well earned.

The electrical detachment of the regiment is a new departure, but a necessity, as the working of heavy artillery in coast defense is entirely dependent upon electrical communication. The method of operating the big coast defense guns being purely a mathematical proposition, and one in which more than one observation station is depended upon for the aiming and elevating of the guns, the introduction of electricity as a means of communication between stations has come to stay.

Electrolytic Treatment of Zinc Ores.—Bipolar Electrode.

By CLINTON PAUL TOWNSEND.

In 1878 Cobley suggested the use of sulphur dioxide as a depolarizing agent in the electrolytic precipitation of copper with insoluble anodes. Copper sulphate solutions require for the separation of the metal a minimum e. m. f. of 1.24 volts, but by the use of this depolarizing gas to combine with the oxygen liberated at the anode, the theoretical minimum is reduced to .34 volt. This procedure has now been further studied by Constantin Jean Tossizza, of Paris, and found to give satisfactory results. In attempting, however, to apply the same method to the separation of zinc from its sulphate solutions, Tossizza finds that the high e. m. f. required becomes a disturbing factor, and that the sulphurous acid is itself electrolyzed with the known result (*Comptes Rendus* T. 85, page 225, Guerout) of anodic oxidation to sulphuric acid and cathode reduction to sulphuretted hydrogen or sulphur.

Tossizza now patents the following procedure for the separation of zinc—a two-part operation permitting the partial utilization of the depolarizing effect of the sulphur dioxid. Zinc is first deposited, using an anode of copper which dissolves to sulphate, the zinc separating in metallic form on the cathode; the resulting solution of copper sulphate is then electrolyzed with insoluble anodes depolarized by sulphur dioxide, the metal being deposited in the form of plates suitable for re-use as anodes in the electro-deposition of zinc.

The voltage theoretically required in the first stage of the process is 1.11, while that actually necessary at the very moderate current density used (40 amperes per square meter) is 1.5; and the copper is deposited in the second stage at a practicable minimum of .5 volt. Thus the total voltage required for the electro-deposition of the zinc is approximately two volts, as compared with the theoretical minimum with insoluble anodes of 2.35 (*Zeit. Phys. Chem.*, 1891, 8, page 299).

The principle of operation here offered is an interesting one, but in considering its commercial aspects it must be borne in mind that this somewhat small saving of energy is effected at the cost of a double manipulation, involving the electro-deposition of two distinct metals; and that the first operation, involving the separation of the sulphates of copper and zinc, can scarcely be carried out without a diaphragm.

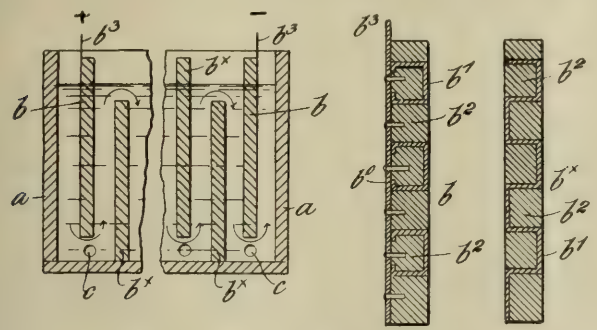
BIPOLAR ELECTRODE.

A form of bipolar electrode, constructed so far as its opposite active surfaces and intermediate conductive connections are concerned of platinum foil, and applicable to the electrolysis of sodium chlorid solutions and the production of hypochlorites, chlorates, etc., is shown in the accompanying figures, the device having been patented to August Alfred Vogelsang, of Dresden, Germany.

In Fig. 1 the slate tank *a* is shown as provided with a series of electrodes, *b*, arranged to divert the flowing electrolyte upward and downward between opposing surfaces. The terminal electrodes, *b*, are connected in the circuit b^2, the intermediate electrodes being unconnected, and hence functioning in the well-understood "bipolar" manner. A series of outlets, *c*, are provided for sludge. Fig. 2 shows one of the terminal electrodes consisting of bars of slate, b^3, sheathed by platinum foil b^4, the whole attached to a lead plate back-

ing, b^0, through which the electrical connection is made. The intermediate electrodes, b^x, shown in Fig. 3, take a similar form save for the omission of the backing plate. The platinum foil b^1, which constitutes the active electrode, is threaded back and forth between the slate bars, alternate surfaces being exposed upon opposite sides of the compound plate and connected therethrough by integral portions of the foil. As a modified construction, alternate bars may be entirely sheathed with the foil.

Kellner has heretofore described a somewhat similar construction wherein wires or plates of platinum were clamped between non-



FIGS. 1, 2 AND 3.—BIPOLAR ELECTRODE.

conducting bars, to form a bipolar electrode with integral connection between the faces. This was a device, however, for applying the "point" or "line" action, believed by Kellner to afford the best results in the electrolysis of brine, and the present construction may be regarded as an adaptation of the same to the use of conductive surfaces. The greatest economy of platinum is said to be obtained by such proportion of parts as will allow two amperes per square millimeter of section and 50 amperes per square decimeter of exposed surface. The foils used may be as thin as .01 inch or less.

New Telephone Patent.

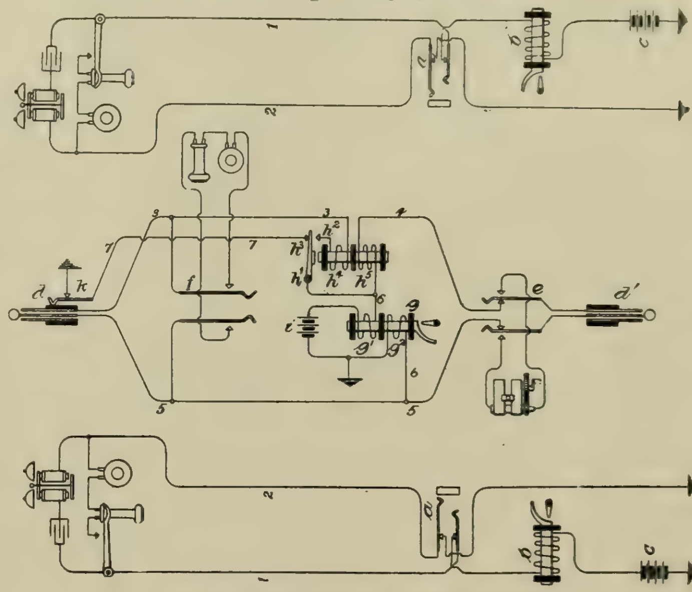
With telephone inventions the Patent Office seems to have struck a steady gait of one a week. The solitary telephone patent of the issue of July 1st is a re-issue to Mr. Charles E. Scribner, of Chicago, of a patent on a supervisory signal for telephone switchboards, originally issued December 5, 1899. Mr. Scribner in this invention employs a single supervisory signal for both lines, which acts when the called subscriber answers, and again when both subscribers hang up. The state of the art regarding supervisory signals is well summarized as follows:

It has been common in telephone switchboards of modern type to provide, in connection with united telephone lines, a source of current, a switch at each substation for controlling current in the line, and one or more supervisory signals associated with both or with each of the lines and responsive to such currents. In following some modes of supervising, a single supervisory signal has been provided in a bridge of the plug-circuit or link connector uniting the lines. This plan has been unsatisfactory in that it imparted to the operator no information as to the response of the called party. In other switchboards a supervisory signal has been provided in connection with each line, each signal responding only to current in its own line; but this plan is inefficient in that it requires the operator to observe two signals in order to ascertain the call for disconnection, and that it permits either of the two signals to be displayed at intervals during the connection, when its indication is of no assistance to the operator and serves merely to distract her attention.

The present invention applies to signalling systems of this general type, and aims to permit the display of a supervisory signal associated with the called line until the called party responds and thereafter to again permit its display only to indicate a call for disconnection in accordance with the replacement of both telephones on their switches at the substations. To this end it consists, in the combination with united lines or with link conductors for temporarily uniting lines, of a supervisory signal designed to come into a bridge of the line, together with a source of current, an electromagnet having a winding in each line, and switch-contacts controlled by the magnet adapted to connect the supervisory signal with the line of the called party when inert, and to connect it with both lines when excited, whereby the supervisory signal indicates a current in the line of the called party when the telephone at the called station is removed from its switch for use, but thereafter is controlled by current in both lines, and serves to indicate only the cessation of current in both. When the plugs or link conductors are not in use the signal remains hidden.

Referring to the accompanying diagram, two lines and stations and a connecting-cord set of a common battery system are shown, the latter having the usual ringing-key, *e*, and listening-key, *f*; *d* is the answering plug, and d^1 the calling plug. The supervisory signal *g* is controlled by relay *h*, which has an armature lever, h^1, playing between two contact anvils, h^2 and h^3. This relay has two windings, h^4 and h^5. Winding h^4 is connected in conductor 3 leading from contact h^3 to the sleeve of plug *d*; winding h^5 is connected in conductor 4, leading from switch-lever h^1 to the sleeve of plug d^1. The tips of the plugs are joined by a continuous conductor, 5. Supervisory signal *g* has two windnigs included serially in conductor 6, which forms a bridge uniting conductors 4 and 5. Battery *i* is in the bridge 6, between the two windings of *g*, which are of high impedance so as not to shunt the telephonic currents.

The plug *d* operates a plug-seat switch, *k*, controlling the continuity of conductor 7, which connects contact h^3 with the battery *i*, the connection being shown to earth; this conductor serves when h^1 and h^3 and *k* are closed to establish a local circuit containing the battery *i* and one or both windings of the signal *g*. Normally, relay *h* is inert and plug *d* being in its seat the local circuit just referred to is complete; therefore *g* is excited, and the indicator, which is designed to appear when *g* is inert, is hidden. When plug *d* is raised to answer a call, opening *k*, the local circuit is broken and the indicator of *g* is displayed. When d^1 is connected



SCRIBNER SUPERVISORY SIGNAL SYSTEM.

with the line called for the circuit through *g* remains broken, being open at the telephone switch at the substation until the called subscriber takes the telephone off the hook. Then the circuit between line wires 1 and 2 is closed completing a circuit through *g* and *h* as follows: from battery *i*, conductor 6 and one winding of *g*, through conductor 4, including winding h^5, to line 2 and back by line 1 to *i* by conductors 5 and 6, including the other winding of *g*.

The signal thus becomes excited and the indicator is concealed, signifying that the called station has responded. Magnet *h* being energized attracts h^1 into contact with h^2, uniting 3 and 4 into a continuous conductor between the sleeves of the two plugs. Thereafter current flows from the bridge 6 to both lines and *h* will remain excited as long as either line is in use. The current traversing *g* is also rendered independent of the condition of either station alone, so that the signal will remain hidden as long as either telephone is off its switch. When the receivers at both stations are replaced on the switches, current through the windings of both *g* and *h* is interrupted, and the magnets of both become inert. The indicator of *g* is displayed, this second display serving as the disconnection signal. The replacement of plug *d* in its seat closes switch *k* and re-establishes the local circuit which effects the restoration of the signal to its normal position of concealment.

This invention avoids all confusion of signals and eliminates all indications on the part of the signals except those which are found in practice to be essential to the proper establishment and supervision of the connection.

CURRENT NEWS AND NOTES.

LAUNCHES FOR ADIRONDACKS.—It would appear that electric launches are in favor in the Adirondack region this year. Several have lately been ordered for use on the St. Regis Lakes.

A LARGE LONDON CONTRACT.—London cables state that the value of the contracts secured by the British Westinghouse Company for the Metropolitan District Railway power house, at Chelsea, is said to be $5,000,000.

PARIS TRACTION.—A report comes from Paris that Messrs. Elkins and Widener are "making great efforts" to buy the underground railways of Paris and consolidate them with the trolley systems; and that Mr. Maurice Untermyer is acting as their counsel. The sum of $100,000,000 is said to be necessary.

ANOTHER GERMAN CABLE.—A cable dispatch from Berlin, of June 30, says: At a meeting to-day of the stockholders of the German Atlantic Cable Company the proposition of the directors to issue bonds to the amount of 20,000,000 marks ($4,760,000), in order to lay a second cable between Germany and the United States, was accepted.

AMERICAN ELECTROCHEMICAL SOCIETY.—The following members were elected at the July meeting of the Board of Directors: Chas. P. Steinmetz, Schenectady, N. Y.; George M. Brill, Chicago, Ill.; Edward L. Anderson, St. Louis, Mo.; Loren Gleason Waite, New York; Arthur Clarke Melcher, Newton Centre, Mass.; David Pepper, Jr., Philadelphia, Pa.; Wm. F. Doerflinger, Niagara Falls, N. Y.; Chas. M. Thomas, Nutley, N. J.; Henry E. Grunet, Basel, Switzerland; Dr. G. G. Pond, State College, Pa.; Edgar F. Price, Niagara Falls, N. Y. The total membership of the society is now 365, and a large number of applications are on file to be considered at the August meeting.

SCIENCE ABSTRACTS.—The total number of periodicals being abstracted for *Science Abstracts* is at present about 150. The following journals have been added since the beginning of the year: *Journal of the Russian Physico Chemical Society* (Russian); *Proceedings of Academy of Sciences, Amsterdam* (Dutch); *Proceedings of Academy of Sciences, Stockholm* (Swedish); *Proceedings of Academy of Sciences, Christiana* (Norwegian); *Proceedings of Academy of Sciences, Copenhagen* (Danish); *Zeitschrift für Anorganischen Chemie;* Royal Society of Edinburgh *Transactions and Proceedings; British Optical Journal; Elettricista (Rome)*; Iron and Steel Institute *Transactions;* American Society of Mechanical Enigneers *Transactions; Engineering and Mining Journal* (New York); *Power* (New York); *American Telephone Journal* (Chicago); *La France Automobile; Der Motorwagen; Automobile Review* (Chicago); *Archives of the Röntgen Ray;* Philosophical Society of Washington *Bulletin.*

CANADIAN NIAGARA POWER PLANTS.—The Ontario Power Company, which is constructing a plant at Niagara Falls to be fed from the Welland River, has applied to the commissioners of the Queen Victoria Niagara Falls Park for the right to construct a second intake, this one to be directed from the Niagara River. Part of the plan was to build a dam in the rapids, in the vicinity of Dufferin Islands, and, with the head gained there, convey the water by conduit to the power house down to the upper suspension bridge. A supplementary agreement prepared provides that the company shall pay a rental of $30,000 a year instead of $15,000, and a certain rate per electrical horse power per annum by the following scale: From 20,000 to 30,000 hp, $1; from 30,000 to 40,000 hp, 75 cents; over 40,000 hp, 5 cents. This application has called forth opposition from the Canadian Niagara Power Company, which is also building a plant for which water from the Niagara River will be utilized. The attorney-general of the province of Ontario will hear the parties at an early date

COMPOSITE ARC ELECTRODES.—A new type of composite arc electrode is the subject of a patent issued July 1 to C. R. Boehm, Charlottenburg, Germany, which type is claimed to obviate the disadvantages incident heretofore to composite electrodes, such as unsteadiness of the arc, formation of slag and production of smoke and injurious vapors. Finely divided fluorides, such as fluorides of sodium, calcium and magnesium are intimately mixed. To one part of this mixture one part of pulverized carbon is added, and a paste formed by the addition of tar or other binding substance. In the case of cored carbons, the core is formed of a mixture of fluorides and carbon, to which is added a silicate. The magnesium fluoride is not reduced in the voltaic arc of the carbon, but is dissociated; the metallic magnesium thus produced being of an extraordinary reducing power, liberates the metals from their metallic salts so that the produced spectrum is a pure metal spectrum, whereas other arcs produced by metallic salts without the addition of magnesium fluoride show an impure spectrum of the salts or oxides employed, which are only partially reduced to metals. When the calcium fluoride is present, an intensely yellow light is produced, which, however, becomes of a flesh color when magnesium fluoride is present mixed with the other metallic salts in the proportion of equal or equivalent molecular weights.

THE TELEGRAPHS OF SALVADOR.—A recent report of the Director-General of the Department of Telegraph and Telephones of the Republic shows that there were 138 telegraph and 61 telephone offices in operation in Salvador in 1901, as compared with 117 telegraph and 49 telephone offices in 1900. The number of employes in 1901 in the two branches of the government service referred to was 433. The telegraph system of the country in 1901 consisted of 2,098 miles of telegraph lines, as compared with 2,029 miles in 1900. There were 1,032 miles of telephone lines in operation in 1901, as compared with 959 miles in 1900. The total length of the telegraph and telephone systems of the nation in 1901 aggregated 3,130 miles. In the 61 telephone offices in operation in 1901 there were 282 instruments employed in the government service, and 202 for private individuals. The number of official messages sent over the wires in 1901 amounted to 232,819, while the number of private telegrams rose to 397,310. The charges for transmitting these telegrams were $197,573.55. The receipts in 1901 for the forwarding of cablegrams over the government wires were $66,797.28, of which amount the cable company received $62,782.04, leaving $4,015.24 as the part corresponding to the government for this service. The total receipts in 1901 from telegraphs and telephones aggregated $344,406.74. The expenses of operation for the year, in both departments, were $325,444.99, which amount deducted from the gross receipts leaves a net profit to the government during the period referred to of $18,961.75

LETTER TO THE EDITORS.

The Thunder Storm.

To the Editors of Electrical World and Engineer:

Sirs.—As thunder storms seem lately to have attracted particular attention, I may, perhaps, be allowed to give briefly my observation and views on the subject.

Thunder storms occur generally in this section of the United States in the summer, and more especially in the spring; they rarely occur in winter. The storms are generally absent when the wind is from between the north and south in the Eastern states. When they make their appearance from between the south and west, they are generally of a long duration, and frequently every cloud, no difference how small, is a thunder cloud. When they come from the west they are generally the evening storm, frequently accompanied by only one or two clouds, and are of short duration. When coming from the northwest they frequently, in early spring, are accompanied with hail; the lightning is of the most terrific character, but generally commences before or directly after the rain or hail begins to fall, and lasts but a short time after; and if no hail falls their duration is much shorter than the storm from the southwest, and something like in duration to those from the west.

When hail falls, the cloud as it approaches generally appears streaked with white, which may be caused by rain falling through a cold stratum of air and turning to hail. All thunder clouds appear to be in a rapid rotation of some kind. It has been stated that they rotate on horizontal axes, which judging from the appearance of the western and northwestern storms, would seem to be correct. It is

evident to my mind that heat, an initial charge, and a stratum of some kind are necessary for their production. The theory that they are immense condensing plates and nothing else, fails entirely to explain. Taking all things together, I would judge the thunder cloud to be an immense static or influence machine of fantastic shape in rotation, and the lightning is produced in somewhat the same manner as sparks from a static machine with Leyden jars attached.

Referring to the terrific storms of Mount Pelée, Prof. Hill says, that "following the salvos of detonation from the mountain, gigantic mushroom-shaped columns of smoke and cinders ascended into the clear starlit sky, and then spread in a vast black sheet to the south, directly over my head. Through this sheet, which extended ten miles from the crater, vivid and awful bolts flashed with alarming frequency. They followed distinct paths of ignition, but were different from ordinary lightning in that the bolts were horizontal and not perpendicular. This is indisputable evidence of the explosive oxidation of the gases after they left the crater."

Such a sheet would possibly have a vortex motion, and would be a different kind of static machine as to rotation from the ordinary thunder storm. There would be, as the mass passed through the crater of the volcano, a kind of hydroelectric machine, which would give a very great initial charge to the cloud in motion. I have read accounts of colored lights seen in the clouds above Mount Pelée; their varied colors could be explained as electric discharges passing through rarefied gases, producing Geissler effects.

Baltimore, Md. Alfred G. Dell.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Limits in the Construction of High and Slow-Speed Generators and Motors.—Niethammer.—A paper, illustrated by diagrams, read before the Berlin Electrotechnical Society. The paper is extremely long, and deals with many details of construction, so that it is impossible to give a complete abstract. He first deals briefly with the efficiency. 0.95 to 0.97, not including friction of the bearings, are the higher limits, while on the other hand, even with small and low-speed motors the efficiency in general is not smaller than 0.7 or 0.8. Efficiencies of 20 or less per cent., as steam and gas engines have, occur in electric machines only in motors of less than 0.1 hp. The heating can easily be limited to a moderate degree in ventilated armatures, as long as the speed is high or medium, but not so easily in slow-speed machines. It is recommended to take as much care to obtain good ventilations in slow-speed dynamos as in those of high-speed; this leads to narrow machines of large diameter, and for direct current to a great number of poles. Properly distributed ventilation slots have a great influence. With inclosed machines the external box surface must be large enough to radiate all the heat at the gixen maximum temperature, and when used for continuous service, he recommends artificial cooling as in transformers; the water in mines is very suitable for that purpose. He shows that the rise of temperature of inclosed, and especially of artifically cooled machines, can be more easily predetermined than that of the open types. If ventilation and artificial cooling are provided for, which are not prohibitive concerning efficiency and price, especially for longer types, the heat does not represent a limit of the construction as long as sufficient space is available. This is not the case, however, with tramway and railway motors; he shows that for this purpose, as long as repeated starting is required, the three-phase motor is at a great disadvantage as compared with the direct-current motor. A very energetic artificial cooling would be necessary, which has not yet been tried in practice. This shows the justification of the many lines in America with 25-period, three-phase transmission synchronous converters and direct-current motors. "The American engineers have chosen this system after careful deliberation, and certainly not for the purpose of getting orders for more machines and apparatus, or because the three-phase appeared to involve difficulties. Besides, the General Electric Company (Schenectady) has perhaps worked more both practically and theoretically in three-phase lines than one thinks; even in Europe anyone may see a three-phase line installed by that General Electric Company, namely the line from Varese to Milan in Italy." For direct-current dynamos, one of the most important requirements is that there should be no sparking at the brushes; for this purpose it is necessary that the reactance voltage of the short-circuited coil is small; he discusses the influence of the type of winding, and gives the analytical method of calculating the reactance voltage. The limit of sparkless operation is determined by the centrifugal force of the armature and the solidity of the construction of commutator and brushes; for slow-speed machines there is no difficulty in avoiding sparks. He then discusses the limits of the voltage; for direct-current machines he gives it as 3,000 to 4,000 volts; for larger polyphase machines as 15,000; machines below 200-kw will scarcely be built for more than 5,000 volts. He then discusses the voltage regulation, and finally the limits in the mechanical construction of polyphase generators and motors. For three-phase railway motors, for which the airgap must be in general 1.5 to 3 times the value in stationary motors, difficulties occur concerning the power factor, especially in small types for tramways with low speed and a frequency of 50. The main-line motors have favorable values of speed and number of poles especially for frequencies between 15 and 30. The paper gives many numerical data concerning very high and very slow speed machines built by various firms. He concludes that all limitations in the construction of electric machines can be reduced to mechanical problems.—*Elek. Zeit.*, May 15; some corrections of misprints are given in *Elek. Zeit.*, June 5.

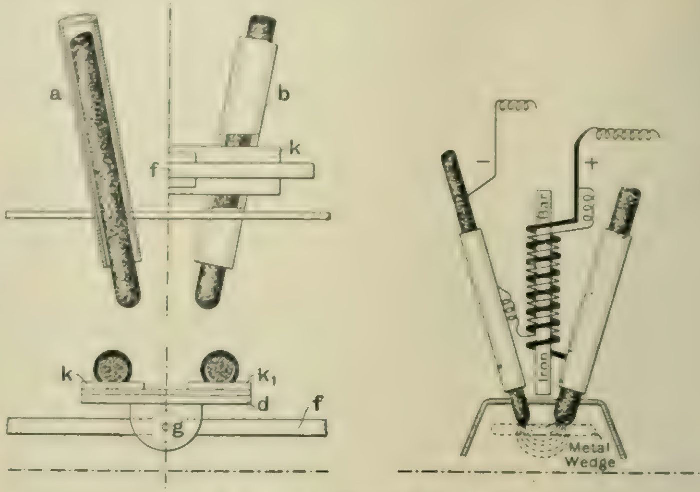
Schimpff, Kuebler.—Two communications in which the statements of Niethammer, concerning the prospect of three-phase traction, are criticised. Schimpff shows that the history of the development of electric traction in the United States has been such that there never was a real opportunity of deciding between direct-current and three-phase motors on the basis of their properties. The development of electric traction in the United States is, therefore, an argument against three-phase traction. Kuebler calls attention to Carus Wilson's comparison between direct-current traction on the South Side Elevated Railroad, in Chicago, with three-phase traction, which were rather in favor of the latter, as has been noticed before in the Digest.—*Elek. Zeit.*, June 5.

Induction Motors.—Meyer.—An article, illustrated by diagrams, in which he discusses the relative advantages of the squirrel-cage type and of the rheostatic motor. Eborall recently stated that squirrel-cage motors which have to start against load should not be used in sizes above 5 hp, and if not required to start against load, in sizes above 8 hp. The present author attacks this general statement, and claims that the service conditions alone decide which type should be chosen. The squirrel-cage type has the advantage of simplicity of construction and operation, adaptability to any number of poles, and thereby the possibility of using an efficient method of varying the speed by changing the number of poles in the stator only. It also has considerably better constants. The power factor is higher, since the self-induction of the end connections is greatly reduced, and since the passage of the currents in the rotor bars is more favorable; also the magnetizing current is generally less due to the lower densities in the rotor iron. The efficiency is better, since the copper is more efficiently used, as no dead copper in the shape of end connections is present, and since the wind resistance is smaller and all losses caused by brush friction and contact resistance are avoided. He gives some data of a 7.5-hp three-phase motor at 220 volts, which was first tested with a squirrel-cage rotor, and secondly with a wound rotor, slip-rings and outside resistance, using the same stator and the same bearings. The air gap was exactly the same in both cases. The core loss was 250 watts in both cases, the Joulean loss in the stator was 320 watts. Friction and windage loss was 125 watts for the squirrel-cage rotor, and 270 watts for the polar wound rotor. The Joulean loss in the rotor was 310 watts in the squirrel-cage rotor, and in the

polar-wound rotor 285 watts were found by test and 215 by calculation from the resistance of the windings, the difference being due to contact resistance. The efficiency at full load is 84.9 and 83.2 for the squirrel-cage rotor and the polar-wound rotor, respectively; the at half load, 84.1 and 80.6; the power factor is 89 and 88 at full load, and 77 and 75.6 at half load; the maximum output is 15.5 hp and 14 hp. The starting torque is 5.7 mkg. and 4.5 mkg. The starting current is 114 amperes and 26 amperes, the full-load current being 19.9 amperes; the rotor copper weighs 6 kg. From these figures he concludes that for motors which have to operate most of the time below their rated load, an appreciable annual saving in cost of current can be effected by choosing the squirrel-cage type. The only drawback is the large starting current, being in the above case 5.7 times its normal full load value, exerting at the same time a torque 1.46 times the full load running torque. It may be reduced successfully by using for starting a compensation, which acts as a transformer, reducing the potential at the terminals of the motors. By reducing the voltage to a certain fraction 1 to X, the current on the primary side and the starting torque are reduced to the fraction 1 to X square. A squirrel-cage type motor with a compensation may be obtained for approximately the same price as a rheostatic motor, including the resistance. In deciding whether a squirrel-cage motor can be used in a particular case, the size and quality of the generating plant and the character of the service are also to be considered. The generating plant should be large compared with the individual motors, at least from 10 to 12 times the kw-capacity which the largest motor has in horse-power. The larger this ratio, the less effect will be produced at starting. Further, the regulation of the generator should be good, say, between 5 and 7 per cent at full non-inductive load where a lighting load is to be supplied from the same bus-bars, and from 7 to 8 per cent. at full non-inductive load where power only is to be considered. In the first case, the lighting load itself will tend to improve the resulting power factor and thereby decrease the drop in volts produced at the moment of starting. In the second case, a drop in voltage, even of 15 to 20 per cent., should have no serious consequences, as all modern induction motors are designed with a liberal margin in over-load capacity, which will allow them to continue their operation even at such a reduced voltage. This refers, however, only to installations where motors have to start light or with a small load, say up to 30 per cent. of full load, and where compensators are used at starting. As to the character of the service, a good deal depends on whether the motor has to be started frequently or whether the process of starting occurs only once or twice in a day, or can be so arranged that the main station is notified beforehand. In such a case even "comparatively" large sizes of squirrel-cage motors can be successfully operated, particularly if the starting happens at periods where there is very little lighting to be done; for instance, a big motor driving a factory which has to be started early in the morning and perhaps at noon. On the other hand, he points to the advantage to be obtained from induction motors of the rheostatic type, if motors, which are large in comparison with the output of the generating plant, are required to start under full load and even overloads. For motors used for intermittent service, as in crane, hoist and elevator work, the maximum starting torque is mostly the deciding feature; since the working periods are mostly followed by periods of rest, such motors may be rated more liberally. For this kind of service he favors the slow-speed motor against the moderate speed motor.—Lond. *Elec.*, June 13.

Lights and Lighting.

Bremer Arc Lamp.—Saubermann.—An illustrated paper read before the Vienna Electrical Society. The essential of Bremer's invention is the determination of the fact that, if the carbon electrode contains more than 20 to 25 per cent. of calcium, silicon or magnesium salts, a better utilization of the high temperature of the arc for the emission of light is obtained than has been possible hitherto in practice. The best result is with halogen combinations of metals of the berryllium group. According to Bremer, the increase of the proportion of the salt to 50 or 80 per cent. often occasions a still greater gain of light; the small strength of such composite carbons and their quick decomposition, even at moderately high temperatures, prevents their practical applications. As a matter of fact, in order to attain the necessary consistence and a certain rigidity, the electrodes containing 20 to 30 parts of calcium fluoride must be covered with a hard, glassy covering, formed by laying on a solution of a mixture of borax, silicic acid, soluble glass and similar substances. In addition, before the customary union by baking, the electrodes are provided with small quantities of boron, common salt, potash, tartar and various silicates, which, acting to a certain extent as fluxes, prevent the otherwise unavoidable scorifying of the carbon points. A particularly large arc is obtained, and this is a matter of considerable importance, as in the Bremer lamp the space between the electrodes is the chief source of light. The automatic method of pushing the carbons forward as they burn is indicated in Fig. 1.



FIGS. 1 AND 2.—BREMER ARC LAMP.

a and *b* are tubes which guide the carbons; they have a slit through which the clamping checks, *k* and *k'* press against the electrodes. *k* and *k'* are insulated from one another and fastened on the pressure plate *d*, in which two projecting metallic holders carry the arbor *g*. The latter is in direct connection with the electromagnetic regulating mechanism, and by means of it the keeper *f* acts on the plate. While the lamp is burning the keeper *f* exerts a suitable pressure upon the plate *d*, through the link *g*, this is conveyed equally to the two carbons. As the current through the arc decreases, a differential or shunt current passes through one magnet coil, the magnet draws the keeper back, the pressure on the two carbons is diminished equally, and they sink downwards. This decreases the resistance of the arc again, and the magnet comes out of action and allows the keeper to return to its former position, pressing the carbons against the sides of the tubes. Several Bremer lamps can be connected in series, and, as the two carbons are normally clamped fast and do not touch one another, the arc is struck as follows: When the current is switched on, part of it passes through the relay, and presses forward the keeper, allowing the carbons to slide down upon a metallic wedge which then supports them. The main current then finds a closed circuit through this wedge, and the shunt coils are no longer magnetized. Consequently, the carbons are once again clamped, and the metal wedge, which is fixed to a movable lever, drops back by its own weight. Now, the arc which is formed is subjected to the action of the series electromagnet, which drives it downward forcibly, and the action becomes greater as the arc approaches nearer to the magnet by the burning away of the carbons. The increased deflection increases the resistance of the arc, the magnet is exerted to a still greater extent, and acts upon the carbon feed as already described, the carbons falling by their own weight. In direct-current lamps only the positive carbon need be impregnated. Fig. 2 shows the arrangement of the differential winding, and is self-explanatory. He gives the results of some photometric measurements of Wedding, which have been noticed before in the Digest. The paper is also discussed in some editorial notes.—Lond. *Elec.*, June 20.

Power.

Electrically-Driven Printing Machinery.—An illustrated description of a method of "parallel" driving, used by a British company, for large rotary web newspaper machines. The main motor is shunt-wound, and is geared to the machine driving shaft. An auxiliary motor, capable of giving a greater turning effort to the machine at slow speed than the large motor, drives the machine through worm gear and an electrically-operated claw clutch, the latter being so designed that it will come out of gear and stop the auxiliary motor as soon as the main motor overruns the auxiliary and drives the machine by itself. A very wide range of speed is obtained, and only about 10 per cent. of the full load power is required at the start. The main driving motor is of just sufficient size and power to drive

at full speed the printing machine to which it is geared, and this motor is never called upon to exert more than the full normal output, so that it works under the most economical conditions. The machine cannot be started from rest without using the auxiliary motor, though the power is always transmitted through the large motor shaft. The large motor is thus always in motion before it is called upon to exert any power.—Lond. *Elec. Rev.*, June 6.

Refuse Destruction.—Some notes on the combined refuse destruction and electric generating plant in use at Grays Thurrock, London. The electric station contains two steam sets of 100 kw each, a balancer booster and a storage battery. The boiler room contains two boilers for coal firing, which are used only when there is an insufficient supply of refuse to burn in the destructor. The destructor house contains two 2-grade Meldrum regenerative "simplex" destructors, working in conjunction with a boiler, and a regenerator for heating the air supplied to the furnaces. The normal burning capacity of each furnace is one ton per hour. The plant is in operation for only six or seven hours a day. The maximum load on the station is 80 kw, and this is easily maintained by the consumption of about 2 tons of refuse an hour. On an average 12 tons of refuse per day, corresponding to about six hours, are burned. The maximum output in kw-hours per ton averages about 35. Some figures are given of a 7-hour test, which is said to have made a record for London refuse destruction.—Lond. *Elec. Rev.*, June 6.

REFERENCES.

Electricity in Textile Mills.—OSBORNE.—An abstract of a paper read before the Dublin local section of the (Brit.) Inst. Elec. Eng., on lighting and driving textile mills by electricity. Concerning lighting, he discusses the advantages of the enclosed arc lamp over the open type. He then enumerates the well-known advantages of the use of electric power.—Lond. *Elec.*, June 6.

Electricity in Printing.—PERKINS.—An illustrated article of a general nature, on the modern use of electric power in printing plants. —*Sc. Am.*, June 14.

TRACTION.

Cardiff Tramways.—The first part of an illustrated description of the new British municipal tramway. The power house contains at present four 300-kw generators, which work as compound machines on tramway loads at 500 to 550 volts, and as shunt machines on lighting loads at 460 to 500 volts. There will also be installed two larger generators, each of 900 kw. An 80-kw motor-generator, working in conjunction with a battery, serves the following purposes. It receives current from the main tramway bus-bars at 500 volts, and gives out current at 100 to 140 volts for charging the battery or supplying the plant's lighting independently, which can also be supplied direct from the battery when the motor-generator is not working. It can also work in the reverse order and receive current direct from the battery at 100 volts, and give current at a pressure of 500 to 550 volts. The capacity of the battery is 2,100 or 1,620 ampere-hours when discharged in ten or four hours, respectively.—Lond. *Elec. Rev.*, June 6.

Electrolysis of Gas Mains.—SWINBURNE.—An abstract of a lecture before the Incorporated Gas Institute. He discusses the origin of the stray currents from the rails, and shows how they enter and leave the pipes with a resulting corrosion where they leave them. One of the chief safeguards is that the tramways must themselves be the chief sufferers by electrolysis, as they have not only their own rails to consider, but they also use lead-covered cables, which are very easily attacked, and destruction of these cables would be a very serious matter. The natural earth currents must have effects comparable with those of tramway leakage. Lead and iron service pipes in metallic contact with cast-iron mains are apt to be corroded without any extraneous currents. Time alone can show whether gas and water pipes will be seriously attacked when tramways are worked with the usual care.—Lond. *Elec.*, June 13.

Railway Shop.—An illustrated description of the electric power plant of the Fort Wayne, Ind., shops of the Penna. R. R. There are three 60-cycle, 220-volt, 100-kw three-phase generators, the currents being distributed by the four-wire system to induction motors, constant potential arc and incandescent lamps. Two 15-kw, 125-volt direct-current dynamos supply the exciting current, and also the current for charging storage batteries, and on some of the parlor cars for car lighting. The arrangement of the switchboard is described in detail. The car lighting department is experimenting with several systems of electric lighting of vestibuled trains.—*Elec. Rev.*, June 14.

REFERENCES.

Three-Phase Traction.—See the abstract of Niethammer's paper under dynamos.

Electrolysis of Underground Mains.—HUMISTON.—An illustrated paper read before the Western Gas Assn., in New Orleans, on electrolysis by tramway stray currents. He discusses briefly the various devices which have been suggested as remedies. He thinks the only absolute cure is a radical one: the entire insulation of both sides of the circuit from the ground; either by means of a double trolley system or some underground double contact device.—*Progr. Age*, June 16.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

French Central Station.—A long illustrated description of the new power house and network of the Est-Lumiere Co., of Paris. The central station, when completed, will have six units of 800 to 1,000 hp each, of which three have been installed. Each of the steam-driven dynamos is a 540-kw three-phase machine, with a power factor of 0.75; the frequency is 50, the number of poles 60; the magnet system serves as a flywheel. Direct current for excitation and for operating the pumps and for lighting the station is produced by 75-kw 125 volt direct-current dynamos coupled to three-phase motors. As a reserve of direct current, a storage battery of 400 amp-hours is used. The voltage of transmission is 5,000. Current is transmitted in three different directions by duplicate, underground, three-core cables to Ivry, Saint-Mande and Saint-Maur. In Ivry there had formerly been a three-wire 220-volt direct-current distribution; this is still used, the former generating station having been replaced by a substation in which 5,000-volt three-phase induction motors drive direct-current dynamos. In Saint-Maur there had been a 3,000-volt single-phase alternating-current supply, with 3,000 to 110-volt transformers, distributed over the network. This supply has been retained, and the old generating stations have been replaced by a substation in which three 100-kw transformers lower the voltage from 5,000 to 3,000. For the new districts no substations have been erected, but transformers are distributed over the districts, placed in overground boxes; the system of distribution is by 125-volt three-phase currents.—*L'Ind. Elec.*, May 10.

ELECTRO-PHYSICS AND MAGNETISM.

Mass and Charge of an Electron.—SEITZ.—An account of experiments in which he measured the ratio of the charge of an electron in absolute electromagnetic units to its apparent mass in grammes, by three different methods, these methods being that of Kaufmann and Simon, of finding the potential, Wien and Lenard's electrostatic deflection method, and Thomson's method of simultaneously determining the energy and the charge of the particles. In addition he determined the magetic deflection. Of all the methods investigated, that of Kaufman appeared to give the best and most consistent results. The magnetic deflection gave a value for the above ratio as 18,700,000, which agrees well with Simon's value, 18,650,000. (These are equal to 187,000,000 and 186,500,000 coulombs per gram; taking the effective mass of an electron as of the order, one gram divided by the twenty-seventh power of 10, the charge of one electron is 187 coulombs, divided by the twenty-first power of 10.) The bolometric method of determining energies is only suitable for high vacua and voltages of more than 8,500.—*Ann. d. Phys.*, No. 6; abstracted in Lond. *Elec.*, June 13; a correction of a figure in Lond. *Elec.*, June 20.

Conservation of Entropy.—ERSKINE.—An abstract of a (Brit.) Phys. Soc. paper. Heat energy may be expressed as the product of two factors—a quantity factor (entropy) and an intensity factor (temperature). The theory of the conservation of entropy holds in thermodynamics when dealing with reversible processes, and is analogous to the conservation of other quantity factors, such as momentum, moment of momentum and electric quantity. He shows the completeness of the analogies by considering Carnot cycles carried out on electrostatic and hydraulic engines. Wiedeburg has suggested to extend the doctrine of the conservation of entropy to irreversible processes by introducing a new quantity analogous to electric resistance. In the discussion which followed, Swinburne stated that the author had got hold of what was no doubt Clausius' original idea of entropy. The science of thermodynamics, as far as it deals with reversible processes, depends upon what the author calls conservation of entropy—but reversible processes do not exist in practice. The author's treatment is quite in accordance with orthodox thermodynamics.—Lond. *Elec.*, May 30.

Absorption of Radiation by Metals.—Hagen and Rubens.—An account of experiments made in the German Reichsanstalt. They have begun a series of measurements of the absorptions shown by various metals with regard to ultra-violet, visible and infra-red rays, primarily with a view towards accumulating material for testing the electromagnetic theory of light. In this first set of observations they examined layers of platinum, gold and silver deposited on glass by various methods. The deposition of silver and its chemical and optical estimation enabled them to test whether sheets deposited chemically and by the disintegration of a cathode, had the same physical constitution. They found that they had, and that even transparent films of silver have the normal density. The curves of absorption given for the three metals extend over wave lengths 200 $\mu\mu$ to 1,400 $\mu\mu$. In the ultra-violet, silver shows a strong absorption band, and gold a less marked one in the blue. The curve for platinum is nearly straight, the absorption decreasing slowly towards the red. In the infra-red, silver shows the highest absorption, gold the next and platinum the least. This confirms Maxwell's postulate that for infinite wave lengths the absorptions are proportional to the conductivities, but the material is as yet too limited for general conclusions.—*Ann. d. Phys.*, No. 6; abstracted in Lond. *Elec.*, June 13.

Discharge Between Flames.—Semenov.—An account of an experimental investigation of discharges passing between a gas jet and a metallic point, or between two gas jets. With two Bunsen flames 10 cm high, and an induction coil, discharges may be obtained which show a characteristic behavior. The spark proceeds from the orifice of the jet connected with the positive pole, follows the dark external layer of the flame, then leaves it a little above the summit of the interior cone, and goes toward the negative flame. It does not reach the latter, however, but stops about 1 cm in front of it.—*Comptes Rendus*, May 26; abstracted in Lond. *Elec.*, June 13.

Inductive Circuit with Harmonically Varying Resistance.—Micuno.—A brief mathematical article in which he deals with the case of an inductive circuit with a constant impressed e. m. f., while a part of the resistance of the circuit varies harmonically in magnitude. Such a circuit is realized by the insertion of a microphonic contact in an inductive circuit. The current is then oscillatory, but the current is almost indifferent to harmonic variation of the resistance, when the variation is small and the frequency is very great.—Lond. *Elec.*, May 30.

Electro-Chemistry and Batteries.

Storage Battery Plate.—A description of a new storage battery plate devised by von Steckow, which is claimed to have a great superficial area with small transverse measurements. It consists of a frame, within which strips of lead wound in spiral form are fixed, one end of these strips being free in order to allow for contraction and expansion. The spirals, after fixing, are subjected to pressure in order to partially close the space between the spiral windings, and to bring their ends within the borders of the frame. A granular mass, which is afterwards dissolved out by water, may be utilized to advantage in this operation, in order to prevent the spaces between successive windings of the spiral from being entirely closed up. The electrode, after dissolving out this inert material in water, is ready for the electrolytic bath.—*Centralbl. f. Accum.*, June 1; Lond. *Elec.*, June 13.

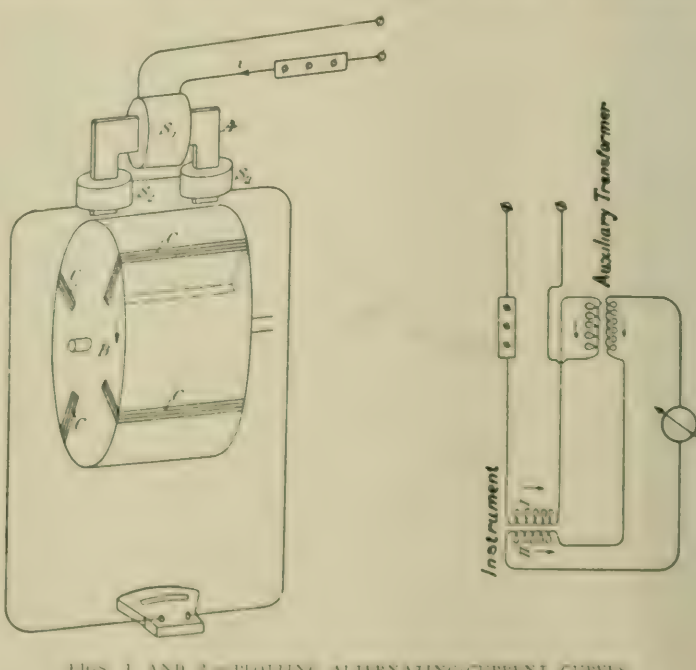
Electric Equipment of Carbide Works.—An illustrated description of the electric installation of the carbide plant at Flums, Switzerland. The hydraulic power station has a capacity of 2,400 hp, and is located 1.8 kilometers from the carbide plant. Three-phase currents are generated and transmitted at 5,000 volts. At the carbide works the voltage is reduced to 65, for use in the furnaces. There are 18 furnaces; they have the temperature of the electric arc, and the current is from 2,200 to 2,500 amperes, the numerous carbon electrodes being regulated by hand with chain gearing. To produce the carbides requires from 2½ to 3 hours, and the product remains another hour or hour and a half in the furnace for cooling after the current is shut off.—*West. Elec.*, June 14.

Edison Accumulator for Automobiles.—Hibbert.—An article referring to recent newspaper reports. He cites two cases in which automobiles with lead cells ran distances of 95 and 100 miles, respectively, with one charge. "British manufacturers of electromobiles contemplate with confidence an early run of 150 miles on one charge of battery." "Still, all must hope that Mr. Edison will succeed. A serious competition with the lead storage cell will do it no harm. Unless the newcomer has such overwhelming advantage as to force lead right out of the field, it will quicken the mental energy, and, perhaps, increase the mental outlook of those responsible for the creditable performance of the present-day accumulator. But the general interest of electrical engineering will be served by producing definite and reliable data only."—Lond. *Elec. Rev.*, June 6.

Hydrogen-Chlorine Battery.—Mueller.—An abstract of a paper giving an account of an experimental investigation of this gas battery. The electrolyte was hydrochloric acid, and the gases were continuously passed over the electrodes. When the acid solution was 1, 0.1, 0.01, 0.001 normal, the e. m. f. was 1.366, 1.485, 1.546, 1.587 volts, respectively. These values are not in agreement with those obtained theoretically under the simplest assumption concerning the dissociation of the acid. This is shown to be partly due to the hydrolysis of the chlorine which takes place, and which increases the concentration of the H and Cl ions. In 0.1 normal solution, the H or Cl concentration rises from 91 to 94.03 "millimols" (— thousandths of a gram molecule) per liter by this hydrolysis, in 0.001 normal solution from 0.98 to 30.48. With the aid of these concentration differences the calculated values of the e. m. f. agree better with the observed values, but the deviations remain greater than the experimental error.—Lond. *Elec. Eng.*, June 6.

Units, Measurements and Instruments.

Plotting Alternating-Current Curves.—Goldschmidt.—A description of an instrument for plotting alternating-current curves, which is based upon the following principle: If the field of a magnet, excited by alternating current, is traversed so rapidly by a coil that it completes the transit in a very small portion of the period of the alternating current, then the e. m. f. induced in the coil is proportional to the instantaneous value of the magnet field, and hence also to the instantaneous value of the magnetizing current. For the construction of the actual instrument he uses a slightly different arrangement. Both the primary magnetizing coil and the secondary coil in which an e. m. f. is induced are fixed, and both are brought together into an inductive relation for an instant by means of a movable iron piece which closes the magnetic circuit. The arrangement is shown in Fig. 1. Upon the horseshoe A of iron the primary coil S is wound, which is excited by the alternating current, and its arms bear two secondary coils, S_2, connected in series. The magnetic circuit is generally open, but at certain instants when the revolving copper drum B brings the iron plates, C, under the ends of the horseshoe, the magnetic circuit is momentarily closed. The drum is revolved synchronously, and the transformer can be moved into any desired position around the axis of the drum. The instantaneous value of the current at any desired phase is obtained by moving the transformer A to a corresponding position around the periphery of the drum. Placing both the primary and the secondary coils on the same iron has the disadvantage that the former induces some e. m. f. in the latter, even when the magnetic circuit is open; but this disturbing e. m. f. can readily be compensated by introducing an equal



Figs. 1 and 2.—Plotting Alternating-Current Curves

and opposite e. m. f. by means of an auxiliary transformer, as shown in Fig. 2.—*Elek. Zeit.*, June 5.

Temperature of the Arc.—FERY.—An account of some further experiments in radiation thermometry. He determined the temperature of the arc by a new method, using Wien's law, giving the radiation in terms of any chosen wave length instead of the total radiation, as in Stefan's law. Wien's formula is an exponential one of considerable complexity, but the author has compensated for this complexity by the following device. He reduces the standard radiation to equality with the radiation to be measured by interposing a very acute-angled prism of absorbing glass, and displacing it so as to interpose various thicknesses. It so happens that the absorption of the prism is also governed by an exponential formula of the Wien type, and the displacement is inversely proportional to the absolute temperature to be measured. The displacement actually found was 91 mm in red light and 49 mm in green light, giving 3,867 degrees for the temperature of the arc in the first case and 3,897 degrees in the second. This shows a considerable disagreement from the value obtained from Stefan's law, which was 3,490 degrees. He finds that this discrepancy is due to the fact that Stefan's law does not apply to this case, because carbon does not behave as an absolutely black body at the temperature of the arc.—*Comptes Rendus*, May 26; abstracted in Lond. *Elec.*, June 13.

High-Tension Testing Set.—AMBLER.—An illustrated description of a 12,000-volt direct-current testing set, installed in the dynamo laboratory of Sibley College. There are 27 machines in all, 24 of which are used to generate the high-pressure current, while the other three are used as exciters to separately excite the fields. The excitors are each of 0.25-hp capacity, designed to run at 1,900 r. p. m., and to deliver 1.05 amperes at 175 volts. The generators proper are each of approximately 1/6-hp capacity, designed for 2,500 r. p. m., with an output of 0.22 ampere at 500 volts. The machines are arranged in groups both mechanically and electrically. The circuit breaker in use is also described.—*Sibley Jour.*, June.

Large Static Machine.—BROOKS.—An illustrated article giving some notes on a large static machine for X-ray and general electro-therapeutic work. It comprises two distinct machines in one case: a Wimshurst-Holtz machine in the upper compartment and a Wimshurst in the lower. The lower machine is to supply an exciting charge to the upper or main machine whenever necessary, and also to supply static effects of low power for special treatment. The upper machine is said to have two noteworthy features, which are a double row of neutralizing pins to secure a more perfect discharge of the plate surfaces after passing the collecting combs, and the metallic connection between the inductor field plates on one side with the collecting combs; this latter connection is claimed to increase the reliability of the machine very much.—*Jour. of Elec.*, May.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraph Statistics.—ROSSI.—Some comparative tables concerning the telegraph service in several European cities. One table shows the average time occupied in each city by a message at the various stages of its transmission; the delay occurring in the transmitting office is always the largest; next comes the time required for transmission; the delay in the receiving station is smallest. A second table shows the average number of messages per day for different cities, the approximate number of staff and the average daily work of each member of the staff. The last figure is largest in Budapest and smallest in Bucharest; in Budapest the number of telegrams per employee per day averages 96.8, in Bucharest 33.3; in London and Paris the average number of telegrams daily are 475,000 and 120,000, respectively; the number of staff, 5,000 and 1,300, and the number of telegrams per employee per day, 95 and 92.3.—*Gionali dei Tel.* (Milan); Lond. *Elec. Rev.*, June 6.

REFERENCE.

General Energy Exchange.—An illustrated description of the new exchange of the Marion (Ind.) Telephone Company.—*Tel. Mag.*, May.

MISCELLANEOUS.

REFERENCES.

Patent Statistics.—WEBER.—A lecture held before the Berlin Elec. Soc'y, in which he gives a summary of statistical data on German patents in electrical engineering.—*Elek. Zeit.*, May 29.

Technical Drawings.—HEFNER-ALTENECK.—A paper read before the Berlin Elec. Soc'y, on uniform methods in technical drawings. —*Elek. Zeit.*, May 22.

New Book.

PRIMARY BATTERIES: Their Theory, Construction and Use. By W. R. Cooper. London: *The Electrician* Printing and Publishing Company. 324 pages, 131 illustrations. Price, 10.5 shillings.

The primary battery was the first type of an electric generator, and has been indispensable until the dynamo appeared. Even now it is of practical utility in certain cases. Besides, there is still a hope entertained by many that some day a new type of primary battery—a carbon cell—may be invented, which would overturn entirely the present conditions of generation of electric energy.

Mr. Cooper's book gives a very complete statement of the theory, construction and use of the primary battery in its present state, with some conservative discussions of what may be accomplished in future. The book has evidently been prepared with the greatest care, and the scattered literature of the subject has been well compiled. In the theoretical part, a considerable number of pages are devoted to a discussion of the modern theories of the ionic mechanism in a galvanic cell, based upon the views of the electrolytic dissociation theory. In the discussion of the construction and use of batteries, the author gives much that is not to be found elsewhere. He shows what the various kinds of batteries, such as Leclanche cells and dry cells, are capable of doing; he compares the capabilities of one type with another, and gives some interesting curves which he has obtained experimentally, enabling such comparisons to be made.

The book is divided into 12 chapters: Historical; the simple voltaic cell; non-chemical cells and thermopiles; testing cells; one-fluid cells; two-fluid cells; dry cells; standard cells; carbon-consuming cells, and the commercial generation of electrical energy. The chapter on standard cells is very good. In the last chapter the possibilities of a carbon cell are discussed, but the outlook is not very promising in the author's opinion.

Some small inaccuracies have been noticed by the reviewer. On page 298, in the discussion of the location of the oxidizing agent, in the case of a simple element of zinc, platinum and acid, the author says that it is "not essential that the zinc should be in contact with the acid"; this should rather have read that it is essential that the acid is in contact with the platinum, and Ostwald's very instructive experiment should be described. It is to be regretted that the author spells cathion with an h; although this is sometimes done, it is wrong, the correct spelling being *cathode* (from cata and hodos), and *cation* (from cata and ion, not hion). We also regret to note that the author has been chary in references and credit to the Continental workers, who established both the theory and the first forms of all the cells which have played any part in industry. On the other hand, undue prominence is given to the part played by the author's fellow-countrymen.

Directory of Electrical Societies, Etc.

AMERICAN ELECTOCHEMICAL SOCIETY. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Next meeting, September, 1902.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Toronto, Ont., 1903.

ELECTRICAL CONTRACTOR'S ASSOCIATION OF NEW YORK. Semi-Annual meeting, Hotel Ten Eyck, Albany, N. Y., July 15, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

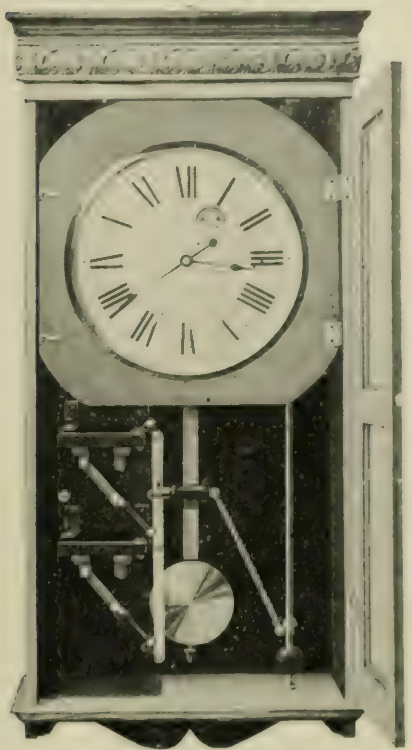
NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION. Annual meeting, Hotel Walton, Philadelphia, July 16, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

Time Cut-Out Switch.

Many cheaply constructed time cut-outs for shutting off display lights in stores at a predetermined time have been put on the market in the past, but in the present cut-out or clock switch, which is manufactured by the Baird Manufacturing Company, of Chicago, no attempt has been made to lessen the cost at the expense of reliability and security from burnouts. The clock is a reliable Seth Thomas movement, and the power of the clock is not utilized in in falling, attains sufficient momentum to jerk the switch open with certainty. The switch, either double or triple pole, is of the plain jack-knife pattern. The switch, which is seen in the clock case below the movement in the accompanying engraving, it attached to the falling weight by a chain. When once the falling of the weights has pulled the switch blades from the jaws the switch will go full open by gravity. There can be no sticking at a partly open position, and consequently no destructive arcing. The switches themselves are substantial. It is endorsed by the National Board of Fire Underwriters. Although more expensive than if a cheap clock were used, the high-grade clock makes the device certain in action, and failures to turn off the lights where large circuits are to be handled might result in bills for current consumption that would soon make up the difference in cost between a good and poor clock. Furthermore, the clock switch is just as available as a public or private time-piece as any clock would be, and can be used for the double purpose of regulator and switch.



TIME CUT-OUT SWITCH.

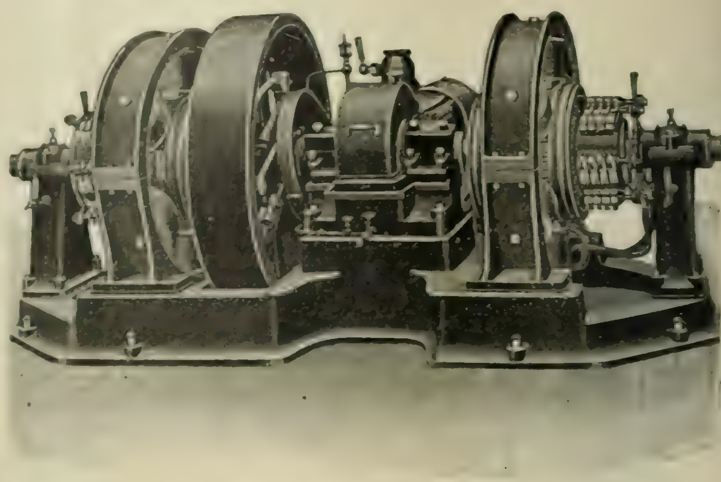
Double Generating Set.

In the accompanying engraving is shown a generating set, comprising a Buffalo forge horizontal center crank engine, and two direct-connected generators. The two generators and engine are bolted to the same cast-iron sub-base, the engine bed being near the center of the sub-base, and the field frames of the dynamos on either side. The two ends of the shaft are carried in out-board bearings, which are likewise secured to the sub-base. The main shaft carries the two armatures and the large governor wheel as well. The cylinders of this engine are provided with an efficient dead-air insulating space, and a polished sheet metal covering. The piston is made remarkably firm and light.

The crank shaft is a single forging of open hearth steel, to which the counter balancing discs are so fastened as to reduce the vibrating and shaking forces to a minimum. The connecting rod is of forged steel, and has a cross-head provided with a bronze box, which may be adjusted by means of a wedge and two screws. The crank end is of the locomotive strap type, with a wedge adjustment, and the boxes are lined with the babbitt metal.

The valve motion is obtained from an eccentric which is controlled by a shaft governor. This governor is especially adapted to the great regularity of speed required for electric lighting service. It is light and effective, and possesses two means of adjustment.

The lubrication has been most carefully considered. The crank disc and connecting rod are enclosed and run in oil, while the wrist pin bearing is provided with a cup which is supplied with oil from the same source. The out-board bearings are of the standard Buffalo adjustable type, ring-oiling and self-aligning. The entire oiling system of this engine is efficient and economical of lubricant. The engine is constructed by the Buffalo Forge Company, of Buffalo, N. Y.



DOUBLE GENERATING SET.

Electric Hoists.

The hoist shown in the accompanying illustration is designed to transfer light work rapidly around ship yards, factories, etc., and when supplied with trolley carriage, geared hand cross-travel and bridge travel motor, to take the place of small traveling cranes. The manufacturers of this hoist, the Sprague Electric Company, claim for it many advantages over any other equipment heretofore put upon the market. It has a very high efficiency, and is much smaller and lighter than any other hoist of like capacity, and, provided it is not greatly overloaded, is almost indestructible.

All the different movements necessary for a traveling crane, namely, hoisting, lowering, cross-travel and bridge-travel, are controlled by a simple pulling of the chains and cords connected to the mechanism, and which can be operated by the ordinary workman to be found in the machine shop, factory or other place where the hoist may be used; no special crane operator or cage being necessary. This is a unique feature, to which special attention is called.

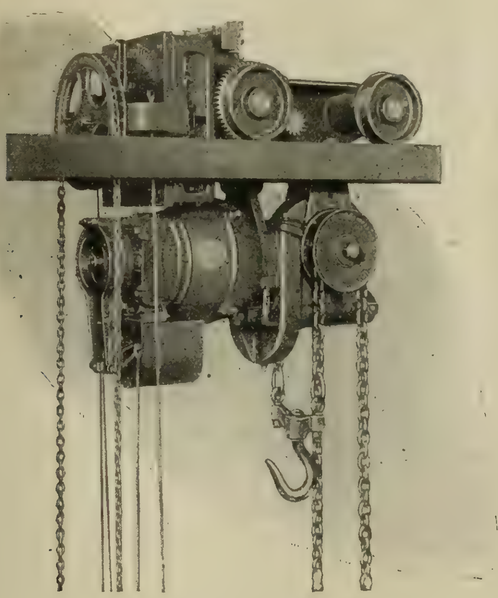
The apparatus consists of a chain and chain-wheel, connected by a hardened steel worm and bronze worm-wheel and steel spur gears to a standard Lundell enclosed round-type motor. The thrust of the worm is taken up by hardened steel rollers. The motor is provided with a rotary reversing switch, which works without the use of external resistance. All parts of this switch are made interchangeable.

The shaft of the hoisting motor is extended on the commutator end, and provided with a mechanical brake and brake-wheel. This brake is operated by a cam and spring, so arranged that when the starting and reversing switch is in the "off" position, the cam is disengaged, and the brake is set. In starting up the motor in either direction by pulling the cords attached to the switch-arm, the cam is thrown against the sides of the brake levers, and lifts the same off the wheel. This arrangement is much superior to a solenoid brake, and in actual practice it has been found that the work can be lifted from a state of rest and raised or lowered one-quarter of an inch or less.

The motor and hoisting mechanism can be hung from two hooks if only a hoisting and lowering motion is desired, or they can be attached to a trolley carriage arranged for cross-travel, either by pushing the load or by a geared hand traverse motion. A bridge-travel is also provided, the controller for which is mounted on the end of the trolley carriage, as shown in cut. This controller is operated by cords, the handles of which are located near the work. The bridge-travel motor itself is mounted in some convenient position on the crane. The bridge-travel controller is reversible, and in practice it is possible to move the crane or hoist a distance back or forward not exceeding one-half inch.

As stated before, the motors furnished with this equipment are Lundell round-type motors, entirely enclosed, and the hoist can be operated out of doors if ordered of weather-proof construction. The resistance plates for the bridge-travel controller are glass grids, the resistance itself being entirely enclosed by the glass which is cast around the same. These grids have a very large overload capacity.

In designing this apparatus, the manufacturers have carefully kept in view the fact that it would be subjected to rough usage. All

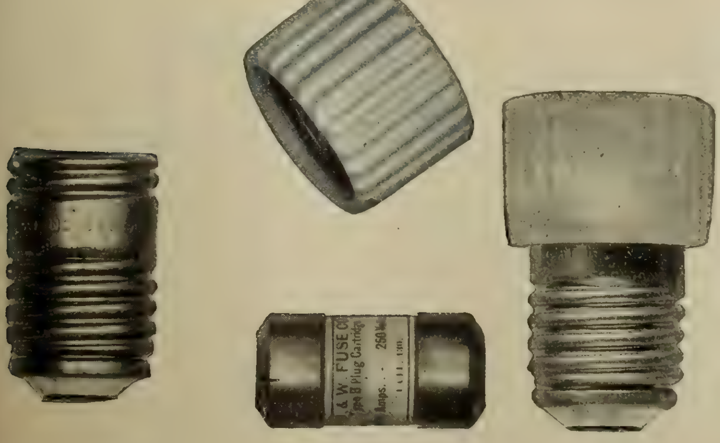


ELECTRIC HOIST.

parts are made of great solidity, and of the highest grade material, and all bearings have been made self-oiling, requiring but trifling attention at long intervals. The worm gear runs in oil and there is a slight oil gauge on the side of the gear case. The trolley carriage is provided with roller bearings, in order to decrease the effort necessary to operate the cross-travel. No resistance box is used for the hoist motor, and thus one source of annoyance and repairs is done away with entirely.

250-Volt Plug Fuse.

The D. & W. Fuse Company, Providence, R. I., has recently placed upon the market an improved form of 250-volt plug fuse, to fit the standard Edison cut-out. The illustrations show the plug assembled, and its several parts, consisting of the casing, porcelain cap and the small cartridge which contains the fuse proper. This company supplies cartridges which are interchangebale in capacities from 3 to



FUSE PLUG.

30 amperes. This little device was recently subjected to most severe trial, being directly short-circuited across a 250-volt circuit within 10 feet of the switchboard of a very large central station. The fuses repeatedly operated with freedom from flash, noise or discharge of any kind, and later were short-circuited directly across a 440-volt circuit under the same conditions, where they operated with like success, the only difference being that there was a slight noise at the instant of rupture of the fuse.

"Perfection" Rail Bond.

The Perfection Rail Bond Company, Monadnock Block, Chicago, is now placing on the market a type of rail bond, which embodies a number of new features. The underlying principle is that in order to make an efficient contact between a rail bond and rail,

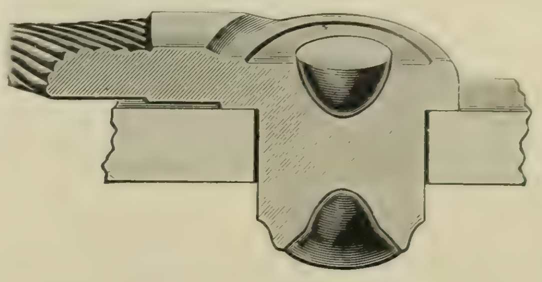


FIG. 1.—BOND IN PLACE.

the terminal must be expanded from its axis toward the surface, and that the pressure must be uniform radially. As will be seen from the illustrations, the "Perfection" bond consists of a plug terminal having cast in each end a semi-oval piece of hardened bronze. The inside bronze piece is slightly flanged so that when the two pieces are pressed home it will flange the bond plug against the rail. A hand compressor of convenient size is used to force the pieces into the bond plug and turn the flange. A movement of ¼ inch enlarges

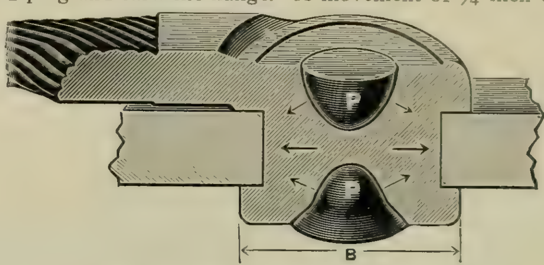


FIG. 2.—BOND AFTER COMPRESSION.

the bond terminal 3-16 inch, and form a rivet-head projecting ⅛ inch.

Fig. 1 shows a bond as entered, and Fig. 2 the same after the compressing operation. Fig. 3 shows a completed bond, which are made in any length from 4 inches up; the standard cross-sections for ⅞-inch terminals are from No. 2-0 to No. 4-0. Other styles than that shown have two cables either parallel, waved or bent to form short or long eyes. The copper cable is made integral with the terminals by a special process giving ample capacity for the current for which the bond is intended. The claims of superiority made for the "Perfection" bond are, that it insures the greatest possible pressure between rail and bond; best rivet head formed on the bond terminal; elimination of electrolytic action between the bond

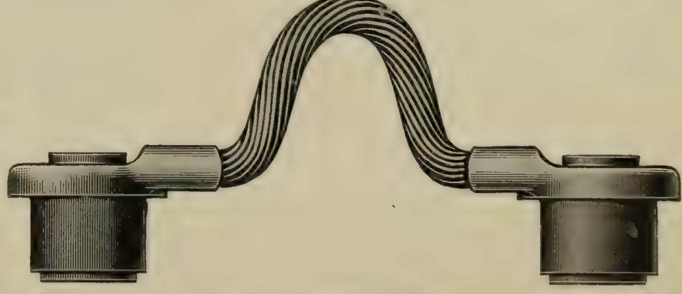


FIG. 3.—COMPLETE BOND.

and its plugs; elimination of electrolytic action between the bond and the rail (no air space exists after the plugs are pressed home); ease of application; attainment of perfect contact, even if the hole is considerably larger than the bond terminal; limited pressure required in applying the bonds; the bond cannot be turned after being pressed in position; it cannot be driven out after being pressed in place; long life, due to great flexibility of the connecting cable, and freedom from crystallization.

An Improved Gravity Cell.

Mr. W. N. Gove, of Philadelphia, has recently been granted a patent for an improved gravity battery, the improvement consisting of an amalgamation of three different kinds of metal, which is substituted for the copper element. It is stated that one cell of this battery will do the work of two gravity cells in telegraph work. The new combination-metal, it is claimed, can be substituted for the copper element in other batteries.

Running Gear for Automobiles.

Running gear is now being specially produced for electric and gasoline automobiles, and a demand has grown up for large quantities of it. The Automobile and Cycle Parts Company, of Cleveland, Ohio, is manufacturing in its Smith stampings factory, at Milwaukee, gears for such work, which they call the Hercules, as here illustrated in Figs. 1, 2 and 3, showing the frame construction, a complete gear without motor or battery and a plan view with the motor in position.

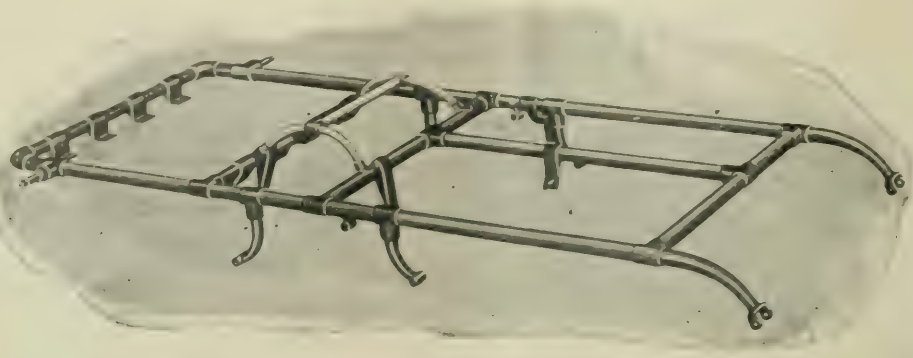


Fig. 1.—Automobile Frame Construction.

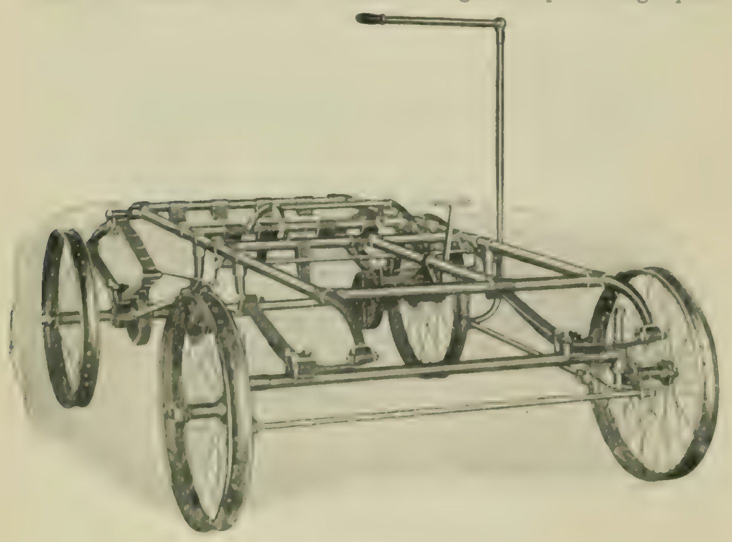


FIG. 2.—FRAME GEAR ASSEMBLED.

With regard to this apparatus, it may be noted that all tubing in the main frame is of high-grade steel, 1½ inches in diameter. The length of the frame from center of spring bolt to center of rear frame tube is 7 feet, and 8 feet from center of spring bolt to end of spring. The width of the frame is 32¼ inches, measured from center to center of side bars. This width will easily accommodate a 30-in. body, but by fitting close to the steering post a 36-in. body may be used. The side bars of the frame are of 10-gauge tubular stock, with reinforcing pieces extending in a forward direction for five feet. The construction of the motor carrier is such that if the motor should be violently swung in a lateral direction it would not be displaced. The frame is thoroughly braced to withstand any strains to which it may be subjected. The motor is permitted to swing by means of adjusting bolts which are fastened to two brackets attached to the cross bar of the frame.

The battery board supporters, eight in number, are brazed to the frame. The rear struts are made of tubing. The front springs are of the three-leaf elliptical pattern. They are clipped to the axle. The rear springs are four-leaf elliptical pattern, bolted and clipped in place. The side bar tubes of the frame form the upper half of the front springs. When the main frame side tubes are connected with the front springs the tubing is tapered.

The steering lever is tubular, reinforced at its upper end to give strength where the knuckle is keyed on. The lower end of the lever is curved inwardly so as to form a crank. At the end of the curve a steel piece connects with a bronze knuckle joint, which actuates the connecting rod, and, through it, the steering spindle. The spindle is a one-piece forging.

The equalizing gear is composed of straight spur gears of bronze; the case being pressed out of one-eighth inch steel. The brakes are of the band-drum type. The front axle is tubular and reinforced throughout its length, and the rear axle is of solid steel 1½ inches in diameter.

The wheels are wire, with 30-in. x 3-in. tires, standard equipment. The bearings of the front wheels are fitted with ⅜-in. balls —12 in the outside bearing and 13 in the inside bearing. The track width is 4 feet 6 inches from center to center of wheels, which permits safe running in street railway tracks.

The wood wheels with which these gears may be equipped are made of A-grade stock. The spokes are set in a wood hub and staggered—a patent construction. The steel bushings are bored after they are inserted in the hubs. This insures true running wheels. The running gears are fitted with 1-inch pitch, ⅜-inch roller bearing chains, for which adjustment is effected by swinging the motor backward or forward.

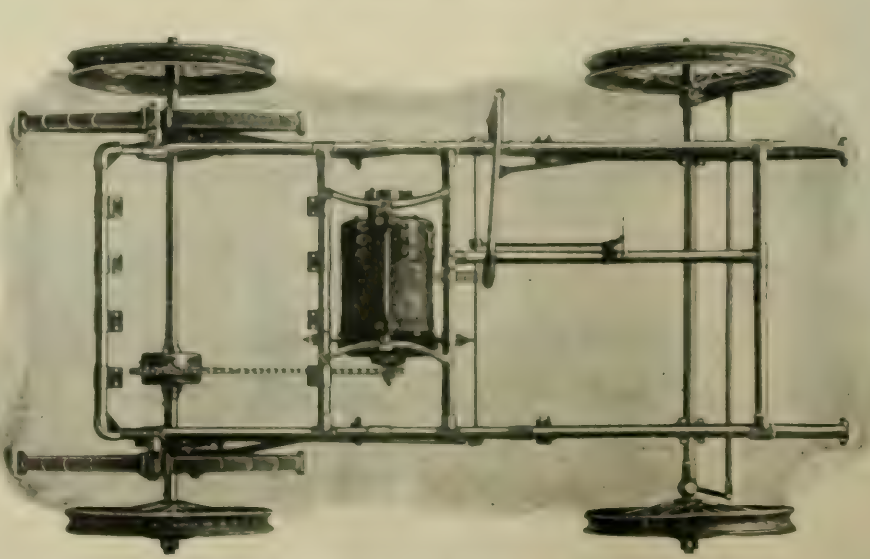


FIG. 3.—FRAME WITH MOTOR IN PLACE.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The large interest disbursements and other payments resulted in more or less disturbance of loans and in the calling of standing arrangements between institutions and stock market interests. The rate for call loans went as high as 7 per cent., while the bulk of business was from 4 to 6 per cent. Time money was not freely offered, the inquiry being also limited, the closing rates being 4¼ @ 4⅛ per cent. for 30 to 90 days and 4¾ @ 4¼ per cent. for four to six months. The stock market was strong, although activity was restricted by the two days' Stock Exchange holiday at the end of the week. Temporarily higher rates for money, caused by the large disbursements, had little effect upon the market. The favorable six months' statement of the United States Steel Corporation's earnings was well received, but pending the decision of the injunction suit the steel issues were quiet and firm. The traction group was neglected, although a good impression was produced by the fact that the Brooklyn Rapid Transit's earnings for May show a net increase. This stock closed at 67⅞, being a net gain of ¼ point, the number of shares sold being 9,980. Metropolitan Street Railway showed a little more firmness, closing at 149⅛, being a net gain of ¾ of a point. Trading in this stock was comparatively limited, the total number of shares sold being 2,610. General Electric showed some strength on limited trading, the highest figure reached being 310, closing at 308, a net gain of 3 points. The sales aggregated 1,000 shares. Westinghouse, common, lost 2 points net, closing at 208. Western Union closed at 87¾, being a net loss of 1½ points, the sales aggregating 10,200 shares. Other closing quotations at the end of the week were: American District Telegraph 38—a net gain of 1½ points; American Telephone and Telegraph 163—a net gain of ¼ point; American Telephone and Telegraph rights 15—a net gain of 1 point. In Boston American Telephone and Telegraph declined 13⅝ points during the week. Following are the closing quotations of July 8:

NEW YORK

	July 1.	July 8.		July 1.	July 8.
American Tel. & Cable..	—	—	Gen. Carriage (n. st'k)..	—	—
American Tel. & Tel....	163	—	Hudson River Tel......	—	—
American Dist. Tel......	38	—	Metropolitan St. Ry....	148⅜	147⅝
Brooklyn Rapid Transit.	67⅝	67½	N. E. Elec. Veh. Trns..	¾	—
Commercial Cable	—	—	N. Y. E. V. T. Co.....	12½	12
Electric Boat	28	30	N. Y. & N. J. Tel......	—	—
Electric Boat pfd.......	40	50	Tel. & Tel. Co. of Am..	—	—
Electric Lead Reduc'n..	2¾	2¾	Western Union Tel.....	87	87¼
Electric Vehicle	6	6½	West. E. & M. Co......	—	—
Electric Vehicle pfd.....	14	14	West. E. & M. C. pfd.	—	213
General Electric	—	—			

BOSTON

	July 1.	July 8.		July 1.	July 8.
Amer. Tel. & Tel. ex. rts.	163	166	Mexican Telephone	2¼	2¼
Cumberland Telephone..	—	—	New Eng. Tel. ex rts...	146	141
Edison Elec. Illum.....	280	—	Westinghouse Elec.	—	104
Western Telephone pfd.	—	103	Westinghouse Elec. pfd.	—	105
General Electric pfd....	—	308			

PHILADELPHIA

	July 1.	July 8.		July 1.	July 8.
American Railways.....	45¾	46	Phila. Traction	98¾	98¾
Elec. Storage Battery...	90	—	Phil. Electric	—	5⅛
Elec. Storage Bat'y pfd.	90	90¼	Pa. Elec. Vehicle......	—	—
Elec. Co. of America....	5⅞	5⅞	Pa. Elec. Vehicle pfd...	—	—

CHICAGO

	July 1.	July 8.		July 1.	July 8.
Central Union Tel.....	—	—	National Carbon pfd...	97¾	102
Chicago Edison	—	179	Northwest Elev. com...	—	—
Chicago City Ry.......	205	207¾	Union Traction	16⅞	14⅜
Chicago Teleph. Co.....	—	—	Union Traction pfd.....	—	51½
National Carbon	23	26			

ST. LAWRENCE POWER.—The St. Lawrence power plant at Massena, N. Y., has been sold at Massena by Referee Lynch under foreclosure proceedings begun by the first mortgage bondholders. The plant was bid in by Mark T. Cox, of New York, representing the reorganization committee of the first and second mortgage bondholders, for $500,000. More than $10,000,000 have been expended in the Massena power scheme, and it is understood that English capitalists are the heaviest losers by the failure. All the capital stock was taken by Englishmen, and practically all the first and second mortgage bonds were sold to English speculators. The failure of the project was due to a lack of field in which to dispose of the company's current. Six million dollars were soon spent. Then $3,000,000 first mortgage bonds were issued and $1,500,000 second mortgage bonds. Two millions of the first mortgage bonds and $1,250,000 of the second mortgage bonds were taken by the English people. The plant was completed after $10,500,000 had been spent. When the interest on the first mortgage bonds came due on July 1, 1901, there was no money to pay the interest charges. Interest charges due on January 1 also went by default, and in February suit was begun by the Commercial Trust Company, of New Jersey, and the Morristown Trust Company to foreclose before Judge Coxe in the United States Circuit Court in Utica. The plant was ordered sold on May 13 by Judge Coxe. The bondholders who are in the reorganization turned their holdings over to Robert Winthrop & Co., of New York.

BALTIMORE CONSOLIDATION.—The entire system of electric railways in Baltimore and its suburbs is to be operated by power from the Susquehanna River, through a deal which involves the United Electric Light and Power Company and also the Mount Washington Electric Light Company. A syndicate, in which it is said New York as well as Philadelphia and Baltimore capital is interested, has been organized, under the financial direction of the Continental Trust Company, of Baltimore, to absorb the light and power companies and develop the Susquehanna plant. A contract has been signed between the Continental Trust Company and the railway company under which the latter is to receive the power for operating its lines from the Susquehanna Company. The price paid by the syndicate for the two lighting and power companies is about $900,000. It is said that the Susquehanna Company will have three plants of 40,000 hp each. The deal between the Continental Company and the United Railways assures the completion of the great works and the further development of a plan to furnish light and power to a number of Maryland towns as well as electric railway connections between several of them and Baltimore. In financial circles it is believed that the syndicate will ultimately control electric power and lighting in Baltimore. It will be some time, however, before the works will be constructed.

THE MICHIGAN TELEPHONE COMPANY, whose securities are held in major part by Chicago investors, has notified that it will default on its July interest. The company announces that it has not in its treasury sufficient funds to meet the interest on its $5,000,000 consolidated mortgage 5 per cent. bonds, payment of which is now due. A committee headed by N. W. Harris & Co. now requests holders of these bonds to deposit them with the Old Colony Trust Company of New York on or before July 21, with the view of combining for the protection of all concerned. This committee, however, is hopeful that the company will in the near future be able to meet its obligations. The mortgage securing the bonds provides for the sale of the property under foreclosure proceedings after default for ninety days in payment of interest. The committee believes that during this period either a satisfactory adjustment can be made with the American Telephone and Telegraph Company, or in the event that the Michigan property has to be sold in accordance with the terms of the mortgage a satisfactory price can be realized.

QUEENS BOROUGH COMPANY'S MORTGAGE.—There was filed in the office of the Clerk of Queens County last week a mortgage executed by the Queens Borough Gas and Electric Light Company, to the Guaranty Trust Company, of New York, for $2,000,000. The company has absorbed the rights, privileges, franchise and capital stock of the Queens Borough Electric Light and Power Company, and those of the Hempstead Electric Light Company. The bonds are to bear interest at 5 per cent. Of the total amount realized, the sum of $200,000 is to be devoted to acquiring the existing mortgage of the Queens Borough Electric Light and Power Company, and $200,000 for the acquirement of the mortgage of the Town of Hempstead Electric Light Company. The sum of $800,000 will be spent for the acquisition of further properties and the extension of the plant. A. H. Bronson is the president of the new company, and Nelson R. Theall secretary.

CUBAN TROLLEY CONCESSION.—W. H. Park and H. G. Hamilton, of Youngstown, Ohio, associated with Devott, Trimble & Co., and H. W. McDonald & Co., Chicago; G. F. Penhale & Co. and H. Whipple, New York, and W. J. Hayes & Son, Cleveland, Ohio, have received a franchise authorizing them to construct and operate electric railway lines through Havana, Cuba. The concessions are estimated to be valued at $25,000,000. Havana has already, however, a fairly large and complete trolley system.

POSTAL TELEGRAPH IN NEW AGREEMENT.—It was authoritatively announced this week that the new contract between the Postal Telegraph and the Pennsylvania Railroad Company had been duly signed. The contract is for fifteen years, and the Postal has already begun to handle some of the business.

JERSEY TROLLEY TUNNEL.—At the last meeting of the Rapid Transit Commissioners the special committee, composed of President Orr, Commissioner Charles Stewart Smith, and Controller Grout, reported favorably on the application of the New York and New Jersey Railroad Company for a franchise to build a tunnel under the North River, with a terminal in New York City. In their report the committeemen say the road will be glad to accept terms very similar to those granted to the Pennsylvania Railroad, and that, considering the relative importance and length of the two tunnels, the agreement with the projectors of the road is as advantageous to the city as that with the Pennsylvania Company. The assurances of the company's financial responsibility are satisfactory. The company proposes to construct and operate a road for the transportation of passengers and property, with two tracks, between New Jersey and New York. The property necessary for the terminal is to be purchased at the expense of the company, which has agreed to begin construction within three months after obtaining the necessary consents, and to have the railroad in working order within three years. Under a schedule compiled by the committee, the company is to make annual payments for the right to enter the city within the pier line, and for underground portions of the streets, at a rate of $14,386.50 for the first ten years, and for the next fifteen years at the rate of $25,673. At the end of twenty-five years the charges are to be readjusted and thereafter at intervals of twenty-five years. If the city and company cannot agree upon the rates at the times of readjustment, these are to be determined by the Supreme Court. The company is to pay the city, for the first ten years, 3 per cent. and for the next fifteen years 5 per cent. upon an estimate of its gross receipts from the traffic within the City of New York. A rough estimate and the franchise fixes this at $300,000 a year for the next twenty-five years.

OTTAWA ELECTRIC ANNUAL REPORT.—President T. Ahearn issues a very satisfactory report for the past year of the Ottawa (Canada) Electric Company, whose new plant was recently described in these pages. The report shows a gross revenue of $227,634, an increase of $31,271 over last year. The gross profit was $112,390, out of which $25,913 went to pay interest on bonds, etc., leaving the net profit $86,477. An amount of $75,000 was carried to the depreciation account, and it is evident that nothing stands in the way of dividend resumption this year, the company having fully recovered from the effects of the big lumber fire. In April, 1902, the company had 5,820 customers, using 104,407 incandescent lamps, 752 arcs, 24 heaters and 157 motors.

LONG ISLAND TROLLEYS.—Permission has been asked from the New York State Railroad Commission by the Mineola, Hempstead and Freeport Traction Company to issue $1,000,000 bonds and increase its stock from $125,000 to $1,000,000, to build about forty-six miles of railroad through Nassau County.

Commercial Intelligence.

THE WEEK IN TRADE.—The weather and crop conditions attracted the most attention during the week, adverse influences affecting different sections to help or depress trade. Throughout the northern half of the country, from the Atlantic coast to the Rocky Mountains, the cool, wet weather has injured or arrested crop development, held retail distribution and checked re-orders and fall business with jobbers. Central-Western bituminous coal operators are doing a rushing business. Lumber is rather quiet at the East, but stocks of all kinds are low; builders' hardware is still active. The situation in industrial lines has not materially changed. A favorable development has been the voluntary increase of wages to 100,000 men in the iron and steel industry. The anthracite coal strike continues in a half-hearted sort of fashion. Between the high prices for material and total absence of stocks, supplies and business in iron and steel have suffered. A good volume of business in finished lines is reported, but most new business is in structural materials and rails for next year's delivery. *Bradstreet's* reports the number of failures for the week as 138, against [illegible] the previous week and [illegible] the same week last year. The copper market was somewhat easier, with sales of Lake as low as [illegible]. Electrolytic and casting stock were sold at [illegible], being quoted at [illegible].

THE CROCKER-WHEELER COMPANY, Ampere, N. J., notes the following among recent orders for direct current apparatus: Standard Steel Works, Burnham, Pa., two 200-kw generators; James Cooper Manufacturing Company, Montreal, Canada, [illegible]-kw generator; Buda Foundry and Manufacturing Company, Harvey, Ill., one 240-kw generator; Whitehall Portland Cement Company, Cementon, Pa., 85-hp motor; Woodward & Lothrop, Washington, D. C., one 200-kw generator, two 150-kw generators, and one 75-kw generator; Sparrell Print, Boston, Mass., 14 motors of 3 to 10 hp; Tidewater Steel Company, Chester, Pa., one 250-kw generator; Minot Light and Telephone Company, Minot N. D., one 90-kw generator; Armour & Co., East St. Louis, Ill., four 50-hp motors and one 75-hp motor; Green Engine and Machine Company, Harrison, N. J., four 35-hp motors; Descubridora Mining and Smelting Company, Mexico, four 20-hp motors; Moline Malleable Iron Company, St. Charles, Ill., one 90-kw generator and 11 motors aggregating 125 hp; Pennsylvania Sugar Refinery, Philadelphia, Pa., 14 motors of 3 to 15 hp; Fretz Umbrella Works, Philadelphia, Pa., 80 motors in small sizes; Lake Shore and Michigan Southern Shops, Collinwood, Ohio, 11 motors aggregating 200 hp have been shipped to apply on the Crocker-Wheeler installation in this plant. Speed control will be obtained by the C.-W. system of multiple-voltage operation.

STEAM PUMPS—The annual report of the International Steam Pump Company for the year ended March 31 shows as follows:

Balance undivided profits last year		$1,962,350
Interest		21,802
Total		$1,984,152
Div'ds: Com. Int. Pump	$490,500	
H. R. Worthington	184	
		490,684
Balance last year's surplus		$1,493,468
Net profits for year		1,510,486
Less preferred dividends:		
International Steam Pump	$531,000	
H. R. Worthington	140,000	
Provision for debentures, interest, preferred dividend, and expenses, Blake & Knowles Steam Pump, Limited (unpaid)	105,050	
		776,050
Surplus		$734,436
Previous surplus		1,493,468
Total undivided profits		$2,227,904

President Dunn, in his annual statement, says: The manufacturing plants of the company have been taxed to their utmost to meet the increased demand. The orders on hand at the present time are largely in excess of the capacity of the works. During the year just closed the orders taken have been over 41 per cent. in excess of the orders taken during the preceding year. The unfilled orders at the end of the present fiscal year amount to $5,750,000, which is $3,500,000 in excess of the unfilled orders on March 31, 1901. It has been found necessary to substantially enlarge the plants. Additions have been made to some of the shops, and the erection of extensive new works has been begun at Harrison, N. J., for the Worthington Company, which will largely increase the present capacity of the Worthington plant. It is intended that the new works shall be the largest and best equipped pump manufacturing plant in the world. There has been purchased during the past year the Clayton Air Compressor Works, which has proved an important acquisition to the properties of the company. The outstanding 40 per cent. of stock of the Holly Company, except a small number of shares, has also been acquired in the process of reorganizing the affairs of the company.

NEW YORK CENTRAL SIGNALS.—The New York Central and Hudson River Railroad Company has awarded a contract to the Hall Signal Company for the equipment of its Putnam Division, from 155th Street to Yonkers, wth the Hall system of automatic electro-gas block signals, to be operated on the normal danger plan. The signal blades, or semaphore arms, are held by gravity to a horizontal position to indicate to the engineer danger ahead, or are drawn down to indicate safety, by carbonic acid gas pressure in a cylinder in each signal post. The gas is stored in liquid form in a tank underground beside the post. The valve controlling the flow of gas from the tank to the cylinder is closed or released by an electric current passing through the rails, and this is done automatically by the presence, or otherwise, of a train in the block ahead, and the approach of a train from behind. The electric connections are such that the signal blade stands normally at danger. When the locomotive approaches it the engineer sees the blade down at safety, if it is safe to go ahead, or the blade remains up at danger if there is a train, open switch, or a broken rail ahead.

ORDER FOR ALUMINUM CIRCUITS.—An important contract for aluminum wire has been closed between the Royal Aluminum Company and the Shawinigan Water & Power Company, for the Montreal power line. The length of this line will be eighty-four miles, and 1,000,000 pounds of aluminum will be required, the equivalent of 2,000,000 pounds of copper wire.

HARTFORD, CONN.—The Connecticut Railway & Light Company, Hartford Conn., is installing a storage battery plant of 260 cells to provide supplementary power for its line in the Derby and Ansonia district.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended July 5: Antwerp—15 pkgs. material, $1,160. Argentine Republic—8 pkgs. material, $523; 1 pkg. machinery, $41. Bremen—7 pkgs. material, $855. Brussels—2 pkgs. material, $118. Bilboa—1 pkg. material, $375. Bristol—11 pkgs. cable, $1,803. Bradford—2 pkgs. material, $33. British East Indies—19 pkgs. machinery, $1,302; 39 pkgs. material, $1,324. Brazil—34 pkgs. material, $154. British Australia—43 pkgs. machinery, $3,285; 89 pkgs. material, $7,920. British West Indies—14 pkgs. material, $376. British Possessions in Africa—1 pkg. machinery, $60; 12 pkgs. material, $414. British Guiana—21 pkgs. material, $485. Chili—32 pkgs. material, $1,122. Central America—13 pkgs. material, $70. Copenhagen—3 pkgs. material, $40; 2 pkgs. machinery, $23. Christiania—10 pkgs. machinery, $16. Cuba—2 pkgs. material, $114. Gothenburg—2 pkgs. machinery, $1,210; 7 pkgs. apparatus, $181. Glasgow—6 pkgs. material, $501; 45 pkgs. machinery, $3,570. Hull—9 pkgs. machinery, $760. Hong Kong—7 pkgs. machinery, $1,099. Havre—15 pkgs. material, $611; 7 pkgs. machinery, $935. Hamburg—2 pkgs. machinery, $105; 36 pkgs. material, $1,415. London—38 pkgs. machinery, $2,361; 266 pkgs. material, $5,288. Liverpool—367 pkgs. machinery, $27,041; 55 pkgs. material, $1,479. Mexico—46 pkgs. material, $2,655; 52 pkgs. machinery, $2,420; 1 pkg. machinery, $75. Marseilles—20 pkgs. material, $310. Nova Scotia—2 pkgs. machinery, $33. Peru—1 pkg. machinery, $35; 18 pkgs. material, $652. Stockholm—1 pkg. machinery, $60. U. S. Colombia—34 pkgs. material, $1,003. Venezuela—38 pkgs. material, $558.

CLARK AUTOMATIC TELEPHONE COMPANY.—The annual meeting of the stockholders of the Clark Automatic Telephone Swtichboard Company, Providence, R. I., was held on June 17th. The following officers were elected: Hon. E. L. Freeman, president; Mr. J. W. Phillips, vice-president; Mr. A. S. Clarke, secretary; Mr. M. E. Torrey, treasurer, and Mr. J. L. Putnam, manager. The following were elected directors for the ensuing year: Hon. E. L. Freeman, Mr. J. W. Phillips, Mr. A. S. Clarke, Mr. M. E. Torrey, Mr. E. M. Prindle, Mr. W. H. Herrick, Mr. W. S. Ballou, Mr. G. H. Smith, Mr. J. H. Preston, Mr. A. E. Farwell, Judge A. Van Wagenen and Mr. J. L. Putnam. The Clark Company now has established agencies in all the leading cities of the United States, Hawaii, Europe, South Africa, Australia and Mexico. Recent sales include the International Paper Company, Wilder, Vt.; the National Cash Register Company, Boston, Mass.; Canada Sugar Refining Company, Montreal; United States Trust Company, Boston, Mass.; the towns of Larchwood and Doon, Iowa; Messrs. Garteiz Hermanos, Yermo & Co., Gijon, Spain, and the East Haven Telephone and Electric Company, East Haven, Conn.

HYDRAULIC MINING having been prohibited by the national government in many parts of California, the hydraulic development companies are very profitably turning their attention to power and irrigation projects. The Central California Electric Company has recently purchased two 1,000-kw Westinghouse alternating-current generators, which will be direct connected to water wheels and used to supply power to Grass Valley, Nevada City, Sacramento and adjacent towns. This is the third station to be installed by the company, two other stations having now been in operation for a number of years. The Central California Electric Company's system is a part of that of the South Yuba Water Company, which controls 400 miles of main ditch line in the heart of the Sierra Nevada Mountains. Formerly the water was used for hydraulic mining, but this having been stopped on account of the filling up of the rivers with "slickens," the water now is sold to ranchers and fruit growers for irrigation purposes. Before being sold to the farmers, however, it is transmitted in pipes to stations at different points along the system where electric energy is produced and then conducted 35 to 50 miles to adjacent cities.

ROCKINGHAM COUNTY LIGHT AND POWER COMPANY'S EXTENSIONS.—The electrical engineering and contracting firm of Sanderson & Porter, 31 Nassau Street, New York, has just let contracts for equipment which will practically double the capacity of the Rockingham County Light and Power Company's plant at Portsmouth, N. H. The plant is intended to furnish the city of Portsmouth with power for both lighting and general use and to supply electric energy for the purpose of operating some 150 miles of street railways in that district, including the Exeter, Hampson, Anesbury, Newton, Haverhill, Lowell and Lawrence. The original plant is 4,000 hp. Additional contracts have been awarded for 3,000 hp. The Westinghouse Company will furnish a 3,000 hp vertical Corliss engine, which will be direct connected to a 2,000-kw, 13,200-volt General Electric generator. The boiler order has been given to Thayer & Co., Incorporated, of 39-41 Cortlandt Street. Babcock & Wilcox will supply the superheater. Roney stokers are to be used.

EQUIPMENT FOR TOKIO ROAD.—Barber & Company's steamship, "Border Knight," which is scheduled to sail for the far East June 14, will carry over 1,000 tons of equipment, etc., for the Tokio Densha Tetsuda Kabushika Kwaisha, the Japanese concern which, it will be recalled, is about to construct with American material a 22-mile electric traction system in Tokio. The contracts so far given out are valued at nearly $800,000 and were secured by the General Electric Company through the Japanese house of Mitsui & Company, which concern, whose New York offices are at Nos. 445-447 Broome street, is financing the contract. The shipment now going forward will include two 1200-kw generators, built by the General Electric Company, and two 1800-hp horizontal cross compound condensing engines, manufactured by McIntosh, Seymour & Company, of Auburn, N. Y. There will also be forwarded part of the pumps, heaters, condensers, wire, pipe, etc., requisitioned for in the contract.

TRADE WITH THE POSSESSIONS.—Commerce between the United States and its newly acquired territory is growing with remarkable rapidity. In 1897, the year preceding that in which Porto Rico, Hawaii and the Philippines came under the American flag, the shipments to those islands were, according to the figures of the Treasury Bureau of Statistics, $6,773,560. In 1901 they were over $30,000,000, and in the fiscal year just ended they will be, according to the best figures that the Bureau of Statistics can obtain, fully $35,000,000. To this may be added the estimate of $15,000,000 of shipments to Alaska in the last year. This would bring the total sales of American goods in the non-contiguous territory of the United States up to about $50,000,000 in the last fiscal year, against about $10,000,000 in that same territory in 1897.

BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio, whose New York offices are under the management of Mr. Paul Bigelow, Taylor Building, has secured a contract from John Pierce calling for two 800-hp vertical cross compound engines for direct connection to 550-kw generators, to be built by the General Electric Company. These outfits are intended to be utilized for dry dock pumping purposes at Kittery Point, Me. The Buckeye Company has also recently obtained an order, through its New York offices, for a 700-hp vertical cross compound engine, to be direct connected to a 400-kw General Electric generator for installation in James Pyle & Son's Works at Greenwich and Vestry streets, New York. This equipment will be used for both light and power purposes.

THE INDUSTRIAL WORKS, of Bay City, Mich., one of the largest manufacturers of railroad wrecking cranes in the world, will shortly install a large amount of additional electrical apparatus for the operation of its shops. A recent purchase from the Westinghouse Electric and Manufacturing Company includes a 150-kw direct-current generator, which will be used to furnish current to eighteen or twenty direct-current motors already in use in the plant; a 200-kw two-phase alternator and a number of induction motors. The alternating current apparatus will be used entirely for power distribution. In addition to wrecking cranes the Industrial Works also manufacture smaller cranes and transfer tables.

BRAZILIAN ROAD TO HAVE AMERICAN EQUIPMENT.—The electrical engineering and contracting firm of James Mitchell & Co., Rio de Janeiro, which concern represents the Brazilian interests of the General Electric Company, the Pelton Water Wheel Company, McIntosh, Seymour & Co., the Peckham Truck Company, Babcock & Wilcox, etc., has been awarded a contract for the conversion of the lines of the Companhia Ferrocarril Santista, at present operated by mules, into an electric traction system.

WATER POWER FOR RUSSIAN MINES.—Mr. J. Stanley James, engineer of the Caucasus Copper Company, South Russia, is now in the United States for the purpose of closing contracts for a water-power plant to furnish power for operating the mines, now worked by steam. Mr. James is at present visiting the West, but will be in New York in about ten days' time. No contracts, it is understood, will be given out until he arrives at the Waldorf-Astoria.

CAHALL BOILERS.—The Boston offices of Thayer & Co., Incorporated, Eastern sales agents for the Cahall vertical water tube boilers, built by the Aultman & Taylor Machinery Company, have secured a contract for a 2,500-hp boiler plant for installation in the Woonsocket (R. I.) Electric Machine and Power Company's plant.

MONOGRAM SIGNS.—The Mason Monogram Company, of New York City, has recently been putting up some large signs, and has just finished one for the Anderson Food Company, Camden, N. J., which can be plainly read across the Delaware River in Philadelphia, and which is exciting favorable comment.

PHILADELPHIA SUBWAY.—President John B. Parsons, of the Philadelphia Rapid Transit Company, states that they expect to be in a position to advertise bids for the construction of the Market Street subway, between Broad and Twenty-third Streets, within the next sixty days.

FANS FOR FOREIGN TRADE.—The Federal Electric Company, 141 Broadway, has lately obtained some fair-sized contracts for both direct and alternating fans for export to London, England; Antwerp, Belgium, and Havre, France.

General News.

THE TELEPHONE.

TOMBSTONE, ARIZ.—[illegible] of the vicinity have [illegible] Valley Telephone Company to build a line to Tombstone. If the company will not construct the line, it is said an independent company will be formed.

SAN DIEGO, CALIF.—The Sunset Telephone Company will build a line from San Diego to Oceanside, Calif.

LOS ANGELES, CALIF.—A contract has been given to the Kellogg Switchboard & Supply Company for an additional 1,080 lines for the present equipment of the Los Angeles exchange. This will bring the capacity up to 7,080 lines.

WILMINGTON, DEL.—The American Telephone Company of Wilmington, Del., has been incorporated; capital stock, $300,000.

DOVER, DEL.—The Bourbon County Telephone Company has been incorporated to construct, maintain and operate telephone and telegraph lines in Paris County, Ky. Capital stock, $75,000.

WILMINGTON, DEL.—The Western Telephone & Telegraph Company, of Wilmington, Del., has been incorporated to construct, maintain and operate telephone and telegraph lines. Capital stock, $500,000.

ATLANTA, GA.—Comptroller-General Wright has rejected the returns of both the Postal and Western Union Telegraph companies, the comptroller averring that they are too small. An increase of about $131,000 is asked from the Western Union and $14,000 from the Postal.

BLOOMINGTON, ILL.—The Home Telephone Company of Bloomington has increased its capital from $30,000 to $100,000.

WINDSOR, ILL.—The Windsor Mutual Telephone Company of Windsor has been incorporated; capital stock, $3,000. Incorporators: H. S. Lily, A. C. [illegible]

CARLINVILLE, ILL.—The Carlinville Telephone Company has started the work of erecting a connecting line between the cities of Medora and Jerseyville by way of Fidelity.

MATTOON, ILL.—Six of the largest telephone companies in Edgar and Clark Counties have merged their plants into one concern, to be known as the Wabash Valley Telephone Company. The capital stock has been increased from $30,000 to $125,000. The officers of the new company are: President, H. H. Knipe, of Marshall; secretary, A. L. Keyes, Marshall; treasurer, James A. Earhart, Chrisman. Directors, George W. Fair, Charles Fair, A. K. Hartley, of Chrisman; A. L. Keyes and H. H. Knipe, of Marshall. The merger controls 1,700 telephones and the bonds for its consummation are already sold.

CLAY CITY, IND.—The Citizens' Telephone Company has been incorporated with $50,000 capital stock by John H. Klinger, S. M. Sibler, M. J. Murphy, S. L. Rowe, T. W. Engelhart and H. D. Falls.

NOBLESVILLE, IND.—The recent destructive storm destroyed many miles of telephone lines. The highways were blocked with poles and wires and the farmers chopped the poles from the roadway, necessitating hauling poles from a distance and stringing new wires. The telegraph companies met with a similar impairment. The Central Union Telephone Company's exchange at Alexandria was demolished by lightning, burning out the toll line switch-board and disabling many local and out-of-town instruments.

IOWA CITY, IA.—Iowa City and West Branch Mutual Telephone Company has been incorporated. Capital $2,000. J. T. Struble is president.

DES MOINES, IA.—The Mutual Telephone Company, heretofore an independent system, having nearly two thousand subscribers, was sold to a private company.

LOST NATION, IA.—The Lost Nation Telephone Company has been incorporated; capital, $5,000. Albert Daniel is president; W. C. Hohn, vice president; L. Rutenbeck, secretary; Tim Appleton, treasurer.

VICTOR, IA.—The Victor Mutual Telephone Company has been organized in the eastern part of the county, with a paid-up capital of $2,000. T. T. McMillan, of [illegible], president; [illegible], secretary; [illegible], treasurer; directors, W. E. Foshier, Robert Converse, W. S. Huffman, R. P. Klein.

BURKESVILLE, KY.—The Gainsboro Telephone Company is putting in a new long distance line connecting Burkesville with Glasgow by way of Tompkinsville. An exchange will probably be established at Burkesville.

FORT SCOTT, KAN.—The Missouri and Kansas Telephone Company (Bell) has bought outright the toll lines of the Kansas Telephone Company, which has [illegible] from Fort Scott [illegible] in Missouri and Kansas of which those towns and Iola and Garnett, Kan., Rich Hill and Nevada, Mo., and Pittsburg and Girard, Kan., are the principal points. The [illegible]. In [illegible] the Bell Telephone Company [illegible] with the independent telephone company of Pittsburg, Kan., [illegible] the Bell exchange and the competing exchange [illegible] will [illegible] their plants and one rate will be charged in place of two.

NEW ORLEANS, LA.—The [illegible] has reported [illegible] for the Telephone Company of [illegible] known as the McFall ordinance for telephone privileges.

ANN ARBOR, MICH.—The [illegible] Telephone Company is about to make extensive improvements in its station at Ann Arbor. An entire new office plant will probably be installed. The amount to be expended will be about $40,000.

MINNEAPOLIS, MINN.—By an order from Judge [illegible] the Northwestern Telephone Company gets practically all it asked in the injunction suit against the Twin City Telephone Company to determine which has the right of way in certain sections of the atmosphere of Minneapolis. Wherever the Northwestern Company has established its lines first, the court holds, it is entitled to the exclusive use and enjoyment of the space between the top crossarm upon its poles and a point 20 feet from the ground. The Twin City Company is ordered to remove its wires at intersecting points in case they go under the Northwestern wires, and is further enjoined for the future from stringing any wires under those of the Northwestern Company.

MEXICO, MO.—G. T. Graham, late manager of the Mexico Telephone Co., will begin the construction of a number of exchanges in Northwestern Missouri about August 1. He will also continue the manufacture of a patent receiver of which he is the inventor.

ALBEMARLE, N. C.—The Albemarle Telephone Company has increased its capital to [illegible]

HENDERSON, N. C.—The town has refused a request for a franchise from the Bell Telephone Company. An independent company is already in the field.

BEATRICE, NEB.—The Nebraska Telephone Company has planned to build a new telephone exchange which will cost about $6,000.

FREMONT, NEB.—The city council has granted a franchise to J. L. Laird, B. W. Reynolds, C. S. Reynolds and others to build and maintain an independent telephone exchange.

HOPKINTON, N. H.—The Hopkinton Telephone Company will make extensions of its line to the Tyler district.

CLYDE, N. Y.—A new independent telephone company, capitalized at $50,000, has been organized by C. A. Lux for the purpose of purchasing and consolidating the various Wayne County telephone systems organized by Bishop Brothers.

NEW YORK, N. Y.—The Western Union Telegraph Co. is said to have raised the salaries of some 200 operators, chief operators and managers in New York since May 1, offsetting many reductions, dismissals, etc., since the new regime came in. Several old employees have been pensioned—a new thing, it is said.

NEWARK, OHIO.—The Newark Independent Telephone Company is arranging to put in a modern central energy system.

MARION, OHIO.—The Marion County Telephone Company has laid off part of its construction force. It is claimed that delay in the receipt of material makes this step necessary.

MONTPELIER, OHIO.—The Montpelier Telephone Company has purchased from the Williams County Toll Line Company lines from Angier to Beck's Corners, giving the company direct connection with Angier.

NEWARK, OHIO.—The Newark Telephone Company will prepare plans for an enlarged and improved system and it is probable that a central energy board will be installed.

CLEVELAND, OHIO.—H. H. Robinson, formerly general superintendent of the Central Union Telephone Company, with headquarters at Chicago, has been appointed assistant general manager of the United States Long Distance Telephone Company of Cleveland. The United States system covers the whole of Ohio and parts of Michigan, Indiana, Kentucky and West Virginia.

GREENVILLE, S. C.—The Citizens' Telephone Company, of Spartanburg, and the Home Telephone Company, of Greenville, were sold at auction recently by Mr. A. G. Furman, trustee, to satisfy a mortgage of $30,000, given on both plants by L. W. Floyd, of Newberry, and G. A. Browning, of Greenville. Both of the plants were purchased by Mr. Floyd; the one at Spartanburg for $23,000 nad the one at Greenville for $10,200, subject to the mortgage aggregating $5,224.

BALLINGER, TEX.—The Central Texas Telephone Company has increased its capital stock from $50,000 to $75,000.

EUREKA, TEX.—The Eureka Telephone Company has been incorporated with a capital stock of $4,000. The incorporators are J. A. Bonner, J. R. McComick, R. G. Goree, T. R. Harwell and C. J. McConinco.

NORFOLK, VA.—The Southern States Telephone Company has completed connections with the Tidewater Telephone Company of Gloucester C. H., Va.

WINCHESTER, VA.—The Winchester Telephone Company's plant, covering Frederick and Clarke Counties, in Virginia, and Berkely, Jefferson, and Hampshire Counties in West Virginia, has been sold to the United Telephone Company, of Philadelphia.

TACOMA, WASH.—It is stated that the new Northwest Telephone Company has [illegible] and is ready to begin building operations in Everett.

MADISON, WIS.—The Lisbon Telephone Company of the village of Sussex, Waukesha County, [illegible], has been incorporated by James R. Watson, Alex. Will, C. W. Weeks, W. D. McGill and G. C. Butler.

ELECTRIC LIGHT AND POWER.

CORONA, CALIF.—A petition is being circulated in Corona to ask the Board of Trustees to bond the city for [illegible] for the purpose of building a municipal electric light plant.

OAKLAND, CALIF.—The Southern Pacific Railroad Company has completed its new electric lighting [illegible] at the West Oakland [illegible]. In the roundhouse flexible cables enable all parts of the locomotives to be examined by electric light.

SAN JOSE, CALIF.—The Globe Light & Power Company which was recently incorporated in San Jose with a capital stock of $[illegible], by J. K. [illegible], H. W. McComas and others, purposes installing a water power electric plant in the high Sierras and operating a transmission line.

SAN FRANCISCO, CALIF.—During the visit of the Imperial Council of Mystic Shriners, about 10,000 Shelby 16-cp. lamps were used in the street illuminations, the lamps being strung in rows of 50 across Market Street at short intervals. The wiring and lamps will probably be used when the Knights of Pythias have their annual gathering in San Francisco in August next.

The 5,000 lights that have been permanently installed on the exterior of the City Hall dome produced a fine effect. The tower of the Ferry Depot was finely illuminated with 2,000 lights. Twelve extra transformers were installed by the Independent Electric Light & Power Company, which supplied the current. The Claus Spreckels building was handsomely illuminated.

GLENWOOD SPRINGS, COL., will soon vote on the question of a municipal electric light plant.

GEORGETOWN, COL.—The Clear Creek Light & Power Co. of Georgetown has made a number of extensive improvements in its plant. The company has acquired additional water rights. The controlling interest in the company has been bought by F. E. Himrod of New York, who is also interested in the Cascade Electric Company of Idaho Springs. The company is installing another 300-hp generator, and is building another line of poles from Georgetown to Idaho Springs. It is understood the new owners have in view a power plant in Grand County and may run wires 70 miles to the east side of the divide at Georgetown.

AUGUSTA, GA.—The council has decided to offer the Augusta Railway and Electric Company $70 per year each for arc lights, beginning July 1. Bids will also be called for supplying arc lights for terms of 3, 5, 10 and 20 years to begin July 1, 1903.

JACKSON, GA.—The Jackson Street Railway Company, incorporated in December, 1900, has just organized and will go ahead and transmit necessary power for electric lights contracted for with the city. Machinery for the street railway will be purchased at once.

VIRGINIA, ILL.—At a special election held July 2 it was voted to have electric lights.

LAFAYETTE, IND.—The Merchants' Electric Light Association, recently incorporated, has increased its capital stock from $30,000 to $150,000.

MADISON, IND.—The Madison Light Company, of this city, has incorporated with a capital of $75,000. John H. Brown heads the board of directors.

RICHMOND, IND.—The city council has appointed a committee to test the new municipal light plant and empowered it to employ an electric expert to assist in the work. This municipal enterprise has been in litigation from start to finish and the end is not yet in sight.

BALTIMORE, MD.—It is understood that an agreement has been reached for the purchase of the United Electric Light and Power Company by the Susquehanna Power Company of the $2,000,000 common stock of the former company which is held by the United Railways and Electric Company. The Continental Trust Company, it is said, will finance the deal. Three developments of 40,000-hp each are contemplated on the Susquehanna river.

CARROLLTON, MO.—The Carrollton water and light plant and the Carrollton street railway have been purchased by local capitalists and consolidated. The purchasers are Herndon Ely, P. L. Trotter, Lewis Ely, Vivian Ely, Thomas Marshall, T. L. West and W. R. Painter. The capital stock of the new company is $100,000 fully paid up.

HAZLEHURST, MISS.—The town has voted to approve the contract for a waterworks and electric light system. Work is now progressing.

ANACONDA, MONT.—A 800-hp motor has been placed in the Anaconda mine at Butte, Mont. Power is being furnished by the Missouri River Power Co.

BUTTE, MONT.—Electric power will take the place of steam in the large Neversweat mine in Butte. A 800-hp motor is already installed to run compressors. Power is furnished by the Canyon Ferry Power Company.

BUTTE, MONT.—A new company has been formed in Butte to supply the city with electric lights. The promotors are: Geo. Casey, J, H. Hesler and J. F. Cowan. They have located 1500 horse-power of water at Race Creek, about 25 miles from Butte.

BOZEMAN, MONT.—G. P. Dier, E. M. Ferris and others will erect a large power plant at Bozeman. The new company has taken up 5,500 inches of water in Hell Roaring Creek. Here the plant will be built and power transmitted to Bozeman and Belgrade. It has also planned to build an electric railway from Bozeman to Salesville and up the west Gallatin Canyon to the Yellowstone National Park.

NEW YORK, N. Y.—The East Hampton Electric Light Company, of East Hampton, has filed articles of incorporation with the Secretary of State. The capital stock is placed at $48,000. The directors for the first year are William A. Wheelock, Everett Howell, George E. Munroe, of New York City; George L. McAlpin, Schuyler S. Quackenbush, Cyrus W. Edlitz, Benjamin H. Van Scoy and Joseph S. Osborne, of East Hampton, and Henry A. James, of Lakewood.

COLUMBUS, OHIO.—Plans have been prepared by W. T. Mills for the plant to be erected by the Eastern Heating & Lighting Company.

COLUMBUS GROVE, OHIO.—A vote on the proposition of bonding the village for $15,000 to purchase the local lighting plant resulted favorably.

MANCHESTER, OHIO.—A special election for a vote on the proposition of bonding the town for $8,000 to build a lighting plant has resulted favorably.

SANDUSKY, OHIO.—Contracts will be closed in the near future for a new power house for the Erie County Children's Home. Plans have been prepared by Architect Marble.

FREMONT, OHIO.—The Home Electric Light & Power Company has been organized by Dr. Creager and E. B. Phillips to succeed the Creager Light Company. The company has secured a city franchise and will rebuild the old Creager plant at Ballville, installing new equipmentt throughout. Current will be furnished for lighting and power.

PITTSBURG, PA.—The borough of Coraopolis has advertised for bids for the construction of a municipal electric light plant which it is estimated will cost about $15,000. The plant will be under the supervision of the councils committee on lighting and will be equipped with generators operated by two automatic engines and a 200-horse power water tube boiler.

MERCUR, UTAH.—The Sacramento Mill Company at Mercur has installed electric motors to run the ore crushers.

SALT LAKE CITY, UTAH.—The Friday mine in eastern Oregon will build an electric power plant to furnish its mill and mine with power.

SALT LAKE CITY, UTAH.—The A. K. mine in Flathead County, Mont., will install a large power plant to operate its mining machinery. Power lines will be built 2,000 feet into the tunnels of the mine.

SALT LAKE CITY, UTAH.—Mahoney Bros., of Tekoa, Wash., have purchased from the Tekoa Cold Storage Power Company the electric light plant. The new managers will make entensive improvements.

SALT LAKE CITY, UTAH.—The Montreal & Boston Copper Company, which has just completed a large smelter at Boundery Falls, B. C., has erected a 250-kw Siemens-Halske generator driven by a high-speed Atlas engine for electric lighting purposes.

NORTH YAKIMA, UTAH.—J. F. McNaught has filed papers appropriating 1,000 cubic feet of water on the Natchez River, about 20 miles from North Yakima. A large power plant will be built, furnishing power for manufacturing purposes. This is preliminary to building the electric road from North Yakima to Sunnyside.

FOUNTAIN GREEN, UTAH.—The Big Springs Electric Light Company of Fountain Green, has been granted a franchise to build a pole line between this town and Moroni. The Western Electric Supply Company has secured the contract to supply the electric machinery. The power house will be located about 10 miles from Fountain Green, where a fall of water of 300 feet can be secured.

SALT LAKE CITY, UTAH.—Contracts have been let for the new electric pumping station to be erected at the head of Jordan River to supply water for irrigation purposes to the farmers of Salt Lake County. A dam will be built at that point costing $35,000. The plant will consist of 4 centrifugal pumps, and four 100-hp Westinghouse motors. Power will be furnished by the Telluride Power Company.

SPOKANE, WASH.—A complete electric plant for power and lighting has been installed on Dixie Creek by the Copperopolis Mining Company, of Spokane, Wash. Power is used for operating electric drills, compressors and hoists. To get a fall of 75 feet a ditch of 1300 feet was constructed.

MILWAUKEE, WIS.—A contract has been awarded by the Milwaukee Electric Railway & Light Company, Milwaukee, Wis., for a storage battery equipment for its lighting system in that city. The plant will, it is stated, cost $250,000. The company is about ready to let contracts for the erection of its new building on Sycamore Street, also for 1,000,000 feet of new conduits.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The United Railroads of San Francisco recently filed with the County Recorder at Redwood City a deed of trust to the Union Trust Company of San Francisco. The loan which was made amounted to $36,279,000, bearing four per cent. interest.

DENVER, COL.—The Denver Tramway Company has started work on its new $400,000 addition to the newly erected power house. It will double the size and capacity of the present structure. This is the first important step toward supplying with power the electric railways which are to connect Denver with the northern coal fields and mountain towns. Plans for the new power house were drawn by Engineer L. L. Summers, who came from Chicago to superintend the building of the plant recently completed.

FORT WAYNE, IND.—The Ft. Wayne & Southwestern Traction Company has filed a mortgage for $2,000,000 in favor of the State Street Trust Company, Boston, to secure bonds. The line from Ft. Wayne to Wabash is mortgaged for $1,000,000. The remainder will be held to cover future extensions.

INDIANAPOLIS, IND.—The Indianapolis Water Works will attempt by suit to hold the city of Indianapolis liable for the damages occurring to its mains for its failure to compel the local street railway company to provide return current circuits or some other change in its equipment that will protect water mains from electrolysis. The water company contends that the city has this authority under its charter and failing to exercise it renders it, instead of the street railway company, liable.

ALEXANDRIA, LA.—J. C. Allen is interested in a $50,000 proposed electric belt line. It is said that the General Electric Company of Atlanta will take about $20,000 stock. The road will be about four miles long.

NEW ORLEANS, LA.—The legislature has passed the "Jim Crow" car bill as relating to all street cars in the state providing for a partition separating the races.

ROCKVILLE, MD.—The Chevy Chase and Kensington electric railway, running from Kensington to Chevy Chase Lake, a distance of about two miles, and which has been in the hands of receivers for some months, has been sold to Mr. George E. Emmons, of Washington. It is understood that the track and rolling stock will be placed in first-class condition.

NEW YORK, N. Y.—The Union Railway Company will build a two-story brick power house on the east side of the Southern Boulevard. The cost is placed at $20,000.

NEW YORK, N. Y.—Thompson, Tenny & Crawford, of 25 Broad Street, are arranging an important consolidation of street railroads in New Hampshire. The proposed company will be known as the New Hampshire Traction Company.

URBANA, OHIO.—The county commissioners have granted a 25-year franchise to the Springfield, Piqua & Sidney Traction Company.

BATAVIA, OHIO.—The council has granted a franchise to the Cincinnati, Portsmouth & Georgetown Railway for its branch to Batavia.

NEW PHILADELPHIA, OHIO.—The Canton-Akron Electric Railway has been granted franchises through New Philadelphia and Strasburg.

DELAWARE, OHIO.—The Delaware, Berkshire & Sunbury Railway Company has secured franchises from councils at Delaware and Sunbury.

GENEVA, OHIO.—The village councils at Geneva and Madison have granted franchises through these towns to the Cleveland, Painesville & Ashtabula Railway.

YOUNGSTOWN, OHIO.—The Pennsylvania & Mahoning Valley Railway Cleveland Electric Railway Company have again voluntarily increased the wages of all employees. The new scale which took effect July 1 amounts to about 10 per cent.

CINCINNATI, OHIO.—A company is being formed by Charles Laval, of Evansville, Ind., C. C. Tennis, of Cincinnati and Charles Randall, of Dayton, to build an electric railway from Evansville, Ind., to a point on the Ohio river opposite Henderson, Ky.

YOUNGSTOWN, OHIO.—Messrs. Park and Hamilton, of this city, have received a cablegram from their representative in Havana announcing that franchises have been granted them authorizing them to construct and operate electric street railway lines throughout the city of Havana. The concessions are said to be worth fully $25,000,000 and include all the franchises in the city of Havanna.

CLEVELAND, OHIO.—The Cleveland, Richfield & Akron Transit Company, which is building a second line from Cleveland to Akron, has opened offices in the American Trust Building, in this city. Officers have been elected as follows: Charles T. Inmans, Akron, president; Horace B. Camp, Akron, vice-president; Daniel Gindelsperger, Cleveland, secretary; S. P. Inmans, Cleveland, treasurer.

PORTLAND, ORE.—The Portland City & Oregon Railway Company has decided to expend $5,000,000 on a new system of trolley roads, the trunk line of which will extend from Portland to Springwater, Clackamas County, Oregon, a distance of 35 miles via Gresham and Powell's Valley. Construction work will be commenced by July 15th. The company recently purchased two miles of water front property on the East Side in Portland, extending along the Willamette River. This will be used for terminal purposes.

SALT LAKE CITY, UTAH.—The Salt Lake & Bingham City Electric Railway Company has been granted a franchise by the County Commissioners of Davis County, Utah.

MIDDLEBOURNE, W. VA.—Capitalists interested in the proposed Middlebourne & Sisterville Electric Railway are having surveys made of the route.

THE AUTOMOBILE.

NEW YORK CITY.—The following board of directors has been elected by the Manhattan Transit Company: Lord Kintore, Equerry to the King; Lord Grey, Executor Rhodes will; Sir Charles Rivers Wilson, Chairman of the Grand Trunk Railway; C. S. Drummond, London Traction Company, all of London. Harold Walker, Walter G. A. Hemming, W. J. Arkell, W. K. Gillette, Walter H. Knight, James B. Brady, of New York, Senator P. H. McCarren, of Brooklyn, N. Y., New York directors. C. S. Drummond was elected president of the corporation and W. J. Arkell chairman of the board. The Atlantic Trust Company will issue certificates in exchange for the old General Carriage certificates, with the assessment paid, the plan having been successfully carried out.

NEW INDUSTRIAL COMPANIES.

THE AUTOMATIC HEATING AND LIGHTING COMPANY, of Cleveland, capital stock $300,000, has been incorporated.

THE MORRIS ELECTRICAL COMPANY, of Wilmington, Del., has been incorporated to deal in electrical goods; capital, $20,000.

THE DIAMOND AUTOMOBILE COMPANY, of Philadelphia, to manufacture vehicles of all kinds, has been incorporated; capital, $125,000.

THE AMERICAN THERMO-CALL COMPANY has been incorporated at Kittery, Me., to make and deal in electrical devices of all kinds; capital, $100,000. President, Horace Mitchell, Kittery, Me.; treasurer, A. M. Meloon, New Castle, N. H.

THE CONSOLIDATED FIRE ALARM COMPANY, New York, has been incorporated; capital, $2,500,000. Directors: Augustus D. Julliard, Thomas R. Brown, Manhattan; Bernard M. Ewing, Wyckoff, N. J.; Thomas R. Were, Maplewood, N. J., and Leroy L. Chuin, Montclair, N. J.

THE O. C. IRWIN ELECTRIC COMPANY has been formed in Crawfordsville, Ind., to manufacture electrical supplies. The capital stock is $50,000. The managers say the company will be able to supply electric lighting plants complete. The Irwin transformer will be made. O. C. Irwin is president of the new company.

OBITUARY.

ALBERT CLARKE WHITE.—We are informed of the death, on June 27, of A. C. White, general manager of the Providence Telephone Company, at the age of 61 years.

PERSONAL.

MR. WM. S. HORRY, electrical engineer for the Union Carbide Company, Niagara Falls, sailed on the steamer "Lucania," July 5, on a short trip to England.

MR. C. H. NORTH, of the North Electric Company, Cleveland, manufacturers of the well-known telephone apparatus bearing his name, was a visitor to New York a week ago.

LT. COM. B. A. FISKE, U. S. N., continues in the July "United Service" his intensely interesting and "human" story of the events at Manila after the great Dewey battle, in which he was an active participant. The narrative is most fascinating.

MR. T. W. WARNER, Muncie, Indiana, maker of the celebrated Warner ringer for telephone service, was one of the visitors at the Convention of the Independent Telephone Association recently held in Philadelphia, following which he spent a few days in New York before returning west.

MR. JOHN L. PUTNAM, manager of the Clark Automatic Telephone Company, was in New York this week on his way South. He is taking an extensive trip through the Southern and Central States, where the Clark system is meeting with great success.

MR. ALEX. HENDERSON has been made Master of Transportation for the National Electrical Contractors Association meeting at Philadelphia on July 16 and 17, and has issued notice of a special train from New York over the Jersey Central at 9:30 A. M. on July 16.

MR. J. C. IRWIN has just been appointed engineer of signals for the New York Central Railroad. He is a civil engineering graduate of the University of Pennsylvania, and has for some time been associated with steam railway, electric railway and signal work.

MR. W. R. MASON has resigned his position as agent for the Sprague Electric Company in Chicago and has accepted the position of Western manager for Coe, Smith & Co., selling agents for the Mechanical Boiler Cleaner Co., with offices in the Western Union Building, Chicago.

MR. J. W. PETERSON, who was formerly connected with the Chicago Sales Department of the Stanley Elec. Mfg. Co., and the Northern Electrical Mfg. Co. has been elected vice-president and general manager of the Electrical Equipment Co., with offices in the Monadnock Building, Chicago. The concern has several large contracts on hand for light and power plants.

MR. RAY D. LILLIBRIDGE, specialist in technical publicity, has moved from 20 Broad Street into the new Broadway-Maiden Lane Building, 170 Broadway, in order to provide accommodations in keeping with the steady increase in his business and facilities. Mr. Lillibridge has already succeeded in creating a large clientele of important concerns, for whom he has done excellent work.

COL. ALLAN C. BAKEWELL, second vice-president and general manager of the Sprague Electric Company, was recently elected Department Commander at the New York State Encampment of the G. A. R., held at Saratoga Springs. There was a strong opposition ticket in the field, but Col. Bakewell, in recognition of his services in both State and National work of the organization, was elected by a handsome majority.

MR. FREDERIC NICHOLLS, after enjoying a good time at the Cincinnati convention, went home to Toronto and plunged forthwith into a street railway strike. He was the only director in town when the strike took place, the military was called out, and it was 62 hours before he got a chance to rest. He would much rather have gone fishing, but it all ended well. He was also unable to attend the Canadian convention owing to the illness of one of his boys, but was represented there by two other sons. His many American friends have been heartily glad to learn that he has, is usual with him, pulled out in good shape.

EDUCATIONAL.

TROY POLYTECHNIC.—Prof. W. L. Robb has now assumed charge of the department of physics and electrical engineering at the Rensselaer Polytechnic Institute, Troy, N. Y. At its commencement last week, Trinity College, Hartford, Conn., conferred upon him the honorary degree of LL. D. in recognition of his work there and in the engineering field. He will have with him as assistants at Troy, Mr. E. D. N. Schulte and Mr. H. H. Rudd, the former an excellent electrical engineer and the latter a physicist who was assistant professor in physics at Trinity. This gives Rennsselaer an admirable teaching corps in a department which it expects to do it great honor.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, will be glad to have the name and address of those interested in wattmeters, who have failed to receive a copy of its new Gutmann alternating current watt-meter catalogue. It will be mailed promptly upon application.

MILLING MACHINE ATTACHMENTS constitute the subject of catalogue 5 and 6 of the Garvin Machine Company, New York. The various attachments are illustrated and briefly described. A copy of this catalogue should be kept handy for reference in every machine shop.

CATALOGUES WANTED.—Owing to a recent change in the office arrangements of the electrical department of the George A. Fuller Co., New York City, its catalogue file has become depleted, and it is now desirous of refilling it. Catalogues should be sent to the company in care of Mr. W. J. Martin.

ELECTRIC SIGNS. "Profitable Advertising" devoted a large part of its June number to a consideration of the value and use of electrical signs for advertising purposes. The subject was well illustrated and the effectiveness of electricity was excellently brought out, from the advertiser's standpoint.

AMERICAN STEEL AND WIRE CO. has received a large number of awards from the South Carolina Inter-State and West Indian Exposition, including gold medals for its copper, iron, steel and aluminum wires and silver medals for its overhead and underground wires and cables. It also received a gold medal for machinery and appliances for drawing wire.

TOOLMAKERS' LATHE.—The Pratt & Whitney Company, Hartford, Conn., has issued a handsome catalogue descriptive of a new 10 in. x 5 ft. toolmakers' engine lathe which it is now placing on the market. The manufacturers claim that this is the most complete precision lathe ever produced for the toolmaker or modelmaker for all purposes where accuracy and convenience are essential.

PITTSBURG TRANSFORMERS.—The reasons why Pittsburgh transformers should be used where reliable service is demanded are pointed out briefly in a neat little pamphlet just issued by the Pittsburgh Transformer Company, Pittsburg, Pa. The front cover has an oval opening through which may be

seen a view of a packing case containing a transformer, a can of oil, and other boxed parts, all ready for shipment.

THE SANGAMO ELECTRIC CO., Springfield, Ill., manufacturers of the Gutmann integrating wattmeters, has been represented in New York recently by Mr. Jacob Bunn, Secretary of the company, and Mr. R. C. Lanphier, superintendent.

THE ENGINEERING OFFICES, San Francisco, will have charge of the electrical, mechanical and sanitary engineering features of the new mining building now in course of construction at the University of California in Berkeley. The Engineering Offices is the title under which business is now carried on by the electrical and engineering firm of Hunt, Meredith, Benjamin Cory & Allen.

THE OHIO BRASS COMPANY, of Mansfield, Ohio, has completed plans for an extensive addition to its plant. For some time the present facilities of the plant have been inadequate. The addition will be 175 feet long and 50 feet wide and three stories high. It will be used for general warehouse purposes. Another structure 350 feet long and 56 feet wide, three stories high, is contemplated to furnish additional machine shop facilities.

TELPHERAGE.—The United Telpherage Company. 20 Broad Street, New York, has just issued three interesting circulars describing and illustrating as many different applications of its system of electric transportation of goods, etc. Circular No. 22 is devoted to the handling of trunks and baggage at railway stations by telpherage; No. 23 is on the subject of cross country lines, an installation of this nature having been described and illustrated in our issue of June 21, and circular No. 24 is on the subject "Telphers in a paper mill."

WILLARD STORAGE BATTERY.—In a 20-page pamphlet just issued by the Willard Storage Battery Company, Cleveland, Ohio, the features of this battery are briefly pointed out, although the pamphlet is almost wholly devoted to tables giving the sizes, and much other information regarding the different types of cells manufactured by this company. The cells are artistically illustrated. Full directions for the setting-up and maintaining Willard batteries are given, which, when adhered to, will secure the most efficient service. Willard storage batteries are applicable to a great variety of uses.

JOHNSON & MORTON, Utica, N. Y., manufacturers of the "J. & M." standard junction boxes and auxiliary contact knife switches, have completed arrangements for adding two floors to their present building and erecting in addition a new one-story building, 50x100 feet. The latter will be so constructed as to permit two more stories to be added when required. These additions will give the firm floor space four times as great as they have at present. This extension of their plant indicates the growing demand for their goods. They have recently opened a New York office at 234 Greenwich Street and placed it in charge of Messrs. Frorup and Levy.

NEW ELECTRIC LOCOMOTIVE.—A test was made recently by the Westinghouse Electric & Mfg. Co. of a self-contained electric locomotive built for the Chesapeake and Maryland Railway, now under construction. The locomotive, which is in reality a complete power plant on wheels, consists of two cars, one of which contains a steam engine, oil being used for the generation of steam; a 220-kw generator and two 100-hp motors. The other car carries a storage battery which is charged when the locomotive is descending grades, and at other favorable times.

FOOTE, PIERSON & COMPANY, 82 Fulton Street, New York, have issued a 72-page catalogue, large octavo size, containing almost 300 illustrations of apparatus of their manufacture, or instruments, etc., the sale of which the firm makes a specialty. The catalogue is divided into two parts, Part I being somewhat general, while Part II is devoted entirely to measuring and testing instruments. In Part I is illustrated and described a complete line of telegraph instruments, not less than 56 cuts being used to illustrate the principal items. Following the section is a description of an anemometer electric clock, designed for determining the velocity of the wind, which gives a direct reading of the number of miles per hour. Next come call boxes and a line of telephone apparatus, followed by sections on house bells, push-buttons, gas-lighting apparatus, fuse protectors, lightning arresters, primary batteries, wires, etc. The section devoted to instruments includes all manner of galvanometers, condensers, shunts, resistance boxes, Röntgen ray apparatus, etc.

THE U. T. HUNGERFORD BRASS & COPPER CO., 121 Worth Street, New York, owing to encroachments by the Rapid Transit Commission, which is about to locate a subway station on a portion of the property at the above address, and the increasing demands of its business, has been compelled to seek larger quarters. It is about to move into the Hallenbeck Building, at the corner of Pearl and Park Streets. The company will occupy the basement, street floor and first floor above the street. There is also a new building now under way adjoining this structure, of which the company will have the three corresponding floors, giving it a total of about 30,000 square feet of floor space. Its largely increased facilities, close proximity to the business centers and shipping accommodations make possible the carrying of even greater stocks than heretofore and the prompt shipping of orders.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 1, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

Reissue, 12,007. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed Dec. 5, 1899. App. filed for reissue Feb. 25, 1901. (See page 59.)

703,369. ELECTRIC INSTRUMENT FOR CAUTERY; W. B. Batcheller, Chicago, Ill. App. filed March 8, 1902. A pistol grip having a trigger by which the switch controlling the cautery instrument can be readily controlled.

703,420. PROCESS OF MAKING ELECTRIC ACCUMULATOR PLATES; R. M. Hunter, Philadelphia, Pa. App. filed Aug. 1, 1899. The process consists in coiling strips of lead into plugs, mounting them in a mold and while subjected to a cooling process, casting molten lead around them which fuses with the outer layers of the plug; the plate is afterwards "formed."

703,446. CONDUIT; W. L. McGowan, Philadelphia, Pa. App. filed Oct. 23, 1901. A conduit having a number of passages through it, built up of sections, each of which has one end convex and the other concave to interlock with each other.

703,447. CONDUIT; W. L. McGowan, Philadelphia, Pa. App. filed Feb. 8, 1902. A modification of the preceding patent.

703,467. ELECTRIC INCANDESCENT LAMP SOCKET; G. H. Proctor, Somerville, Mass. App. filed Feb. 28, 1902. An insulating lining for the cap of an incandescent lamp socket having projecting ears through which the screws which fasten the cap to the body, pass.

703,468. BRAKE FOR ADMINISTERING PRESCRIBED RESISTANCE TO THE STARTING MOVEMENTS OF HAND OPERATED CONTROLLERS; W. E. Quimby, New York, N. Y. App. filed Dec. 7, 1900. A vacuum cylinder and piston are geared to the controller shaft so that atmospheric pressure opposes the movement of the shaft and compels a slow motion thereof.

703,472. ELECTRIC LOW WATER ALARM; E. W. Rider, Detroit, Mich. App. filed July 24, 1901. A U-shaped expansion tube connects with the boiler at different levels and closes an alarm circuit by its expansion when the water drops below a certain level.

703,476. OVERHEAD TROLLEY; G. H. Russell, Pittsfield, Mass. App. filed Jan. 27, 1902. The bearings of the wheel are in dovetailed blocks which enter the harp and are held therein by spring catches.

703,490. STORAGE BATTERY; M. O. Smith, Depew, N. Y. App. filed July 13, 1901. A variation of that type of cell in which the plates are shaped like pans and placed one within the other.

703,515. ELECTRIC SWITCH; A. P. Anderson, New York, N. Y. App. filed June 6, 1901. The pivot of the blade is formed by a bolt having a chamber in its head for a spring which maintains good contact and prevents lost motion.

703,541. WATER PURIFIER; Chauncey Cook Clark, Philadelphia, Pa. App. filed Jan. 22, 1901. An electric current passes through the inflowing fluid.

703,563. GUARD FOR THIRD RAIL SYSTEMS; S. Elliott, Boston, Mass. App. filed April 3, 1902. Side guards rest upon the lower flange on each side of the third rail and are held in place by bolts passing through the guards and the rail web.

703,589. TROLLEY FOR ELECTRIC CARS; C. J. Johnson and C. W. Benedict, St. Louis, Mo. App. filed Sept. 23, 1901. Details.

703,623. ELECTROPLATING APPARATUS; Theodore F. Taylor, Camden, N. J. App. filed June 26, 1901. The articles to be plated are within a drum, the interior of which is lined with felt, over which is placed a series of wires electrically connected with one brush of the generator; the wires form the cathode with which the articles to be plated are always in contact. The drum is revolved upon a stationary axle and the anode is suspended within the cylinder from this axle.

703,649. SELF PROPELLED VEHICLE; E. R. Gill, Englewood, N. J. App. Nov. 11, 1899. The motive power of the vehicle consists of an electric motor applied directly to each wheel; the rotary part of the motor is rigidly attached to the wheel while the relatively fixed part is mounted in an annular bearing in the rotating part and is restrained by a flexible connection with the vehicle body which at the same time permits the wheel and motor to be turned in steering.

703,673. ELECTRIC BATTERY AND MOUNTING SAME; E. A. Sperry, Cleveland, O. App. filed Sept. 13, 1899. The negative plates are attached to the case, which is made of sheet lead and thus forms one terminal of the circuit.

703,674. CONNECTION FOR BATTERIES; E. A. Sperry, Cleveland, O. App. filed Sept. 13, 1899. Details.

703,691. ELECTRIC LOG REGISTER; W. B. Armstrong, San Francisco, Calif. App. filed Sept. 15, 1900. The apparatus includes certain indicating devices to show when the apparatus is deranged or not working.

703,692. MANUFACTURE OF CARBONS FOR ARC LAMPS; C. R. Boehm, Charlottenburg, near Berlin, Germany. App. filed April 12, 1902. (See Current News and Notes.)

703,700. TROLLEY WHEEL; W. F. Hall, Boston, Mass. App. filed April 29, 1902. A built-up wheel, the parts of which are held together by spring rings adjusted to a sleeve around the hub.

703,701. TROLLEY WHEEL; W. F. Hall, Boston, Mass. App. filed April 30, 1902. A modification of the preceding patent.

703,712. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed Feb. 12, 1901. The receiving relay has two circuits, one of which includes a battery and the other a condenser which is charged by the battery when the circuit of the latter is closed. The reception of a number of impulses indicating a dash are thus transformed by the relay into a clearly defined dash, because the condenser discharges through the relay in the intervals between the closures of the battery circuit.

703,717. INCANDESCENT ELECTRIC LAMP AND SOCKET; J. C. M. Brown, Philadelphia, Pa. App. filed Feb. 28, 1902. Details.

703,777. CABLE TESTING APPARATUS; H. W. Fisher, Pittsburg, Pa. App. filed July 15, 1901. A hand switch to be used in connection with cable testing apparatus for conveniently throwing in successively the proper instruments and circuits for making the tests.

703,779. ELECTRIC RAILWAY; E. P. Frederick, St. Louis, Mo. App. filed March 20, 1902. The bond, which is a twisted wire, is secured to a coupling head by passing it into a chamber therein and then filling the chamber with molten metal.

703,782. TROLLEY FORK; E. L. Gentis, Newport News, Va. App. filed Feb. 21, 1902. The wheel is mounted to tip laterally when necessary.

703,786. APPARATUS FOR PREVENTING TROLLEY WHEELS FROM LEAVING THE FEED WIRE; G. W. Hammond, Philadelphia, Pa. App. filed March 3, 1902. Details.

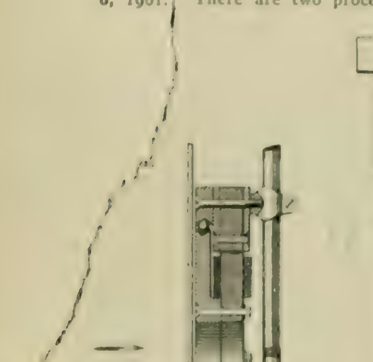
703,791. INCANDESCENT LAMP; H. J. Jaeger, New York, N. Y. App. filed Aug. 13, 1901. A telephone annunciator lamp having a thick translucent top, which takes the place of the usual translucent shield placed over the lamp in the switch board.

703,810. TELEGRAPHICALLY-OPERATED SIGNAL SYSTEM; J. N. Newsom, St. Louis, Mo. App. filed March 11, 1901. By means of this invention a train despatcher or signal man can set the semaphore signals by merely sending over the circuit Morse characters properly grouped to control the respective signals.

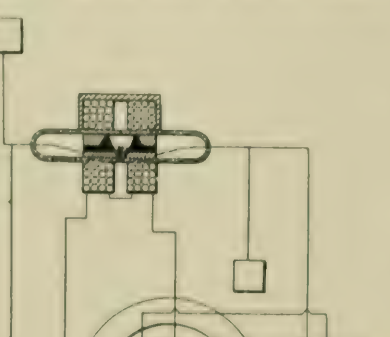
703,837. MANUFACTURE OF BRAIDED CORDS OR CABLES FOR ELECTRIC LIGHTING OR LIKE PURPOSES; C. Schurmann, Dusseldorf, Germany. App. filed Dec. 24, 1900. The insulating threads are braided around the individual wires of a cord or cable and at the same time interbraided with each other to hold the structure together.

703,842. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed Feb. 1, 1901. The sounder carries two circuits, one of which is closed when the coherer is actuated and the other, which includes a condenser, charged from the battery in the first circuit, is energized while the decoherer is active; the sounder therefore indicates a dash when the usual rapidly recurring impulses representing the same are received.

703,857. ELECTROMETALLURGICAL TREATMENT OF ZINC ORES, AND ESPECIALLY BLENDE; C. J. Tossizza, Paris, France. App. filed Aug. 6, 1901. There are two processes, the first consisting in the electrolysis



703,640.—Self Propelled Vehicle.

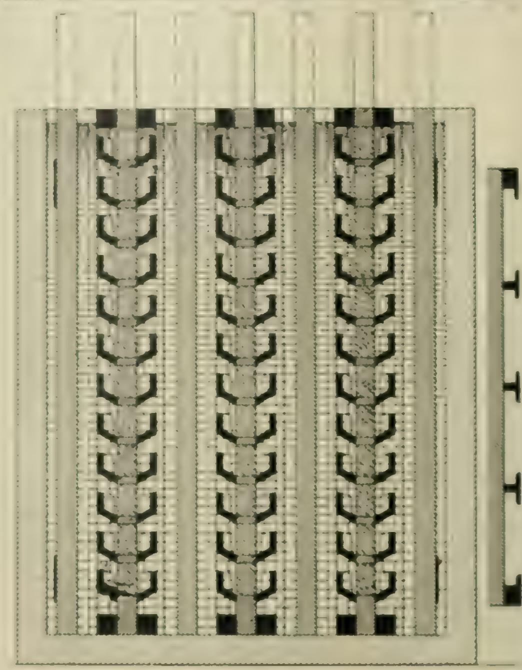


703,842.—Wireless Telegraphy.

of the salt of zinc with the employment of soluble anodes of pure copper. Metallic zinc is thus obtained at the cathode while the anode dissolves with the production of copper sulphate. The voltage necessary for the operation is 1.1 volt at the minimum, rising to 1.5 volts with 40 amperes per square meter. The second operation reconstitutes the anode plates of copper, to which end they are used as cathodes in an electrolytic operation wherein the anodes are insoluble, the electrolyte being formed of the sulphate of copper produced in the first operation, which is preliminarily charged with sulphuric acid. The copper is deposited at a minimum voltage of .31 and for practical current densities has a voltage of about .5. Taken together the two operations permit the electrolysis of the zinc at a voltage the sum of which for the two operations has a minimum of 1.4 and a maximum of 2 volts.

703,861. ELECTROLYTIC CELL AND ELECTRODE THEREFOR; August A. Vogelsang, Dresden, Germany. App. filed March 5, 1901. Enables platinum electrodes to be used economically. The cell is so constructed that the electrolyte passes alternately up and down between the electrodes, the end ones of which only are used for the inflow and outflow of current, the intermediate ones having no connection whatever with the external circuit. The electrodes consist of a slab composed mainly of an insulating material faced on each side with conducting strips of platinum, which strips alternate with exposed portions or surfaces of the body of the electrode.

703,875. ACTIVE MATERIAL FOR STORAGE BATTERIES AND PROCESS OF MAKING SAME; W. E. Winship, San Francisco, Cal. App. filed March 14, 1901. The process of forming an active material for storage batteries, consisting of suitably binding a mass of lead salt which will retain its conformation after immersion, and reducing it by elec-



703,895.—Separator Plate for Secondary Batteries.

trolysis to spongy lead in an electrolyte which is a solvent for the lead salt, and from which solution lead trees essentially parallel to each other are plated out within the mass.

703,892. ELECTRIC TELEGRAPHY; S. G. Brown, London, England. App. filed Nov. 5, 1900. A number of transmitting instruments, a corresponding number of batteries adapted to be worked in series thereby, a similar number of recording instruments actuated by the combined effect of positive and negative impulses simultaneously transmitted and adapted to simultaneously register signals on one side or the other of their zero lines depending on the polarity of the currents sent by the transmitters.

703,895. SEPARATOR PLATE FOR SECONDARY BATTERIES; A. F. Clark, Philadelphia, Pa. App. filed Oct. 18, 1900. The separators have pockets which receive the active material that becomes detached from the plate, thereby preventing it from falling to the bottom and short-circuiting the cell.

703,902. PROTECTING DEVICE FOR INDUCTION MOTORS; J. H. Diggle, Lasalle, Ill. App. filed Oct. 21, 1901. A switch whereby a heavy fuse can be thrown into circuit in starting the motor and a lighter fuse afterwards thrown in to serve under running conditions.

703,909. AUTOMATIC FIRE ALARM; M. K. Fred, Bandera, Texas. App. filed March 22, 1902. Metallic links are suspended from two conductors which are strung through the area to be protected, said links being partially covered by insulating material and looped together in a manner to prevent contact between their metallic parts. Excessive temperature melts the connecting device between the links and allows them to assume a position under the action of gravity, where they will be in contact with each other and thus close an alarm circuit.

703,921. TROLLEY POLE; J. D. Hickman, Anderson, Ind. App. filed Oct. 11, 1901. The harp is pivoted to the upper end of the pole in such manner that the wheel can be disconnected from the wire by lowering the harp without moving the pole.

703,942. ELECTRIC MOTOR POWER TRANSMITTING DEVICE; H. S. Miller and G. C. Marx, Elizabeth, N. J. App. filed Nov. 30, 1901. A sewing machine motor having a brake and a circuit controller operated by a single lever.

703,953. SELF WINDING ELECTRIC CLOCK; C. M. Crook, Bristol, Conn. App. filed March 4, 1901. The time train and the striking train are wound by power derived from the same electro-magnet and by the same movement of the magnet armature.

703,967. SEMAPHORE INDICATOR FOR ELECTRIC SIGNALING; H. Gulliver, South Yarra, Melbourne, Victoria, Australia. App. filed April 23, 1902. Details.

703,975. ELECTRICAL HEATING APPARATUS; J. R. Quain, Middlesex County, England. App. filed March 10, 1902. A tubular apparatus in which the passages are surrounded by heating coils for the purpose of heating liquids flowing through the tubes.

Electrical World and Engineer

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NEW YORK, SATURDAY, JULY 19, 1902.

CONTENTS.

A LOWER PRICE FOR CURRENT.

On another page we publish the text of an important circular just issued by the New York Edison Company, announcing a heavy reduction in the price of current to date from September 1. The new scale applies to the maximum rate, and the reduction is not less than 25 per cent., which is the more remarkable in view of the fact that pretty well everything else one can mention is higher in price and is still going up to heights unknown at any time past, whether in the shortness of war or the prosperous days of peace. Hence, householders and dwellers in residences when they return to New York City next fall, will find something that is materially reduced in cost, and we shall be very much surprised if they do not avail themselves very liberally of the new rate. It would probably not be at all exact to say that it puts electric light to the small retail user at the same price as gas, but when other considerations are taken into account, the conditions become fairly even, and electricity can certainly compete for its share of the business on more advantageous terms than have prevailed on Manhattan Island since the introduction of the electric light twenty years ago.

It will be very interesting to note the effect of the new scale of 15 cents and downward on residence lighting. Doubtless the management of the company has gone carefully into the prospects of increased sale of current, and perhaps in due time we shall be able to learn how far their calculations and expectations have been realized. We cannot forget that some of those in control of the property have occasionally been credited with an indifference to the public and an intention to "work the thing for all there is in it." We can ourselves only felicitate them upon this direct evidence of a resolve promptly to share economies of production with the public, which even at the worst shows a selfishness that is at least enlightened, and which if regarded impartially is a move upon which any wise and progressive administration deserves to be warmly complimented. The whole electrical industry is touched by such an action as this, for the price of current is to-day the dominant factor in the entire range of electric light, heat, power and traction, or more than 75 per cent. of that domain of human activity covered by the word electricity, and besides most nearly affects the multitude.

A TYPE OF SHORT-DISTANCE TRANSMISSION.

In these days there is a disposition among engineers to turn up the nose of scorn at power transmissions less than a few score miles in length, and to such a contemptible low pressure as 2,500 volts. Yet the short transmissions, like the early one at Concord, N. H., described in our columns last week, have really to bear the brunt of commercial work. They are small individually, but numerous and useful, and do their full share of the world's work in spite of their lack of sensational features. The Concord plant in particular deserves something of the respect due to age, for it was one of the very earliest of American polyphase transmission plants. If our memory serves us correctly, the first three-phase induction motor put into service on this side of the water went into the Concord plant in the very early autumn of 1893, before the hydraulic plant was started. A customer had contracted for service, and wanted it before the water plant was ready. He did not want to get a continuous-current motor for merely a few months of use, and so a small three-phase generator was borrowed and put up in the old steam station in the city. The customer got the first three-phase induction

motor sold and delivered in this country, and later, when the new station was ready, the polyphase equipment was transferred to the transmission circuit.

The Concord plant, too, was one of the first alternating plants to break away from the 2,000-volt limit in its primary circuits, and one of the first to adopt the practice, now standard, of using long secondaries fed from banks of large transformers. It is like other plants on rivers subject to freshets, more or less liable to interruptions from high water, and has been bothered by anchor ice—that greatest pest of hydraulic plants—so that in due season it had to come to an auxiliary steam plant, as many another plant has, and in the course of enlargement has come to direct-coupling and modern methods of governing. And speaking of regulation, the Concord plant was one of the first to try automatic regulation of the generator fields from pressure wires led back from the center of distribution. So, altogether, it is an interesting type of short-distance transmission, and is to-day handling an exceptionally large load for a city so small as Concord. And, even now, where the main transmission has been raised to 10,000 volts, it is interesting to note that the distribution voltage of 2,500 remains where it was put ten years ago, and that present advanced practice has merely moved up to the Concord mark.

The Ionic Theory of Conduction.

The ionic theory of conduction through liquids, *i. e.*, electrolytes, now rests upon a reasonably well fortified base. The ionic theory of conduction through gases is in very general provisional acceptance; and now the guns of the ionic theory are brought to bear upon the conduction of electricity through metals, *e. g.*, copper wires. It would seem that the jostling of molecules or atoms in gases beget a few free corpuscles or ions in every second of time; the more accentuated elbowing of the more compressed atoms or molecules of electrolytes keeps myriads of ions always on the shelf of opportunity, and the yet more active collisions of adjacent atoms in solids brings enormous numbers of ions into temporary existence; so that at any instant there are always hordes of them at command. It is suggested that, allowing for the great disparity in the numbers of ready ions ,their proximity and mean free path or sphere of influence, the phenomenon of conduction is essentially the same in insulators, electrolytes or metallic conductors.

A recent research at the Cavendish Laboratory, published by Mr. J. Patterson, in the June number of the *Philosophical Magazine*, throws light on this important theory. A flying ion is bothered by a magnetic field. If the direction of the field be parallel to the initial velocity of the ion, the ion describes a corkskrew spiral about that direction as axis. If, on the contrary, the field is transverse to the initial velocity, the ion moves in a cycloidal path. In either case the ion is delayed, with its encumbent electric charge, and the process of conduction is interfered with. In technical language, the resistance is increased. By measuring the increase in the resistance of conductors, when subjected to measured magnetic fields, much can be learned concerning the supposed active ions in the conductor. It has long been known that bismuth undergoes a distinct and readily measurable increase of resistance in a magnetic field. In fact, field intensities are most conveniently measured by an ohmmeter and a thin bismuth flat spiral. But according to the ionic theory, the effect should be met with not only in bismuth, but also in every metal; although no necessary limit existed as to the magnitude of the effect. Whatever the magnitude of the effect may be, it should, however, increase as the square of the transverse field intensity.

Mr. Patterson examined the resistances of fine spirals of different metals in powerful transverse magnetic fields, using intensities up to 29.2 kilogausses. In all materials except German silver, he found a small increase of resistance, which appeared to vary as the square of the gaussage. In cadmium, the increase was most marked, amounting to nearly one-quarter of one per cent. at the highest gaussage used. In platinum it was the least, being only one two-hundredth of one per cent., or some fifty times smaller. Working out the results on the ionic theory, the acceleration developed in these metallic ions in unit electrostatic field varies between 4 and 27 bicrons per second, the mean free path being from 6 to 41 bicrons. The number of ions per cubic centimeter is about one hundred times the accepted number of molecules in a cubic centimeter of gas at standard temperature and pressure. Silver and copper behaved in all respects very nearly alike, as their close agreement in normal resistivity would suggest.

According to this theory, the conductivity of a metal is equal to the product of the total free ionic charge per cubic centimeter and the square of the acceleration under unit impressed electrostatic field. If this view is correct, then the more numerous the ions, or the more thoroughly disrupted the atoms in the metal, the better conductor it should become. Perhaps it might be possible some day to employ patent ionized copper wire of 2,000 per cent. Matthiessen conductivity at normal temperatures. One can scarcely imagine the economic revolution that would follow in electrical engineering.

Electrolysis from Electric Railway Currents.

We regret to note that one of our electrical contemporaries has seen fit to reopen in a sensational manner the question of electrolysis from electric railway currents. Though the matter of corrosion by leakage from railway return currents was some years ago one of much concern, with the advance of the electric railway art and as a consequence of the thorough study given the subject by engineers, it is now known, even to the tyro in electric railway engineering, that in the relatively few cases in which injury from the corrosion of underground piping is apt to occur, a definite remedy is indicated by the local conditions. This has become so well recognized that even the daily newspaper press has ceased to harp on a subject which at an earlier time could always be depended upon to supply copy with a thrill in it. Until this condition was reached, corrosion from railway currents was one of the principal means with which to harass electric railway companies in the case of friction with city authorities, and our contemporary is taking upon itself a very grave responsibility when it puts forth the wild statement that "the time is beginning to arrive when reckoning of a gigantic character is to be had between electric street railway companies and those who employ buried piping systems for various purposes." The technical competency of the writer who would thus resuscitate a question that in the past has been so annoying to the electrical railway industry, may be gauged from the remedy proposed for the alleged great danger—the insulation of all joints of underground piping! And it is left an open question as to whether or not railway companies should bear the expense of applying this extraordinary remedy. It is not our custom to refer in criticism in these columns to our electrical contemporaries, but we must make an exception in this case in view of the serious damage that might be inflicted upon a great industry by such an ill-judged editorial utterance; for though none with any technical knowledge would give it a moment's consideration, the newspaper press is apt to accept the statements to which we refer as the opinion of one competent to speak on the subject, because they happened to appear in the columns of an electrical journal.

ELECTROLYTIC CONDENSERS IN ALTERNATING-CURRENT CIRCUITS.

A paper on this subject, by Messrs. A. Trowbridge and E. R. Walcott, was read at the recent Pittsburg meeting of the A. A. A. S. It contains some interesting experiments on electrolytic cells carrying from 10 to 20 amperes under alternating current pressures of about one volt. The frequencies were 60 cycles and 144 cycles. The electrodes were metallic plates, immersed in the electrolyte, and separated by one or more sheets of paper. The apparent capacity of these cells is enormous by comparison with the capacity of electrostatic condensers, but it is only obtained at the expense of energy loss. The efficiency of good electrostatic condensers is very high, approaching 99 per cent. in some cases; while the efficiency of these electrolytic condensers is quite low, roughly about 50 per cent. in some cases. In other words, the power factor of an electrostatic condenser is usually very small, and the phase displacement of its current, ahead of the terminal e. m. f. nearly 90 degrees; whereas the power-factor of these electrolytic condensers was frequently as high as 60 per cent., and the capacity reactance nearly equalled by the internal resistance.

It has been due apparently to this large internal resistance, and consequent waste of energy, that the electrolytic condenser has not come into use on alternating-current circuits for the purposes of phase displacement. The apparent capacity of the apparatus is ample, and there is no difficulty in securing the requisite number of microfarads, but the apparatus gets hot under load and wastes power to a prohibitive degree. For the purposes of artificial lines in experimental telegraphy, where no great precision is desired, and where retardation is sought for without any accuracy as to its adjustment, the electrolytic condenser may become a very useful apparatus. Up to the present time this seems to be its only sphere of application. It is a pity that it cannot be freed from internal waste, because the contrast in bulk and cost between one farad in electrolytic and electrostatic condensers is amazing.

THE PROBLEM OF THE AUTOMOBILE.

The present season brings automobilism into a more conspicuous position than it has before occupied, but we regret to say that in general the electric machine is not taking the prominent place which it ought to have. The cause of this backwardness is not far to seek, although somewhat complex. In the first place, the dismal failure of public electric automobiles in several cities tended to give the motive power a black eye irrespective of its real merits. Secondly, so far as private automobiles are concerned, the lack of proper charging facilities outside of the larger cities and towns is discouraging to those who are fond of touring. Gasoline is available everywhere, and the supply can be promptly replenished, while charging a battery is always a slow job, and unless all the conveniences are at hand a troublesome one to boot. One does not wish to limit his country tour to lines of travel along which he can strike charging facilities every evening, and the oft suggested programme of sending charged batteries ahead to be taken on at the proper time is one which bespeaks very limited knowledge of the difficulties involved in the task. For twenty years the distribution of charged batteries to the consumer has been a favorite resort of the newspaper electricians, but except on a very trivial scale it has amounted to nothing whatever, nor will it in our opinion ever do so. It is not as some credulous souls have thought, a question of the weight of the battery, within at least the limits of reasonable probability. It is not the fact of a battery weighing one hundred or two hundred pounds that makes the difference, but rather the nuisance of having it replaced at the proper time, be it heavy or light. And one in touring the country wants to have a certain liberty of action which a journey fully prearranged does not and cannot give.

Another cause of the relatively small growth of electric automobiling is the altogether reprehensible present tendency toward scorching. The storage battery in spite of the very fast running that it has sometimes accomplished, is not the chosen motive power of the driver of the Red Devil. It is, too, quickly exhausted if forced to the output required for the record-breaking runs over the country roads, which seem to be the present fashion. Even if the Edison's new battery fulfills the rosiest expectations of its inventor, it will still be ill-suited to this malignant purpose. Unless this recent tendency is put down with a strong hand the whole automobile business may be put out of existence. One-half of one per cent. of the population cannot long continue utterly reckless of the lives and happiness of the other ninety-nine and one half per cent., and if this minority banks upon the wholesale use of its money to escape the penalty of its recklessness, we beg to remind it that buckshot and the rope cannot be bribed, and that from the decisions of Lynch, J., there is no appeal. It will take very little more of the sort of thing we have been having to bring either legislation so drastic as practically to suppress motor vehicles, or a summary resort to that final law of self-defence, which is the substratum of all law. Be this as it may, the electric vehicle does not meet the needs of the scorcher, we are happy to say, and hence it has not yet come to its own. When the automobile settles down to a full realization of the field that is really its own, we have little fear that electric power will not take its proper place of prominence.

In all cities of any size it may be safely assumed that facilities for charging batteries can be easily secured, and the more required the more will be established. The electric vehicle has at least one unique advantage, it can be stopped and started without any annoying preliminaries, and is far simpler to operate than any other known type of automobile. Once the batteries are fully charged, the subsequent operations become very simple indeed. The whole success of the machine turns on the good qualities of the battery. We are not disposed to think that extreme lightness in the battery is a prime necessity, although in itself it is a good thing. The endurance which implies reliability and a low rate of depreciation are the qualities most important. We believe that Mr. Edison attaches far more importance to the mechanical and chemical stability of his new battery than to its efficiency of light weight. In these latter particulars it is not widely different from the lightest lead batteries, ignoring the matter of depreciation. The time has come, we think, for the electric vehicle to be taken up seriously as a means of ordinary urban transportation of passengers and freight, and for a determined effort to forget the past failures in present successes. The earlier vehicles not only were in constant trouble with their batteries, but many of them had very bad motor drives. The gearing that can be heard five blocks away is not a sign of high efficiency, nor of battery endurance. On the whole, we are disposed to think that the present run on steam and gasoline vehicles may prove a good thing from the standpoint of the electrician. It throws a very disagreeable burden of sorrows on the other fellow, and it gives time for a careful, steady attack on the electrical problems involved. It is not a bell hanger's job, this electric automobile business. On the contrary, it requires very careful and intelligent engineering to bring out a successful result. The electric carriages so far built have been good just in proportion to the designer's ability, and a moderate demand is better for judicious and effective work than a rush of business that encourages the production of makeshifts. The best of our builders have all the business they can comfortably handle even as it is, and they will not complain if the demand does not bring competitors.

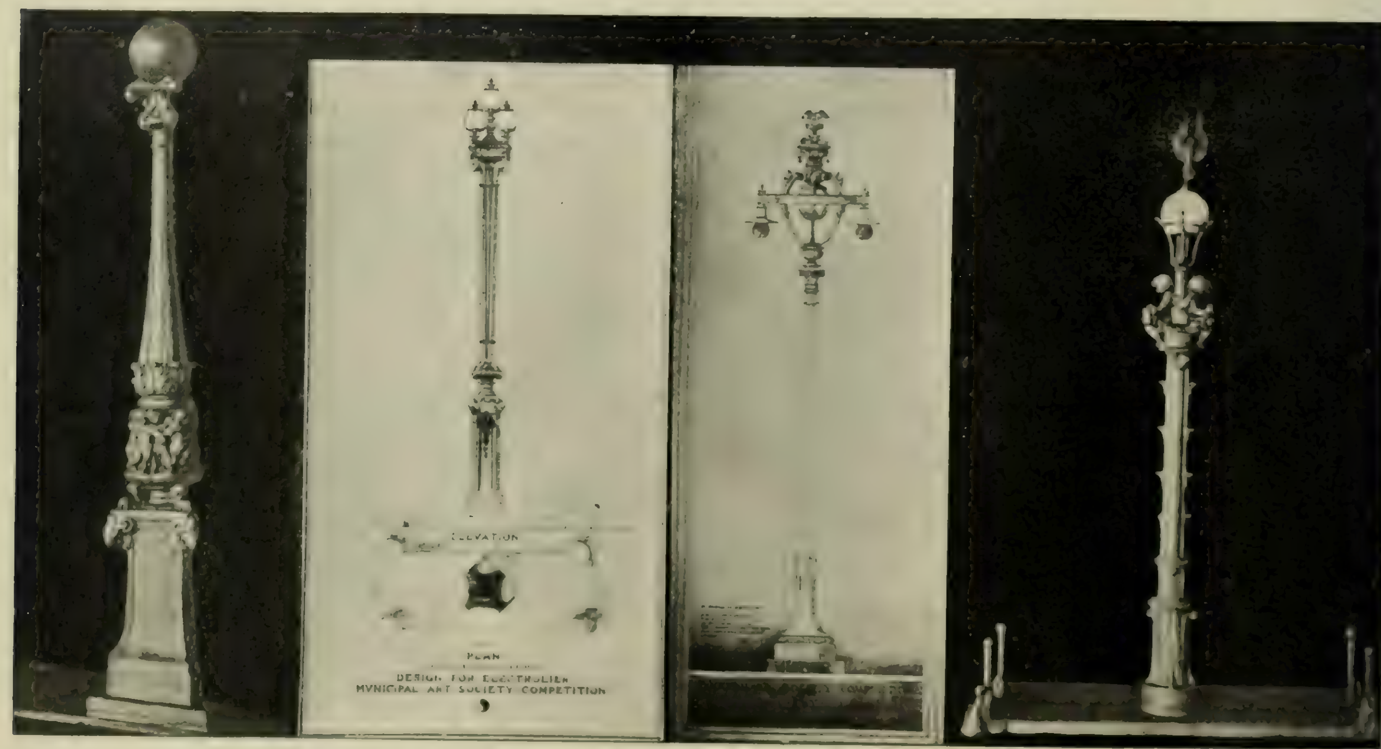
Reduced Price of Current in New York City.

An important announcement has just been made by the New York Edison Company, reducing the maximum price of current for incandescent and arc lighting 25 per cent., or from 20 to 15 cents per kilowatt-hour. We give the circular below in full:

In accordance with the declared policy of reducing the prices of the electric service of this company as rapidly as possible, consistent with efficient service, we beg to announce that on and after Sept. 1st next, the maximum price for electric current for incandescent and arc lighting will be reduced from 20 cents to 15 cents a kilowatt-hour.

This change is now made possible by the addition to our facilities for the production and supply of electric current of our new Waterside station, at Thirty-eighth and Thirty-ninth Streets and the East River. This station, designed for an equipment of about 130,000 hp, is the largest, the most complete, and the most modern in the world.

The daily average use of the entire installation connected with the meter and service wire—excepting fan motors and heating appliances



FIGS. 1, 2, 3 AND 4.—FIRST, SECOND, THIRD AND FOURTH PRIZE ELECTROLIERS.

will continue to determine the rate of the monthly charge. With this reduction the future schedule of prices will be:

Average Hours' Use	Per Kilowatt Hour	Per Standard Arc Lamp Hour (500 Watts)	Per Incandescent Hour 16 Candles (50 Watts)
1st and 2d	15c.	7½c.	¾c.
3d and 4th	10c.	5c.	½c.
5th and 6th	7½c.	3¾c.	⅜c.
Over 6 hours	5c.	2½c.	¼c.

The existing contracts will remain in force, except as affected by this reduction, and our present records of installation will continue to serve as the basis of determining the average use of current until notice is given in writing of any changes or corrections.

An Electrolier Competition.

The Municipal Art Society of New York City organized recently a competition for the design of an electrolier to be combined with an isle of safety at the intersection of Fifth Avenue and the South side of Twenty third Street, the electrolier when completed to be presented by the society to the city.

The aim of this excellent organization, whose broad object is to improve artistically public buildings and prominent objects on the city streets, is in this specific case to obtain a simple and beautiful street fixture which may serve as an example for future work; to help divide the traffic; to furnish a place of safety for foot passengers in crossing the wide and crowded avenue, and to afford a place not only for the lamps, but for street signs.

The competition was open to artists without distinction of age or sex, and the jury consisted of 15 members, including ten architects, painters and sculptors and five laymen, among its members being Hon. Jacb A. Cantor, president of the Borough of Manhattan; Mr. F. Crowninshield, president of the Fine Arts Federation, and Mr. John DeWitt Warner, president of the Municipal Art Society. Other members were Messrs. F. S. Lamb, F. B. Herzog, Geo. B. Post and Bruce Price. The first prize was a commission to execute the necessary full-sized drawings and such modeled details as would be required for the execution of the proposed work, for a sum of $500. The second prize was $100, and the third prize, $50.

The regulations required that the design submitted should not call for an expenditure of more than $1,500 for the final and complete execution of the electrolier. A space not larger than 3 feet by 20 feet was given as the size of the isle of safety, upon which the electrolier would be set up. Drawings and models submitted were required to be on the scale of 1½ inch to the foot, and competitors could submit a drawing or a model, or both, the models being in wax or plaster. It was provided that competitive material should be sent in by June 14, and that the jury should render its decision within two weeks of that date.

The competition thus undertaken by the society proved very successful, and no fewer than 45 drawings and models were submitted, all of which have been placed on public exhibition in the rooms of the Architectural League, Fine Arts Building, West Fifty-seventh Street, New York City. Four awards have been made, and we illustrate the designs thus distinguished. The first prize of $500 has been awarded to Victor A. Ciani; the second prize of $100 has gone to Henrik Wallin; the third prize of $50 has been carried off by Wilkinson & Magonigle, while honorable mention has been accorded to the design of Mrs. Edith Woodman Burroughs. The successful competitor is required by the rules of the contest to make the full-sized drawings and modeled details; the Municipal Art Society will take charge of the execution and placing of the work, in collaboration with President Cantor.

We believe that our readers will be very much interested in the designs which we now submit, and will view with favor and approval the effort which has thus been made to improve the electric light poles or lamp posts employed in American cities. Several companies have already made laudable efforts themselves in this direction, notably the New York Edison Company, and they realize that such efforts will enjoy public support and sympathy of an active character.

An Electric Cement-Making Plant.

AN electric power plant recently installed at the Alsen American Portland Cement Works, at Alsen, seven miles below Catskill, Green County, New York, furnishes an excellent example of the adaptability of electric power to meet the severe requirements of cement making machinery. This is the only cement manufacturing plant in America using electrical power so extensively and exclusively. The extended area on which power is required to be distributed, and the heavy overloads under which many of the machines start, constitute the greatest problem in driving machinery in cement mills. These conditions appear to have been successfully met in this installation.

The boiler plant consists of four horizontal water-tube boilers, of 300-hp each, working at 150 lbs. pressure. Natural draft is furnished by a chimney 210 feet in height. The generating plant consists of three cross-compound Corliss-type engines, each direct-connected to 400-kw generators, running at 90 r. p. m. The flywheel and generator are placed between the frames of the high and low-pressure cylinder. There is also one automatic tandem-compound engine direct connected to a 100-kw generator, running at 200 r. p. m. The generators are wound for direct current and 250 volts. A 15-ton crane spans the width of the generator room, and travels the entire length. The room is lighted with arc lamps mounted on ornamental cast-iron posts.

The switchboard is of colored marble, and contains four generator panels, one total load panel, four power panels and one lighting panel. The board is equipped with circuit breakers, illuminated-dial instruments and a recording wattmeter of 5,000-ampere capacity. The service switches are all fused on the back of the board, and the distributing switches are provided with illuminated name plates, which are placed in front of an opening cut through the marble; back of this is connected a lamp, which serves as a pilot lamp for that circuit and illumination for the name plate. Connections are made between the dynamos and switchboard by lead-covered cables carried under the floor of the engine room, excavations around the foundations and under the entire engine room floor providing ample room for the arrangement of cables and connections.

All power generated is electrical, a total of 2,500 hp being developed. Current is supplied to 51 motors and for lighting service. The system of electrical distribution is by means of underground ducts and cables, man-holes being constructed at convenient points

FIG. 2.—ELECTRIC DRILLS IN QUARRY.

throughout the mills, and separate feeders run to each group of motors. The cables generally are of a standard size, 500,000-cm cross section.

Motors installed throughout the plant are of the slow-speed type, and are designed and wound for the particular service required of them, individual motors being generally direct-coupled or direct-geared with flexible couplings. Gears are provided with planished

FIG. 1.—ENGINE ROOM, SHOWING SWITCHBOARD AND EQUALIZERS.

iron, dust-proof covers, the arrangement of the covers being such that the gears can be readily inspected; the lower section of the

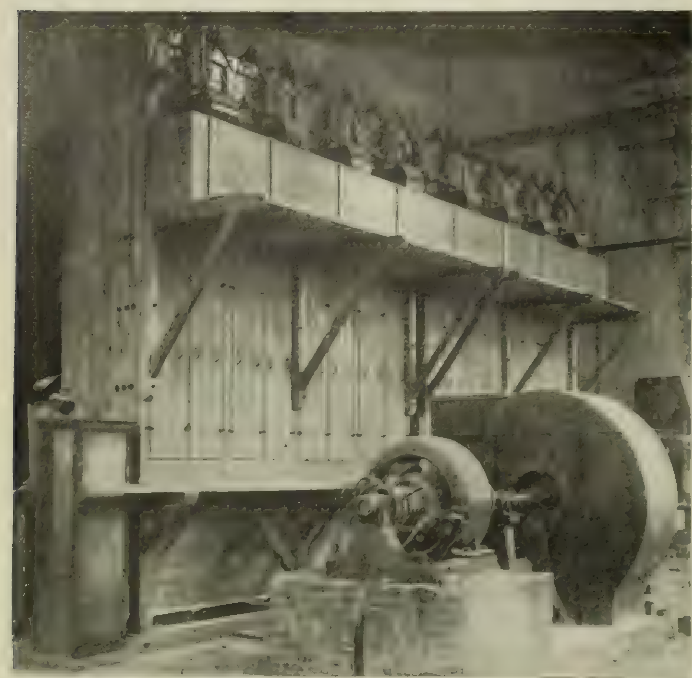


FIG. 3.—DUST COLLECTOR, FINISHED MATERIAL DEPARTMENT.

gear case is a heavy casting set in the foundation construction, which permits of the gears being run in oil.

Each motor is provided with a starting panel mounted on an angle-iron construction, erected on a heavy cast-iron base and enclosed with a planished iron cabinet. Each cabinet is divided into three sections. The first or lower section is designed for the start-

FIG. 4.—MOTOR STARTING PANEL AND CABINET.

ing resistance, which is unusually heavy, to allow for the severe overloads required to start the various machinery; the second section is designed for the multiple switches for cutting out the resistance, and the third section is designed for the circuit breaker, knife switch and fuse. Circuit breakers are provided with a stop device, arranged to prevent action when the motors are thrown in,

FIG. 5.—DIRECT-CONNECTED MOTOR AND BLOWER FOR FURNISHING AIR TO CLINKER PIT.

thus providing a time element feature. Above the third section, at the top of the cabinet, is mounted, exposed to view, an ammeter and pilot lamp; the ammeter is continuously in circuit, showing at all times the load on the motors.

FIG. 6.—ENGINE ROOM SWITCHBOARD.

Cement-dust collectors are electrically operated. Two collectors are installed, one in the raw material department, and one in the finished material department, connection being made from the collector direct to the various machines.

The pumping station is located on the Hudson River, about one mile from the power house, and is connected by a pole line. The motor pump supplies water to a reservoir for boiler feed and condensing purposes and general use.

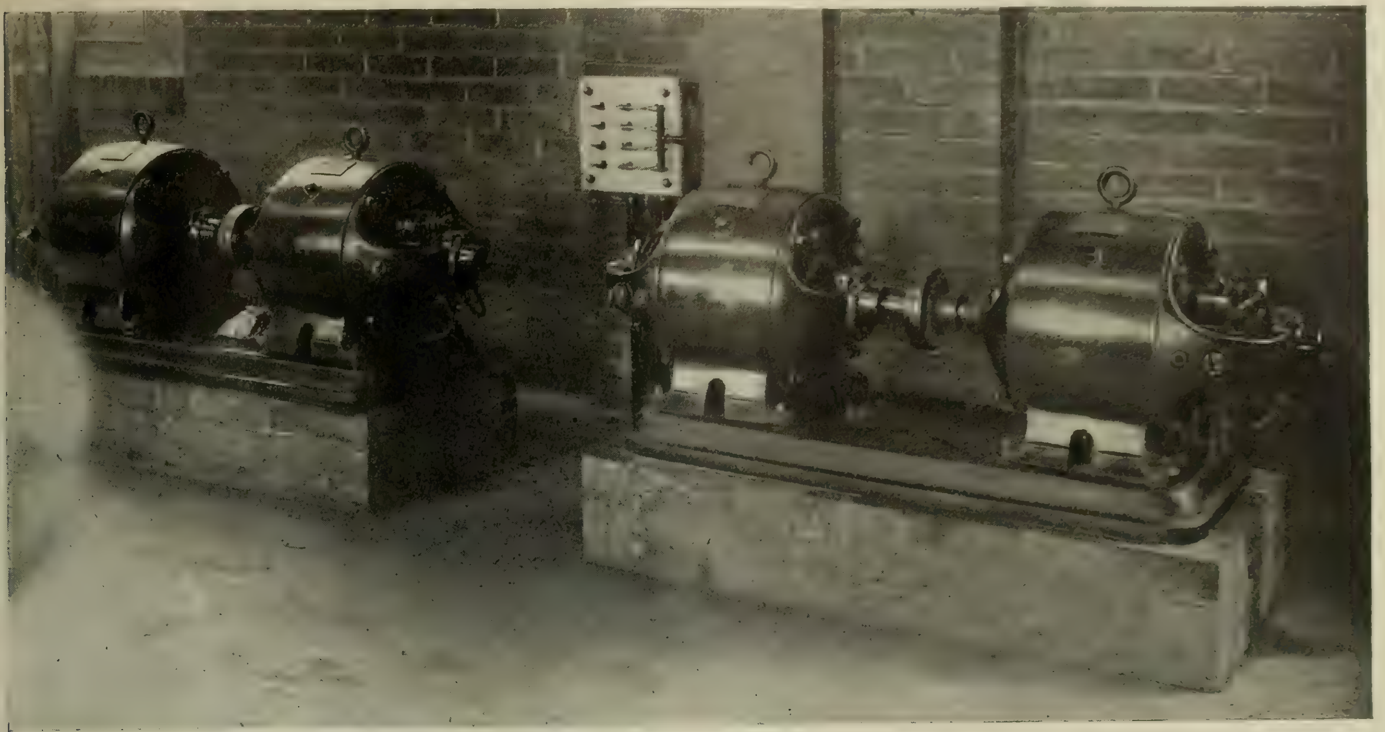


FIG. 7.—EQUALIZING SETS FOR LIGHTING SYSTEM.

The quarry is located about a half mile from the main building, connected by a tram road. Electric drills are used throughout, power being secured from the main generating plant by a pole line connection. At the quarry, a direct-current motor drives an alternating-current generator of low voltage and low frequency, from which the drills are operated. The drills are each provided with double solenoids, which are alternately energized, drawing the drill spindle up and down through the coil. A rotary motion is given to the spindle by means of a rifled rod, ratchet and pawl.

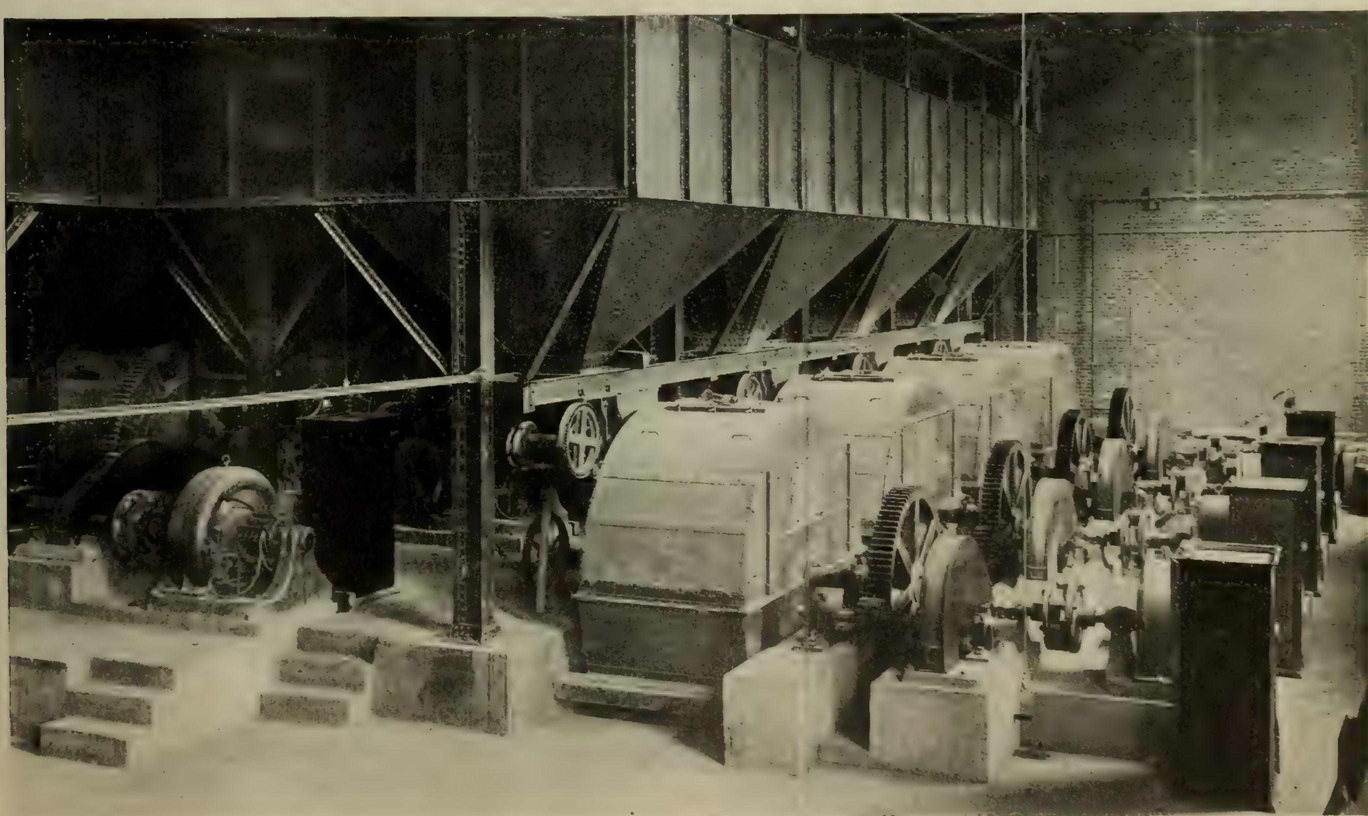


FIG. 8.—GENERAL VIEW OF BALL AND TUBE MILLS.

The lighting is installed on the 110-volt, three-wire system, with a duplicate set of motor-generator equalizers installed in the engine room. These equalizers consist of two 5-hp direct-current, shunt-wound motors, connected in pairs on a common bed plate, by flexible couplings. The equalizers are thrown in circuit by means of a triple-break, two-pole switch, resistance being inserted through the different clips of the switch. A double-reading ammeter shows the amount of current furnished to either side of the system.

The buildings are lighted by incandescent electric clusters, which

are hung below the bottom chord of the roof trusses, and are provided with lowering apparatus similar to that generally used for arc lamps. The various machines and tunnels are lighted with single incandescent lights. The wiring throughout the buildings is installed in steel conduit.

The grounds around the building are lighted by arc lamps suspended on iron brackets bolted to the walls of the buildings. The centers of distribution for lighting service are placed at various locations throughout the mills, and are fitted with planished iron cabinets of general design and construction, similar to those described for motors. Each lighting circuit is controlled by a separate switch.

A signal system is provided from various locations throughout the mills, connecting with a signal gong in the engine room for the purpose of signalling to the engine room for cutting in or out current to various feeders.

A fire-signal system is installed throughout the entire plant, connecting the various points with an alarm in the chief engineer's office. A complete private telephone system affords connection between various points throughout the plant, the offices of the company and the private dwellings of the officers. The electrical plant was installed by the D'Olier Engineering Company, of Philadelphia.

A New Laboratory Switchboard Jack.*

By F. C. Caldwell.

THE requirements of a good dynamo laboratory switchboard jack may be stated as follows: It should be able to carry its proper current without undue heating or drop; the plug should be so designed that it will be easy to insert and withdraw and cannot be forced so tightly into the jack that it will stick. This latter requirement rules out the taper jack, which is also excluded by the next requirement, namely that the jacks and plugs shall be inexpensive; further, the jack should be such that the plug cannot be unseated by a sideway pull, and it should lend itself readily to multiplication—that is, allow of the insertion of more than one jack in a terminal; the jack should also give a neat appearance to the front of the switchboard, and the part exposed on the front of the board should be easily and cheaply dressed up or replaced in case of burning.

As will be seen from Fig. 1, the jack proper, *A*, consists of a

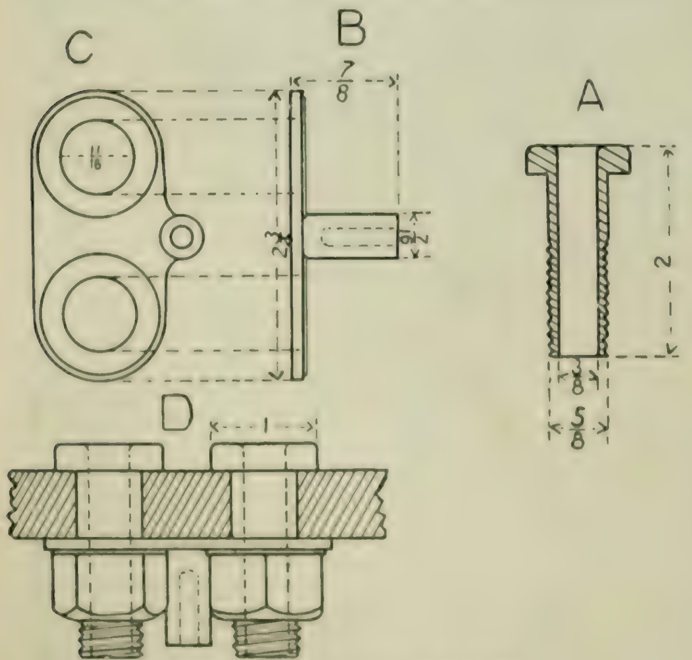


FIG. 1.—DETAIL DRAWING OF JACK.

brass tube made on the turret lathe from one inch brass rod. This is bored and reamed to ⅜ inch, and turned down to ⅝ inch, with the exception of the shoulder which forms the front or exposed end, which is left full diameter and is ¼ inch long. The front edges, both inside and outside, are rounded, and the back end is threaded with a standard ⅝ inch thread for about one inch of its length. This jack tube forms the unit, and any number required can be connected up by suitable yokes on the back of the board. In the laboratory of the Ohio State University the standard yoke is a small brass casting, having two holes for the jack tubes and a lug into which is soldered the wire. This is shown in *B* and *C*, Fig. 1. A standard ⅝-inch iron nut, preferably faced off, is screwed on the back of the tube to hold the jack in the board, as seen at *D*, Fig. 1, where the standard terminal having two jack tubes is shown.

The plug used with this jack is simply a piece of ⅜-inch brass rod 6 inches long, with one end rounded and slit about two inches with a saw; the other end is drilled for the cord, and the plug is

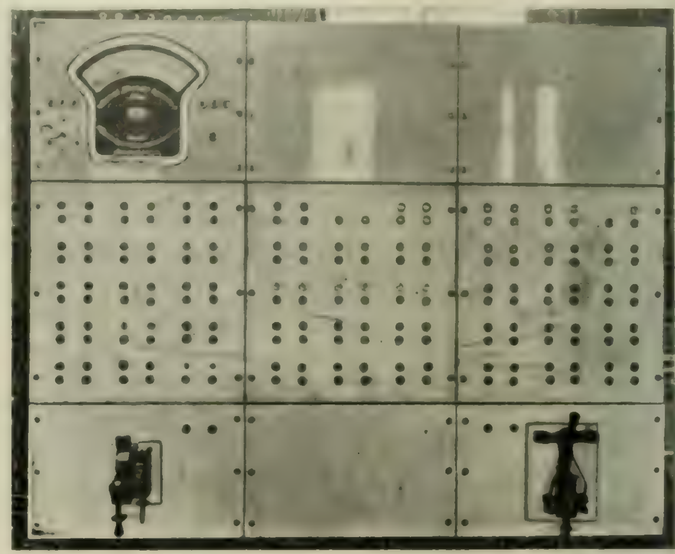


FIG. 2.—LABORATORY SWITCHBOARD.

pinned in a wooden handle with a small screw. To make it more springy it is best to reduce the diameter a little where the plug leaves the handle.

It will be noticed that there is very little machine work on any part of this terminal. The tubes are made very rapidly on the turret lathe, and require no further treatment except reaming out and facing. The yokes require a little facing on the emery wheel and drilling for the wire connection.

As made in small quantities and with cheap labor, the cost of the tubes is about 9½ cents each, of the yoke 6 cents, of the nuts ⅔ cent, and of the plug complete in the handle and ready for soldering in the cord, about 10 cents. Thus a complete terminal with two tubes costs about 26 cents. If made in larger quantities this cost could, of course, be reduced, especially by making the yokes from sheet brass with a die. It is also to be noticed that these jacks are very easy to install in the board, only one ⅝-inch hole being necessary for each jack tube. The tubes are also very readily removed for facing off or replacing, and are very easily smoothed up in a lathe in case of burning. These jacks give a very neat appearance to the board as is seen in Fig. 2, which shows a board fitted with the jacks.

With regard to the current carrying capacity, a test was made by selecting 10 of these jacks which had been in use for several months, connecting them in series with plugs and cords, and sending 100 amperes through them. The highest drop between the jack and plug was .01 volt, the lowest, .002 and the average .006. The heating of the jacks at the end of 15 minutes was hardly perceptible.

* Paper read at the Pittsburg meeting of the A. A. A. S.

Marconi's Transatlantic Experiments.

Mr. Vyvian, engineer in charge of the erection of the Marconi station in Canada, states that Mr. Marconi will not come to Cape Breton until the latter part of August next. The postponement of Marconi's return to Canada is said to be due to the fact that the Italian Government has just placed at his disposal a war vessel, on board of which Marconi will make experiments in long-distance wireless telegraphy. In the meantime it is altogether likely that communication with the station at Cornwall, Eng., will be established by Mr. Vyvian. It is thought that Marconi will go direct to Cape Breton in the Italian warship.

An Electromagnetic Rectifier for Alternating Currents.

By GEORGE HART MORSE.

THE following experiment is due to a suggestion by the writer. The apparatus was arranged and the experiments performed by Mr. C. R. Cushman, a recent graduate from the Department of Electrical Engineering in the University of Nebraska.

The object to be attained was the division of an alternating current into two unidirectional, pulsating currents, through the medium of a double electric arc drawn between three carbon points, the arcs being immersed in a strong magnetic field. To this end three electric light carbons were arranged, as shown in Figs. 1 and 2, the alternating current entering by the lower carbon, Fig. 1, and leaving through two simultaneous arcs established between the lower and upper carbons, respectively. The plane determined by the three pointed ends of the carbons was in the experiments so situated half way between the poles of the large electromagnet, also shown in Fig. 1, that it was at right angles to the line joining the centers of the poles, the arcs being in the strongest part of the field.

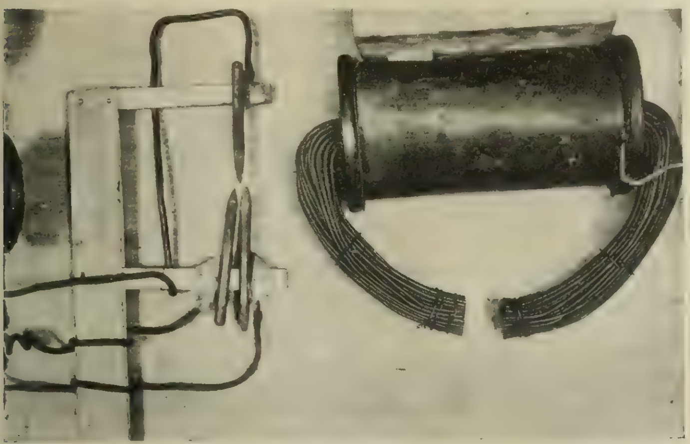


FIG. 1.—ELECTRIC LIGHT CARBONS AND ELECTROMAGNET.

The core of the magnet was composed of 56 pieces of very soft iron wire, their average length being three feet, and the diameter of each wire approximately .15 inch. The winding consisted of 1,000 turns of No. 10 copper magnet wire. This magnet was fed with a constant, direct current by means of an independent circuit provided with a regulating rheostat, *R*, and ammeter, *C*, Fig. 3. For the sake of clearness the magnetic poles are in Fig. 3, indicated as being merely in the vicinity of the arcs, and not at all in the position which was really occupied by them during the experiments.

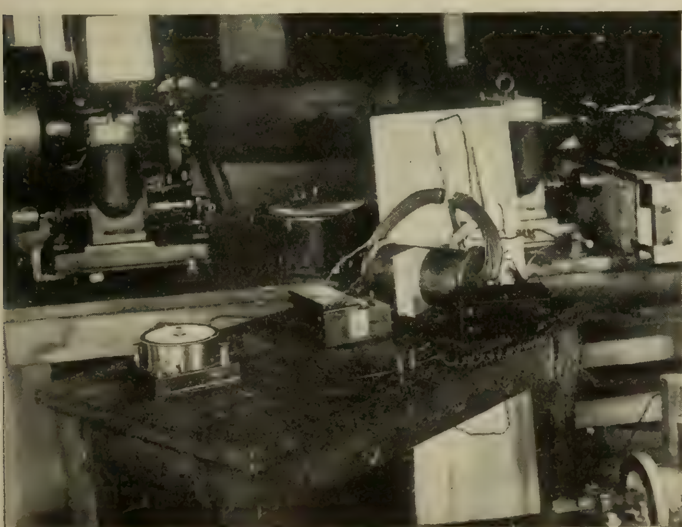


FIG. 2.—EXPERIMENTAL APPARATUS.

The alternating current was obtained from one phase of a General Electric three-phase, rotating-field alternator, which was run at such a speed as to produce a frequency of 44 cycles per second. In the lower diagram of Fig. 3, *D* is an alternating-current ammeter of the Hoyt type, while *B* is a direct-current Weston ammeter. That the latter was incapalbe of responding to an alternating current was shown by reversing the terminals during the experiment, thus causing the needle to kick off from scale in a negative sense. Any deflection of ammeter *B* would therefore indicate a unidirectional component of the alternating current as circulating through the upper branch in which *B* is located, while it may be likewise inferred that an equal and opposite component is at the same time circulating in the lower branch of the experimental circuit. Since normally before the magnet is energized we would have equal alternating currents flowing in these two paths, assuming that they are of equal resistance, a reading of *B* equal to half that of *D* would imply, roughly, a complete degree of rectification. This condition was by suitable arrangement acutally achieved, as will be seen from the following experimental results:

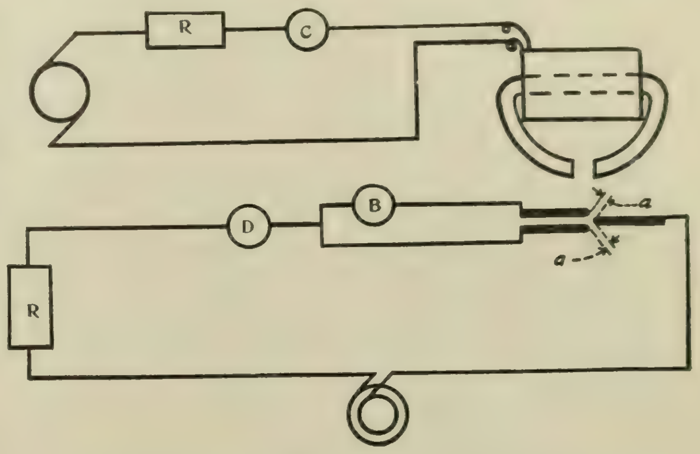


FIG. 3.—DIAGRAM OF ARRANGEMENT OF APPARATUS.

Experiment I.

15 *amperes through Magnet*	*Distance a in Inches*	*Reading of Alternating-Current. Ammeter. D.*	*Reading of Direct-Current. Ammeter. B.*
"	04	30	6
"	.05	28	6
"	.07	25	7
"	.09	22	9
"	.10	20	10

Experiment II.

1.7 *amperes through Magnet*	*Distance a in Inches.*	*Reading of Alternating-Current Ammeter. D.*	*Reading of Direct-Current. Ammeter. B.*
"	.07	32	5
"	.09	28	5
"	.10	25	9
"	.12	22	11

Comparison of the two experiments also show that for the same length of arc, other conditions remaining the same, less alternating current flows while the arcs are affected by the stronger field.

Professor Bell and Wireless Telegraphy.

According to a recent dispatch from Chicago, Prof. Alex. Graham Bell, while passing through that city on his way to Minneapolis, expressed himself in the following language regarding the future of wireless telegraphy:. "Wireless telegraphy will never be made practicable for service on land. I believe the invention will supplant the oceanic cables when it is sufficiently developed to be reliable for the transmission of messages, but it can never take the place of the telegraph or the telephone."

Radiant Efficiency of Arons Mercury Arc Lamp.*

By William C. Gass

THE electric arc between mercury terminals in a vacuum has been known for many years[1] to emit an intense light. Arons[2] first made a form of vacuum tube in which the arc could be easily studied. From the intensity of the emission spectrum it was supposed that the radiant efficiency of this arc would be high In order to test this idea, the measurements to be described were made.

A mercury arc lamp after the form described by Arons[2] was mounted upon a block of wood which could be tipped so as to make the arc, and connected to a 110-volt direct-current circuit.. The method of measuring the efficiency was the one described by Merritt[4], and frequently used in the Cornell laboratory. Certain modifications in proceeding and calculation were employed in accordance with the deduction of Nichol.[5]

The radiation from the lamp was allowed to fall upon the face of a thermopile, and the first throw of the galvanometer read[6]. This value gives the total radiation A. The throw was then observed with a cell of water interposed between the lamp and the thermopile, giving the reading due to the luminous energy alone, a'. A correction reading for heat transmitted by the water was taken by observing the throw of the galvanometer when a cell of iodine in carbon disulphide was interposed together with the water cell. Calling this reading e', then, acording to Nichols,

$$\text{efficiency} = \left(1 - \frac{e'}{a'}\right) \frac{a'}{A'}$$

Considerable difficulty was experienced at first owing to the frequency with which the lamp went out. This happened most often when running with low currents. There was no way that this could be remedied. In order to be sure that all readings were observed when the lamp was burning, a small mirror was so mounted near the galvanometer that the light from the lamp was reflected into the free eye. In this way the extinguishing of the lamp was recognized. It was thus necessary to repeat until readings were obtained with the lamp burning throughout the time of the throw.

Another more serious difficulty was due to the fact that the glass of the lamp became highly heated by the arc. Thus the total radiation readings do not represent the real total energy from the arc, but rather the energy from the arc plus considerable energy from the heated glass. To overcome this difficulty and obtain readings which would be proportional to the energy of the arc alone, several devices were tried. None of them gave complete satisfaction; by far the best, however, is with the use of a chronograph in the following manner:

With the iodine and water cells removed, as soon as possible after striking the arc the screen was drawn away and the first throw of the galvanometer observed. At the instant this reading was obtained the key was pressed, thus simultaneously extinguishing the lamp, by breaking the circuit, and recording the time of the observation by means of the chronograph. This latter instrument was actuated by a chronometer which was marking two second intervals.

Table I.

Time Seconds.	*Throw.*	*Reciprocal.*
0	4.36	0.98
99	2.12	0.472
192	1.56	0.640
287	1.30	0.769
320	1.13	0.885
377	1.02	0.980
453	0.92	1.088
507	0.82	1.220

While the lamp cooled several successive throws were observed, the time being recorded at the instant of each throw. By this means a time curve of cooling of the hot glass was obtained which, when exterpolated back to the zero time—in this case the ordinate axis—indicated the throw proportional to the energy of the hot glass on the instant that the lamp was extinguished. The difference between the exterpolated reading and the one actually read gives the energy due to the arc alone, which was the value desired. On plotting the reciprocals of galvanometer throws as ordinates and time as abscissas, the curves proved to be straight lines, which fact simplified the exterpolation. One illustration will suffice. The exterpolated reciprocal value is 0.296. The corresponding throw is 3.38. The difference 4.36 — 3.38 = 0.98. The efficiency or $a'/A = 0.448$. The efficiency corrected, or $(1 - e'/a')\ a'/A = 0.427$.

Table II.

Volts.	*Amperes.*	*Efficiency.*
14.3	3.85	0.305
14.7	5.02	0.419
14.4	6.03	0.458
14.6	7.09	0.406
14.5	8.11	0.438
14.7	9.04	0.479

The results are given in the Table II. The discrepancy between the values is doubtless due to the extreme unsteadiness of the arc, which could not be overcome. They indicate on plotting efficiency as ordinates against amperes as abscissas, that a proportionality exists between the efficiency and current.

* Paper read at the Pittsburg Meeting of the A. A. A. S.
1 Way, Ding. Polyt. J. [illegible] (1860).
2 Arons, Wied. Ann. 47, [illegible] (1892).
3 Arons, Wied. Ann. 58, 73 (1896).
4 Merritt, Am. J. Sci. 37, 167 (1889).
5 Nichols, Phys. Rev. 11, 215 [illegible].
6 Merritt, Am. J. Sci. 41, 417 (1891).

The Trend of Progress of the Prime Movers.

FOLLOWING is an abstract of the paper read by Prof. R. H. Thurston at the Pittsburg meeting of the A. A. A. S., and referred to last week in our report of the proceedings:

The great prime movers have been known in type, and in some cases in specific forms still familiar, since the days of Hero, of Alexandria, and, probably, may have been in some forms known to prehistoric Greeks and Asiatics. The sources of power—heat, falling waters, the winds—all were well known when the earliest scientific writings were produced, and the famous Alexandrian "museum" contained illustrations and examples of even some of our simpler familiar types of steam engine and steam boiler.

The prime movers made little progress toward their present perfection until the commencement of the eighteenth century when the steam engine of Savery and Worcester—the old steam-fountain of Hero the Younger—was displaced by the modern steam-engine, a real train of mechanism, devised by Newcomen, the inventor of the modern type of machine, about 1707. Meantime, water-wheels and wind-mills were taking form, and the prime movers thus were preparing to do their part in the world. Improved by Watt, the steam engine assumed the largest part of the load, but the water-wheels and windmills have always done a large amount of work in the aggregate. The industrial world came after a time to be moved as a whole by the prime mover of Watt, and steam power has of late performed vastly more work than could the whole population of the world, unaided.

The gas engine has a history of about the same length as has the steam engine in its form of a prime mover for mills. It was introduced about a century ago and has progressed meantime less rapidly than its rival, but since the middle of the last century its advance has been steady, both in construction and in employment. To-day, this motor has assumed a perfection of design and construction, and has attained an excellence of economical performance, which is rapidly bringing it into use in a great variety of fields, and is, in fact, making it a promising competitor with the older motor.

The other motors have been meantime greatly improved. The modern hydraulic turbine has attained an efficiency of 80 per cent. and upwards, and the contemporary windmill is a scientifically designed and skilfully made apparatus of but little if any less perfection for its purpose or efficiency in utilizing its form of energy. All the common forms of prime movers have now, thanks to advances in sciences related to engineering and to the progress of invention, become highly perfected, and the next question of the engineer and of the employer of power has come to be: "What new motor can be devised to more perfectly utilize the available energies of Nature?"

The serious wastes of the best of heat-motors are doubly serious and important in view of the fact that our coal deposits are of limited extent, and that, however, great they may appear, that limit will be attained in one-fifth the time, even with the best practice of to-day, that would be secured could the wastes, now apparently inevitable, be extinguished. Our best steam and gas engines waste four times as much of the thermal energies supplied them as they utilize. A substitute for these engines must be sought

if they cannot be made thus practically perfect; but no way is known by which the purely thermodynamic wastes which constitute the greatest obstacle can be avoided.

Our existing stores of available energy may possibly be reinforced by more complete employment of the water powers, the wind currents and the internal heat of the earth. Our present wastes of thermal energy might be reduced to comparative insignificance could a way be found of imitating nature in the complete utilization of the supply through other processes than thermodynamic. Nature actually does produce light without heat, and, apparently, at least power without thermodynamic wastes; it would seem that man should be able to imitate her methods. If this could be done, our electric lighting could be provided, or a substitute of similar value obtained in a way that should reduce the wastes, as in the firefly and the glow-worm, with one four-hundredth as much expenditure of energy as now is exacted in the production of light by our usual forms of illuminant. It would be possible to increase the amount of power derived from a stated quantity of potential energy four or five times. Heat drawn from the interior of the earth would provide us with what may be needed by man as long as man can live upon a cooling globe.

When the inventors and discoverers have thus performed their task, we shall be assured of a vastly longer persistence of civilization upon the globe, shall be able to employ mechanical power at a fraction of its present cost, shall secure light without heat, and of a hundred times greater quantity at the same expenditure, shall distribute the electric current for whatever purposes at minimum expense and shall make every civilized nation on the earth many times wealthier, and shall extinguish poverty and, largely, crime.

The Telephone Situation in the Northwest.*

By C. H. JULSON.

Independent telephone companies, Mr. Judson stated, began operations in Minnesota as early as 1893, when two or three venturesome individuals established exchanges in towns lying at a considerable distance from the commercial center of the State. These exchanges were not in competition and were soon connected with the Bell systems under traffic arrangements. He then went on to describe the work done at first by irresponsible promoters, who had, however, now disappeared from the scene, leaving good and earnest independent companies engaged in reconstruction and extension.

The field in Minnesota and the two Dakotas has been a good one for the independents, since the Bell Company, operating in these States, owns a comparatively small number of exchanges, perhaps not to exceed sixteen in all. It was found that if a good independent exchange were built along the route of the Bell Company's long distance lines that the Bell people were immediately anxious to secure connections with the new exchange. This, of course, helped to encourage the independents very greatly, and while the Bell Company has built no new exchanges in the States mentioned within the last five years, every town of five hundred inhabitants or more has a telephone system, some of them reaching to the important centers near them over independent lines exclusively, and some part of the way over independent lines and part of the way over the Bell lines. The policy of the Bell Company being to absorb the lion's share of the receipts, the arrangement has not been altogether satisfactory to the independents, and new toll lines have been constructed giving strictly independent connections with the largest independent exchanges from the outlying districts. Other lines are planned for construction during this and the coming season which will give the center of distribution, that is, the twin cities of Minneapolis and St. Paul, close connections with all points in the States of Minnesota and North and South Dakota and will link the splendid system of the Wisconsin independents to it, making a Northwestern independent system capable of holding its end of the competition.

From the report of President Vallentine of the Wisconsin Association he quoted the following statistics as to the independents in that State: Exchanges, 137; copper metallic toll lines, 200 miles; iron metallic toll lines, 3,000 miles; iron grounded toll lines, 4,000 miles; toll stations, 650; telephones in use, 23,000; invested capital, $2,316,875.

From the fact that the Minnesota Association has just been organized it has been impossible to gather complete statistics regarding the business in that State, but from present information they are as follows: Exchanges, 147; miles of long distance toll lines, 4,000; miles of circuit, 7,000, of which 1,150 miles are copper metallic; toll stations, 725; invested capital, about $3,300,000; telephones in use, 34,000.

South Dakota shows 103 exchanges, 2,350 miles of toll lines, 450 toll stations, and North Dakota 89 exchanges, 1,875 miles of toll lines, carrying 2,750 miles of circuits and 350 toll stations.

This showing is indicative of the enthusiasm which prevails in the Northwestern States regarding independent telephony. Since the Bell Telephone Company came into control of the Northwestern Telephone Exchange Company and the Wisconsin Telephone Company, their licensees in that territory, it has been endeavoring to tie up as many as possible of the independent exchanges under the Bell license contract, by the terms of which the exchange company agrees irrevocably to sell to the Bell. Very few of the independent exchange companies have signed this contract. They hold the situation in their own hands as the long distance connections are of far greater importance to the Bell Company than to them; they are firmly maintaining their position and closing no contracts which will bind them to the Bell corporation. In the natural order of events the Bell Company will make extraordinary efforts to get hold of many of the larger independent systems, since, if they are cut off from them, they will lose very valuable connections in future. Were the independents in a position to duplicate on short notice the six trunk lines running in various directions throughout the State of Minnesota and into the Dakotas, the Bell people would find themselves without feeders in almost the entire territory, so that it is very clear why they should make the most extraordinary efforts to tie the independent people to them. There is little danger as matters stand at present that such a consummation will come to pass unless inducements far out of the ordinary are made. In any event, however, the money received would probably be reinvested by the independent who sells out to the Bell in an opposition plant, giving him in all probability a better exchange and toll line system than he had before.

The largest independent company in the northwest is the Twin City Telephone Company, operating exchanges in Minneapolis and St. Paul. This company entered the field in 1898 under the name of the Mississippi Valley Telephone Company. In 1901 the name was changed to the Twin City Telephone Company and a new organization and ownership effected. The plants of the Twin City Telephone Company in the two cities are in active competition with the Bell and are giving a quality of service which probably cannot be excelled in the country. The construction, both aerial and underground, is of the very best, the equipment is of the most up-to-date and efficient pattern and great care has been exercised to procure only the very best material and apparatus in all of the work.

A large portion of the work in both cities is underground, vitrified clay conduit being used exclusively, something like 1,000,000 feet of conduit being now in. The cable used runs from 200 pairs down built on the very best specifications, all being No. 19 B. & S. G. double wrap.

The pole lines of the Twin City Telephone Company are probably the handsomest to be found in the country, Idaho and Washington poles having been used for the most part and painted uniformly.

The plant of the Twin City Telephone Company comprises seven exchanges in the cities of St. Paul and Minneapolis, the company owning four of its own buildings, all having been constructed within a year, and each being built especially for the purpose in the most convenient and substantial manner. The extraordinary amount of territory covered by the Twin City Telephone Company renders the branch exchange system a clear necessity and the trunking service between the different exchanges has proven very satisfactory. The total ultimate capacity of the switchboards which are now installed is about 26,000 in the two cities. New switchboards will be installed next season, adding five or six thousand ultimate.

The growth of the Twin City Telephone Company's business

* Abstract of paper read at the Philadelphia Meeting of the Independent Telephone Association of the United States.

has been along the same lines as of all other independent companies and has even surpassed the expectations of those who are familiar with the demands which might be made upon them. Nearly 7,000 telephones are now in operation in Minneapolis and St. Paul and orders are being taken and installed at the rate of over 500 per month. The Twin City Telephone Company installs no party lines, and it is therefore for the present cut off from doing business with a large number of the subscribers of the Bell Company who can afford to pay but little for a telephone. This, however, has no effect on its earning power nor upon its business prospects, since the telephone user who must get along with a telephone at a dollar and a half a month is of comparatively little importance in the business field. The company has installed a large number of private switchboard systems and has been compelled to maintain a separate department for the installation and care of this particular branch of the work. The company has invested over $2,000,000 in the Twin Cities up to the present time.

The Zenith City Telephone Company of Duluth is the second largest independent telephone company in the State of Minnesota. It commenced construction in 1899 and at that time the Bell Company in Duluth had 700 subscribers. At the present time the Zenith City Telephone Company has about 1,900 subscribers in Duluth and it is unable to keep pace with the demand. Closely allied with the Zenith City Telephone Company is the People's Telephone Company of West Superior, Wisconsin, which began business at the same time and has been as prosperous as the Zenith City Company.

These two companies are connected with the Twin City Telephone Company of Minneapolis and St. Paul by a long distance line carrying three No. 10 copper circuits. This line belongs to the Consolidated Telephone and Telegraph Company, a corporation composed of officers of the Twin City Telephone Company. This connecting line is doing a good business and must have made some impression on the American Telephone and Telegraph Company, which it parallels, since immediately upon the completion of the consolidated line the American Telephone and Telegraph charge was cut from 75 cents between the Twin Cities and the head of the lakes to 40 cents, the Consolidated Company having made its rate considerably lower than the old rate. The company is doing a very satisfactory business and has some 28 stations on its line, which is about 150 miles long, the through business between the head of the lakes and the Twin Cities being especially good.

The Consolidated Telephone and Telegraph Company has material on the ground for the construction of a line between St. Paul and Eau Claire, connecting at that point with the Wisconsin system and running directly into the exchanges in Eau Claire, Menominee and Chippewa Falls, Wisconsin; also a line running southeast along the river to La Crosse, Winona and intermediate points, perhaps thirty in all. This line will feed a large number of lines which have connections with the Twin Cities and will probably get 100 toll stations and 25 exchanges off of these lines. 1903 will see the Consolidated Telephone and Telegraph Company's lines extended southwest and west and northwest into the territory which is now connected with the Twin Cities only by Bell lines. These lines will be of the very best copper construction.

The United Telephone and Telegraph Company, with headquarters in Minneapolis, operates about 250 miles of line running southwest and south from St. Paul, with connections with the Twin City Telephone Company. These lines pass through three of the largest towns in which the Northwestern Telephone Exchange Company has exchanges, and in each of these towns an independent exchange is doing a successful business. One of these cities, Mankato, Minn., is rebuilding its entire plant this season, installing a new lamp signal switchboard, and putting in considerable underground construction. The Winona Telephone Company is also very successful, and the La Crosse Telephone Company is well known to be one of the pioneers in the independent field and is doing remarkably well. Perhaps the most successful independent in Wisconsin is the Madison Company.

Farmers' lines in Minnesota are taking hold in good shape, one company having over 400 farmers connected with its lines and increasing its plant constantly. Parts of Wisconsin and Minnesota are as good farmers' line territory as can be found in the country, while other portions, of course, are so thinly settled that it will be some years before much is done along this line.

At the meeting of the Minnesota independents recently held in Minneapolis, the constitution adopted contained an important clause and one worthy of mention at this time. It particularly provides for the elimination of poor construction and the building of toll lines and exchanges in the best possible manner, standardizing the work to the greatest possible extent. The independent owners in Minnesota have found that poor construction is not satisfactory from an investment standpoint and this agreement is certain to give the business in our territory a solid basis for future calculation and a standing among the independent systems of the country.

Portions of the Northwest demand telephone service because of the long distance between railroad stations and their inaccessibility at certain seasons of the year. In these districts it has been found difficult to make a good line pay at present, but the telephone has been found to be an active agent in the settlement and building up of a new country, and men of means and energy are at hand to furnish, next to transportation facilities, the most valuable adjunct to frontier and backwoods settlements. Fortunately many of these districts supply plenty of good cedar poles immediately at hand, making the construction to a great degree cheaper than in the more settled districts. The telephone is so important to every class of business and to every kind of community that no one is willing to be without it, even the Indians on the reservations, among the more educated ones, finding the telephone to be of some use to them, since the farmers among them have learned that if they have anything to sell, they are certain to get better prices where they can ascertain what the markets are at the centers of trade.

A High Potential Direct-Current Plant for Experimental Work.*

By G. S. Moler.

In order to have a direct-current potential of about twelve thousand volts available for experimental purposes it was decided by Dr. E. L. Nichols, professor of physics, and Harris J. Ryan, professor of electrical engineering in Sibley College, of Cornell University, that they would purchase jointly a large number of small high-potential, direct-current dynamos, and after thoroughly insulating them from each other, connect them like battery cells in series so as to obtain a potential equal to their added pressures. Such a set of dynamos was obtained and have been mounted in a suitable manner by the writer, making a high-potential plant which has proved satisfactory in its workings.

In this plant 24 direct-current separately-excited dynamos of 500 volts each have their armatures connected in series so that a pressure between the terminals of the series is given which is equal to the sum of the individual pressures of the dynamos, this sum being from 12,000 to 14,000 volts, depending upon the speed and the degree of excitation. The full-load current for which they were constructed is .22 of an ampere. For excitation purposes they are divided into three groups of eight each, which have their fields connected in series and to these the terminals of a 170-volt exciter is connected.

Three similar exciters with controlling rheostats are used. The dynamos and exciters were constructed by the Crocker-Wheeler Company, of Ampere, N. J., especially for this use, great care being taken in highly insulating them so that they would not break down under the enormous strains to which they might be subjected. It was assumed that the terminal pressure of 4,000 volts in a group of eight would not be sufficient to cause a leap from one terminal brush to the frame, then to the field wire and from that again to the frame of the eighth and to its brush, thus short-circuiting the group through their fields and through the exciter. To further insulate their frames from each other they were placed upon individual slabs of polished dark Tennessee marble, and the wires from the brushes and those from the fields were carried down through glass tubes placed in holes drilled through the marble. The dynamos and exciters are all driven from the same countershaft by means of leather belting. It was thought that the leather would afford ample insulation between the frames of the machines, so no additional precautions were taken to insulate them from the countershaft. A massive table or frame-

* A paper read at the Pittsburg meeting of the A. A. A. S.

work of white pine was constructed and was stained, then it was coated with hot linseed oil, which was allowed to dry for several days, after hich it was thoroughly varnished with shellac.

The table was constructed so that the dynamos could be mounted in two rows upon it. In each row they are placed one to each foot in length of the table, and in one row they are set a little ahead of those in the other row, so that their belts will not interfere upon the countershaft, which is placed between the legs of the table and near the floor. The exciters are placed upon raised platforms between the rows, as can be seen in the view. The rheostats shown near the exciters have grooved wheels and are operated by means of cords extending to one side of the room. The top of the table is not solid, but consists of four longitudinal planks placed edgewise, supporting the ends of the two rows of small marble slabs. The slabs are about seven inches wide, thus leaving about five-inch spaces down through which the belts are carried. The counter shaft is belted to an electric motor.

Over each machine is placed a galvanized wire netting cage and this is connected to the upper brush to keep it of the same potential as that brush; the adjacent cages, therefore, have a difference of potential of 500 volts. These are to protect the dynamos from any induced discharges which may take place among them. In the view two of the cages have been removed. A glass case with doors hinged at the top encloses the whole of the upper part of the table. The wires from the terminal dynamos are carried through porcelain tubes up through the top of this case, one of them to the circuit breaker, and each to an oil-break switch.

HIGH-POTENTIAL DIRECT-CURRENT PLANT.

The circuit breaker shown on the left-hand end of the case has a long arm hinged at the top; this is actuated by means of a spring, so that when it is released from the catch at the bottom it flies upward, thus making an 18-inch gap in the circuit. The flash takes place between two pieces of carbon. The arm is latched again by revolving the wheel shown at the top of the circuit breaker, the wheel also opens the oil-break switch before it latches the arm of the circuit breaker. The core of the solenoid of the circuit breaker has been adjusted to jump up with .24 of an ampere. The oil-break switch consists of a plunger immersed in oil but held up by means of a spring unless it is pushed down against the contact plate in the bottom of the oil reservoir by an arm extending outward from the wheel of the circuit breaker. When opening the oil-break, the plunger follows the arm to the limit of its path then the arm leaves it, making an 18-inch gap in the circuit. In this way the wide gap is made without swinging through space an arm which is dripping with oil.

At the farther end of the case the second oil-break switch is located; it is also operated by means of a wheel, and these wheels are both turned by means of cords extending to the side of the room. A cord to open the circuit of the driving electric motor extends to the same place. These cords are all for the purpose of enabling the operator to make the proper adjustments without exposing himself to the high-potential current.

The wires from the oil-break switches are carried to insulators, which consist of long porcelain tubes suspended from the ceiling of the room; screwed into plugs in the lower ends of these tubes are screw eyes, through which the wire is carried.

In the preliminary test of the apparatus each little dynamo was run alone, and its brushes were connected to two 250-volt incandescent lamps which were joined in series, and at the same time the exciter was connected to the eight field circuits of that group to which the little dynamo belonged. In this way the brushes were adjusted before the cages were placed over the machines.

After these adjustments were made, the individual groups were tried to note the effect of changing the rheostats of the exciters. A Klvin electrostatic voltmeter having a range of 20,000 volts was used to denote the pressures obtained.

The circuit breaker was found to work promptly under all conditions of overload, the severest test being suddenly to short-circuit the terminals at the voltmeter. In this case a thick flame, nine or ten inches long, would be drawn out by the moving parts as the gap was being widened. A rough test of the jumping distance of the current at 12,000 volts was made by bringing the blunt ends of two No. 14 B. & S. gauge copper wires near to each other, these wires being connected to the leads near the electrostatic voltmeter. When the space was reduced to about 16 mm. an arc was suddenly formed, which lasted till the circuit was opened by the circuit breaker. With 14,000 volts the space was about a millimeter longer.

The plant was run in the dark to observe the brush discharge that might take place around the small dynamos or from any part of the circuit and connections. A feeble glow could be detected at the ends of the leads, especially when they were almost near enough for the current to leap across; also a glow was detected around some of the connections, but around the brushes and the dynamos themselves none could be seen for the reason that the sparking commutators gave considerable light.

Each little dynamo appears to operate just the same as if it were entirely alone, so it would seem that another similar set might be connected in series to the present one with a considerable degree of confidence that they would operate successfully together.

Hand vs. Machine Telegraphy.

BY JOSEPH B. BAKER.

I HAVE read with astonishment Mr. Barclay's letter in the ELECTRICAL WORLD AND ENGINEER of July 5. Apart from the ultroa-conservatism of the views expressed on the merits of systems for rapid machine telegraphy that have been designed for American lines and conditions by the best brains in electrical America, and apart from the relegation of the designers of such improved systems to the ranks of college professors, interested inventors and promoters, it seems to the writer that Mr. Barclay's letter is merely a defence of the operating methods of his telegraph company, and limited to a presentation of a series of issues aside from the real fundamentals of the subject, "Hand *vs.* Machine Telegraphy." It is not the writer's wish to reply to Mr. Barclay or to controvert the points in his communication referring to existing telegraph operating practice. He desires, however, to present some broad considerations more directly related to the heading of this article.

In the early days of the Morse telegraph in this country, hand working was a wonderful thing enough. It was realized by the public that the extension of so new an art necessarily carried with it what might be called an emergency charge for telegraph service. The use of the telegraph came to be regarded as a sort of luxury, only to be resorted to when the urgency of the intelligence to be transmitted outweighed all questions of cost. The property of the single telegraph operating company, and latterly of the two large companies in possession of the field to-day, has consisted largely in "rights of way," which mean possession of the field and the discouragement of all genuine competition. The growing conservatism inherent to an enormous business carried on under monopoly conditions made it easier, as the business of the country increased, to add wires on existing pole lines than to experiment with systems of operating designed to be an improvement over the "key and sounder." Furthermore, some difficulties in the way of the American working of such foreign systems as the Wheatstone seemed to constitute a precedent against any innovation tending to displace manual telegraph operators, trained in the first instance to the reading of the Morse tape, and later to the reading of the Morse sounder. The lines could always be made to fill nearly, or quite, the demand for the expensive and infrequently resorted to "telegram," so, with a few unimportant ex-

ceptions, hand operating has persisted until the present time, both for heavy traffic between large cities and for local messages; all messages having to pass through the crude process of being clicked off by the hands of operators more or less expert.

In further considering this situation in comparison with the possibilities of machine telegraphy, the question arises: What is manual telegraph operating? In the case of a line from New York to Chicago, it is the exclusive holding of a 984-mile line by one man while he opens and closes his key by hand, spelling out the message, to be as slowly and laboriously interpreted and written at the other end. The introduction of repeaters does not affect the truth of this broad statement, and the use of the quadruplex only multiplies the virtual speed of transmission by four, although regarded in its day as a very great improvement. The operating of the key at the transmitting end is practically the subjecting of the long line wire to a series of electrical blows, by, so to speak, whacking a battery on to it as one might pound the end of a rail in Morse characters, to be read by a distant receiver with his ear to the track. The individual signals travel with the speed of electricity, but the length of each signal and the spaces between them answering to indentify the groups of signals as letters of the alphabet make this process singularly slow compared with the nature and capabilities of the agent, electricity, by which the impulses are transmitted.

To cut short the description of the, electrically speaking, painful and clumsy process of manual sending, it is the limiting of the hundred-fold carrying capacity of the wire (realizable by existing methods of applying a rapid series of impulses proper to the line) to the output of one man's hand moving scarcely faster than a pen can be driven. The "harnessing of electricity" to this, electrically speaking, pitifully slow pace, is as out of date, as jarring with the spirit of the age, as an ox team.

When the telegraph was invented, and, indeed, for as long as the people were content with merely improvements on the methods of their fathers, the apparent instantaneousness of the signal—the response of the sounder simultaneous with the closing of the key—was a wonder, awe-inspiring, and more than satisfying. But the present-day demand is for quickness of transmission, not of the individual signal, but of intelligence—not the crude manipulation of wires in order to deliver a few thousand messages at a rate that makes the average man think of the expense at least one and one-half times before sending one, but the scientific use, to the full, of an agent whose powers it is absurd to compare to or limit by hand labor. This present day is too busy a one to do things in slow and painful ways. If one travels, it is by train, at twice the speed all day of the fastest horse for a single mile; the walk or ride from the station to one's home is the local exception to the train that proves the rule of the train's essentiality to modern life. If a city newspaper is to be printed, its tens of thousands of copies every issue can only be turned off by giving practically the whole contract, from type-metal to folded newspaper, to a set of machines; the fact that hand-bills are printed slowly on a laborious "printing press" is a local fact that only serves to show forth the essentiality of a linotype and a Hoe. Whenever there exists a large aggregate of purely mechanical movements, the time is at hand when any further growth in the number of such movements, whether they spell manufacture or traffic, means that machines must be employed—there is no alternative but the raising of prices of manufactured article, or rate for traffic, respectively.

This brings us to the root of the particular issue under discussion—"Hand *vs.* Machine Telegraphy." The operating companies of this country have been able to exercise the conservatism that grows with private monopoly, and is necessarily tended and nurtured by it. They have acquired and become firmly intrenched in their "rights of way." With the enormous material growth of these United States has come the corresponding growth of the need of facilities for the transmission of intelligence. The mail service is one of these facilities, and with the growth of its traffic has been able to reduce its "rate for messages"; letters being carried for one-third less than formerly, under improvements that have made the 2-cent stamp possible. The postal rate was reduced not only actually but relatively, because sway was given to the law of reduction of cost with increase of output of traffic. The same remarks are broadly true of the express service.

But now consider the telegraph service. The rates have been reduced from time to time, under pressure of a sort of competition, imperfect and not free to make for the public good to the limit; but the reduction of rates has not been such, had not been allowed to become such, as would require, in order to maintain dividends, an increase of traffic at all corresponding to the need of instantaneous communications by the business world. If the telegraph monopoly were less impersonal and had a voice, one could imagine it to say: What is the use of benefiting the public, *per se*, when by the maintenance of the present rates we can still handle the business by hand labor? Mr. Barclay tells us that rates are even higher abroad. That means, it is even more expensive and difficult to send telegrams there than here, as he sets forth in several comparative examples. In the same way, it becomes more difficult to send telegrams when a blizzard causes a loss of two-thirds of the wires between Boston and New York; hand operating, with or without the quadruplex, over the remaining good wires accentuates the general absurdity of hand operating by the spectacle of the business communities of both cities waiting for hours for the operators to click off their messages.

It is not at all a question of the best business and operating methods of electrically transmitting intelligence at an emergency cost to the public, prohibitive of all messages, but those where the urgency becomes the ruling factor; it is, as the writer views it, a broad question of whether machine telegraphy would serve the public better, or hand telegraphy does serve the companies easier. It is idle to assert that machine telegraphy is a college professor's dream, aside entirely from the propriety of so contemptuous an allusion. It is idle to maintain that electricity cannot be made to work a machine at least as fast as the typewriter, which, in the hands of a mere novice at the sounder, can easily keep up with the fastest manual sending ever executed; and, at that, leaving all the added speed capacity of the machine, as a machine, untouched. It is merely an issue with the everyday facts to say that the capacity or other attenuating properties of the line inhibit rapid machine telegraphy; to cite the telephone current, doing its work perfectly by an alternating current whose mean frequency is in the neighborhood of 2,000 alternations per second, and traversing long and electrically difficult lines, is a sufficient answer. It is a patent fact, of which it would be almost impertinent to remind well-informed electricians, that there are in existence several complete systems of rapid telegraphy, any of which at its very worst disadvantage shows the manual method of handling heavy traffic to be just what it is at its best, in the hands of clever operators with brains and endurance: slow, clumsy and inadequate.

Metered Telephone Charges.

By M. J. Wohl.

THE subject of telephone metering has been discussed repeatedly, but up to the present the flat rate of charging has kept the lead. It has been pointed out that an exchange as its business increases gives poorer service, and the annoying cry of "busy" becomes augmented. To reduce this often-repeated cry, "busy," is the object to strive for, and as soon as that ceases the list of subscribers will increase.

It appears that a system of charging on an *average time basis* would tend to correct all difficulties. For instance, if the time spent in all calls from the moment the called-up party responded, until conversation ended, was added together and the total thus obtained, divided by the number of calls charged for at a predetermined price per minute, it seems without doubt that the subscriber would aid the central in making better and more rapid connections.

For example, say that the telephone company charges on an average for one minute calls, 2 cents; two minutes, 3 cents; three minutes, 4 cents, and so on, and that a subscriber has a meter which records all actual calls and time spent on each of them. If the meter records, after the expiration of say 30 days, 70 calls, and sum total of 280 minutes, the average would be four minutes, and at the rate of 5 cents per call the charge would be $3.50. Or suppose that the meter reads 25 calls and 175 minutes, or 7 minutes per call, for which the charge would then be at the rate of 8 cents, or a total of $2.00.

It would seem that such a method or a similar system of charging, where the subscriber is encouraged to use the telephone oftener, and for short intervals, should meet with the telephone company's approval. It would not only tend to increase the speed in making connections and leave open lines for communication, but the price would encourage persons to use the telephone where now they often times use the mails.

New Marconi Wireless Telegraph Apparatus.

In his recent Royal Institution lecture, reprinted in these columns, Mr. Marconi announced a new form of magnetic detector of electric waves, which can be employed as a receiver for space telegraphy. In a paper presented June 12 before the Royal Society a fuller account is given of the principles of this new apparatus, which we reprint below:

The present note bears upon the special manner in which a core or rod of iron or steel placed in a varying magnetic field is affected by high-frequency oscillations transmitted from considerable distances.

The magnetization and demagnetization of steel needles by the effect of electrical oscillations has long been known, and has been noted especially by Professor J. Henry, Abria, Lord Rayleigh, and others. Mr. E. Rutherford also has described a magnetic detector of electric waves, based on the partial demagnetization of a small core composed of fine steel needles, previously magnetized to saturation, and placed in a solenoid of fine copper wire connected to exposed plates. By means of a magnetometer Mr. Rutherford succeeded in tracing the effects of his electrical radiator up to a distance of three-quarters of a mile across Cambridge.

The detector about to be described is based upon the decrease of magnetic hysteresis, which takes place in iron when, under certain conditions, it is exposed to the effect of high-frequency or Hertzian waves. As employed up to the present, it has been constructed in the following manner:

On a core or rod, consisting of thin iron wires, are wound one or two layers of thin insulated copper wire. Over this winding, insulating material is placed, and over this again, another longer winding of thin copper wire containing a narrow bobbin. The ends of the winding nearest the iron core are connected to the plates or wires of the resonator, or as is the usual practice in long-distance space telegraphy, to earth and to an elevated conductor; or they may be connected to the secondary of a suitable receiving transformer or intensifying coil, such as are now employed for syntonic wireless telegraphy. The ends of the other winding are connected to the terminals of a telephone or other suitable receiving instrument. Near the ends of the core, or in close proximity to it, is placed a magnet, preferably a horse-shoe magent, which, by a clockwork arrangement, is so moved or revolved as to cause a slow and constant change, or successive reversals, in the magnetization of the iron core.

It has been noticed that if electrical oscillations of suitable period be sent from a transmitter according to the now well-known methods, rapid changes are effected in the magnetization of the iron wires, and these changes necessarily cause induced currents in the windings, which induced currents in their turn reproduce on the telephone with great clearness and distinctness the telegraphic signals which may be sent from the transmitting station. Should the magnet be taken away, or its movement stopped, the receiver ceases to be perceptibly affected by the electric waves, even when these are generated at very short distances from the radiator.

This detector has been successfully employed for some time in the reception of wireless telegraphic messages between St. Catherine's Point, Isle of Wight, and the North Haven, Poole, over a distance of 30 miles, and also between Poldhu, in Cornwall, and the North Haven, over a distance of 152 miles, of which 109 are over sea and 43 over high land. It has also been ascertained that signals can be obtained over these distances with the new detector when employing less power at the transmitting station than is necessary if a reliable coherer be substituted for the magnetic detector. It has been noticed, however, that the signals audible in the telephone are weakest when the poles of the rotating magnet have just passed the core and are increasing their distance from it, while they are strongest when the magnet poles are approaching the core.

Very good results have also been obtained by keeping the magnet fixed, and using an endless iron rope or core of thin wires revolving on pulleys (worked by a clockwork arrangement), which cause it to travel through the copper wire windings, in proximity to a horse-shoe magnet, or, preferaby, two horse-shoe magnets with their poles close to the windings, and with their poles of the same sign adjacent. In this case the copper wire windings are separated from the iron by means of a stiff, thin pipe of insulating material in order to prevent chafing of the wires. With this arrangement the signals appear to be quite uniform in strength.

There appears to be a certain magnetic force which gives best results, but different qualities of iron require different values. There would also appear to be a particular speed of revolution for the magnets employed which is more suitable than any other. Good results have been obtained when the magnets were caused to revolve at the rate of one revolution every 2 seconds, or, when using a moving core, by causing it to travel at a speed of about 30 cm. in 4 seconds.

Either iron or steel can be used for the cores or revolving rope, but by far the best effects are obtained when using hard-drawn iron wires or iron wire that has been considerably stretched or twisted beyond its limits of elasticity prior to its employment.

The cores used generally consisted of about thirty hard-drawn iron wires of approximately 0.5 mm. in diameter, with a winding on them made up of a single layer of silk-covered copper wire 0.019 cm. in diameter and of a total length of 2.4 metres. The other winding, connected to the telephone, has consisted of similar wire, and a sufficient number of turns have been employed to give a resistance about equal to that of the telephone used.

It would, no doubt, be possible to obtain the signals by causing the iron core to act directly on a telephone diaphragm, and in this case the secondary winding on the core could be omitted. The length of the electric waves used in the experiments between St. Catherine's Point and North Haven was about 200 metres. If longer waves are employed, it is desirable that the length of the winding nearest the iron should be increased.

This detector appears to be more sensitive and reliable than a coherer, nor does it require any of the adjustments or precautions which are necessary for the good working of the latter. Further advantages in its use become apparent when it is employed in connection with my syntonic system of space telegraphy. According to this system, electrical syntony between the transmitter and receiver is dependent on the proper electrical resonance of the various circuits of transformers used in the receivers. With certain coherers one difficulty has been that it was not always possible to restore them by mechanical tapping to the same electrical resistance which they possessed before being affected by the transmitted electric waves, the result being that the secondaries of the receiving transformers were at certain times open and at other times closed by a variable resistance, thus causing an appreciable variation in their natural period of electrical oscillation.

The magnetic detector described possesses, on the other hand, a practically uniform and constant resistance much lower than that of a coherer in its sensitive condition, and, as it will work with a much lower e. m. f., the secondaries of the tuning transformers can be made to possess much less inductance, their period of oscillation being regulated by a condenser in circuit with them, which condenser may be much larger (in consequence of the smaller inductance of the circuit) than those used for the same period of oscillation in a coherer circuit, with the result that the receiving circuits can be tuned much more accurately to a particular radiator of fairly persistent electric waves.

The considerations which led to the construction of the above-described detector are the following: It is a well-known fact that after any change has taken place in the magnetic force acting on a piece of iron, some time elapses before the corresponding change in the magnetic state of the iron is complete. If the applied magnetic force be either subjected to a gradual increase followed by an equally gradual diminution, or caused to effect a cyclic variation, the corresponding induced magnetic variation in the iron will lag behind the changes in the applied force. To this tendency to lag behind, Professor Ewing has given the name of magnetic hysteresis.

It has been shown also by Gerosa, Finzi, and others that the effect of alternating currents or high-frequency electrical oscillations acting upon iron is to reduce considerably the effects of magnetic hysteresis, causing the metal to respond much more readily to any influence which tends to alter its magnetic con-

dition. The effect of electrical oscillations probably is to bring about a momentary release of the molecules of iron from the constraint (or viscosity) in which they are ordinarily held, diminishing their retentiveness, and consequently decreasing the lag in the magnetic variation taking place in the iron.

It was therefore anticipated that the group of electrical waves emitted by each spark of a Hertzian radiator would, if caused to act upon a piece of iron which is being subjected at the same time to a slowly varying magnetic force, produce sudden variations in its magnetic hysteresis, which variations would produce others of a sudden or jerky nature in its magnetic condition. In other words, the magnetization of the iron, instead of slowly following the variations of the magnetic force applied, would at each spark of the transmitter suddenly diminish its magnetic lag caused by hysteresis.

These jerks in the magnetic condition of the iron would cause induced currents in a coil of wire of strength sufficient to allow the signals transmitted to be detected intelligibly on a telephone, or perhaps even read on a galvanometer. The tests referred to above confirm the belief that the magnetic detector can be substituted for the coherer for the purpose of long-distance space telegraphy.

Another paper presented before the Royal Society on the same date related to the effect of daylight upon the propagation of electromagnetic impulses over long distances. The greater part of the contents of the paper was resumed in the Royal Institution lecture, reprinted in our columns, and we give below the concluding portion, consisting of a discussion of the cause of the phenomenon observed:

The cause of these observed differences in the effects obtained by night as compared with those noticed by day may be due to the diselectrification of the transmitting elevated conductor, operated by the influence of daylight. The electrical oscillations in the transmitting elevated conductor may thus be prevented by the discharging influence of light from acquiring so great an amplitude as they attain during darkness. The diselectrification of negatively charged metallic bodies by light has been noticed by many observers, and as each alternate half-oscillation in the transmitting elevated conductor must necessarily charge it negatively, the dissipating effect of light on each alternate oscillation of the electrical wave in the transmitting wire may be sufficient to cause a material decrease in the amplitude of the oscillations.

Other tests were instituted with the object of ascertaining whether the illumination of the spark-gap of the transmitter had any effect upon the impulses transmitted, and accordingly the ball dischargers were inclosed in a box opaque to light. No perceptible difference, however, was noticed in the strength of the signals received, whether the spark-balls were or were not exposed to daylight.

It would be interesting to ascertain whether the same effects are to be observed when using transmitting elevated conductors covered with insulating material opaque to ordinary light. Mr. Marconi stated he had never noticed any appreciable difference in the distances over which signals are obtainable during the day and the night respectively in the course of all the other numerous experiments which he had carried out with installations not designed for very long distances, and in which the electrical power used at the sending stations has been small compared with that used at the Poldhu installation. Probably the much higher potential to which the elevated conductor at Poldhu was charged may have greatly increased the facility with which losses might occur due to diselectrification through the influence of daylight. In conclusion, Mr. Marconi said he hoped to be able to make a complete study of the effects described in this note, in the course of further long-distance tests which are likely to be undertaken shortly.

More Power from Chicago Drainage Canal.

It is currently reported in Chicago that a syndicate has obtained options on land lying along the Des Plaines River below Joliet for the purpose of utilizing the power made available by the flow of water from the Chicago drainage canal, which empties into that river a short distance above Joliet.

Electric Meters.

In the Patent Office issues of the last month, electric meters are represented by 12 patents. One of the most interesting of these is a meter patented to Thos. A. Edison. The principle of this meter consists in the employment (Fig. 1) of an electric motor, the speed of which is maintained constant by a centrifugal speed governor. By means of a worm this governor drives a horizontal shaft carrying a cam or cylinder, the longitudinal surface of which is curved to the arc of a circle. On this cylinder bears a friction wheel geared to the recording dial and carried by a frame attached to a scale beam below its fulcrum; one arm of this beam is weighted and the other is connected with the core of a solenoid. As the pull of the solenoid varies, the position of the arm changes, and with it the frame carried, and, therefore, the position of the above-mentioned friction wheel on the surface of the curved cylinder or cam driven by the constant-current motor.

The present patent relates to details of this device as follows: First, details of a centrifugal speed governor for the motor; second, improvements in the construction and arrangement of the indicator; third, in the use of cut-out devices for short-circuiting the indicator in the event of destructively large currents; fourth, in an improved manner of connecting the register with the constant speed motor,

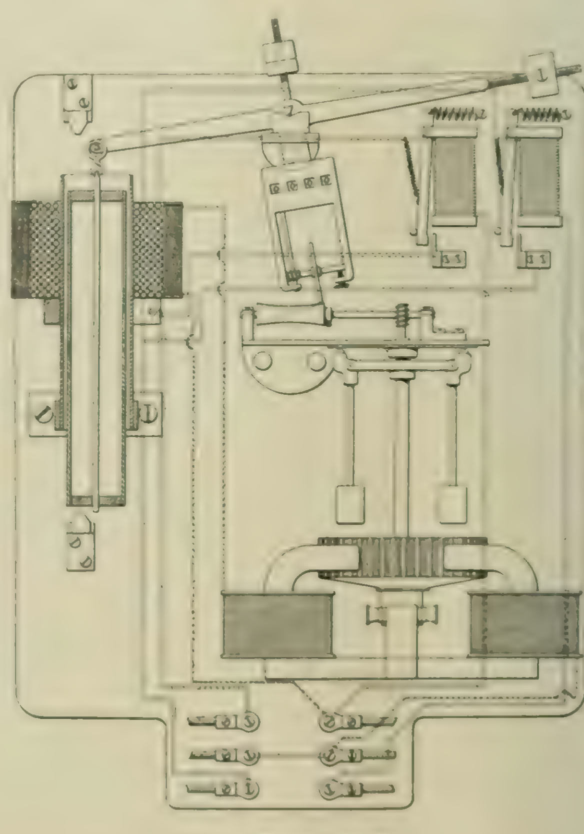


FIG. 1.—EDISON METER.

whereby during periodic intervals the current will be free to adjust itself to changes in the load, entirely independent of any friction other than the negligible friction of the knife edges of the scale and meter; fifth, the employment of means whereby may be overcome a slight error due to magnetic inertia in the registration of the first increments of current, and sixth, to means for the doing away of magnetic electric or elastic constants which are necessarily variable, and the employment of gravity only as a constant.

Another meter patent is on a means whereby only one pressure coil may be employed, the patentee being E. G. Holm, of Berlin, Germany. The means employed consists of a small piece of soft iron of suitable shape, attached to a part which revolves with the brake disk in such a manner that the attraction which the brake magnet or a separate magnet exercises upon it constantly tends to move the armature away from the dead points which it occupies at the short-circuiting periods of the pressure coil through the brushes of the commutator. During the revolution of the armature the soft iron piece alternately comes nearer to and recedes from the magnet, but the tractive power of the magnet is constantly exercised in the same direction—that is to say, it alternately accelerates and retards

rotation. Auxiliary brushes are provided for the purpose of short-circuiting the main brushes at the moment of the change-over or the reversal of the current.

Referring to Fig. 2, upon a spindle made readily revoluble both at the top and bottom, there is mounted the annular pressure-coil, *b*, the brake-disk *c*, the soft-iron piece (a double hook) *d*, the commu-

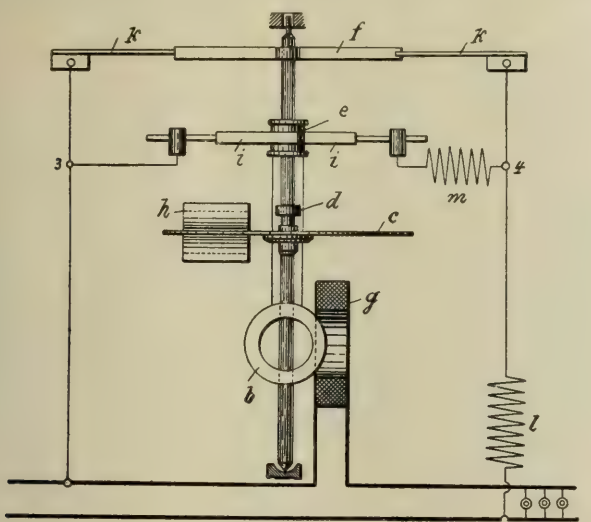


FIG. 2.—HOLM ELECTRIC METER.

tator *e*, and the insulated short-circuiting piece *f*. The stationary parts are the main-current coil *g*, the brake-magnet *h*, the commutator brushes *i*, and the auxiliary brushes *k*. In the main circuit there is only one coil, *g*, while in the pressure-circuit, in addition to the coil *b*, the two segments of the commutator *e*, and the brushes *i*, sweeping along these, there are located the preliminary switching resistance *l* and the small auxiliary resistance *m*, and in addition to that there are situated at the points 3 and 4 the auxiliary brushes *k*, which short-circuit the main brushes at the dead-point.

A patent issued to Prof. Elihu Thomson describes a new arrangement for obtaining the desired phase displacement of the shunt field in an alternating-current meter; a new arrangement for transmitting motion from the driving shaft to the recording mechanism, and a new arrangement of the terminal connections whereby the meter may be readily installed or removed. Referring to Figs. 3, 4 and 5, *D* is a disk armature mounted on a shaft, *X*. A portion of this armature is included between the poles of the permanent retarding magnet *M*. At a point removed from the latter and above the armature is located a series coil, S. On the other side of the armature and in a plane parallel thereto is located the shunt-magnet, *I*, and a series of coils, *K*, surrounding its core. The shunt magnet is so situated that the free poles of the laminated core lie directly below the center of the series coil on both sides. Interposed between the poles of the magnet core is a mass of conducting material, *C*, the function of which will be explained later.

The coils, *K*, constituting the shunt-winding, are connected in series with one another across the mains through which the current to be measured is applied. The construction of the shunt magnet is such as to secure as high an inductance as possible in the shunt-circuit, so that the free shunt-field may be as nearly as possible in quadrature with the electromotive force impressed on the shunt-circuit.

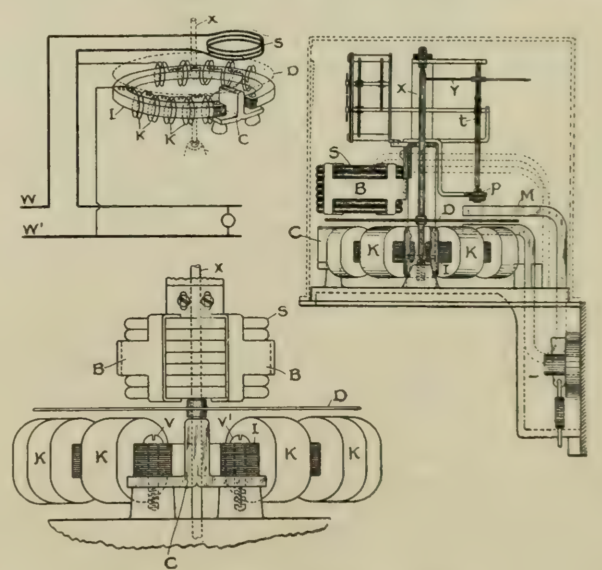
The free field across the gap between the poles of the laminated ring, *I*, would naturally tend to be greatest directly across the space between the poles, and would have a phase displacement somewhat less than 90 degrees behind the field, due to the series coil on non-inductive loads. In order to deflect this free field toward the armature, and at the same time to give this deflected field a certain increased phase displacement up to 90 degrees on non-inductive load, into this gap is inserted a body of copper or other suitable conducting material, *C*. This body of copper has a thick portion constituting a heavy inclosing circuit around the flux between the poles of the ring *I*. The flux being rapidly alternating in character cannot easily pass through the heavy conducting circuit which the copper piece presents, and, therefore, tends to be deflected, so as to pass around the same. This deflection is produced in virtue of the induced currents set up in the copper piece *C*. In order that the deflection may be toward the armature, the copper body is provided with a portion extending laterally beneath the poles of the shunt-magnet and is also made of considerable width, so that the shortest path around the copper mass is over the top of the portion projecting upwardly between the magnet poles.

The magnetic flux which actually passes over the part *C* and affects the armature *D* comprises two components, one of which consists of a portion of the main shunt-flux actually diverted around the mass *C*, and the other of which consists of a flux due to the induced currents set up in the copper mass itself by that portion of the main shunt-flux which threads the said mass. By properly proportioning the parts the resultant flux which affects the armature *D* may be made to lag by substantially 90 degrees behind the electromotive force of the circuit in which the meter is included.

In order that the flux may be caused to cut the armature *D*, it is desirable that the mass, *C*, be extended until it almost touches the armature, and, as already stated, in order that the flux may not be diverted in other directions it is desirable that the copper mass be extended to a considerable distance both below and at the sides of the shunt-magnet poles. The mass of copper tends, as it were, to shield the free field and to concentrate the effect on the armature, and at the same time it produces a field acting on the armature which is slightly later in phase than the magnetic flux induced in the core of the shunt magnet.

With the arrangement shown, the armature disk will not rotate unless current is flowing in the winding *S*, and its speed of rotation will be proportional to the energy to be measured.

In order to reduce as much as possible the friction of the moving parts of the meter, and at the same time to render it possible to make the parts small and compact, a magnetic gearing is interposed between the meter-shaft and the recording mechanism. This gearing comprises a thin disk, *Y*, of magnetic material, so positioned that it has a rolling engagement with the shaft *X*, which is constructed of some magnetic material, preferably of soft steel, and which may be slightly magnetized. The disk *Y* is mounted on a shaft of magnetic material, the lower end of which is pivoted in a gearing, *p*, in proximity to one of the poles of the retarding magnet, *M*. The supports for the different parts of the meter are constructed of brass or other non-magnetic material, and, therefore, the magnetism indrced by the retarding magnet in the shaft upon which the disk *Y* is mounted



FIGS. 3, 4 AND 5.—THOMSON METER.

finds a nearly closed circuit of magnetic material through the disk *Y* and the shaft *X* back to the other pole of the permanent magnet. The amount of sticking between the edge of the disk *Y* and the shaft *X* may be nicely adjusted, so that the disk may be rotated as the shaft *X* revolves without any considerable frictional resistance. The upper pivot of the shaft upon which the disk *Y* is mounted is, of course, made free enough to permit the shaft and the disk to always remain in engagement.

In order to prevent actual magnetic contact between the shaft and the disk, a thin coating of non-magnetic material, such as brass or copper, may be applied either on the shaft or on the edge of the disk, or, if desired, both may be coated. The shaft upon which the disk *Y* is mounted is provided with a worm gear, *t*, which through suitable gearing actuates the recording mechanism in the usual manner. With

the arrangement just described, a very slight torque exerted on the armature D is sufficient to turn the disk Y through the shaft X, and the advantage of the leverage obtained by this construction materially reduces the retarding effect of the recording mechanism upon the meter shaft. If the worm gear, t, were placed directly on the shaft X, not only would the friction be considerably increased, but the parts could not be made so delicate or so small as is possible with the construction shown, and, as already stated, it is one of the objects of my invention to so construct the meter that it shall be small and compact. The patent also describes means for automatically connecting the meter to the line terminals.

An indicating meter—voltmeter or ammeter—is the subject of a patent granted to L. T. Robinson, the chief feature of which lies in the magnetic return strip employed instead of a spring to exert a restoring torque. In its general features the indicator is of the usual type, consisting of a moving system in a field between two magnet poles.

The moving element consists of a coil of fine wire wound on a spool or support, as shown in Fig. 6. The coil support P is mounted within a metal tube, R, of copper, which also tends to damp the oscillations of the needle. The ends of the tube are fitted with heads, m^2 m^2, each of which is extended to form one of the shafts or pivots M' M'. Mounted within the tube R and within the influence of the field magnets is a magnetizable return strip, O. As here shown, it consists of a very thin piece of magnetic material, O, occupying the space within the spool P, and is soldered or otherwise secured in the tube R. This strip may be formed by taking a piece of copper or similar material and plating it with magnetic metal—as iron or nickel, for example. Very good results have been obtained with a copper strip plated with nickel, but a very thin strip of soft iron gives good results. When assembled in the instrument, the magnetic returning piece, O, is substantially at right angles to the side faces of the magnet, so that the flux will pass from one face to the other through it.

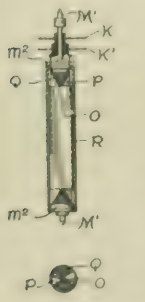


FIG. 6.—DETAIL OF ROBINSON METER.

The return strip is of exceedingly thin material working in a field strong enough to saturate it, or at least to carry its magnetism above the bend of the hysteresis curve in all positions. Such a strip will not exert any substantial effect on the flux passing between the pole pieces; and will not as it assumes different positions in the magnetic field substantially vary the strength or distribution of said field. Further, its own magnetism will remain very constant in all positions, at least unless it is deflected to an unreasonable extent, and the effect of hysteresis in the strip will therefore be very small. To make this result more certain, the instrument is so designed that the strip is considerably narrower than the distance between pole pieces, and also so designed with reference to the magnetomotive force in the air-gap that it is somewhere near saturation, so that its magnetism is not appreciably varied by changes in the flux, and ceases to depend on the value of x. Further, the effective position of its poles does not substantially change, so that the law of the instrument becomes simply:

$$x = tan.^{-1} D I.$$

It is, of course, easy to change this to the more general law: $x = f(I)$, the function being a simple linear one by merely adjusting the angle between the coil and the strip. This has the effect of varying the scale, which is "crowded" at the top if the law is:

$$x = tan.^{-1} D I.$$

and may be crowded at the center or at the lower end, or at both ends, or made substantially even by a proper adjustment of the angle above mentioned, and by properly shaping the coil and pole pieces.

Mr. Arthur Wright, of Brighton, England, well known for his work in connection with central station systems of charging, is represented by six patents. Two of these relate to maximum demand indicators on the well-known Wright principle, three to electrolytic-current meters, and two to details of meter circuits. Figs. 7 and 8 show forms of meters described in the first-mentioned patents, being improvements in the original type of maximum meter patented in this country by Mr. Wright, in 1897. Referring to Fig. 8, the main improvement consists in the use of a trap bulb, 4, below the expansion bulb of the maximum demand meter, and in a new form of index tube. The ordinary compression bulb is numbered 5, but the expansion bulb, 1, instead of being continuous with the limb 2 of the U-tube, is drawn out at one part to a nozzle, 3, which nozzle is sealed into a trap bulb, 4, so as to penetrate for some distance into the same. The object of this arrangement is not only to prevent the liquid from entering the expansion bulb on the instrument being re-set, but also to prevent air passing from the compression bulb around to the expansion bulb should any sudden cooling of the expansion bulb take place during re-setting. Two or more such expansion bulbs may be used, and the patent gives details of the construction of the multiple forms.

Another improvement included is that the index tube, 9, is made conical in form, the advantage being that it will thus hold a larger amount of liquid than the cylindrical form of index tube, and allow the instrument to have a larger range of registration, say from one-twentieth to its full load capacity. It also allows of a larger scale reading to be obtained with a smaller current, and, owing to the swelling out toward the top of the cone, enables the reading to be crowded together at that point so as to form a longer range of current readings than if the divisions were equally placed over the scale. The general operation of this meter is the same as of the earlier form. The effect of the heating resistance about the expansion bulb is to cause the liquid in the meter to spill over into the index tube, the amount of the liquid in such tube being read off on the scale. This

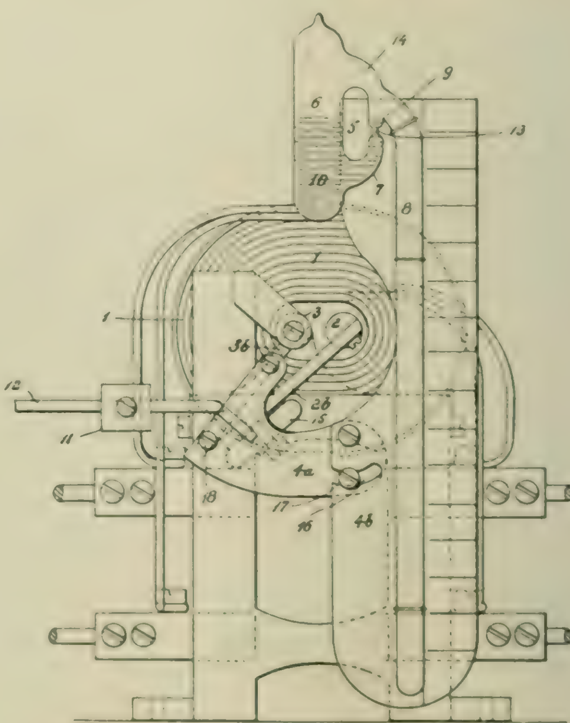


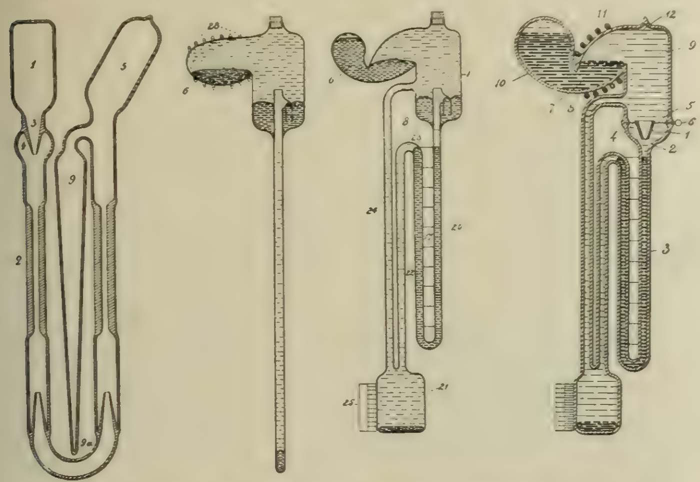
FIG. 7.—WRIGHT MAXIMUM DEMAND METER.

scale may be so calibrated as to enable the user to read therefrom the maximum amount of current which has passed since the instrument has been set. To re-set the meter it is merely tilted at such an angle as to cause the liquid in the index tubes to flow back into the compression bulb.

A second patent relates to a demand meter of a type quite different from the original Wright instrument. In this new type, instead of the liquid being driven into the index tube by means of expansion caused by current flowing through a heating coil, the tube is tilted and spills into the index tube an amount of liquid depending upon the angle of tilt, and which in turn depends upon the value of the current passing. The tilting arrangement is actuated by a coil having two armatures, one of which is fixed and the other is movable. These armature cores lie side by side within the coil, and being similarly magnetized by the current in the coil, they repel one another; but as one is fixed the second alone will move, and the amount of this movement will vary with the current traversing the coil. This form of indicator is shown in Fig. 7. The tilting arrangement is pivoted at 3, and the action of the current in the coil is to tilt the top of the tube to the right, whereupon the registering liquid flows into the indicating tube, H. In order to prevent a spill from a sudden kick produced by a momentary current, there is a constriction at

13. In resetting the meter the liquid returns to the receiver through the passage 14.

As stated above, three of the Wright patents relate to a new form of electrolytic meter. Referring to Figs. 8 and 9, the former shows a simple form of such a meter, and the latter shows the same with a cathode feeder and a "second dial effect." The liquid 1 (Fig. 10) is an electrolyte, which may be a solution of mercurous nitrate. A pocket in the same chamber contains a



FIGS. 8, 9, 10 AND 11.—WRIGHT METERS.

mass of mercury constituting the anode, in connection with which is a feeding chamber, 6. Around the anode portion of the chamber may be a coil, 28, to set up convection in the electrolyte, in order to prevent crystallization, which is further prevented by keeping the anode level constant by means of the anode feeder. A pocket of mercury at 8 constitutes the cathode. Referring now to the simpler form shown, the action is as follows:

The instrument being arranged usually in shunt, when the current passes, the volume of mercury constituting the anode decreases, while the volume of mercury constituting the cathode increases, the increase of the cathode being a measure of the electricity passed. As the volume of the cathode increases mercury will pass from the cathode-chamber and flow over into the tube shown, at the bottom of which it will collect. This tube is graduated or has a scale attached to or placed beside it; the volume of mercury in the tube can then be read off by noting the level of its surface, the said level showing the amount of current which has passed since the instrument was reset. Such resetting may be obtained by turning the instrument through half a revolution until it is upside down, and then onward through the other half revolution until it again reaches its normal position.

The function of the arrangement shown in the cathode chamber is as follows: As is well known, the surface tension of a mass of mercury is so great that as soon as a small quantity can pour over a lip, a considerable mass is brought over after it. In other words, it flows over not in minute quantities, but in considerable "blobs," as it is termed. By partitioning off a small part of the mercury, as shown, instead of the mercury coming over in large blobs, it may be made to come over in very minute quantities, so as in fact to give delicate readings. The intermediate chamber may be of any desired form and may consist of a mere partitioning off of a part of the mercury or of its chamber. A mere strip of glass, for example, placed close to the overflow-lip may suffice for the purpose of partitioning off, so as to obtain an intermediate chamber.

In Fig. 10 is illustrated a means for obtaining the second dial effect of a geared registering mechanism. In this figure, 1 is the main chamber of the meter, containing the electrolyte, 6 is the anode, and 8 the cathode. Increase of the mass of the cathode on passage of the current causes mercury to be transferred to the U-shaped tube 20, where its height in the two limbs can be read off by the scale 17. 21 is a receptacle connected by a tube 22 with the upper part 23 of the second limb of the U-tube 20. 24 is another tube connecting at a point above the cathode the main chamber 1 with the receptacle 21. The action is as follows: When sufficient mercury has passed into the U-tube to rise through the bend at the point 23, a flushing action of a well-known kind will take place, and the whole of the mercury in the tube 20 will flow into the receptacle 21, and each time that the U-tube is filled with mercury it will empty itself into the receptacle 21. If a scale, such as 25, be attached to or placed beside receptacle 21, each division of which is equal to the whole space of the U-tube, it will be seen that a reading of a true second-dial effect is obtained.

Another patent describes mechanical arrangements by means of which the meter may register along a scale or by a train of gearing. This may be accomplished by the decrease of weight of the mercury anode or increase of weight of the mercury cathode. In one case shown, the mercury constituting the anode is supported in a receptacle; as the weight decreases, a spiral spring in connection with a rod extending from the receptacle causes the extension to move a lever along a dial. In other cases the change in weight causes the meter as a whole to tilt, thereby actuating a dial hand or a train of gears.

In another form of meter a platinum cathode is employed, as shown in Fig. 11. This cathode consists of a cone, 1, of platinum foil, with its apex pointing downward, the said apex being cut off so as to form an orifice, 2, through which the mercury deposited in the interior of the cone can drop freely downward into the depositing-tube 3. Any mercury deposited on the outside of the said cone will also drop freely into the depositing-tube. The cathode 1 is supported by the platinum wires 4, 5, the wire 5 being sealed into the glass and 4 being sealed through the glass and continuous with the connecting-wire 6. The mercury, 7, constituting the anode, is contained in the anode-chamber 8, this anode-chamber being shown in the form illustrated as a pocket arranged on one side of the instrument.

Of the two remaining Wright patents, one relates to a circuit arrangement whereby the counter e. m. f. of the meter is counteracted, and another to a circuit whereby both an electrolytic and maximum demand meter may be employed with no further loss than entailed by a single instrument.

Commercial Pacific Cable Plans.

It is stated that the Commercial-Pacific Cable Company has laid before the administration at Washington a proposal that if the soundings in the Pacific Ocean, taken by the United States boat "Nero," are thrown open to that company for use in laying its cable, the company will agree to have the entire cable from San Francisco to Manila laid and in operation by June 1, 1903, which is less than eleven months from now. This is over one and a half years sooner than the company has at any time before indicated that it could put the cable into operation. The Western Union Company has all along favored the Corliss bill for laying of this cable by the United States Government, by which bill the Western Union would get a part of the land-line business on messages between the United States and Asia. That bill was defeated, and the Asiatic business will go to the Commercial Cable Company and the Postal Telegraph Cable Company. The Administration is considered most likely to throw open the soundings to the public, including the Commercial Cable Company, just as it has always thrown open to the public all soundings taken by the government along the coasts of the United States and elsewhere. It appears that the United States Government has already published the general soundings between San Francisco and Manila, but has in its archives details which are essential to the laying of the cable, and these are the details which the Commercial Cable Company wishes to use.

It is announced that the rates which will be charged the United States Government by the new Pacific cable will be 50 cents per word, which is over $1 less than the present rate paid by the government. This in itself is a great inducement to the government to expedite the enterprise.

British Pacific Cable.

The cable steamer "Colonia" sailed from London on July 10 for Vancouver to lay the British Pacific cable from British Columbia to Fanning Island. Another steamer will sail in a few days to lay the section from Fanning Island to the Fiji Islands. The Colonia was recently illustrated and described in these pages.

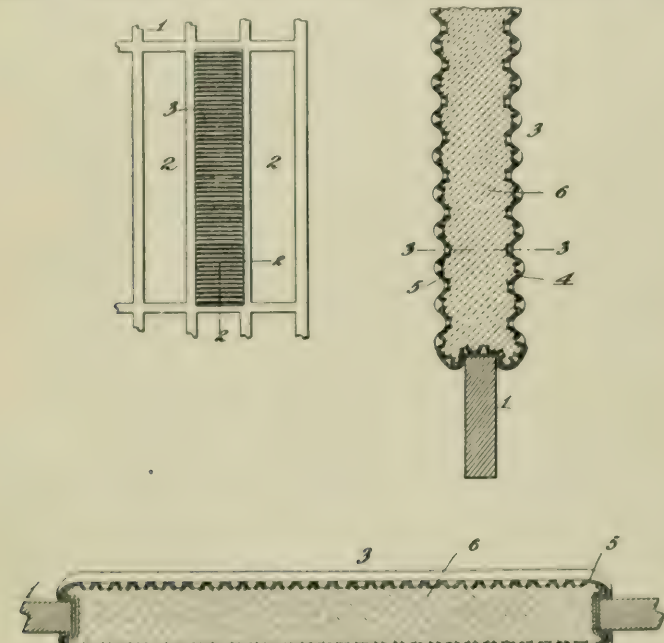
Recent Electrochemical Developments.

Clinton Paul Townsend.

ADDITIONAL EDISON PATENTS.

In discussing the theory of Edison's reversible batteries, and in forming such estimates as we may of their commercial promise, one is apt almost to overlook the inventor's undoubtedly valuable contribution to the chemistry of the metallic oxides; their constitution, the conditions of their formation and reduction, and, above all, their relations in alkaline solutions. The question of their solubility has been largely one of minute measurements, for local action does not cease at the second or third decimal.

A series of four patents in the current Patent Office issue, deals with both the chemical and mechanical aspects of the cell. The first patent covers the reversible series, namely, zinc-alkali zincate-oxide of mercury. In this series the zinc is plated upon magnesium in the manner heretofore described, and the fact that upon charging the mercuric oxide passes to some extent into solution is advantageous rather than otherwise, since the resultant amalgamation of the zinc aids in depositing it in coherent form; it is the one exception to the rule of deleterious local action from traces of the depolarizer in the solution. For retaining the mercury perforated pockets are employed as for the solid depolarizers.



MODIFIED FORM OF EDISON BATTERY.

The second patent relates to the iron-cobalt oxide cell, and insofar as disclosure is concerned, is identical with the companion case on nickel oxide. A third, containing specific claims to the employment of copper in a state of extreme subdivision as an insoluble oxidizable electrode, has already been described in these columns, the invention having been disclosed in an earlier case. It is in this connection that Mr. Edison makes the extraordinary statement that the tendency of copper to dissolve in the electrolyte may be overcome by a sufficiently fine division.

The fourth patent covers the modified form of the cell shown in the accompanying figures. The usual grid, 1, is provided with rectangular openings, 2, into which the perforated receptacles, 3, for the active material are secured, the sides, 4 and 5, being fitted one into the other and securely locked by crimping the edges around the grid. The special feature of the present patent is the horizontal corrugation of the perforated walls of these pockets, the effect being to so stiffen them as to permit the use of very thin high carbon steel for the walls; by this means the elastic limit of the walls is increased and a more effective contact maintained with the active material through the changes of bulk consequent upon charging and discharging.

METHOD OF FRAMING GLASS.

Two patents to Julius Taluau, of Philadelphia, and a third issued jointly to Taluau and Henry W. Scattergood, also of Philadelphia, deal with the tempting proposition that fragments of glass, stone or other non-conductor, may be united into a mosaic or similar structure by means of an electro-deposited framework of copper filling the interstices between the pieces. Such mosaics are of pleasing appearance, and the nodular surface of the deposited metal, if not too pronounced, rather heightens the effect.

In 1889, Henry F. Belcher patented a process consisting in electroplating the exposed surfaces of the cast-metal framework of a stained glass window in such manner as to securely bind the fragments by the overlapping deposit. In 1897, William H. Winslow, of Chicago, patented a method for assembling rectangular blocks of glass, the essential feature being the provision of a framework of copper strips extending around and between the blocks in rather loose relation to them, and serving as a foundation for a subsequent electro deposit of copper to firmly secure the several parts. The Luxfer Prism Patents Company, of Chicago, operating under this method, has for several years past been placing extremely rigid and ornamental prism lights upon the market.

According to Taluau's method electrodeposition is relied upon to build up the interstitial deposit; the fragments of glass are cemented in their proper relation upon a backing plate of lead foil and properly supported in the plating bath. The deposit is built up from the backing plate to, or even above, the upper surfaces of the glass, lapping slightly for additional security. For transparent constructions the backing plate is finally stripped off. As modifications of the method a non-conducting support may be used, a conductor, as plumbago, being applied to the interstices, or the process may be somewhat hastened by using metal filings between the plates.

It is not clear that the new method is an improvement over that of Winslow, for every electroplater is familiar with the difficulties which arise when it is sought to increase the thickness of an electrodeposit above a certain rather small maximum. The deposit tends to become loose, nodular, and even branching, and it is with the greatest difficulty and only by working slowly and with low current densities, that the character of the early deposit can be maintained. It seems also that these difficulties, sufficiently pronounced upon a plane surface, are increased when the effort is made to deposit metal between adjacent non-conducting walls constituting a virtual crevice, for it is not easy to maintain the concentration of the metal ions under these conditions. It may be safely predicted that the element of time will enter into the new method as a serious factor.

New Telephone Patents.

Two patents relating to telephony occur in the issue of July 8, one protecting a combined district telegraph and telephone signal, the other a protector. Mr. Charles Selden, of Baltimore, adapts the familiar make and break messenger call to send a distinctive signal to serve as a call for telephone connection, by supplying the contact-wheel with an extra brush bearing on its surface instead of on the periphery and operating a vibrating bell at the central, instead of a single-stroke bell. In the drawing 3 is the brush giving the normal

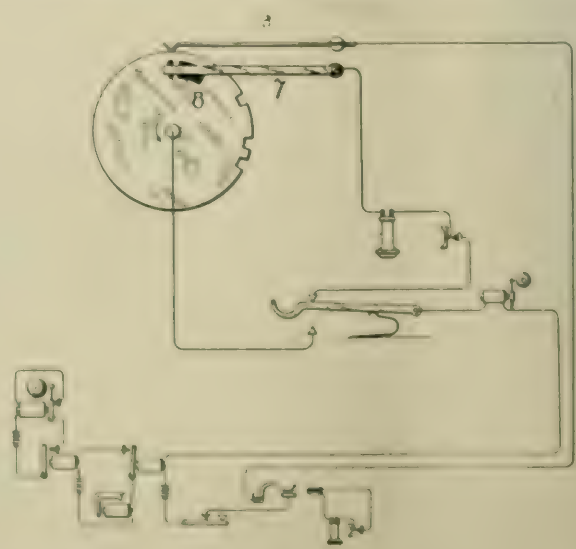
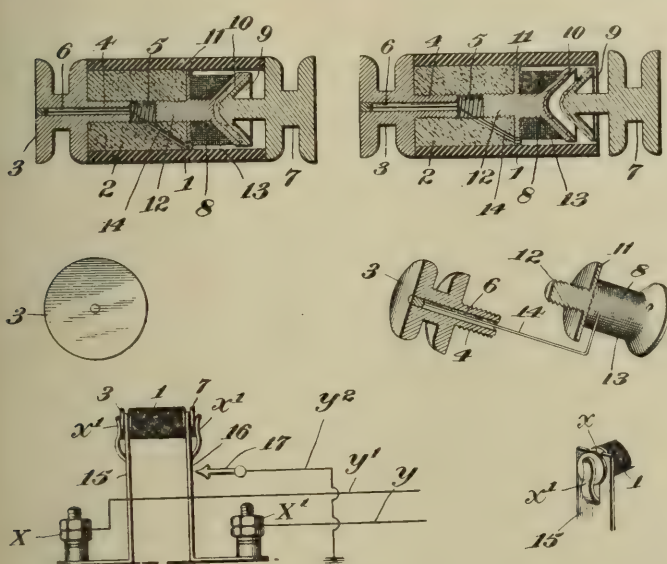


FIG. 1.—SELDEN'S COMBINED TELEGRAPH AND TELEPHONE SIGNAL.

messenger call signal when the box is operated, and 7 is the special brush for the telephone signal; opposite the bearing point of 7 on the surface of the contact wheel are insulating strips or spaces, 8. By lifting the receiver from the hook switch, 6, the brush, 7, is switched into circuit, and on the box being pulled the signal governed by 7 is transmitted. This signal is usually a long dash operating a vibrating bell and so readily distinguishable from the messenger call signal which is a combination of dots.

Mr. Frank B. Cook, of Chicago, patents a protector, for which he claims simplicity and cheapness of construction, and the advantage that in operation the heat coil is not damaged, the only change produced in the appliance being the melting of the solder. Referring to Figs. 2 to 6, Figs. 1 and 2 show the appliance in detail, Fig. 2 representing the solder, 10, as melted, and the circuit opened. Fig. 3 is an end view, Fig. 4 a perspective of the heat coil and cap, Fig. 5 a diagrammatic view of the protector mounted for use, and Fig. 6 an end view of the protector and supporting spring. A cylinder of insulating material, 1, contains the heat coil, 8, which has a flange, 11, and



COOK'S THERMAL PROTECTOR.

stem, 12, screwing into the insulating sleeve, 2, set in cylinder 1. Into 2 also screws the cap, 3, which has a groove or collar to fit the forked end of the supporting spring. The wire of the heat coil is connected to the cap, 3, through the bore, 6, in the shank, 4. The outer end of the heat coil has a concave depression into which fits the convex end, 9, of the cap, 7, the two being held together by the solder, 10. One end of the heat-coil winding is soldered to the metal concave head, 8, so the circuit from cap, 7, to cap, 3, traverses the heat coil and the solder, 10, which holds 7 and 8 together. The complete protector is mounted as shown in Fig. 5, on two springs, 15, 16, which normally bear outward and are held in tension by the protector. When the heat coil operates, solder, 10, is melted and cap, 7, is pulled away by the tension of spring, 16, which then comes in contact with ground stop, 17, and grounds the line.

Moving Sidewalk for Brooklyn Bridge.

The plan of an electric moving sidewalk for Brooklyn Bridge has been revived, a company standing ready to undertake the installation. The plans as drawn by Mr. George S. Morrison, the company's consulting engineer, provide for a main platform, 8½ feet wide, to run on the tracks now used for the bridge cars. This was to be provided with cross-seats, and would be, in effect, one continuous street car. Being built in 12-ft. sections, with the rounded end of one fitting into the concave end of the next, it could go around curves of small radius. The cars would not be roofed, but a light covering like a gallery would be erected over the whole track, which would serve the same purpose.

The station platform at the Manhattan terminus would not be materially altered in size. Around its outer edge, the plan provides for three narrower moving belts, three feet wide. The first would move at 2½ miles per hour, the second, two inches higher and overlapping a trifle, at 5 miles an hour, and the third at 7½ miles. The third in turn would overlap the main platform, the rate of which would be 10 miles an hour. Passengers could walk across diagonally to their seats without any uncomfortable jar. For getting off and on, 361½ feet are allowed in the plan. To prevent possible accidents to persons trying to crowd on at the extreme end of the platform, a railing would be hung from above to guard the moving platforms. A high grating would separate the arriving and departing platforms, each of which would be 23½ feet wide. The plan is warmly favored by Commissioner Lindenthal.

Vermont Electrical Association.

A meeting of a number of the representatives of the electric lighting interests in the State of Vermont was held in Bellows Falls, Vt., July 9, 1902. The question of forming an association similar in scope to the National and other State electrical associations was thoroughly discussed, and it was decided that it was expedient to do so. The result was the formation of the Vermont Electrical Association, with the following list of officers and executive committee: President, Harry Bottomley, Bellows Falls; 1st vice-president, C. F. Thompson, Brattleboro; 2nd vice-president, M. Patterson, Fair Haven; secretary-treasurer, C. C. Wells, Middlebury; executive committee, E. E. Larrabee, Bennington; E. D. Blackwell, Brandon; E. E. Gage, St. Johnsbury; G. S. Haley, Rutland; F. Barney, Jr., Springfield.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY AND SUBMARINES.—A cable dispatch from Paris, of July 10, says: There was a successful test at Cherbourg to-day of the application of wireless telegraphy to submarine torpedo boats. A mast with receivers was fitted to the submarine boat, "Triton." The vessel dived and received signals from the central submarine station clearly.

THE ARC LAMP IN EXAMINATION OF GEMS.—As a result of some observations by Mascart on the effect on gems of the violet rays from an arc lamp, M. Chaumet has recently made some experiments with a view to the use of such rays in the determination of the value of gems. Becquerelainé noted years ago the fluorescence of diamonds under the influence of various colored rays. Chaumet has ascertained that there is a close relationship between this fluorescent property and the brilliancy of diamonds under artificial light, particularly candle-light, which brings out most clearly the quality of first-class stones. Diamonds that sparkle most vividly are not always those cut in the most regular shape, but those showing the greatest amount of fluorescence when examined with violet light. While diamonds that are non-fluorescent when exposed to this light simply take a violet coloration, the most sparkling stones show a notable fluorescence of a very luminous and clear blue. Diamonds, whatever their quality, always offer the same transparency to Röntgen rays, so that it is impossible to differentiate them by means of radiography. In a jewel-case in which are grouped diamonds of all qualities, the gems, when illuminated by violet light, assume different tints, some showing a vivid blue brilliance, while others are of a sombre violet. As soon as the electric lamp is put out, all degrees of phosphorescence are noticeable, the jewel-case appearing to be studded with violet or blue glowworms, some very bright, others almost extinct; and the most sparkling stone will be found to be the best. In the course of his experiments, M. Chaumet has observed a curious fact with respect to a yellow diamond with numerous facets which showed remarkable golden reflections in daylight as well as in artificial light. The violet light produced no fluorescence in this case, but gave rise in place to flashes of an intensely red color, particularly noticeable on the feather-edged sides. A violet pencil of rays was projected upon this yellow diamond for a few minutes, when the experimenter found to his surprise that the yellow color had changed to dark brown, the stone thus losing four-fifths of its commercial value, which, however, was recovered after some hours. In experimenting on the action of the various rays on rubies, M. Chaumet has ascertained that the Siamese stones are of scarcely appreciable fluorescence under violet light, while all the valuable Burmese rubies are intensely fluorescent, exhibiting a clear vivid red light that puts them in evidence when they are mixed with stones from Siam, which remain sombre.

RUHMER'S WIRELESS TELEPHONY.—A cable dispatch from Berlin, of July 12, says: "Ernst Ruhmer, the physicist, has invented a system of wireless telephony. His experiments have been successful over a distance of three miles. The invention acts on the principle of the transformation of light waves to sound waves by using a searchlight and a microphone." There does not seem very much new about this to an American who has followed the work of Bell, Hayes and others.

ELECTRICITY AND THE KING.—It is stated that during his recent illness, King Edward has derived much benefit and relief during the hot weather from the use of fan motors in his bedroom. He is now to be moved to the royal yacht, and a new dynamo is to be put in to minimize the vibration of the plant. St. James' Palace, one of the royal residences in London, has been newly equipped with thousands of electric lights and these were used with great effect at the reception given by the Prince and Princess of Wales to the coronation Colonial visitors in London last week.

NEW RADIO-ACTIVE ELEMENT.—A special cable dispatch from Berlin, of July 9, makes the following announcement: Professor Marckwald, of the Berlin University, announced at the last meeting of the Physical Society that he had discovered a new element. The element in question is radio-active and of extraordinary energy. Professor Marckwald has separated it from radio-active bismuth, so-called polonium, found in uranium ore. It consists, as Professor Marckwald discovered, substantially of ordinary bismuth and of a new metal in the proportion of a thousand to one. The new metal can be separated by the electrolytic process. The rays it emits are something like those of the metal radium, but differ in being almost completely absorbed by paper as well as by glass. Professor Marckwald has proved that a porcelain tube heavily charged with electricity by rubbing immediately lowers its charge when a morsel of this metal weighing hardly a milligramme is brought within a distance of one decimetre. A chemical analysis of the new metal is rendered very difficult by the fact that one ton of ore contains hardly one gramme of it.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—The National Electric Light Association has just issued a new edition of "Municipal Lighting Statistics" for the confidential use of its members. It is full of information from all over the country as to rates for arc lighting, etc. The association has enrolled the following new members since June 28: Albert Lea, Minn., Albert Lea Light and Power Company; Anaconda, Mont., Anaconda Copper Mining Company, Elec. Dept.; Clay Center, Kan., F. L. Williamson & Co.; Durango, Colo., C. H. Peters; Fair Haven, Vt., Fair Haven Electric Company; Lancaster, Ohio, The Lancaster Electric Light Company; Mason City, Ia., Brice Gas and Electric Company; Menomonie, Wis., Menomonie Electric Light and Power Company; Middlebury, Vt., Middlebury Electric Company; Montpelier, Vt., Consolidated Electric Company; New Albany, Ind., United Gas and Electric Company; Nokomis, Ill., Nokomis Electric Light and Power Company; Nyack, N. Y., Rockland Light and Power Company; Norwich, N. Y., Norwich Gas and Electric Company; Red Wing, Minn., Red Wing Gas and Electric Compony; Rutland, Vt., Rutland City Electric Company; Tuxedo, N. Y., Tuxedo Electric light Company; Wabash, Ind., The Wabash Electric Light Company; Watertown, N. Y., The Watertown Electric Light Company.

ELECTRIC FURNACE IN MANUFACTURE OF STEEL.—A recent consular report gives an account of the manufacture at Gysinge, Sweden, of steel in the electric furnace. In the latter part of February, 1900, the first furnace was finished and ready for trial and after a few experiments the first ingot was produced. The steel was found to be of excellent quality, but with the dynamo of 78 kw used, not more than 575 pounds of steel were obtained in twenty-four hours, and the furnace had a capacity for only 176 pounds. A larger furnace was seen to be necessary, and this was completed in November, 1900, and proved to be a great improvement. In the second furnace, which held 397 pounds, from 122 to 134 pounds of steel were produced in twenty-four hours. The Gysinge sulphite factory burned down on August 11, 1901, and it was decided to build steel works in its place and to use the water power available there. For the steel furnace there was utilized a turbine of 300 horsepower, with direct-coupled generator. The new furnace is to have a capacity of 3,970 pounds and the production is estimated to be at least 1,500 tons a year. The steel produced is said to be of superior quality, and characterized by strength, density, uniformity, toughness, and the ease with which it can be worked in cold, unhardened condition, even when containing a very high percentage of carbon. Compared with other steel, it also has less tendency to crack or warp when hardened. The reason why this steel in certain qualities differs from other steel, especially in its softness when unhardened, is considered to be its freedom from gases. The manufacture of special steel, with nickel, chrome, manganese or wolfram, will, of course, not meet with many difficulties. The chrome steel and wolfram steel produced at Gysinge has proved to be excellent for lathe tools. When used for permanent magnets, the Gysinge wolfram steel has been found to give stronger magnets than other wolfram steel and has not warped in the hardening. From estimates made, it has been ascertained that the furnace used at Gysinge, which is simple in construction and easily managed, has prospects of competing, as to cost of operation, with the furnaces heretofore used for fusion of steel, especially as it yields steel of a better quality.

LETTERS TO THE EDITORS.

American Association for the Advancement of Science.

To the Editors of Electrical World and Engineer:

Sirs.—I think I echo the thought of many of your readers in expressing appreciation of the very full report which appears in your issue of July 5, of the recent meeting of the American Association for the Advancement of Science. If in previous years there was similar material which might have been available for presentation to the readers of technical journals, it is a real misfortune that the administration of the Association has seen fit to ignore this channel for the dissemination of knowledge. It is indeed no less than astonishing that the association has not in the past taken advantage of the opportunity for the advancement of science afforded by the technical press of this country. According to newspaper reports, of a total of almost 350 papers, more than 150 were presented in the departments of physics, chemistry, mechanical science and engineering. As these several sections held their sessions simultaneously, and most of the papers were probably read merely by title or in brief abstract, the impossibility of any one in attendance at the meeting deriving full benefit from their attendance is evident. It is true that members of the association receive in an annual volume an account of the proceedings at the meeting of the year, but aside from the relatively small audience to which this belated volume goes, many of the papers appear therein only by title, and for many others—perhaps the majority—readers are referred to periodical publications of such a character as to be unavailable to all but a select few. For example, in a volume of the A. A. A. S. *Proceedings* before the writer, the reader is constantly referred to such journals as the *Philosophical Magazine, American Chemical Journal, Journal of Physical Chemistry, The Physical Review*, etc., for papers mentioned only by title in the volume, or appearing in bare abstract. If the governing body of the Association were to provide facilities enabling the technical journals of the country to use such portions of the proceedings as appealed particularly to their respective readers, that body would, I believe, rapidly assume a position in this country similar to that occupied in Great Britain by the British Association, and would also greatly extend its membership among the technical classes. A glance over the list of membership shows that in the past these classes have held aloof for a very good reason it would appear.

BOSTON, MASS. CHAS. L. MANSON.

State and National Telephone Associations.

To the Editors of Electrical World and Engineer:

Sirs.—I am glad to note the attitude taken toward the abuse heaped on Bell telephone men in your recent discussions of the work of the National convention, at Philadelphia. Such attacks on personnel as you have stigmatized have nothing to do with the merits of the case, and there is no question that the men aimed at have long enjoyed the esteem of the electrical public. It would be just as fair to assert

that every man who has gone into the independent telephone field is a "striker," who proposes at some time or other to make a deal with the Bell companies regardless of the public.

It is not quite clear to me, however, that your advocacy of the National Association does full justice to the various State organizations. What you say about the poor policy of dividing forces in face of a strong enemy is true, and there certainly should be and must be the best kind of a national body, so that it is unwise on the surface to detract from the interest and importance of that annual affair. But the point you seem to overlook is that these minor State and interstate organizations are created mainly by the need of fostering toll lines and developing long-distance work. Presently, large companies will grow up out of the scattered units, and probably we shall see only a few independent companies in each State. As an old telegrapher, I remember the history of the telegraph art in the bringing together of scattered systems, and I cannot see how the telephone business is different. For the time, then, it is plain to me that the State associations are doing excellent work in getting people acquainted and in laying the foundation of large local networks. The Western Union telegraph system began in this humble fashion, although in its early days there were no conventions to help things along. Moreover, it is particularly in the big western States that the newcomers in telephony need to co-operate.

This view granted, I believe with you that the best efforts of the independents should be devoted to strengthening their National Association, giving it the right and power to speak with authority for the art as a whole.

St. Louis, Mo. Paul M. Rice.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Nonsynchronous Single and Polyphase Generators.—Heyland.—A long illustrated paper read recently before the Society of German Electrical Engineers. He claims the following advantages of his type of generator over the old normal synchronous alternators: First, the problem of parallel operation of alternators is solved in an easy way; secondly, the new machines have an ideal elasticity against variations of load and besides this they can be exactly and absolutely compounded against voltage variations by a simple accessory. In the first part of the paper he discusses the simple "compensation," *i.e.*, the arrangement by which the power factor is made equal to unity; this has already been described repeatedly and at length in the Digest; the description which Heyland gives in the present paper is somewhat more exhaustive and illustrated by vector diagrams, he also gives diagrams showing how the compensating winding can be best arranged. The commutator is no longer a principal part of the machine; it is only an accessory for the purpose of self-excitation; it is so small and operates sparklessly like an ordinary slip-ring; it has only just enough segments that an electric short-circuit between two succeeding brushes is avoided, 4 to 6 segments being used per pole. He shows theoretically that on account of the compensating winding, the efficiency does not become lower, but may even be increased. For perfect compensation the self-excitation produces an increase of the overload capacity by 40 to 50 per cent. There is no armature reaction. The exciting current is nearly constant for all reactions. The curves given in the adjoining Diagram 1 represent the results of tests of a 12-hp motor,

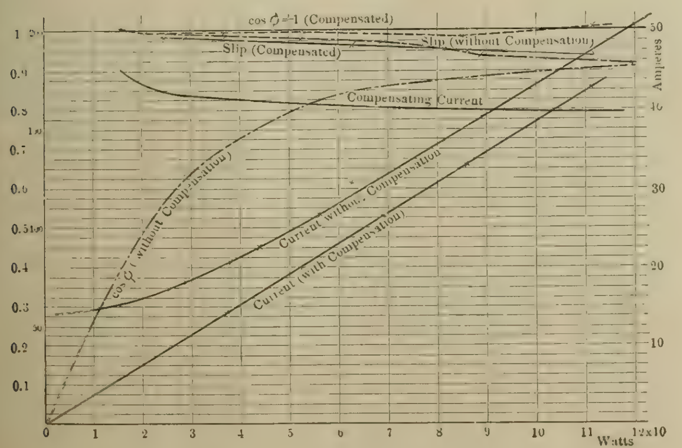
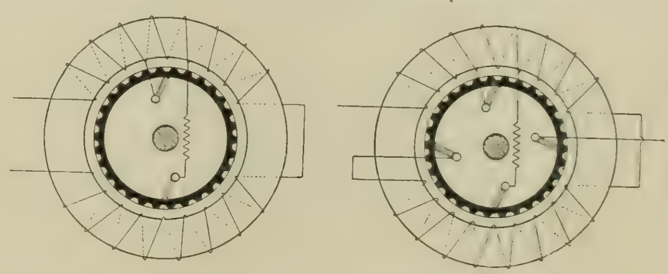


FIG. I.—RESULTS OF TESTS OF 12-HP MOTOR.

built by the United Electric Company, of Vienna. The power factor is here always exactly equal to unity, even for no-load and for overload. In the second part of the paper the author discusses the method of compounding. For non-inductive load there is a natural compensation, due to the currents induced in the rotor. These induced currents, however, are always in phase with the energy component of the main current, and, therefore, for wattless currents the full armature reaction remains. For complete compounding he uses the following device; besides the compensating current, he also sends the main current into the rotor through a second set of brushes, so that it must overcome the stator ampere-windings in any case. Figs. 2 and 3 show the arrangement for a



FIGS. 2 AND 3.—NON-SYNCHRONOUS GENERATORS.

single-phase machine, Fig. 2 representing a compensated machine without compounding, Fig. 3 with compounding. Instead of supplying the stator current to the rotor, it is sufficient to supply the wattless component only; with machines operating in parallel, this can be accomplished by compounding the one, but not the other, and sending the main currents through a transformer with the primary windings in opposite direction. The secondary winding then gives the differential current, which represents the wattless component of the compounded machine and is supplied through the compounding brushes to the compound machine. He then gives several diagrams showing the connections for the compound winding. In general he uses three-phase currents; but for certain numbers of poles, it is necessary to use two-phase excitation, the well-known Scott system being used for obtaining two-phase currents for excitation and for compounding. He gives the results of tests of a 100-hp compound generator of Brown, Boveri & Co. The results show that it is possible to compound or overcompound a machine at will, furthermore by choosing proper values of the transformation ratio of the transformer and a proper position of the brushes, it becomes possible for instance to exactly compound the machine for non-inductive loads, and overcompounded it for wattless currents, etc. At the conclusion of the paper the two types—the compensated uncompounded machine and the compensated compound machine—are characterized as follows: The advantages of the former are the great simplicity, the favorable utilizations of the material, the small exciting current, the substitution of the exciter by a simple and safe commutator of small dimensions, automatic compounding for non-inductive load, the great elasticity and adaptability to any existing installation; either as generator if no wattless currents are required from it, or as motor with a constant power factor equal to unity, it is very suitable for power transmission between similar machines and for parallel connection to existing plants. On the other hand, the compounded machine is character-

ized by greater independence in connection with machines operating in parallel. It is not so clearly non-synchronous as the simply compensated machine. With perfect compounding, speed and number of alternations are nearly synchronous; with overcompounding, the number of alternations may be even greater than the product of number of poles and speed. It is a "universal machine," and is suitable for any plant. It is somewhat larger, the commutator by which the main current is supplied to the rotor being especially so. On account of its approximate synchronism and its absolute constancy of voltages, it is very suitable when used as a single machine; or as main generator and "frequency setter," when used in operation in parallel with other machines. In the latter case he recommends using one or two compound machines, and for the others simple compensated machines.—*Elek. Zeit.*, June 26.

Compound Alternators.—Boucherot.—An abstract of a paper read before the International Society of Electricians, in Paris. His method of compounding alternators by a special exciter has already been described at length in the Digest in connection with the compound machine exhibited by him at the Paris exposition. The compounding effect is theoretically perfect, but in practice it is impaired by the leakage effect. For a high-leakage machine having 92 poles, for instance, with a non-inductive load the compensation was perfect, but with inductive load there was an over-compounding effect. Ordinary machines show no practical differences, however; illustrations of load and speed, of course, result in perturbations, but these can be allowed for just as the effects of hysteresis and heating. This automatic compounding offers an instantaneous compensation much better than the hand rheostat regulation, which is never simultaneous with the variation it is intended to compensate. The exciters used by Boucherot are designed for a comparatively low number of brushes, eight for instance, for 20 or 30-pole alternators. An advantage claimed by him for the compensated alternator is that it can be given a higher inductance and a smaller flywheel than other machines of equal output, and is, therefore, less expensive to build. In the case of paralleled alternators the compounding transformers are grouped in parallel, so that they compound as a whole with reference to the network. Among the compensated alternators in operation in France, he showed photographs of 20, aggregating about 3,000-kw.—Lond. *Elec.*, June 20.

REFERENCES.

Induction Motors.—Eborall.—A communication in which he gives some critical notes on Meyer's recent article. He agrees with this article in general.—Lond. *Elec.*, June 20.

Reactance Voltage.—Holm.—A brief communication in which he gives a note on Rothert's formula, recently noticed in the Digest, for calculating the reactance voltage of direct-current machines.—*Elek. Zeit.*, May 29.

Sparkless Commutation.—Fischer Hinnen.—A communication in which he gives a practical formula which follows from his theory of commutation.—*Elek. Zeit.*, May 22.

Rothert.—A brief reply to the criticism of Dick.—*Elek. Zeit.*, June 5.

Lights and Lighting.

Reichsanstalt Tests for the Nernst Lamp.—An account of official tests made quite recently by the German Reichsanstalt on two specimens of the Nernst lamp, as made by the General Electric Company, of Berlin (which owns the European patents). Two types of lamps were tested, one pattern having a straight, and the other a curved filament. The former of these is the one now on the market, and the latter is an experimental pattern which the company hopes to perfect in a short time. The results of the test of the straight filament lamp are given for the mean of five lamps, at a pressure of 220 volts: after 0, 50, 100, 200, 300, 400 hours the current was 0.264, 0.261, 0.260, 0.253, 0.242, 0.237 ampere, respectively; the candle-power 35.1, 32.4, 32.3, 30.1, 27.5, 26.5; the watts consumed per candle 1.65, 1.77, 1.77, 1.85, 1.93, 1.97. The candle-power, therefore, decreased in 400 hours by 24.5 per cent. The mean consumption of watts per candle is 1.83. One of the filaments burnt out after 310 hours, another after 379 hours, and the remaining three were intact after 400 hours. The mean life is, therefore, over 378 hours. The heating spirals were not damaged. The results of the tests of the other specimen, that with the curved filament, were as follows for a mean of 5 lamps, at a pressure of 220 volts: After 0, 50, 100, 200, 300, 400 hours the current was 0.259, 0.259, 0.259, 0.247, 0.238, 0.219 ampere, respectively; the candle-power 40.1, 36.3, 38.1, 34.1, 33.2, 27.6; the watts per candle 1.42, 1.57, 1.49, 1.59, 1.58, 1.75. The candle-power, therefore, decreased in 400 hours by 31 per cent. The mean consumption of watts per candle in this time was 1.57. One filament burnt out after 150 hours and the other four were intact after 400 hours. The mean life of the filament was, therefore, over 350 hours. The heating spirals of two lamps broke down after 110 and 395 hours, respectively. Therefore the mean life, taking account of the heating spirals, was 291 hours.—Lond. *Elec.*, June 20.

Lighting Miners' Safety Lamps by Electricity.—Brown.—An abstract of a paper read before the Midland Inst. of Min. Eng. A metallic conductor is fixed in a glass surrounding the wick of the lamp, which is lighted by placing it on a stand having a battery and induction coil inside it. Contact plates are arranged on the top of the stand, and by pressing down the lamp the primary circuit of the coil is closed, causing a spark to pass between the conductor in the glass and the wick tube, this being sufficient to light the wick. It was possible by this arrangement to light an ordinary safety lamp without passing a conductor through the bottom.—Lond. *Elec.*, June 20.

Power.

Gas Engine Driven Alternators in Parallel.—Rosenberg.—A very long illustrated article, in the first parts of which he discusses the problem analytically at great length. In the last part he describes an actual installation. In recent years the parallel operation of gas-driven, three-phase machines has become of great importance in such works where the furnace gases were formerly wasted, but are now used in gas engines. In many such plants three-phase currents are preferable to direct-current. He describes such an installation in some iron works in Bobreak, Silesia, as an example that a perfect parallel operation can be obtained with gas engines. The coke furnace gas is utilized in the gas engines. The plant contains six 300-hp three-phase machines; a 50-hp direct-current machine, and two motor generators consisting of a 50-hp three-phase induction motor and a 33-kw direct-current dynamo. The direct-current machines give the exciting current for the alternators, and assist an older direct-current plant for lighting. The three-phase alternators have a power load only, the capacity of the motors connected aggregating 1,500 hp. The "degree of non-uniformity" of speed during one revolution of the machines is 1:150; the magnet system of the dynamo is used as flywheel; both the gas engines and dynamos were installed by the same company. The connection in parallel is done in a very satisfactory way by means of an eddy current brake; there is no difficulty whatever, and the machines may be connected in parallel at any relative position of the cranks of the machines.—*Elek. Zeit.*, May 15, 22, 29.

Traction.

Acceleration on the Liverpool Overhead Road.—An illustrated article on the proposed changes of equipment of this road which was equipped a dozen years ago. The total length is a little over 6.5 miles, with double track and a third rail feed, and a special rail return operated by 500 volts direct current; the distance was run in 32 minutes, including 16 stops, or practically at a scheduled speed of 12.5 miles per hour. Recently trials have been made with a new equipment and it was found that the journey can be made in 20½ minutes. The acceleration curves obtained in these trials are given in a diagram. The acceleration reached 4.2 feet per second, or nearly three miles per hour per second. During the acceleration of the train on the series notch of the controller, each motor carried 300 amperes, or three times the normal current; there was no sparking at the commutator. The action of the brakes during retardation is perfect; the negative acceleration reached 4.75 feet per second per second. In the trials, the watt-hours consumed were 137 per ton mile, or about 6.35 kw-hours per train mile run. With the old equipment the watt-hours per ton mile were 110. The results of the trials were so satisfactory that the new equipment will be introduced. Each of the new trains is to be fitted with four 100-hp motors; their efficiency is 93 per cent. at full load; their weight, 4,200 lbs. each. The temperature rise, after one hour's run at full load is 55° C. for the commutator, 57 degrees for the fields, 39 degrees for the armature, 14 degrees for the pinion bearing, and 9 degrees for the commutator bearing. The construction of the motors is described. The following comparison is given of the scheduled speeds with the new Liverpool equipment and those of

the other lines: Liverpool Overhead, 19 miles per hour, including stops; Manhattan Elevated, 13.5; Metropolitan Elevated, 14.1; Chicago South Side Elevated, 14.6; Chicago Lake Street Elevated, 12.5; City and South London, 12.5; Central London, 14.—Lond. *Elec. Times,* June 26.

REFERENCE.

Calculation of Feeders for Electric Tramways.—EENGEL.—A reply to Sieber's criticism, recently noticed in the Digest.—*Elek. Zeit.,* May 29.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Lightning Arresters.—GOLA.—A long illustrated abstract of a paper read before the Milan section of the Italian Electrical Society, on the protection of electric installations against atmospheric discharges. He refers to accidents of a peculiar kind, in which atmospheric discharges destroyed machines, while the line was protected by ordinary lightning arresters, and at times when there was no thunderstorm. The ordinary lighting arresters did not show any sign of having been acted upon. In these cases the path which such discharges take in the dielectrics of the machine was peculiar; it was found that the discharge had gone from a wire of the armature to one or several pole shoes, although this path was much longer than to any part of the earthed case, and also much longer than the air-gap of the lightning arresters. It appeared, therefore, that discharges of this kind are directed by a strong magnetic field and that in such cases large air spaces can be overcome. To protect against discharges of this kind, he devised a new kind of lightning arrester; but as it has not yet the property of interrupting the arc with sufficient rapidity, he used it in conjunction with the old lightning arresters. His new type of lightning arrester is described in detail and illustrated. It may be briefly said to have the form of a hollow ellipsoid, consisting of two halves of iron, separated by a zinc frame; above one half is another half ellipsoid of iron, so that there are two air spaces between the three iron pieces. In these a strong magnetic field is produced. Two pieces of carbon are placed opposite to the rim of the ellipsoid, the distance being adjustable. The exciting coil of the electromagnet is in series with the line. An atmospheric charge, which distributed itself over the surfaces of the apparatus, is driven by the magnetic field to the rim of the ellipsoid and is caused to discharge over to the carbon pieces. These lightning arresters have been installed on a mountain line where in five months four accidents of the type mentioned above had occurred, in spite of the older ordinary lightning arresters. Both types have been used together since May, 1901, and since then no accidents have happened. *Elek. Zeit.,* May 22.

Switch Construction.—MAYES.—An article in which he calls attention to some faults often found in switch construction. There is sometimes a marked want of proportion in comparing the gap allowed between the switch contacts and the arc through which the contact maker is caused to pass when the switch is opened. The difference between the operation of single and double-pole switches is often not sufficiently appreciated, as the same width of gap is often allowed between the contacts whether the switches are single or double pole, for any given voltage; in the single pole switch the gap should, of course, be twice that in the double-pole switch.—Lond. *Elec. Rev.,* June 13.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Wiring for Experimental Work.—STEINTHAL.—An illustrated description of a carefully arranged system of wiring for experimental work, based on the experience gained in the equipment of the new physical laboratories at Owens College, Manchester.—Lond. *Elec. Rev.,* June 6.

ELECTRO-PHYSICS AND MAGNETISM

Canal Ray Ions.—W. WIEN.—An account of an experimental investigation concerning the charges and masses of the ions in canal rays. However high the vacuum, a positive or negative discharge can always be obtained from an electrode kept at a white heat. A glowing carbon filament will discharge negative electrons when charged to —800 volts, and positive ions in the form of canal rays when charged to + 3,000 volts. A platinum wire will go on discharging in a similar manner until its whole substance is worn away. In determining the heating effect of the canal rays and the charges transported by them, he obtained values for the ratio of the charge to the mass of the positive ions in canal rays, which are very much lower than those for the same ratio for the negative electrons in cathode rays. This is not surprising, for so far as we know, positive electrons are always associated with atoms of matter when discharged from solids. The author finds, in addition, that the ratio of the charge to the mass varies within wide limits—say 3,500 and 40,000 absolute electromagnetic units per gramme, as against 10,000,000 in the case of negative electrons. The value for hydrogen ions in electrolysis is about 10,000, and the author draws attention to the possibility of the hydrogen ion being identical with the canal ray ion. Hs is, however, not quite certain of it yet, as he has failed to discover a characteristic variation of the ratio of the charge to the mass for the canal rays, with the atomic weight of the gas.—*Ann. d. Phys.,* No. 6; abstracted in Lond. *Elec.,* June 20.

ELECTRO-CHEMISTRY AND BATTERIES.

Carbon and Diamonds.—LUDWIG.—An account of experiments relating to the fusion of carbon. Under ordinary conditions of heating, carbon, like arsenic and phosphorus, volatilizes without passing into the liquid condition. By the use of a pressure of 1,500 atmospheres he obtained carbon in a non-conducting state, clearly indicating its passage into the transparent liquid condition. The carbon passed rapidly, however, from this state into that of graphite, and experiments proved that this last allotropic form of carbon can be formed either with or without the intervention of the liquid state. Attempts to form diamonds by rapid cooling of the liquid carbon while still under pressure, were not very successful, but he believes that he has solved the problem of the natural formation of diamonds, and that, by following the lines which he has indicated later workers may be successful in producing this form of carbon in the laboratory.—*Zeit. f. Elektrochemie,* May 8; abstracted in Lond. *Elec.,* June 20.

Edison Storage Battery.—JOEL.—A summary of the patents taken out by Edison for different forms of his new storage battery. "Mr. Edison is a worker, and his patents bear evidence of his hard plodding work, and of the patience and perseverance he has given to this subject. He has undoubtedly advanced our knowledge of the alkaline genus tribe of storage batteries, and of the special preparations of metals, copper, iron, nickel and zinc for use with such solutions. The reading of the specifications comes fresh, and brings one up to date."—Lond. *Elec. Rev.,* June 20.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Direct Reading Instruments of Precision.—MARCK.—A communication from the technical department of the Imperial Bureau of Standards in Vienna. He gives a large number of notes concerning the use of modern direct reading electric instruments of precision, such as built by Weston, Siemens & Halske, etc. Among many other things, he remarks that the influence of an external magnetic field is often much greater than one supposes; he, therefore, always takes the arithmetic mean of two readings, between which the instrument has been turned through 180 degrees. When used in dry rooms, care must be taken that single parts of the instrument do not get a considerable static charge. By rubbing the glass of a Weston voltmeter with a clean dry cloth, he has found a change of the reading up to "15 parts of the scale"; blowing with the damp breath from a distance of 20 to 30 cm takes away the static charge. The insulation of the leads must be taken care of. He remarks that in order to diminish the cost, millivoltmeters are sometimes made very sensitive—for instance 150 parts of the scale = 300 mm. = 0.05 volt —and the shunts of small dimensions. In such cases the shunt heats considerably and the binding posts are heated unequally, so that a thermo current is sent into the instrument; in such a case he found this thermo e. m. f. equal to 0.00021 volt, *i. e.,* 0.7 parts of the scale, corresponding to an error of 1 per cent. for a reading of 70 parts of the scale.—*Elek. Zeit.,* May 22.

Measuring Small Self-Inductions.—VARLEY.—An article in which he describes a new method of measuring or comparing self-inductions of small solenoids and coils. The principle of the method depends on the relation between the maximum current obtained when a condenser is discharged through a circuit containing small resistance, and the self-inductance in circuit. This maximum current is then V multiplied by the square root of the ratio of C to L, when C is the capacity of the condenser, L the self-induction, and V the potential difference between the condenser plates before discharge. If we

keep the capacity constant and charge the condenser to the same potential every time, then the maximum current is inversely proportional to the square root of the self-induction in the discharge circuit; and by comparing the values of the current for different self-inductions, we can compare the latter with each other; for absolute instead of relative measurements, a standard known self-induction is necessary. As the method is a comparative one, it is not necessary to know the absolute values of the quantities measured. The condenser is best charged from the secondary of an induction coil through the primary of which an alternating current of 4 or 6 amperes is passed, and it is allowed to discharge through a spark-gap of 1 mm. or 2 mm., which ensures the potential being very nearly the same for each discharge. The maximum current is measured by passing it through a solenoid which is used to deflect a beam of cathode rays in a Braun tube. The method is described in detail, and a numerical example is given.—Lond. *Elec.*, June 20.

Measurement and Calculation.—Woodward.—While at present the units of length, mass and time are assumed as the fundamental units (c. g. s. system), it is by no means certain that these units will best satisfy the requirements of science in the future. It seems rather probable that advancing knowledge will find some other system of units preferable if it does not find several different though interconvertible systems essential. We have, in fact, already attained two such diverse systems in the units of electromagnetic science. He shows how different systems can easily be constructed, for instance by using energy mass and time, or energy length and mass, instead of length mass and time as the fundamental units; the dimensions of several quantities in these three different systems are given in comparative tables. He says that "it is to be hoped that the end of the barbaric system of 'weights and measures' we have inherited from an unscientific ancestry is near at hand, and this not so much in the interest of men of science as in the interests of those less well fitted to struggle with the ingenious intricacies of the British system." He describes the standards of meter and kilogram. The time unit is the least stable of our three fundamental units, and hence the most in need of checks on its stability. He then discusses the measurements of quantities of all sizes, from the dimensions of corpuscles and atoms up to the distances between the stars.—*Science*, June 20.

Röntgen Ray Apparatus.—Rollins.—The first part of a well illustrated serial on "apparatus for X-light diagnosis." He urges that the following precaution should always be taken in X-light work. The X-light tube should always be used in a non-radiable case, from which no X-light can escape except the smallest cone of rays which will cover the area to be examined, treated or photographed. The fluorescent screen should be covered on the side nearest the eyes with a sheet of heavy lead glass one centimeter thick, because the fluorescent salt allows much of the X-light to pass through it unchanged. All parts of the fluoroscope, except the screen, should be heavily painted with non-radiable paint. The physician should wear spectacles of lead glass one centimeter thick. He describes the construction of non-radiable cases for X-light tubes; the arrangement of spark-gaps, and a simple form of examination table.—*Elec. Rev.*, June 14.

Telegraphy Telephony and Signals.

Selenium Telautograph.—Korn.—An illustrated description of an instrument for the reproduction of images at a distance. It is based upon the sensitiveness of the vacuum discharges at an exhaustion of 0.2 to 2 mm., to slight changes in the resistance of the circuit, and the extraordinary photo-chemical activity of the rays proceeding from the discharge tube. The picture to be transmitted is divided up into small squares, each of which is projected in turn upon a selenium cell. At the receiver end a sensitive plates is made to move past an aperture transmitting the Röntgen rays, the plate moving at a rate corresponding to the motion of the original picture at the sending end. The variations in the current produce a variation in the size of a spark-gap, which in turn produces a corresponding variation in the actinic intensity of the vacuum tube. A period of two seconds suffices to give a good impression of each square. The way in which the spark-gap is shortened is as follows: An astatic galvanometer carries, in addition to the two needles, a small brass needle acting as one of the electrodes of a spark gap. The greater the deflection of the galvanometer, owing to the illumination and consequent lowering of the resistance of the selenium cell, the more does the brass needle approach a fixed needle representing the other electrode. One of the electrodes of the vacuum tube is attached to the fixed needle, while the other electrode is put to earth, and the movable needle is connected with one of the poles of the secondary coil of a Tesla apparatus. The second pole of the Tesla coil is connected with a large capacity. He has worked successfully with pictures consisting of 400 squares. He proposes to reduce their size to 1 sq. mm. in the transmitter, and the exposure to tenths of a second. The original contains reproductions of a few simple geometric figures, which were transmitted in this way.—*Elek. Zeit.*, May 22; abstracted in Lond. *Elec.*, June 6.

Castelli Coherer.—An illustrated description of the Castelli coherer, which is used with good success in the Italian navy, and which in an improved form is stated to have been used by Marconi in his well-known attempts to signal across the Atlantic. Castelli's tube, as shown in the adjoining Fig. 1, consists of two carbon electrodes enclosing two drops of mercury separated by a small iron cylinder. This tube is self-decohering. The receiving arrangement used in the Italian navy is shown in Fig. 2, in which *G*, is a bell, *H* a relay, *A* telephones, *R* an induction coil, *L* a bell switch, and *E* a lightning protector. In practice the Castelli coherer ensures regularity and rapidity of communication to much greater distances than when other coherers are used. For a good tube carefully adjusted, the e. m. f. of the cell should be from 1 to 1.5 volts. Considerable moisture in the atmosphere has an appreciably injurious effect on the tubes which are not perfectly closed. In the mercury tubes the self-decoherence is more or less perfect according to the purity and freedom from amalgam of the mercury used, to the dryness and cleanliness of the interior of the tube, and to the smallness of the drops of mercury. The most suitable diameters of the drops are comprised between the extreme limits of 1.5 mm. and 3 mm. Drops less than 1.5 mm. in diameter give insentitive tubes; those greater than 3 mm. diminish the completeness of the decoherence. The diameters of the tubes must be proportional to the drops of mercury used; in general they are 3 mm. in internal and 5 mm to 8 mm. in external diameter. These tubes must be regulated by the telegraphist on duty, and after a certain time they lose their good qualities, but the telegraphist can readily dismount the tube, clean it, and put in fresh mercury, taking all the necessary precautions for obtaining absolute cleanliness—*L'Elcttricista*, May; *Lond.* Elec., June 27.

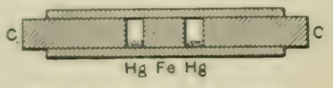


FIG. 1.—CASTELLI'S COHERER.

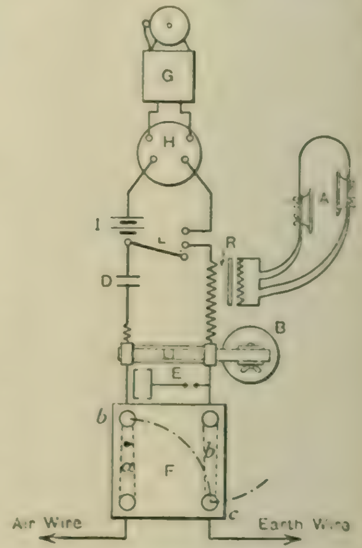


FIG. 2.—CASTELLI'S COHERER.

New Book.

The Elements of Physical Chemistry. By J. Livingston R. Morgan, Ph. D. Second Edition, revised and enlarged. New York: John Wiley & Sons. 352 pages, 23 illustrations. Price, $2.00.

This treatise is an extremely comprehensive one, embracing practically all the elements of physical chemistry, together with the important and but little known applications to the other branches of chemistry. This is made possible by a free use of mathematical formulas and symbols, which enable the author to express relations in a brief and concise way, while otherwise he would have had to use many words to express them completely. This shows the wisdom of the claim that a mathematical training is considered indispensable for the modern chemist.

The book is divided into ten chapters. In the first he gives some introductory remarks on physical chemistry, energy and the methods of determining the atomic weight. The second, third and fourth chapters deal with the gaseous state, the liquid state and the solid state, erspectively; the fifth chapter takes up solutions; the sixth

gives a brief outline of thermochemistry, while the seventh on "chemical change" is divided into three parts—the conditions of chemical equilibrium and the law of mass action; the rôle of the ions in analytical chemistry; and chemical kinetics.

The author is an adherent of the orthodox, modern, electrochemical school—that is, of the dissociation theory—but his views on the part taken by the ions in analytical chemistry might be greatly modified in view of Kahlenberg's recent important and striking researches on instantaneous chemical reactions in non-conducting liquids. The eighth chapter gives a brief statement of the phase rule of Gibbs, while the ninth deals with electrochemistry, and is divided into four parts—on the migration of the ions; the conductivity of electrolytes; electromotive force and the ionic mechanism in galvanic cells; electrolysis and polarization. The last chapter gives a useful collection of problems with answers.

The book seems to be chiefly a text-book for colleges, and appears very sutiable for that purpose. The author hopes that it may also be used to advantage by those studying the subject without an instructor; he says "the physical meaning of all relations is shown, so that those who have not sufficient mathematical training to actually derive the single relations will at least understand them and be able to apply them when necessary." In the reviewer's opinion, however, this should be done only with great caution. Engineers know the serious consequences which may result when one tries to apply a formula without knowing exactly whence it comes, unless its application is very fully and clearly described and all its limitations stated; otherwise a formula on any engineering subject can only be completely understood if its derivation is known, as then only do all its essential conditions become clear. It is the same in physical chemistry. Only those who take pains to see how the results have been reached can understand them thoroughly, and whoever has not sufficient training for this purpose had better not attempt their application, unless all the limitations and applications are clearly stated.

The author is sometimes a little careless in his definitions. For instance, on page 2 he says: "At Washington a body falling freely for one second acquires the velocity of 980.10 centimeters," whereas he should have said, "centimeters per second." A few lines below he uses the word "dynes" when he should have said "dyne-centimeters" or ergs.

Directory of Electrical Societies, Etc.

AMERICAN ELECTOCHEMICAL SOCIETY. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Next meeting, September, 1902.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Toronto, Ont., 1903.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

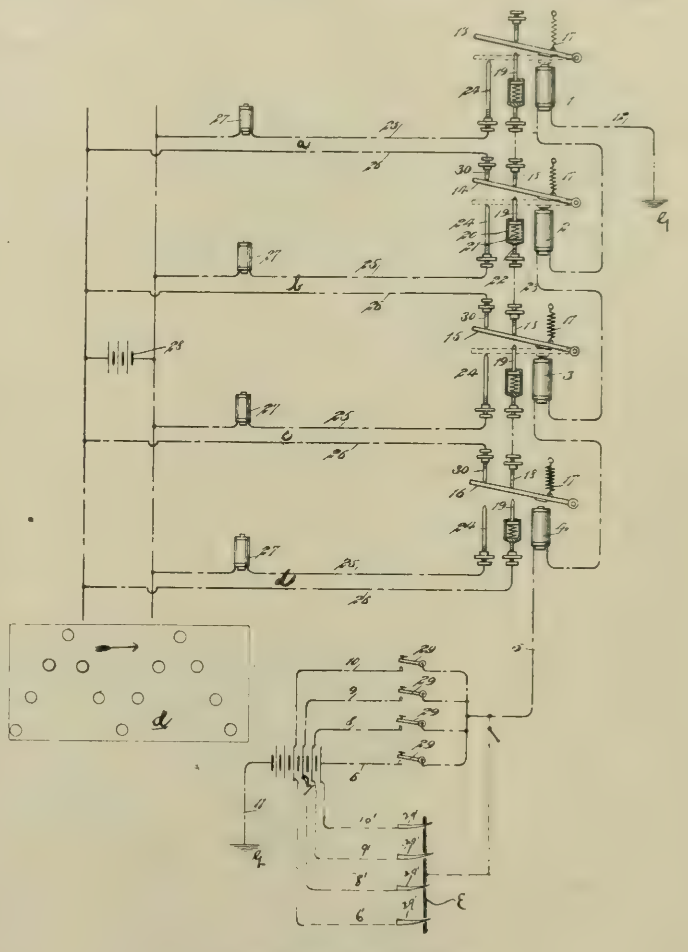
A New Multiple Telegraph.

By S. T. FOSTER, JR.

IN view of the present discussion as to the advantage and disadvantage of machine telegraphy, some of your readers may be interested in the details of a multiple-telegraph system which the writer has recently devised and which involves a very simple arrangement.

Referring to the accompanying illustration, the receiver is shown as consisting of a number of controlling devices in the form of electromagnets connected in series in main line, 5. Though only four are shown, as many can be employed as may be required—for instance, one for each character to be transmitted, one for the space, one for line shifter, one for typewriter carriage shifter, etc. The several controlling devices are of different resistances; that is, of different number of turns on the magnets, or of different tensions on their armature levers, so that each requires a different current strength to operate it. For example, electromagnet 1 will require a certain predetermined current strength to energize it sufficiently to operate its armature; 2 a greater current strength to operate its armature, and thus the current required is increased throughout the whole series of the electromagnetic controlling devices.

There is a keyboard, 29, for connecting into the circuit different amounts of battery. The circuit is grounded after passing through all electromagnets, 4, 3, 2, 1, and ground wire 12. At the sending end the line-wire is grounded through the keyboard, 29, battery, and ground wire, 11. Completing the circuit through 10, there is enough voltage to overcome the resistance of the line and to force enough current through the whole circuit to operate 1; completing the circuit through 9, there is enough voltage to overcome the line resistance and to force enough current through the circuit to operate 2, and more than enough to operate 1, so that both 1 and 2 will operate simultaneously. Likewise, completing through 8 will cause 1, 2 and 3 to operate and to pull down their respective armature levers simultaneously; similarly, only one pulsation of current will cause any of the controlling devices (together with all those below that one in the series) to operate.



MULTIPLE-TELEGRAPH SYSTEM.

When operated, the armature lever of each controlling device is designed to close a local circuit containing a translating device and to open the local circuit closed by that controller next below it in required current strength.

Assume the main circuit is completed through 8, then 1, 2, and 3 will operate their respective armature levers, 13, 14 and 15, as shown by dotted lines; 13 will close the local circuit *a*, between 19 and 24; 14 will open this local circuit between 30 and 18 and will close local circuit *b* through its 24 and 19, and thus similarly 15 will open the local circuit *b* and close local circuit *c*; and, 4 not operating, local circuit *c* will remain closed through 30, 16 and 18, so that local circuit *c* will be the only one completed. Hence, by closing the main circuit

through 10, only the local circuit *a* is completed; by closing the main circuit through 9, only the local circuit *b* is completed; and so on.

Translating devices 27 may be electromagnets, and one each made to operate a key of a typewriter, one to shift spacer, one to shift carriage, etc., and each operated independently of all others from a distant station with only one pulsation of current for the operation of each one. The keys for cutting in different voltages on the main line may be conveniently arranged similar to the keys of a typewriter.

Different amounts of battery power may be automatically thrown in circuit according to the local circuits to be operated, by having a strip of paper punctured properly, and passed between a copper strip, *e*, and contractors, 29′. The punctures should be so arranged that only one will pass over the copper strip, *e*, at a time, and their respective positions across the paper will determine by which of the connectors, 29′, the main circuit will be completed, and, therefore, the battery strength cut in.

A paper strip, *d*, is punctured so that if it is run in between *e* and connectors, 29′, and in the direction of the arrow, then the battery will be cut in successively through 6′, 8′, 9′, 10′, 9′, 8′, 6′, 8′, 9′, 10′, 9′, 8′, 6′, which will cause local circuits at the receiving station to be completed successively in the same order, *d*, *c*, *b*, *a*, *b*, *c*, *d*, *c*, *b*, *a*, *b*, *c*, *d*. A machine can easily be devised, something after the fashion of a typewriter for puncturing the paper strip, each key to puncture in a certain relative position across the page.

The advantages of this system are as follows: For each pulsation of current through the line, a letter, figure or other character may be printed on a typewriter; a typewriter or a linotype machine may be worked rapidly from a distance by the manipulation of a keyboard or by pulling a previously prepared strip of paper through a slot; there are no wheels nor gears to get out of order except such as are in the machine selected to be operated by the translating devices, 27.

Weston Duplex Instruments.

The accompanying illustrations show a type of combined voltmeter and ammeter now being made by the Weston Electrical Instrument Company. These instruments are particularly useful where practically simultaneous readings of current voltage are made, and also in all cases where space is limited and compactness is a necessary or desirable feature.

The two instruments are enclosed in a neatly designed water-proof

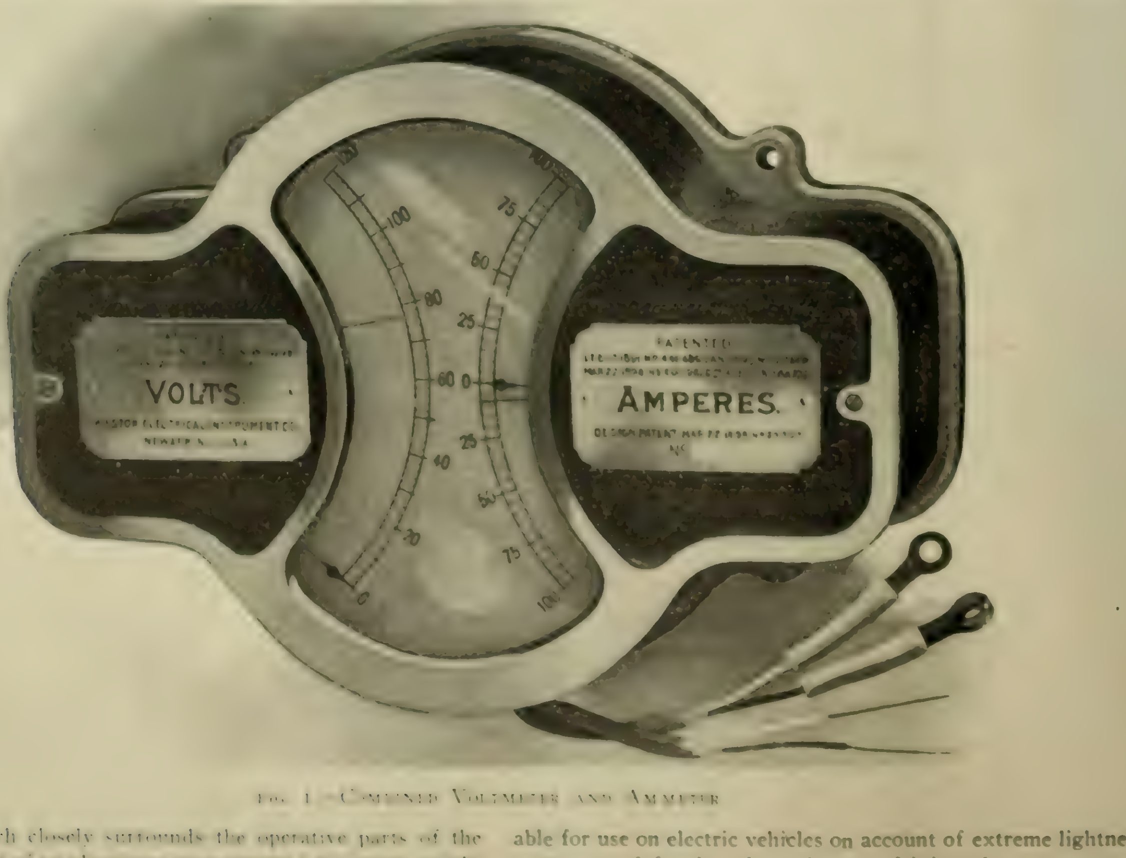


FIG. 1.—COMBINED VOLTMETER AND AMMETER.

aluminum case, which closely surrounds the operative parts of the instruments. The use of an aluminum case secures a minimum weight as well as size, and as the case is water-proof, this model is well adapted for outside use, where the instrument is exposed to the

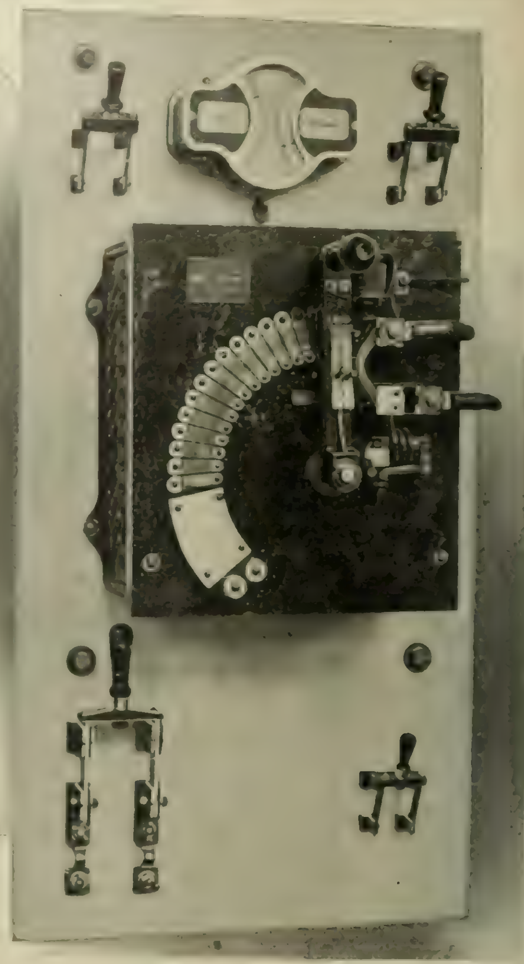


FIG. 2—DUPLEX INSTRUMENT ON SWITCHBOARD.

weather, or in other cases where water or dampness would be likely to affect the working of the instrument. They are particularly suitable for use on electric vehicles on account of extreme lightness, compactness and freedom from danger of injury by water, snow, mois-

ture or dust and dirt. The dimensions and weight are as follows: Length, 9½ inches; width, 7 inches; height (or depth), 3¼ inches; weight (without shunt), 8 pounds. These instruments were originally designed for automobile service, and the whole instrument, and especially the moving parts, being so designed and constructed as to be able to bear without injury the constant vibration to which such instruments are subjected while in use on vehicles. Aside from their adaptability to use on vehicles, the instruments are also particularly well adapted for use in all other cases where extreme vibration is met with, or where space is very limited, and lightness a desirable or necessary feature; as for use on small switchboards, and especially on motor-starter switchboards, where they will be found to render valuable service in indicating the power used in driving single machines or groups of machines. Fig. 2 shows their application for this purpose. By their use in this manner it is easy to ascertain the power used to drive machines, and thus to charge the proper proportion of power to each department, or even to each machine. They also serve, when so used, to indicate abnormal conditions arising from friction or other causes, and will thus be found to materially aid in securing economy of operation of machinery in general.

Another model has working parts precisely the same as used in that illustrated, except that the scale is larger, and consequently the divisions more open for the same range, and the case is made of cast-iron, is not water-proof, and does not closely surround the working parts of the instrument. This latter model is well adapted for use in small isolated plants, and for all cases where the existence of powerful external fields would render it impossible to use the other model. The function of the cast-iron case is to shield the instrument from external fields.

Niagara Developments.

A notable and important step in connection with the power development at Niagara Falls has been taken by the Niagara Falls Hydraulic Power and Manufacturing Company in the purchase of a large tract of land in the northeast part of the city, where a new industrial center will be established by that company, its present lands being well occupied by manufacturing plants. Electric power will be transmitted to the newly acquired territory, and Niagara Falls will soon have great factories on its northern as well as on its southern outskirts.

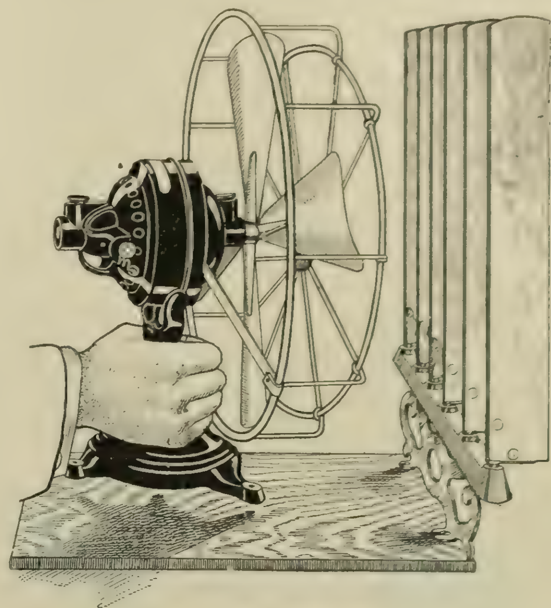
The first large industry to seek this new section will be the Carter-Crume Company. This company has purchased five acres in the same portion of the city and will at once erect a large factory building for the manufacture of counter check books. The buildings will cover about four acres. The Carter-Crume Company now has a large establishment on Main Street, and is a power customer of the Niagara Falls Hydraulic Power and Manufacturing Company. It now employs about 300 hands, but this number will be increased in the new plant, which will go forward at once.

When the Carter-Crume Company vacates its present large buildings, they are to be occupied by the William A. Rogers, Ltd., manufacturers of hollow ware. This company has a plant adjoining the Carter-Crume Company, and when it secures its additional space the company's other plants, in Northampton and New Bedford, Mass., as well as in Oneida, N. Y., will all be moved to Niagara Falls.

The Atmospheric Products Company has broken ground on the lands of the Niagara Falls Power Company, for a building that is to be 125 x 50 feet, two stories high, and of pressed brick. In this building the apparatus necessary to equip a second building to be 500 x 50 feet at the foundation will be made. The first building will be close by the aluminum plant, but the site of the second building is yet to be selected. The Atmospheric Products Company will use air as its raw material.

Air Diffusing Fan Motor.

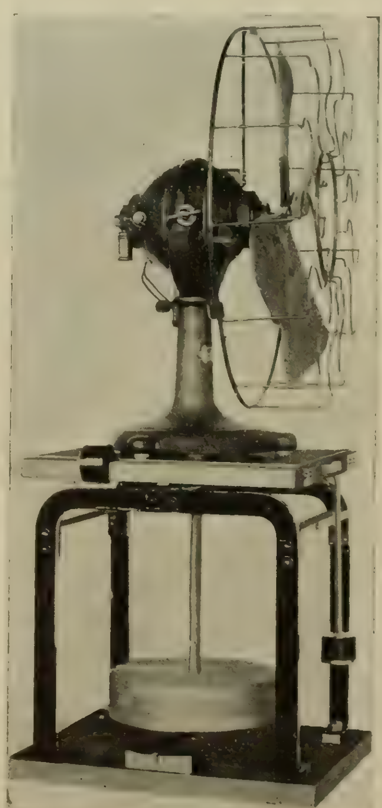
Probably no device for adding to comfort in hot weather has become more universal and popular than the fan motor, and most people are interested in any effort made to improve its efficiency and general utility. One of the latest ideas of improvement has been that of varying or controlling the directions of the fan motor breeze, and we ilustrate herewith the device put forward by Degge & Musick, of St. Louis, Mo. It is so obvious and simple as hardly to need any explanation after a glance at the cut. The Degge "air diffuser," as shown, can be attached to any fan already owned by an individual or on the market. The blades remain steadfast at any angle as fixed, and can be readily swung and set in any new direction when a change of position or direction is required. It will be seen that the diffuser takes the breeze from the fan blades and may deliver it at two distinct parts of any room, so that a generous distribution is obtainable by such feathering; or the blades can all be set at the same angle;



AIR-DIFFUSING FAN.

or a person can still enjoy the breeze while intercepting direct currents that he may dislike to have leveled at his person, causing a cold or chill in the eye or ear. The device is not less simple than inexpensive, and is an ingenious attempt to meet the problems of air circulation in hot weather.

A New Fan-Motor Balance.



MOTOR BALANCE.

The useful work of a fan depends upon the pitch of the blade. Some fans run at a high speed and with little noise, but a purchaser soon learns that very little air is moved, the pitch of the fan blades being so small that the power demanded of the motor and the breeze produced are far below expectation.

The accompanying illustration shows a new instrument for measuring the useful work of a fan. Its design is based on the well-known law that action and reaction are equal and opposite in direction. The force exerted in moving air forward is exactly equaled by the backward thrust on the fan, which is accurately weighted by this instrument.

In conjunction with the measurements of the electric current used, this gives also the practical efficiency of the fan motor. This instrument was constructed by the Sprague Electric Company, and is in use by it to show the high power, large air moving capacity and high efficiency of its fan motors.

Regulating Incandescent Lamp.

The problem of producing an incandescent lamp, the light of which can be varied at will and economically, as easily as a gas jet is controlled, has received the serious attention of many inventors. The lamp illustrated herewith represents the latest idea in a turn-down lamp and possesses the important qualification of being economical in current per candle-power when it is turned down. It gives two degrees of light, viz.; full candle-power or one candle-power, the latter being sufficient to light a room enough to enable one to move about without danger of running into and upsetting furniture, etc.

Fig. 1 represents a lamp designed to be used in any fixture, with all styles of shades and in any position, the operation of changing from one degree of light to the other being performed by the aid of two strings suspended from the lamp base. Pulling one string gives the full candle-power and a pull on the other turns on the one candle-power light. The light can thus be changed without touching the bulb, by simply pulling on one string or the other. On the outside of the base a little switch is provided, which cuts in one or the other filament according to which of the strings is pulled. There are three terminals, the base of the lamp constituting the common terminal for one end of each of the two filaments, the second and third terminal points representing the other ends of the filaments. It is evident, therefore, that according to the position of the switch the current flows through either the full candle-power filament or that of one candle-power.

FIGS. 1 AND 2.—REGULATING LAMP.

Another design of this lamp is shown in Fig. 2. Variation of light is effected by simply taking hold of the bulb with the fingers and turning it one way or the other. The base of the lamp is provided with a sliding outside shell, the latter constituting the base, which is screwed into the socket in the usual manner. When the base is screwed home into the socket it remains firmly in place without danger of being loosened by vibration. The sliding shell bears the two terminal points which shift positions under the contact on the stationary base, as the lamp is turned by the hand, whereas in the "pull-string" style the small switch, which is constructed on the "walking beam" principle, forms contact at the lower end with one of the filament terminals. Thus while there is a difference in construction, the results are the same in either case.

It is evident from the construction of this lamp that the danger of its working loose from the socket by the effect of vibration is entirely obviated. The lamp is, therefore, especially adapted for use on steamboats and in other places where vibration is excessive. These lamps are made in two sizes, 8-1 and 16-1 candle power, and for all standard sockets, by the Economical Electric Lamp Company, 123 Liberty street, New York.

Torches.

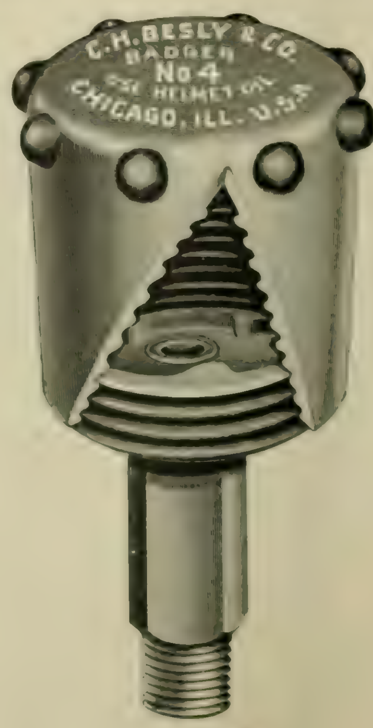
The torches illustrated herewith have recently been brought out by the Clayton & Lambert Manufacturing Company, Detroit, Mich. The torch shown in Fig. 1 was designed for the use of mechanics who desire a powerful burner capable of doing heavy work out of doors in cold or windy weather. It is claimed to have great generating power. It produces a clear, blue, intensely hot flame, which is under perfect control of the operator, and is economical in the use of gasoline. The


FIGS. 1 AND 2.—TORCHES.

tank is quart size, drawn out of heavy brass, free from seams, and all fittings are heavy. A brass air pump of the latest design screws into the tank and is submerged in gasoline, which aids in keeping it cool and also protects it from injury. In Fig. 2 the torch is provided with a hook and support, so that soldering coppers may be heated, making it particularly valuable to repair men and mechanics who are called upon to do work of this kind.

Oil Cup for Automobiles.

A form of oil cup, especially adapted for automobiles, has been brought out by Charles H. Besly & Co., 10-12 North Canal Street, Chicago. It is here illustrated, and, as will be seen, is similar to their regular Badger cup, except that it has double depth or capacity,



OIL CUP.

and that the stem is made proportionately longer. The cup is made of cast-iron and can be operated by hand or wrench. The base has a round thread and will not strip, clog or cross. The stem being made of bar steel, drilled and threaded, will not break off in the oil-hole.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was in fair demand, the closing rates being 4½@5 per cent. for all periods On the stock exchange prices were stronger, on a favorable interpretation of the Government crop report; the activity, however, was on a somewhat restricted scale. It was intimated during the week that the litigation against the United States Steel Corporation might have a speculative origin, and the reported intention on the part of the company to combat such attacks affected the steel stocks favorably. Western Union suffered a drop of several points on rumors that the Vanderbilt interests might take action against Missouri Pacific, which action would affect adversely Western Union and other Gould properties. Traction shares were, on the whole, neglected, although Manhattan shared in the temporary depression of the Gould securities. Metropolitan Street Railway dropped 1⅝ net, closing at 147½, the week's sales being 4,200 shares. Brooklyn Rapid Transit fluctuated within a range of 1½ points, closing at 67¾, a net loss of ⅛ point. General Electric showed some strength on limited trading, the total sales being 1,600 shares. The closing price was 318, which was also the highest figure reached during the week, the lowest being 305. This stock made a net gain of 5 points. Western Union closed at 85½, a net loss of 2¼ points, the sales aggregating 25,483 shares. Westinghouse securities, common and preferred, were quiet, the quotation of the former being 208 and of the preferred 213, the latter representing a net loss of 4 points. American Telephone & Telegraph made a net gain of 4 points, closing at 167, "rights" closing at 15⅛. In Boston, American Telephone & Telegraph made a net advance of 2¼ points during the week. Following are the closing quotations of July 15:

NEW YORK

	July 8.	July 15.		July 8.	July 15.
American Tel. & Cable..	—	—	Gen. Carriage (n. st'k)..	—	—
American Tel. & Tel....	—	—	Hudson River Tel......	—	107
American Dist. Tel....	—	36	Metropolitan St. Ry....	147⅝	148¼
Brooklyn Rapid Transit.	67½	68¾	N. E. Elec. Veh. Trns..	—	—
Commercial Cable	—	160	N. Y. E. V. T. Co.....	12	12
Electric Boat	30	25	N. Y. & N. J. Tel......	—	175
Electric Boat pfd.......	50	40	Tel. & Tel. Co. of Am..	—	—
Electric Lead Reduc'n..	2¾	2⅝	Western Union Tel.....	87¼	86½
Electric Vehicle	6½	6*	West. E. & M.........	—	208
Electric Vehicle pfd....	14	14½*	West. E. & M. pfd....	213	213
Gen. Electric ex. stk. div.	—	192			

BOSTON

	July 8.	July 15.		July 8.	July 15.
Amer. Tel. & Tel. ex. rts.	166	165	Mexican Telephone	2¼	2
Cumberland Telephone..	—	—	New Eng. Tel. ex rts...	141	—
Edison Elec. Illum.....	—	—	Westinghouse Elec.	104	—
Western Telephone pfd.	103	—	Westinghouse Elec. pfd.	105	—
General Electric new...	185	—			

PHILADELPHIA

	July 8.	July 15.		July 8.	July 15.
American Railways.....	46	46	Phila. Traction	98¾	99⅛
Elec. Storage Battery...	—	95½	Phil. Electric	5⅛	5⅛
Elec. Storage Bat'y pfd.	90¼	94½	Pa. Elec. Vehicle......	—	1
Elec. Co. of America....	5⅞	6	Pa. Elec. Vehicle pfd...	—	3

CHICAGO

	July 8.	July 15.		July 8.	July 15.
Central Union Tel.....	—	—	National Carbon pfd...	102	102
Chicago Edison	179	—	Northwest Elev. com...	—	35⅝
Chicago City Ry......	207¾	208	Union Traction	14⅜	15
Chicago Teleph. Co.....	—	170	Union Traction pfd.....	51¼	49
National Carbon	26	29¼			

* Asked.

UNITED POWER AND TRANSPORTATION.—It is stated from Philadelphia that the new stock issue of the United Power & Transportation Company, decided upon some time ago, has now been allotted and completely taken up. The issue was 18,750 shares, which, at the par of 25, has brought into the company's treasury $568,750. President Rigg, of the United Power and Transportation Company, says: "The gross earnings of the company for the six months ending June 30 aggregated nearly $2,000,000, showing a gain of about $100,000 over the figures for the first six months of 1901. The company will within 30 days commence the building of a line eight miles long from Limerick to Boyertown, connecting our Schuylkill Valley and Oley Valley roads at a cost of from $250,000 to $300,000. When this link has been completed we will have a through line from Roxborough to Reading. The Reading and Lebanon roads, both of which we own, come within five miles of connecting. This gap also we have planned to close in the near future, which would take us to Palmyra, within nine miles of Harrisburg."

STORAGE BATTERY OUTLOOK.—A cable dispatch from London, of July 10, says: At a meeting of the shareholders of the Electrical Power Storage Company to-day, the chairman alluded to the persistent rumors about the new accumulator invented by Edison. He said he thought it was too early to place any reliance on statements which had been evidently circulated by irresponsible persons. The chairman said that the company had followed Mr. Edison's figures closely and was unable to find, even on his own statements, that he was able to make a battery more than 10 per cent. lighter than the special battery made by the Electrical Power Storage Company, and it was about two or three times more expensive in manufacture. It would have to last a long time, the chairman said, if it were to come into competition with those which the company was now selling. Judging from his own experience, the chairman said, he thought it might be found that Edison was still far from being in a position to make a commercial article of his invention.

GEORGIA RAILWAY AND ELECTRIC.—The Georgia Railway & Electric statement for the month of May shows an increase of about 7 per cent. over the preceding month, and for the five months of 1902, ending May 31, an increase of 20 per cent. over the same period last year. The May earnings are: Gross, $107,387.19, as compared with $90,283.34 for May, 1901, an increase of $17,103.65; net, $56,333.39, showing an increase of $14,355.80 over 1901. The proportion for interest and taxes is $38,598, leaving $17,730. Of this, $7,500 is necessary for preferred stock, leaving a surplus of $10,230 for common stock. In view of the fact that this corporation was only formed January 1, 1902, consolidating the Atlantic Railway & Electric Co., Atlantic Rapid Transit Co., Atlanta Steam Co., and Georgia Electric Light Co., this statement is considered excellent.

JOHNSON TROLLEY INTERESTS.—It is stated that in order that the management of the Johnson trolley syndicate in the East may be controlled with more ease than formerly, the Trenton, Lawrenceville and Princeton, the Princeton Street Railway, the Yardley, Morrisville and Trenton, Newtown and Yardley Street Railways have been consolidated with the New Jersey and Pennsylvania Traction Company, which concern controls the Lehigh Valley lines in Pennsylvania. Each line will maintain its original individuality, though the officers become subordinate to the directorate of the New Jersey and Pennsylvania Company. The company will raise its capital from $1,000,000 to $3,000,000, and Jilson J. Coleman, who has long been in charge of the Johnson lines in this section, and who is a brother-in-law of the mayor of Cleveland, will be president of the directorate.

DIVIDENDS.—The directors of United Gas and Electric Company, of New Jersey, have declared the initial semi-annual dividend of 2½ per cent. on the preferred stock, payable July 15. The directors of the American Light and Traction Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable August 1. The directors of the Harrisburg Traction Company have declared a semi-annual dividend of 2½ per cent. out of the earnings of the first half of the year. The trustees of the Worcester Railway & Investment Company have declared a regular semi-annual dividend of $2.25 per share, payable August 1.

GENERAL ELECTRIC'S NEW STOCK.—The $16,812,600 new General Electric stock, representing a dividend of 66⅔ per cent., which was distributed among the old shareholders, is now dealt in on the New York Stock Exchange. The old stock closed at 315 on July 15, and the price of the increased issue started off at 189¼, or ¼ above the old level, allowing for the increase, and advancing to 195½ before noon. The old stock sold ex-dividend of $2 in cash on July 1.

B. R. T. MORTGAGE.—A mortgage of $150,000,000 made by the Brooklyn Rapid Transit Company to the Central Trust Company, of Manhattan, which covers all the property of the Brooklyn Rapid Transit Company, the Brooklyn Heights Railroad Company and the constituent companies, has been filed in the Register's office in Brooklyn. The mortgage is secured by bonds. This mortgage was authorized by the board of directors of the Brooklyn Rapid Transit Company at a special meeting, held on March 20 last, was executed and bears date of July 1, and is signed by President Greatsinger. The object

of the mortgage is to furnish the Brooklyn Rapid Transit Company with money as needed for construction and betterments, and to take up underlying mortgages as they mature. Bonds to the amount of $5,000,000 have already been sold, but none of them have been issued. President Greatsinger states that some of the money would be used in the new Third Avenue power house and some would be used for rolling stock and other improvements. He said there was also talk of extending various lines.

SPRAGUE GENERAL ELECTRIC DEAL.—It was stated that a slight modification has been made in the terms that the General Electric Company offered several weeks ago to the security holders of the Sprague Electric Company for their holdings. The new terms are somewhat less than the original terms, although the offer is looked upon as still a very advantageous one for both parties in interest. The original offer was based upon the Sprague Company showing a certain percentage of earnings, which an examination, made subsequently, failed to show fully. For this reason the General Electric Company has reduced its offer. The new terms are stated in a circular that John Markle, president of the Sprague Company, has sent to the bondholders and shareholders of the company under date of July 10. In it he notifies them that the option was not exercised by the General Electric Company, because of a disagreement as to the price of the properties to be taken over, but that he has entered into a contract with the General Electric Company and with the United States Mortgage and Trust Company under the terms of which, if two-thirds of the Sprague bonds and two-thirds of the Sprague stock are deposited with the United States Mortgage and Trust Company before September 30, the General Electric Company will pay certain specified prices for the company's bonds and stock. The proposed plan for the acquisition of the Sprague properties carries with it a payment for their holdings in Otis Elevator Company stock, a proportion of which is owned by the Sprague Company. The last-named company some time ago, as is well known, sold the elevator manufacturing branch of its business to the Otis Company, receiving in payment a block of Otis securities, which has since been in its treasury. Although President Markle's circular has been just issued, it is stated that a majority of the Sprague securities has already been deposited under the new terms. It is stated that under the modified offer, each Sprague 5 per cent. bond will receive $540 in cash and 5½ shares of Otis Elevator preferred. Sprague preferred will receive $100 in 3½ per cent. 40-year gold debenture bonds of General Electric, redeemable at par within ten years, and thereafter at 105. Sprague common will receive 41.9 per cent. in Otis Elevator common. With regard to the change in the terms, while the General Electric acquires an excellent manufacturing business in the Sprague property, one of the chief assets acquired consists in the fundamental Sprague multiple unit patents.

WESTERN UNION.—There appears to be good authority for the statement, says the *Wall Street Journal* that the Western Union Telegraph Company has recently been a large purchaser of telegraph instruments and materials, and that it is proposed to practically duplicate whatever new lines the Postal Company may construct in what has heretofore been Western Union territory. Routes may be different, but all important points will be entered and connections maintained. This will involve considerable outlay, but the business will not be allowed to suffer. More up-to-date methods are being inaugurated, and it is confidently asserted that not a dollar will be lost in net earnings. The lines along the Pennsylvania Railroad are for the most part galvanized wire, or a light grade of copper wire, being thus far behind modern requirements. Along the Baltimore & Ohio, where the contract still has a long term of years to run, heavy copper wire is in general use. Lake Shore officials decline to make any comment on the Philadelphia report that the contract with Western Union will not be renewed. Vice-President Baker, of the Postal Telegraph, has specifically denied that there is any movement on foot looking to the installation of Postal lines on the Vanderbilt roads.

KEYSTONE TELEPHONE.—In interviews in Philadelphia, Keystone Telephone officers state that the company has more than fulfilled its promise to have 5,000 places installed with telephones before any charge is made. When the company began recently to earn an income there were nearly 6,500 telephones in service, including Philadelphia, Camden and Gloucester. It is estimated that this number will yield about $300,000 gross receipts, the charge for an unlimited service being $80 and perhaps a third of the subscribers being on party wires. To pay the six per cent. dividend on $5,000,000 preferred stock requires $300,000, and the management estimates that double the present number of telephones in service will show net profits equal to the amount of the preferred dividend. About half or $2,500,000 of the preferred stock offered with the common stock bonus was taken on the original subscription and by the syndicate of organizers, and the fourth installment of $12.50 per share, making the stock full paid $50, matures next September. By that time, it is stated, the expenditures in constructing the plant will be represented by about that figure, and it will be then the purpose to go on and put up the balance of the $2,500,000 cash capital to complete the plant, which will then have a capacity for 30,000 telephones.

Commercial Intelligence.

THE WEEK IN TRADE.—The general trade conditions have been somewhat improved by the warmer and more settled weather, one encouraging feature being the discovery that the reports of the damage to crops by the recent rains were exaggerated. There is, however, hesitation still in some lines of distributive trade, due to the cool, backward weather, but the outlook is assuring. Among the industries, iron and steel still rank first in activity, the chief source of complaint being the scarcity of fuel, both coal and coke. There is some improvement noted in the labor situation. The railway earnings thus far reported for June, with the exception of the anthracite roads, show an aggregate gain of 8 per cent. over last year, and all reports as to probable crops and trade point to the maintenance of a heavy tonnage. Many furnaces in Pennsylvania have been shut down because of lack of fuel, and this reduces production, the full volume of which could be handled advantageously. Rails are in unprecedented demand, and 50 per cent. of the country's production for the next year has already been arranged for. There is also a lively demand for structural material, and it is stated that six months' production is easily on the order books. Hardware is in very active sale. The business failures for the week ending July 10, as reported by *Bradstreet's* aggregated 195 as against 138 the week previous and 199 the same week last year. The copper market was dull, the prices being in the buyer's favor. Closing quotations were 11.95@12.15c. for Lake, 11.95 11.05c. for electrolytic and 11.75@11.95 for casting stock—all for October delivery.

AMERICAN AUTOS IN ENGLAND.—A cable dispatch from London, of July 9, says: "The London Road Car Company, the second largest of the London street omnibus companies, has ordered ten Fischer electro-gasolene 'buses, to be built at Hoboken, N. J., at a cost of £500 sterling each. The new 'buses are to be delivered in three months. They will have a speed of 12 miles an hour and a capacity of 30 passengers, as against 26 passengers carried by the horse 'buses. The Fischer 'buses will travel 100 miles a day, as against 56 by the horse carriages. The cost of running each 'bus will be 2½ cents a mile." The automobile mentioned has been illustrated and described in these pages.

WESTINGHOUSE PRODUCER GAS EQUIPMENT FOR SPAIN.—The Westinghouse, Havre, France, which concern takes care of the Westinghouse interests (other than those of the Air Brake Company) in France, and some of the other countries in Continental Europe, has requisitioned, through Westinghouse, Church, Kerr & Company, for a 125-hp vertical producer gas engine for operating on Dawson gas for Juan Martinez, Linares, Spain.

THE ILLINOIS GLASS COMPANY has recently purchased an extensive electrical equipment from the Westinghouse Electric & Mfg. Co. This apparatus will be used for the operation of the machine, blacksmith and mold shops, blowers, etc., and includes a 250 k.w., two-phase, 440 volt, 60 cycle belted generator, twenty induction motors, thirty-eight transformers, and arc and incandescent lamps.

BROOKLYN BRIDGE MOVING SIDEWALK.—The New York Herald says that Cornelius Vanderbilt, Stuyvesant Fish, E. P. Ripley, Moses Taylor Pyne, S. S. Palmer and several other men prominent in the financial and railroad world are behind the scheme to put electric movable sidewalks on the bridge, and that the plan will be put in operation within a year.

SMITH & HEMENWAY CO., 296 Broadway, New York City, have bought out the entire business of Thomson Bros. & Co., manufacturers of the improved Seavey mitre box, the purchase including contracts, patents, good will, machinery, tools and plants; and will hereafter execute all orders for this device.

VALPARAISO, CHILE.—The municipality of the city of Valparaiso, Chile, invites tenders for the construction of an electric system and the supply of electric lighting. Bids will be received up to Sept. 1.

THE ELECTRICAL EQUIPMENT COMPANY, Chicago, has been awarded the contract for an addition to the Whiting (Ind.) Electric Light Company's plant.

SOME BUFFALO FORGE ORDERS.—The Buffalo Forge Company reports receipts, within the past few days, of a number of orders for induced draft plants, and engines for both foreign and domestic account. The American Trading Company has sent in an order for an induced draft plant for an electric light plant in Dutch Guiana. There will be a six-foot wheel, direct connected to a 6x6 inch vertical engine. O. B. Stillman, the sugar plant expert, of 80 William street, New York, has ordered five Buffalo engines for driving generators, etc., in the sugar factory to be built near Manzanillo, on the south side of Cuba, by the Cape Cruz Construction Company. Four of the engines are to be of vertical type, inclosed, for running in oil. Their dimensions are to be 10x12 inches. There will also be an 8x8 inch engine for operating pumping equipment. Domestic orders include one just secured from the Morse Iron Works of Fifty-eighth street, Brooklyn, for a 6x7 inch single vertical engine, to be direct connected to a Triumph generator. This outfit will be installed for electric lighting purposes on the oil steamer Patonia, now under construction for the Cuffy Oil Company. The Burnett Company has requisitioned, on behalf of the Consolidated Coal Company, Frostburg, Md., for a 6x6 inch vertical engine, to be direct connected to a 10 k.w. Sprague generator, for lighting use. The contracting firm of F. G. Blanchard, of 45 Willoughby street, Brooklyn, is to be furnished with a 9x16 x10 inch tandem compound engine, for direct connection to a 50 k.w. Fort Wayne generator. This equipment will be utilized for lighting purposes in the Ridgewood pumping station, Brooklyn. Mr. Blanchard has also ordered from the Buffalo people, for similar use, in the Millburn pumping station, Brooklyn, a 7x8 inch vertical engine, to be direct connected to a 17½ k.w. Fort Wayne generator.

MEAD CONVEYING MACHINERY ORDERS.—John A. Mead & Company, Bowling Green Building, has been awarded a contract for the supply of the necessary coal and ash conveying machinery to be installed in the Fisk street, South Chicago, station of the Commonwealth Electric Company. The Mead Company will in the first instance furnish a plant having a capacity of 75 tons per hour, to be run in connection with the first of the ten sections of the Babcock & Wilcox boiler equipment, which are to be ultimately installed on completion of the contract. The coal and ash conveying machinery will represent an expenditure of some $125,000. The Cleveland (O.) Electric Illuminating Company has ordered a Mead plant, to take care of 45 tons of material hourly. The Edison Electric Illuminating Company, Topeka, Kans., has also requisitioned for a coal and ash handling plant, having a capacity of 45 tons per hour. The Cincinnati (O.) Edison Company has sent a second order to the Mead people, which will increase the capacity of its existing coal and ash handling equipment from 45 tons to 90 tons per hour.

THE MOVEMENT IN COPPER.—Advices from Boston state that there is a belief in that city that the falling off in June exports of copper from the average of the previous five months marks the end of the abnormal outward movement of copper, which movement since Jan. 1 represented deliveries on old 11-cent contracts taken last December and early in January. The copper exports for June were but 12,500 tons, as compared with an average of 16,786 for the previous five months this year, a decline of 4,226 tons, or 25 per cent. Coupled with this falling off in exports is a production larger than ever before in the history of the industry. In conservative circles it is not believed that the home consumption of copper is sufficient to absorb without difficulty an increased production and the unshipped surplus. It is this situation which leads many copper people, including copper consumers, to move cautiously, believing that the statistical position of the metal favors lower rather than higher quotations.

INDIAN WATER POWER PLANT.—The British Indian house of Tata & Company, new Tontine Building, is desirous of securing data regarding water power plants, which their principal partner, Mr. J. N. Tata, of Bombay, one of the most influential and richest men in India, proposes to build, for the purpose of operating extensive iron and coal properties located in the Chanda district, Central Provinces. All the equipment will be of American manufacture and the expenditure will reach into the millions. Mr. Tata, who is now in London, will, according to present arrangement, arrive in the United States some time in September.

DE VEAU TELEPHONE APPARATUS.—The name of De Veau is well known in the telephone field, and there are many who will be interested to learn that Mr. A. S. De Veau, having severed his connection with Stanley & Patterson, is now devoting himself again exclusively to the manufacture of telephone apparatus. He has founded the De Veau Telephone Manufacturing Company, of which he is president, and has opened shops at 27 Rose street, where an up-to-date plant is producing telephone apparatus and material throughout the whole range. On August 15 he proposes to issue a complete catalogue.

THE JANDUS ELECTRIC COMPANY, of Cleveland, O., has been awarded the contract for furnishing 1,300 arc lamps for the complete equipment of the new store of R. H. Macy & Co., located on Herald Square, New York. This is one of the largest contracts, perhaps the largest, ever awarded for an isolated installation of arc lamps. The Jandus Company congratulates itself also that the contract, as made, calls for its most expensive lamps, viz.; the improved Jandus standard structure, which is more expensive than the ordinary lamp furnished by the company. Macy & Co. have used Jandus lamps for six or seven years past in their old store, and have evidently found them to be entirely satisfactory in service.

EQUIPMENT FOR BROOKLYN EDISON COMPANY.—The Brooklyn Edison Company's union station, at Sixty-sixth street, Brooklyn, is to be installed with a Buffalo force-draft plant, consisting of three steel-plate fans, with 10-foot wheels, each direct connected to a 10x12 inch Buffalo horizontal, centre-crank engine. The engines will be inclosed for running in oil. This outfit will take care of the 10.000-hp boiler equipment, which is being furnished by Thayer & Company, Incorporated, sales agents for the Cahall boilers, manufactured by the Aultman & Taylor Machinery Company.

SAULT STE. MARIE POWER.—In an official statement before the county board of supervisors, a representative of the Michigan Lake Superior Power Company, the Clergue syndicate, has stated that the company's plans includes the construction of many mammoth industries on this side of St. Mary's river. It was estimated that for this purpose 1,200 acres of land would be needed, and that the completion of the plants, practically all of which are to be operated by water power, would double the valuation of every acre of land in Chippewa county.

A LARGE TELEPHONE CONTRACT.—A competitive telephone test, over 400 miles of long-distance telephone lines, conducted by Wilbur H. Johnston, chief engineer of the Frontier Telephone Company, Buffalo, was recently held at Scranton, Pa. The result of this test was so satisfactory, it is stated, as to warrant the above company immediately placing an order with the Kellogg Switchboard & Supply Company for 6,000 telephones complete. The Kellogg transmitters have been tested on lines up to 1,500 miles, and found to be perfectly satisfactory.

POWER PLANT FOR COSTA RICA.—The Abangares Gold Fields Company, of Costa Rica, which concern, with Anglo-American capital, operates three mines in Central America, has placed contracts for the conversion of its present steam plant into a water-power plant. The initial electrical equipment will have a capacity of 300 hp, which, it is said, will be added to in the near future. The General Electric Company has been allotted the contract for the electrical apparatus. The Pelton Water Wheel Company has secured the water-wheel contract, as well as an order for 1½ miles of pipe.

WESTINGHOUSE ENGINES FOR AFRICAN COAL MINES.—The Indwe Coal & Land Company, of Cape Colony, South Africa, is to be furnished with two Westinghouse compound engines of 330-hp capacity, each for the purpose of driving an electric plant to work and light the company's extensive coal mines. The contract has just been awarded to Westinghouse, Church, Kerr & Company, by the South African commission house of Leaycraft & Company, 140 Pearl Street, N. Y.

LAWRENCE CENTRIFUGAL PUMP ORDERS.—The Lawrence Machine Company, 39-41 Cortlandt Street, N. Y., has secured a contract for a 4-inch centrifugal pump, to be direct connected to a Lawrence vertical engine for circulating purposes on a British man-of-war at Bermuda. The New Jersey Hot Water Heating Company, Atlantic City, has requisitioned for a 12-inch centrifugal pumping equipment of 7,000 gallons per minute, to be direct connected to a 150 h.-p. Lawrence vertical engine.

BALL ENGINE ORDERS.—The electric power plant of the new United States Steel Corporation, at Duluth, Minn., will consist of a 75-kw Westinghouse generator, direct connected to a tandem compound engine, built by the Ball Engine Co., Erie, Pa. An electric plant will soon be installed in the Deaf and Dumb Asylum, at Austin, Texas. The unit to consist of a Ball tandem compound engine, built by the Ball Engine Co., direct connected to a Westinghouse 90-kw alternator.

HOTEL TELEPHONE SERVICE.—The new St. Regis, Fifth avenue and Fifty-fifth street, and the Marie Antoinette, have been added to the list of New York hotels having long distance telephone service in every room. Contracts have been signed for 350 stations at the St. Regis and for 300 stations at the Marie Antoinette.

General News.

THE TELEPHONE.

WILMINGTON, DEL.—The [illegible] Telephone and Telegraph Company has been incorporated with a capital of [illegible]. Incorporators: Josiah Marvel, Andrew Marvel and Ralph C. Lupton, all of Wilmington, Del.

WILMINGTON, DEL.—The Western Telephone and Telegraph Company, Wilmington, Del., has been incorporated; capital $500,000. Incorporators: Josiah Marvel, Andrew Marvel and Ralph C. Lupton, all of Wilmington, Del.

AUGUSTA, GA.—The Bell Telephone Company has decided to install entirely new equipment. A modern supervisory common-battery switchboard will be installed.

AUGUSTA, GA.—Another step in the telephone war in Augusta is a petition of the Bell Company to be permitted at once to place its wires underground. An ordinance was passed some time ago requiring that all wires be placed underground within ten years.

MASON CITY, ILL.—A rural mutual telephone company will be organized in this place.

FLANAGAN, ILL.—The Flanagan & Dana Telephone Company, which was incorporated last March, is using Stromberg-Carlson and American Electric apparatus. The exchange was started in July last year and has 50 subscribers.

ATWOOD, ILL.—The Atwood Mutual Telephone Company, which was incorporated last April, is using Stromberg-Carlson apparatus. The shares are $40 apiece, each shareholder contributing 20 cents per month for the maintainence of the exchange.

WINCHESTER, IND.—The Eastern Indiana Telephone Company has increased its capital stock from $5,000 to $15,000. Many improvements will be made to take care of increasing business.

RISING SUN, IND.—The Ohio River Telephone Company is operating exchanges at Vevay and Rising Sun, the total number of subscribers being 325. The company is also operating 150 miles of toll lines. Both exchanges are full metallic. The company now contemplates building some new lines. It has 100 new subscribers waiting for connection.

ELDON, IA.—The Eldon Independent Telephone Company has been incorporated with a capital stock of $25,000.

MITCHELLVILLE, IA.—The Mitchellville Telephone Company, capital stock $10,000, has been incorporated by J. B. Uhl, B. R. Patterson and S. J. Oldfield.

MAYKING, KY.—Citizens of Cornettsville have organized a telephone company to build a line to Hazard.

FRANKFORT, KY.—The Cynthiana Telephone Company has increased its capital stock from $30,000 to $40,000.

NICHOLASVILLE, KY.—The Jasamine County Home Telephone Company has been formed with a capital stock of $50,000.

LEXINGTON, KY.—Desha Breckenridge, president of the Lexington Home Telephone Company, is interested in two new independent companies proposing to build exchanges at Paris and Nicholasville, Ky. The companies were incorporated under Delaware laws by Kentucky capitalists.

BOYDS, MD.—The Boyds Telephone Company has been merged with a new company to be known as the Cumberland Valley Telephone Company. The merger with the Maryland Telephone Company, of Baltimore, the Westminster Company and the Western Maryland is now complete.

HARRISONVILLE, MO.—The Cass County Telephone Company, of Harrisonville, has increased its capital stock from $2,000 to $20,000.

MEXICO, MO.—R. V. Montague and other gentlemen from Kansas City have purchased the Mexico Telephone system and are going to extend the lines throughout this section of the state. It is said that $10,000 will be spent in improvements.

BEATRICE, NEB.—The Nebraska Telephone Company has planned to build a new exchange which will cost about $6,000.

CAZENOVIA, N. Y.—The Cazenovia Telephone Company has been incorporated with $1,000 capital. Directors: H. Burden, Jr., J. A. Boyster and M. R. [illegible].

WILMINGTON, N. C.—The Southern Bell Telephone Company will lease a [illegible] new building soon to be erected as an exchange. Fifty thousand dollars will be expended in rebuilding the local exchange. The long distance line has been completed for a distance of fifty miles.

MANDAN, N. D.—The Mandan Telephone Company, which was organized early this year, is building [illegible] miles of new line. It is using Eureka apparatus, the switchboard having a capacity of [illegible] drops.

ANTWERP, OHIO.—The Antwerp Telephone Company has increased its capital stock from [illegible] to [illegible].

GALION, OHIO.—The Galion Telephone Company is making many improvements. The company has orders for over [illegible] new telephones.

LA RUE, OHIO.—The Marion County Telephone Company has brought suit in the probate court to compel the council at La Rue to grant it a franchise.

BOWLING GREEN, OHIO.—The Bowling Green Telephone Company has announced a flat rate of [illegible] cents for all toll business throughout the entire county.

CHILLICOTHE, OHIO.—The Chillicothe Home Telephone Company has converted [illegible] of its common stock in preferred stock. The company is making improvements.

CINCINNATI, OHIO.—The City & Suburban Telephone Association is preparing to erect a branch exchange at Cumminsville. The switchboard will have a capacity of [illegible] lines.

TOLEDO, OHIO.—The Central Union Telephone Company has secured permission to extend its underground district throughout a considerable portion of the business section of the city.

NEWARK, OHIO.—The Newark Home Telephone Company is making preparations to rebuild its entire system and install first-class central energy equipment. Plans for the system are being prepared.

BERGHOLTZ, OHIO.—The Bergholtz Telephone Company has been incorporated with $5,000 capital stock by Lewis Steinmetz, J. W. Carlson, A. G. McBane, James McBane and W. E. Steinmetz.

CHARDON, OHIO.—The Chardon Telephone Company has increased its capital stock from $10,000 to $25,000 to provide for improvements. Orange Pomeroy is president and W. C. Parsons, secretary.

MANCHESTER, OHIO.—The Manchester Telephone Company is preparing to build several miles of farmers' lines on both sides of the Ohio River. Mr. R. C. Henderson is secretary and treasurer of the company.

TROY, OHIO.—The Troy Telephone Company is enjoying prosperous business. About fifty instruments were placed during June and an equal number during both April and May. The company's list is now close to the thousand mark.

MONTPELIER, OHIO.—The Montpelier Telephone Company has purchased from the Williams County Toll Line Company a line from Angier to Bocks Corners. This gives the home company direct connection with Angier and Bridgewater.

CLEVELAND, OHIO.—The directors of the United States Telephone Company have voted favorably on the proposition to increase the company's capital stock by an issue of preferred stock. The additional stock will be subscribed for by the various independent companies identified with the United States Company.

MARION, OHIO.—The Marion County Telephone Co. has completed arrangements with the Morrow County Telephone Company and the Logan County Telephone Company whereby both systems will be connected with the Marion County system. The Marion company is making rapid progress and expects to commence business in the near future with 1,000 subscribers.

WAKEMAN, OHIO.—The Wakeman Mutual Telephone Company has sold out to the Local Telephone Company of Norwalk. The latter company is headed by F. J. Lanning, who has been buying up a number of independent properties in northern Ohio. The system will be improved and long distance connection afforded through the lines of the United States Telephone Company.

HAMILTON, OHIO.—The Hamilton Home Telephone Company has placed a contract with the Northern Construction Company for the construction of its new exchange. The company will start with about 750 telephones, contracts for almost that number having already been closed. Rates are $2.50 for business, $1.50 for residence and from $1 to $1.50 per month for farmers' lines.

PORTSMOUTH, OHIO.—Judge James M. Thomas, of Cleveland, has purchased practically all of the stock of the Portsmouth Home Telephone Company, heretofore controlled by the Federal Telephone Company. He was in Portsmouth recently to arrange to reorganize the company on local lines; local people to take a large portion of the stock. If the deal is effected, it is the intention to make many necessary improvements and to extend the toll lines throughout the surrounding country.

NORWALK, OHIO.—The stock of the Huron County Telephone Company and the Attica Telephone Company has been transferred to the new Local Telephone Company which was formed a short time ago to absorb a number of exchanges in this section. The new company is now one of the largest in the independent field. It owns exchanges at Norwalk, Milan, Berlin Heights, New London, Monroeville, Chicago Junction, Plymouth, Attica, Galion and other towns, besides many miles of toll line.

CLEVELAND, OHIO.—The May statement of the United States Long Distance Telephone Company shows gross earnings $24,291, operating expenses $12,849, net earnings $11,643, interest $7,771, surplus $3,872. For the same month in 1901 the figures were $11,926, $7,287, $4,639, $4,166 and $472 respectively. It is figured that on the above basis the company will have a surplus this year of over $30,000 after paying all fixed charges and the interest on $200,000 preferred stock which it is proposed to issue.

CHARLESTON, S. C.—The council has voted that the Bell Telephone Company shall place all wires underground.

LANCASTER, S. C.—The Lancaster Telephone Company, capitalized at $5,000, has been formed. W. B. Moore is president and J. T. Thomasson vice-president.

GREENVILLE, S. C.—The Home Telephone Company has been sold out to L. W. Floyd, of Newberry, for [illegible]. The plant was sold to satisfy a mortgage of [illegible].

KERSHAW, S. C.—The Kershaw Telephone Company, capital $5,000, has been incorporated. W. B. Moore is president, S. W. Heat, vice-president, and J. T. Stevens, secretary and treasurer.

COLUMBIA, S. C.—L. W. Floyd, of Newberry, by recent purchases now owns exchanges in fifteen towns and cities of the State. Mr. Floyd intends now to connect all these exchanges together and also with Columbia.

COLUMBIA, S. C.—The Blacksburg Telephone Company, capital $3,000, the Bedford Telephone Company of Yorkville, S. C., capital $5,000, and the Lancaster Telephone Company, capital $5,000, have been chartered. W. B. Moore is interested in each of these enterprises.

McMINNVILLE, TENN.—The Warren County Telephone Company has been incorporated; capital stock, $12,500. Incorporators: W. S. Ross, J. C. Biles, J. B. Biles and others.

NASHVILLE, TENN.—The Cumberland Telephone and Telegraph Company will establish a large cresote plant in Nashville to treat its poles, on account of scarcity of cedar poles.

EUREKA, TEX.—The Eureka Telephone Company has been incorporated: capital stock, $4,000. Incorporators: J. A. Bonner, J. R. McCormick, R. Goree and others.

PAMPLIN CITY, VA.—Telephone communication has been established with Madisonville. The line will be completed to Red House.

CLOVERMONT, VA.—The Clovermont Telephone Company has been chartered to build a line to Surry Court House, Waverly and Petersburg, capital $1,000 to $5,000. Geo. H. Woods is president.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Standard Electric Company, of California, has made a survey of a new eight-mile power line from the Electra power station to Sutter Creek. The plant has been operating with scarcely any interruption for some weeks to within a few miles of San Francisco. The San Francisco sub-station will probably be started up within two weeks. The Pacific Power Company's underground system will be used for distribution, but will have to be reconstructed. Three storage batteries will be installed in San Francisco.

CRIPPLE CREEK, COL., has granted two franchises to electric companies; the Colorado Electric Power Company and the People's Electric Light Company. These two companies have agreed to pay 2 per cent. of their gross receipts into the city treasury.

DENVER, COL.—J. R. De Remer, of Glenwood Springs, Col., has taken up water rights at Shoshone Falls. It is estimated that 20,000 horse power can be derived from the fall of 850 cubic feet of water per second. The new company when formed, will furnish electric light and power for all towns between Red Cliff and Grand Junction. Mr. De Remer has associated with him C. W. Darrow, B. T. Napier, T. E. Ryan and H. J. Holmes.

McRAE, GA.—An election has been carried for bonding the town for water and electric lights.

HARTWELL, GA.—The town will erect water and electric lighting plants. It is probable that municipal bonds will be issued.

ATWOOD, ILL.—A domestic electric lighting plant in this town would no doubt prove to be a paying investment, and an electric railway would also prove equally profitable.

RISING SUN, IND.—There is no electric light plant in this place, which seems to offer a good field for such an enterprise.

BOONVILLE, IND.—A suit has been brought to set aside a franchise and contract for fifty years granted to the Boonville Electric Light & Power Company. A franchise has been granted to a new light and heat company and it will furnish cheaper light.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company, of this city, has incorporated with $150,000 capital stock. F. M. Ayers heads the board of directors. The franchise offered by the board of public works provides for a rate of 10 cents per kilowatt for incandescent electric lighting.

HARTFORD CITY, IND.—The city council has repealed the franchise of the Hartford City Lighting Company. The city has also repudiated the proposition to sell the plant to the city. The council now threatens to remove the company's poles and wires from the streets. As yet the company has not made a move in the matter, but it is understood that it will attempt to hold the city to the contract for 120 lights at the rate of $80 per light per year for ten years. Citizens have subscribed a fund to pay for litigation in the matter.

BURNSIDE, KY.—The Burnside Electric Light & Power Company is in the market for supplies, including wire and fixtures. This company operates two Bullock direct-current generators and has a small power load. Mr. R. McCracken is treasurer and general manager.

DIAMOND, LA.—A new electric light plant for the inspection of ships has been completed by the Safety Electric Company and delivered to Dr. Thomas.

DETROIT, MICH.—The Detroit United Railway has offered to lease its poles to the city for lighting purposes at the rate of $1 each per year.

ST. LOUIS, MO.—The first carload of porcelain electrical appliances shipped to the World's Fair site by the Commercial Electrical Supply Company arrived July 7. This is the first of eleven carloads which will be needed to equip the lighting lines of the Exposition. Chief Electrical Engineer Rustin states that 1,492,250 wiring knobs will be required.

ALBEMARLE, N. M.—The Gold Road mine at Albemarle will build a large power plant to furnish power to its own mine and others.

PLATTE, N. D.—An electric light plant in this place would fill a want, as there is none here.

MANCHESTER, OHIO.—There is an opening in this town for an electric light plant.

NEW LONDON, OHIO.—Citizens have voted to issue $2,000 bonds to improve the lighting plant.

DELAWARE, OHIO.—The Delaware Gas Company has amended its charter to enable it to furnish electricity as well as gas. It is the intention to install an electrical plant.

HUBBARD, OHIO.—The electric light committee of the council has been instructed to proceed with the work of rebuilding the lighting plant which was destroyed by fire some time ago.

NORTH AMHERST, OHIO.—The village council is procuring estimates as to the cost of a municipal lighting plant and the work of constructing the same will commence as soon as possible.

BOWLING GREEN, OHIO.—The county commissioners have passed a resolution deciding to build a lighting plant in this place, with sufficient capacity to heat and light all the county buildings.

NEW BREMEN, OHIO.—The village council has called an election to decide on the question of issuing bonds to the amount of $50,000 for a municipal lighting and water works plant.

COLUMBUS, OHIO.—Bids will be advertised for improvements to the electric lighting and heating systems at the state institution for the blind. Stribling & Lum, architects, have prepared plans.

SANDUSKY, OHIO.—The plant of the Sandusky Electric Light Company was damaged by lightning a few days ago. The town was dark for several days and a number of manufacturing establishments using electric power were tied up.

CLEVELAND, OHIO.—A company headed by B. P. Foster has applied to the council for a franchise to lay pipes for supplying hot water, heat and electricity for power purposes. The promoter claims the company will furnish electricity much cheaper than the existing company.

EL RENO, OKLA.—The El Reno Light and Power Company was organized January last and purchased the old plant, which is being entirely rebuilt on new lines. Two Bullock two-phase, 60-cycle alternators constitute the new generating equipment. The new system is modern throughout, and it is thought by the managers that this plant is a model one. Mr. Henry Larsen is president, J. A. Masters secretary and manager, and C. M. Jackman, treasurer.

YORK, PA.—An ordinance will be presented to the councils of this city recommending the installation of a new city electric light and power plant. After consideration several of the councilmen have come to the conclusion that it would be cheaper for the city to own a plant than to pay rent at the rate of $24,000 per annum for street lighting alone. A "careful estimate" by some of the councilmen, it is stated, shows that a new plant could be installed at a cost not to exceed $50,000.

CAMDEN, S. C.—The Carbon Light and Power Company, chartered in New Jersey with $40,000 stock, has applied for permission to do business in South Carolina with headquarters at Camden.

SALT LAKE CITY, UTAH.—The Salt Lake office of the General Electric Company has closed a contract with an Idaho Falls corporation for a lighting plant of 2,000 incandescent lamps capacity, including a 100-kw power generator.

OTTAWA, ONT.—The Trenton Electric Company, of Trenton, Ont., will develop 600 additional horse power and will build a second transmission line to Belleville, Ont.

OTTAWA, ONT.—The town council of Cookshire, Que., has decided to purchase the water power on the St. Francis river and to establish an electric light and power plant. The town council of Sherbrooke, Que., also contemplates the purchase of a water power with a view to establishing an electric light system of its own.

OTTAWA, ONT.—The extensive works of the Ottawa & Hull Power Company, in Hull, Que., which have been in progress for the past eighteen months, are expected to be completed within the next three months. When the present work is finished, the company will be in a position to furnish 12,500 hp of electric energy. The company will, in time, further develop its property to about 35,000 hp. Over half a million dollars have already been expended on the works, which will cost upwards of $1,000,000 before final completion. Over 240,000 cubic feet of solid rock have been excavated for the reservoir. The dynamos will be direct-connected to the turbines. Five dynamos of 2,500-hp each will be installed.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The directors of the Birmingham Railway, Light and Power Company have declared a semi-annual dividend of three per cent. on the preferred stock.

JACKSONVILLE, FLA.—The street railway interests of Jacksonville have passed into the hands of Stone and Webster, of Boston, who already control a number of similar holdings in the South. It is stated that the new owners expect to spend $150,000 in the next twelve or sixteen months improving the Jacksonville lines and terminals.

MACON, GA.—It is reported that the Railway and Light Company of America is negotiating for the power plants of Macon. J. W. Middendorf, of Baltimore, is president of the company proposing to purchase.

WEBSTER, MASS.—Dispatches from Webster, Mass., state that four street railways, aggregating sixty miles, are to be consolidated as the Worcester and Connecticut Eastern Railway, controlled by New York parties.

DETROIT, MICH.—The Detroit United Railway is now operating a special observation car which makes a two-hour trip over the city and suburban lines A well-informed attendant accompanies the car for the purpose of pointing out places of interest. The fare for the trip is 25 cents.

MERIDIAN, MISS.—The Meridian Light and Railway Company has increased its capital stock to $450,000.

JAMESTOWN, N Y.—The Warren and Jamestown Electric Railway Company has filed papers of incorporation with the Clerk of Chautauqua County. The company is capitalized at $100,000, and will build an electric railway from Warren, Pa., to Jamestown.

YOUNGSTOWN, OHIO.—The Mahoning Valley Railway Company has applied for a franchise to make some extensions in town.

CANAL DOVER, OHIO.—The council has granted a franchise to the Akron-Canton Railway Company for its extension to New Philadelphia.

FREMONT, OHIO.—A H. Jackson, a wealthy manufacturer of this city, is at the head of a new project to build a line from Fremont to Sandusky.

YOUNGSTOWN, OHIO.—The Pennsylvania & Mahoning Valley Railway Company has voluntarily increased the wages of motormen and conductors on several divisions.

YOUNGSTOWN, OHIO.—It is announced that the Youngstown-Sharon Railway & Light Company is earning at the rate of $100,000 a year compared with $79,000 last year.

YOUNGSTOWN, OHIO.—The Pennslyvania & Mahoning Valley Railway Company will probably build a new line from Youngstown along the south side of the river to Struthers.

MARIETTA, OHIO.—The power house and car barns of the Parkersburg & Interurban Street Railway Company were badly damaged by a tornado a few days ago. Several cars in the car house were demolished.

KINSMAN, OHIO.—Citizens of Orangeville, Gustavus and Kinsman are raising a fund to secure an extension of the Eastern Ohio Traction Company's road through these points. The road now extends to Chardon and Garrettsville.

CLEVELAND, OHIO.—As the result of lightning the power house of the Cleveland, Painesville & Eastern Railway, at Willoughby, was disabled for several days recently. One of the large generators burned and an engine was disabled.

YOUNGSTOWN, OHIO.—The Youngstown & Southern Railway Company has been organized by A. W. Jones, J. H. Ruhlman and W. S. Andrews, of Youngstown, and R. L. Andrews, of Cleveland. The road will be 38 miles long, extending from Youngstown to East Liverpool.

CLEVELAND, OHIO.—The Pomeroy-Mandelbaum syndicate has decided to push to completion the Cleveland & Southern Railway which is now in operation from Cleveland to Medina. As soon as possible it will be extended to Chippewa Lake and then to Seville, a distance of ten miles from Medina.

COLUMBUS, OHIO.—The Columbus, Newark & Zanesville Electric Railway Company has been incorporated with $1,500,000 capital stock by J. R. Harrigan, A. C. Ralph, C. A. Alderman, H. A. Fisher and J. A. Godown. The company proposes to build a road from Newark to Zanesville.

NORWALK, OHIO.—The city council has declared forfeited the franchise granted some time ago to the Sandusky, Monroeville, Bellevue & Norwalk Railway and has ordered the company to remove its property from the street and repair the street. The road has been partially completed but inactive for many months.

CLEVELAND, OHIO.—The two Cleveland street railway companies have agreed to permit a committee appointed by the United Trades and Labor Council to inspect their books and ascertain exactly what it costs to operate the road and carry a passenger. The railway officinls claim this is the first time they have ever been approached by a non-partisan committee looking for facts.

YOUNGSTOWN, OHIO.—At the annual meeting of the Youngstown, Park & Falls Electric Railway Company officers were chosen as follows: C. S. Grier, president; Joseph Hastings, vice-president; C. W. Dahlinger, secretary-treasurer. Samuel C. Grier, Joseph Hastings, J. R. Murphy, Robert McAfee, of Allegheny, C. W. Dahlinger, of Pittsburg, and Harry G. Hamilton and W. H. Park, of Youngstown, are directors. The semi-annual dividend of three per cent. was declared.

NEW INDUSTRIAL COMPANIES

THE NEW ENGLAND ELECTRIC MUSIC CO., of Jersey City, has been incorporated; capital, $200,000. Incorporators: Ernest P. Hoes, Wm. M. Fischer and K. K. McLaren.

G. B. W. ELECTRIC SPECIALTY CO. has been formed in New York by Josef Veit and C. F. Lewis, of New York City, and L. C. Scrymser, of Brooklyn, with a capital stock of $[illegible].

J. D. JEWETT CO. has been formed at Boston, Mass., with $30,000 capital, to succeed J. D. Jewett & Co. In the new concern Mr. J. D. Jewett is president and Howard E. Whiting treasurer.

THE DE VEAU TELEPHONE MANUFACTURING COMPANY, of New York, has been incorporated; capital, $50,000. Directors: A. S. De Veau, Wilson Hoffman, New York; Charles Aertl, Brooklyn.

THE ELECTRIC METAL SEPARATING COMPANY of Paterson N. J. has been incorporated to refine scrap metals, etc.; capital, $150,000. Incorporators: Samuel Roden, Wm. Jacobus and John Unger.

THE KENTON CONSTRUCTION COMPANY, Kenton, O., capitalized at $10,000, has been organized by J. Timmons, J. W. Fulton, J. B. Seymour, James Reynolds, J. D. Rice and others, to construct telephone plants.

THE DIAMOND ELECTRIC MACHINERY COMPANY, of St. Louis, has been incorporated with a capital stock of $[illegible]. The incorporators are Charles Lindenberger, Harry Lindenberger, Houston Jones, Alexander M. Dowell and others.

QUINCY ELECTRIC DRILL CO. has been formed under the laws of New Jersey to make electric drills with a capital of $[illegible]. The incorporators are G. F. [illegible], of [illegible], R. M. Farnes, of Jersey City and H. L. Keves of Hackensack, N. J.

THE LENOIR ELECTRIC COMPANY, Lenoir, N. C., has been chartered, with a capital of $[illegible], to deal in electrical machinery, construct telephone lines, power plants, etc. G. L. Benhardt, G. W. F. Harper and L. M. Parks are the incorporators.

LEGAL.

AUTOMATIC LUBRICATION.—The Circuit Court of the United States for the Western Division of the Eastern Circuit of Missouri handed down an opinion [illegible] in a suit for the infringement of a patent granted April 1, 1890, to Chas. R. Meston for an improvement in lubricated bearings, designed specially for use in connection with electric ceiling fan motors. The court defines the essential features of the invention as follows: The method of operation is to supply a lower oil cup, which is integral with the hub, with oil sufficient to submerge the lower bearings of the hub and the lower end of a spiral groove, which forms a continuous channel in the interior bearing around the shaft from the lower or central portion of the oil cup, extending upwardly to the reservoir at the top of the hub. When the fan is put in motion the oil is forced by the centrifugal action of the rotary cup, up the channel on the principle of an archimedean screw, lubricating the shaft as it enters, and any superfluity finds its way into the upper reservoir. When the fan is stopped the oil by gravity falls back through the channel into the lower oil cup ready for repeated service when the fan is again started. To avoid friction the lower end of the revolving head rests upon a ball bearing consisting of a series of hardened steel balls, which travel or rest upon an annular shaped track placed in the bottom of the oil cup. The contention of the defendent was that Meston was not the original and first inventor of the device. The opinion states that though it be conceded that the elements were all old, this is of no consequence provided the application as found in the claims is new and original and produces a new and useful result. After discussing in detail all the points brought forward by the defendant and analyzing the testimony given, the court decides that each of the four claims in suit covering the invention are valid, and a decree was ordered to be entered for the complainant.

OBITUARY.

MR. F. B. THOMAS.—We regret to note the death of Mr. Frank B. Thomas, assistant manager of the Waldorf-Astoria Hotel, from typhoid fever, at his summer home, Bensonhurst, Long Island. He was only 33 years of age, and leaves a widow and two children. Mr. Thomas was known to a large number of electrical people and was interested in one or two electrical enterprises.

PERSONAL.

MR. FRANK J. GOULD will, it is reported, spend $2,000,000 in improvements on the trolley system of Richmond, Va.

PRESIDENT HOOD, of the Western Maryland Railroad Company, has been made president of the United Electric Light & Power Company of Baltimore.

MR. M. D. MAZENET, managing director of the Mexican General Electric Company is now on a visit to the United States. He will be in this country for about three weeks.

COL. R. G. MONROE, a well known leader in political reform movements in New York, has succeeded Mr. J. H. Dougherty as Commissioner of Water Supply, Gas and Electricity.

MR. EDMUND R. CROSS, of the Westinghouse Electric & Manufacturing Company, has just returned to Pittsburg after a vacation trip to his home in Huntington, Mass., and to Boston.

MR. L. B. SHEPHERD, of the City of Mexico and Monterey, it is reported, will build a power plant at Montemorelos. An electric traction system, 23 miles in length, is also proposed.

MR EUGENE HOLCOMB, formerly lessee and general manager of the Capital Electric Company, sailed for London on July 4 on his way to Buenos Ayres. He will represent Westinghouse interests in the Argentine Republic.

MR. WM. STANLEY, JR., went abroad immediately after the Great Barrington meeting of the American Institute of Electrical Engineers, in which he took so prominent and active a part. He is said to be now on the Continent.

MR. C. J. H. WOODBURY has a very interesting article on "The Telephone System" in the *Lynn Business Magazine* for June, in which he discusses the invention, the apparatus, the operation and miscellaneous applications of the telephone.

MR. R. PFUND, electrical engineer, has arrived on the Pacific Coast to install a wireless telegraph system for the U. S. Signal Service in Alaska, between Fort Gibbons on the Yukon River and Bates Rapids Fort, on the Tanaua River, a distance of 195 miles.

MR. RUDYARD KIPLING.—The latest thing in science always interests Rudyard Kipling. His new story in the Fiction Number of *Scribner's* for August, has for its setting a house on the coast of England where Marconi experiments are taking place on a cold winter night, and they are listening to the battleships of England talking back and forth through the air along the Channel.

BINGHAM-STEVENS.—Mr. W. Briston Bingham, of the direct-current engineering department of the General Electric Company, was recently married in Schenectady, N. Y., to Miss Bertha A. Stevens of that city. Mr. Bingham is a '98 graduate of the Worcester Polytechnic Institute and has been ever since identified with the General Electric Company in the testing, drafting and engineering departments. Mr. and Mrs. Bingham returned, June 30, from a trip to Provincetown and Boston, where they renewed acquaintance with friends.

MARTIN-KANE. The wedding occurred at Bluehill, Ellsworth, Me., of Miss Lillian May Kane, daughter of Capt. John W. Kane, to Mr. Fred L. Martin, formerly of Hancock Point, but now in charge of the publication bureaus of the Kellogg Switchboard & Supply Co., of Chicago. The church was filled with guests and friends, and the ushers were six young women, companions of the bride. A large number of handsome presents were given to the happy pair, who have since been spending their honeymoon in Maine before returning to Chicago to make their home in that city. Mr. Martin has been doing excellent work in the West, and some of the booklets and pamphlets prepared by him are very valuable and interesting.

MR. T. J. LEE, the general passenger agent for the Lackawanna Railroad, is a firm believer in the telephone for railroad purposes, and he says: "It will not be very long before we will have a telephone at about every place we now have the telegraph. It will take time, of course, to get the entire system up to that stage, but it's coming. The Lackawanna recently established a tourists' bureau and I think that telephone scheme is about the whole thing in it. As for the time tables and the circulars and telling when the 8 o'clock train leaves, why, that part's easy; they all can have that kind. But the way I've got it fixed is immensely better. In comes a fellow and says he's going to the Pdq House for a week with his family. 'How much is the board there?' he asks. He is told and also the other usual small things he wants to know. And then in comes the telephone. Our friend says when he's going and the hotel proprietor is told at just what train to have his team to meet him. And the arrangements for room reservation are also made. It's great; everything is fixed before he starts."

Trade Notes.

SECOND-HAND MACHINE TOOLS.—List No. 25 of second-hand machine tools has just been issued by the Garvin Machine Company, New York. The list covers 12 closely printed pages and includes about everything coming under the head of this general subject.

THE WELLMAN-SEAVER-MORGAN ENGINEERING COMPANY, of Cleveland, is developing plans to erect two more foundries in addition to the large foundry building nearly completed. The company will also build a large office building adjoining the new plant.

THE LIBBY GLASS COMPANY, of Toledo, Ohio, is erecting two additions to its plant; also two new furnaces. The manufacture of electric light bulbs is becoming a very important feature of this company's business and the new plant will be used largely for this work.

CROSS OIL FILTERS.—The Burt Manufacturing Company, of Akron, Ohio, announces that it has just furnished two very large Cross oil filters to the U. S. Steel Corporation for its works at Youngstown, Ohio, making 108 of these filters now in use by this company.

STORAGE BATTERY LOCOMOTIVES.—The C. W. Hunt Company, West New Brighton, Staten Island, New York, is sending out a card containing illustrations of its storage battery electric locomotives and some text matter pointing out the principal features of these machines.

THE YOST-MILLER COMPANY, Toledo, Ohio, now capitalized at $40,000, will increase its capital stock to $75,000. Among other articles the company manufactures incandescent lamp sockets and at present it has orders on hand for over 100,000 of them, necessitating an increase of facilities.

THE NEW EAST RIVER BRIDGE, between Manhattan and Brooklyn Boroughs, has its wires and cables coated with a mixture of Acheson graphite and slushing oil as a thorough preventive against rust and corrosion. There are four cables containing all told 30,784 wires, weighing 5,000 tons.

THE E. G. BERNARD CO., of Troy, N. Y., has been awarded the contract, at $6,000, for installing a lighting and power plant in the United States government armory at Springfield, Mass. Though the Troy company was not the lowest bidder, it received the contract through the fact that it successfully installed a $30,000 plant in the Watervliet arsenal.

FOUNTAIN MFG. CO. has removed its general offices and salesroom from 97 Bank Street, New York City, to 15 Cortlandt Street, where all communications should be addressed. It will retain as its stock room its present Bank Street quarters, where it will carry a complete supply of junction, outlet and panel board boxes for the benefit of the local trade.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is taking particular pride just now in its "multiple burning" sign lamp. This is very effective for advertising and decorative purposes, and is unsurpassed in window displays. This lamp is being sold quite extensively at present for sign work in connection with street fairs and expositions. As it is a product of the Packard factory it goes without question that it is just the thing for the purpose.

RENOLD SILENT CHAIN is the subject of a very dainty little pamphlet just issued by the Link-Belt Engineering Company, of Nicetown, Philadelphia. It is devoted to an illustrated description of the Reynold silent chain gear which has been brought out of late with so much eclat, and of whose good work there is abundant report. Several applications are shown. Due notice of this chain has been made already in these columns, as its eminent applicability to dynamo and motor drive is obvious.

PUMPING MACHINERY.—The Stilwell-Bierce & Smith-Vaile Company Dayton, Ohio, has just brought out a very complete catalogue of its pumping machinery. The catalogue contains 176 pages and is illustrated with views of general types of pumps. The illustrations are all half-tone and executed in a very artistic manner. Many of the pumps shown are electrically driven by single reduction gear. In addition to the trade features of the catalogue there is some useful engineering information.

THE TESLA LABORATORY.—The pipes in the plant of the Tesla Laboratory, Warden Clyffe, Long Island, N. Y., were recently covered by the H. W. Johns-Manville Company. Mr. Tesla writes: "I have watched this work with interest and am well satisfied with the manner in which it has been done." The covering used in this instance is the well known Asbestos-Sponge felted sectional pipe covering constructed of fibres of asbestos and a small quantity of granulated sponge, the result being an excellent insulator.

THE STANDARD VITRIFIED CONDUIT CO. is the name of a new concern recently formed to handle vitrified salt-glazed underground conduits and insulators, with general offices at 39 Cortlandt St., New York. Mr. R. W. Lyle is president and manager and Mr. B. S. Barnard, vice-president and secretary. Both of these gentlemen were formerly with the American Vitrified Conduit Co. Mr. Barnard, whose friends are legion and without whom an electrical convention would be without its most scintillant light, will attend to the sales end of the business.

THE STERLING ELECTRIC MANUFACTURING COMPANY, Warren, Ohio, has broken ground for a new building which will be as large as its present establishment. When it is completed it is stated the company will have a capacity of 10,000 lamps per day. The company is going to considerable trouble and expense to educate its employees and make them more efficient. A class has been organized which meets regularly and a thorough electrical course, in charge of a competent teacher, has been mapped out for employees who care to make an endeavor to advance.

SWITCHES.—S. K. C. Bulletin No. 127, headed "Switches," 32 pages, of the Stanley Electric Manufacturing Company, is ready for distribution. Besides the well-known type of S. K. C. slide switches, carbon break switches, etc., many specialties are included, among which are a combined oil switch and circuit breaker for great capacities at high voltage and a line of knife switches, the blades of which are made up of units, providing a range in capacity from 50 to 3,000 amperes, single or double throw, with or without fuses and with or without quick break.

DIRECT-CONNECTED GENERATORS.—The Fort Wayne Electric Works, Fort Wayne, Ind., in Bulletin No. 1024, describe and illustrate their type M. R. L. 10—400—120 direct-current generator with vertical split frame. These machines are designed for supplying power and lighting circuits, not only in large central stations, but also in small isolated plants where space is valuable. Special attention is called to the brush holder. The carbon brushes are held in radial position in one long narrow brass box so arranged that the pressure of any brush on the commutator can be adjusted without in any way disturbing the other brushes or changing their adjustment. The illustrations show very clearly the construction of the generator. Diagrams and accompanying tables give the general dimensions of the machines.

WESTINGHOUSE, CHURCH, KERR & COMPANY announce the removal of their Pittsburg office from its former location on the first floor of the Westinghouse Building to more commodious quarters on the eighth floor of the same building. This change is the direct outcome of largely increased business in this district, and is accompanied by the acquirement of a commodious reception room devoted exclusively to the convenience and entertainment of visitors and patrons. The object of the management in making the change is to be able to accommodate more thoroughly and promptly the wishes and needs of their patrons. They are prepared to give immediate attention to all classes of general engineering and construction work as applied to power and its uses in transportation and industry. They will provide in all cases from their engineering force adequate personal supervision of work in hand, both during construction and subsequent thereto, and the increased facilities afforded by their new quarters will enable them to fulfill the most extensive contracts. The official address is: Westinghouse, Church, Kerr & Co., Westinghouse Building, Pittsburg, Pa.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 8, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

703,980. COMBINED SWITCH AND LIGHTNING ARRESTER; W. J. Bell, Baraboo, Wis. App. filed March 26, 1902. A movable switch arm which opens and closes the main telephone circuit, and plays across the face of a carbon block so that regardless of whether the switch be open or closed, it will carry a lightning charge to ground through the block.

703,984. SUPPORTING DEVICE FOR ELECTRIC LAMPS; W. F. Brewster, New York, N. Y. App. filed Dec. 19, 1901. The lamp sockets are mounted upon a chain of links so that their positions can be arranged to form letters and figures for sign purposes.

703,989. MAGNETO THERAPEUTIC APPARATUS; J. Burry, Fort Lee, N. J. App. filed May 8, 1900. A solenoid through which alternating currents are passed to create a changing magnetic field into which the diseased portion of the body is thrust for treatment.

704,010. APPARATUS FOR CONCENTRATING MAGNETIC IRON ORES. T. A. Edison, Llewellyn Park, N. J. App. filed May 23, 1898. A connected apparatus comprising grinding rolls, screens, magnetic separators and drying apparatus arranged in a series.

704,019. ELECTRICAL TRANSPORTATION SYSTEM; H. F. Freed, Harrisburg, Pa. App. filed March 11, 1901. Details of automatic switching apparatus for electric cash and parcel carriers.

704,023. TELEGRAPH; C. E. Fritts, New York, N. Y. App. filed April 2, 1881. The line is divided up into sections connected in series by condensers, the transmission being thus effected by induction.

704,092. CONTACT SYSTEM FOR ELECTRIC RAILWAYS; T. B. Patch, North Cambridge, Mass. App. filed Nov. 29, 1901. Standards are erected along the side of the track and carry at their upper ends contact pieces suitablly insulated, with which the brush carried by the car makes connection.

704,093. CONTACT SYSTEM FOR ELECTRIC RAILWAYS; T. B. Patch, North Cambridge, Mass. App. filed April 4, 1902. A modification of the preceding invention.

704,099. ELECTRIC MOTOR REGULATION; O. H. Pieper and A. F. Pieper, Rochester, N. Y. App. filed March 24, 1899. A variable resistance is connected in shunt across the armature of a machine for alternating currents, in which the field winding and armature are connected in series, as customary in constant current motors.

704,113. CIRCUIT CLOSER FOR PORTABLE ELECTRICAL APPARATUS; W. Roche, Jersey City, N. J. App. filed Dec. 5, 1901. Details of a spring circuit closer fixed to the outside of a case adapted to contain battery cells and a bull's eye lamp.

704,117. SIGNALLING SYSTEM; J. J. Ruddick, Newton, Mass. App. filed July 26, 1901. In a block signal system for railways, a power circuit including a main conductor and a return wire, a single signal-circuit including a signal, said signal-circuit normally having both ends thereof connected to the same side of the power-circuit, means operated by a car entering the block to connect one end of said signal-circuit to the opposite side of the power-circuit and means operated by the same car on leaving the block to connect the other end of said signal-circuit to said opposite side of the power-circuit.

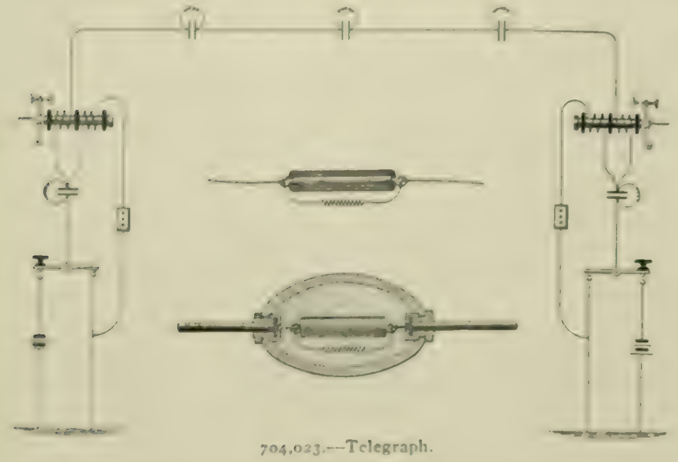
704,125. BATTERY; [illegible] App. filed July 20, [illegible] Alternate zinc and [illegible] the other being in the form of hollow boxes and containing a liquid depolarizer.

704,127. COMBINED DISTRICT TELEGRAPH AND TELEPHONE SIGNAL; C. [illegible] (See page [illegible])

704,165. TELEGRAPHIC SAFETY DEVICE; S. R. Wright, Morton, N. Y. App. filed Dec. 13, 1901. A time switch adapted to close a telegraph circuit after a predetermined interval, in case the operator unintentionally leaves the circuit open.

704,172. INSULATOR; J. E. Calvin, Camptonville, Cal. App. filed May 1, 1902. A base having a longitudinally slotted screw-threaded post into the slot of which the wire is inserted and a cap then screwed over the post.

704,177. ELECTRICAL APPARATUS FOR OPERATING RAILWAY SWITCHES AND SIGNALS; T. Ducousso, Paris, France. App. filed Sept. 22, 1898. An electro-magnetic interlocking system for controlling the switches and signal.



704,023.—Telegraph.

704,202. SWITCHING APPARATUS; C. Michalke, Charlottenburg, Germany, App. filed Nov. 18, 1899. Details.

704,246. BURGLAR ALARM; P. W. Dunne, River Forrest, Ill. App. filed March 30, 1901. A window shade carries wires through its fabric which form a part of an alarm circuit necessarily closed by the movement or injury of the shade.

074,247. BURGLAR ALARM; C. Fruehauf, Chicago, Ill. App. filed Dec. [illegible] Details.

704,252. PROCESS OF MAKING PLATES FOR STORAGE BATTERIES AND PRODUCT THEREOF; H. K. Hess, Philadelphia, Pa. App. filed July 30, 1901. The active material and a number of metal plates are compressed together in a suitable mold to form a self-supporting plate.

704,264. CONTROLLING SYSTEM FOR ELECTRIC HOISTS OR ELEVATORS; A. E. Maccoun, Braddock, Pa. App. filed April 29, 1898. An automatic switch for slowing down and stopping the motor at each end of its travel.

704,271. CONTROL DEVICE FOR HOISTING MACHINES; G. H. Reynolds, Chicago, Ill. App. filed Dec. 29, 1898. Automatic regulating devices connected to some moving part of the apparatus, for reducing the speed of the motor before the hoist reaches the limit of its movement.

704,303. REVERSIBLE GALVANIC BATTERY; T. A. Edison, Llewellyn Park, N. J. App. filed Jan. 8, 1901. (See page 92.)

704,304. REVERSIBLE GALVANIC BATTERY; T. A. Edison, Llewellyn Park, N. J. [illegible] (See page [illegible])

704,305. ELECTRODE FOR BATTERIES; T. A. Edison, Llewellyn Park, N. J. [illegible] (See page [illegible])

704,306. REVERSIBLE GALVANIC BATTERY; T. A. Edison, Llewellyn Park, N. J. [illegible] (See page [illegible])

[illegible] ELECTRICAL PUSH AND SWITCH; Edgar G. [illegible] [illegible] jects a spring catch. The dome of the button has a curve on its inner side to engage the catch, and a recess in its lower edge intersecting the [illegible]

704,323. AUTOMATIC ELECTRIC SEMAPHORE SIGNAL; J. N. Harper, Kansas City, Mo. [illegible] Details.

704,336. REVERSING SWITCH MOTOR; J. D. Ihlder, Yonkers, N. Y. [illegible]

704,337. CONTROLLING SYSTEM FOR ELECTRIC ELEVATORS; J. D. Ihlder, Yonkers, N. Y. App. filed Jan. 11, 1902. The invention consists [illegible] inoperative during the operation of the motor.

704,338. CONTROLLING SYSTEM FOR ELECTRIC ELEVATORS; J. D. Ihlder, Yonkers, N. Y. [illegible] ling circuit is cut out during the operation of the motor, the portion [illegible]

704,347. RAILROAD SIGNALLING SYSTEM; A. W. Knee, Syracuse, N. Y. App. filed March 7, 1902. Details.

704,349. PROCESS OF MANUFACTURING RICE-STARCH OR OTHER AMYLACEOUS SUBSTANCES; Eugene Leconte, Estaires, and Jerome Loiselet, Paris, France. App. filed March 15, 1901. Starchy substances are treated with successive alkaline solutions of decreasing strength. After [illegible] is subjected to the action of an alternating current while in an alkaline solution.

704,361. ELECTRIC CUT OUT; G. N. Oehmen, Brooklyn, N. Y. App. filed Dec. 14, 1901. A thermostatic tripping or releasing device.

704,371. VOLTAGE REGULATOR; T. M. Pusey, Kennett Square, Pa. App. filed Aug. 5, 1901. Details.

704,393. MANUFACTURE OF IRON, MANGANESE AND ALLOYS OF THESE METALS BY AID OF ELECTRICITY; Albert Simon, Bordeaux, France. App. filed Feb. 27, 1901. Carbon is added to the material to be treated, and an electrolyte consisting of fluorite of calcium, the mass being then subjected to the action of a direct electric current, which causes electrolytic decomposition and keeps the material in a fluid condition.

704,398. SAFETY DEVICE; A. Sundh, Yonkers, N. Y. App. filed Oct. 12, 1901. A safety device comprising means in the circuit of the shunt field of a motor controlling the armature circuit and means controlled by the armature circuit for bringing the motor to a stop when the armature circuit is broken or when the field circuit is broken.

704,399. STAINED GLASS WINDOW OR SIMILAR OBJECT AND PROCESS OF MAKING SAME; J. Taluau, Philadelphia, Pa. App. filed Dec. 16, 1895. (See page 96.)

704,400. METHOD OF FRAMING GLASS; J. Taluau and H. W. Scattergood, Philadelphia, Pa. App. filed June 30, 1897. (See page 96.)

704,401. METHOD OF FRAMING GLASS; J. Taluau, Philadelphia, Pa. App. filed March 22, 1898. (See page 96.)

704,423. WALL PLATE OR SHIELD FOR ELECTRIC WIRES; B. W. Allen, Boston, Mass. App. filed Feb. 26, 1902. A ring is secured to the wall around the projecting wires; the ring has a forwardly projecting, screw-threaded flange upon which a cap screws, the cap having a central opening for the wire.

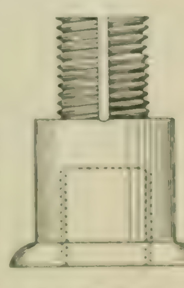
704,424. JUNCTION BOX FOR ELECTRIC WIRES IN BUILDINGS; B. W. Allen, Boston, Mass. App. filed Feb. 26, 1902. Details.

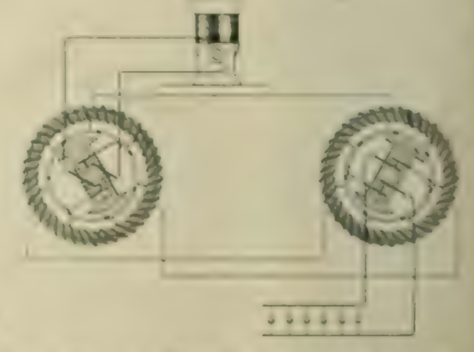
704,425. JUNCTION BOX FOR ELECTRIC WIRES IN BUILDINGS; B. W. Allen, Boston, Mass. App. filed March 8, 1902. Details.

704,439. THERMAL PROTECTOR FOR ELECTRIC CIRCUITS; F. B. Cook, Chicago, Ill. App. filed July 29, 1896. (See page 97.)

704,446. WATCH DIAL ILLUMINATOR; F. M. Durkee, Newton, Mass. App. filed Sept. 26, 1901. A battery casing adapted to be fastened to the wall and having in front of it a hook upon which a watch may be hung, also a small lamp mounted in a position to throw its light upon the face of the watch whenever the circuit is closed.

704,447. PROTECTIVE OPERATING DEVICE FOR ELECTRIC MOTORS; A. C. Eastwood, Cleveland, O. App. filed Nov. 16, 1901. A rheostat in which the arm is drawn into connection with the contacts as soon as the current flows through a magnet and a spring lifts the arm as soon is the circuit is broken.





704,172.—Insulator. 704,453.—Means for Changing the Tension of Currents.

704,478. RHEOSTAT; A. C. Eastwood, Cleveland, O. Filed April 10, 1902. A rheostat consisting of a core upon which is strung a number of rings consisting of high resistance material coated with low resistance material, the connection between them being established through the coating.

704,453. MEANS FOR CHANGING THE TENSION OF CURRENTS; W. M. Fairfax, Brooklyn, N. Y. App. filed Oct. 11, 1892. A system in which a low tension current can be changed into a high tension alternating current and conveyed to a distance and there reconverted into a low tension current, the circuits and connecti[illegible] which the high tension alternating current is induced and transmitted, [illegible] unchanged during the operation of the apparatus.

704,484. SYSTEM OF ELECTRIC DISTRIBUTION; C. J. A. Michalke, Charlottenburg, Germany. App. filed Dec. 31, 1897. The system constituting the present invention comprises a receiving device, one of the members of which is provided with a plurality of angularly displaced windings and a subdivided source of single phase current connected thereto through a switching means in such a manner that the rotation of the device constituting the switching means will cause the currents supplied to the angularly-displaced windings to be varied in such a manner as to produce a continuous progression of the magnetic field generated thereby.

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NEW YORK, SATURDAY, JULY 26, 1902.

CONTENTS.

MACKAY.

While Mr. John W. Mackay had reached the good age of seventy-two years, his general vigor and youthfulness of bearing were such as to make the news of his sudden death a very painful surprise to his friends and associates on both sides of the Atlantic. Mr. Mackay was a man who could ill be spared from the administration of great wealth or from the management of the vast properties he had built up, especially in the electrical field, during the past 15 or 20 years. It is true he had able and loyal men on his staff, upon whom, indeed, he leaned heavily, but the decision when made was his, and his share of activity and direction was far larger than the outside public imagines.

In our opinion, the European and American public is deeply indebted to Mr. Mackay for cheaper and better submarine cable service, and in this country the work that he undertook in preserving and building up the Postal Telegraph system has done much to promote and improve the efficiency of land telegraphy. The influence he exerted was wholly for good. There was nothing mean or small about him. The calibre of the men he gathered around him is striking proof of his own estimable qualities of mind and heart; and neither capital, nor labor, nor the great mass of the community, was ever affected otherwise than beneficially by his electrical enterprises of whatever kind. Besides, he had not exhausted his worthy aims, for as U. S. Senator Clark, of Montana, remarks: "His ambition in life was to encircle the earth with his telegraphic cable lines, and there was little doubt that he would have accomplished his purpose had he lived." It is, perhaps, too early to tell what will be the disposition of the Mackay telegraph and cable properties as they now stand, but we shall not be surprised to learn that Mr. Mackay with his usual shrewd forethought had provided for their continuance along the lines he had laid down. In the meantime we can but extend our condolence to the family and our deep sympathy with the corps of talented workers, whom he made his friends, who helped him render the names "Postal" and "Commercial" synonyms for progress, efficiency and good service to the public.

GROUNDING SERVICE WIRES.

At the Cincinnati Convention of the National Electric Light Association an unexpected development was an attack by representatives of several smaller light companies on an underwriters' rule relating to the grounding of service circuits. Had the gentlemen followed closely central station history they would have known that the rule in question originated with the electrical interests, and that it was only after years of persistent effort on the part of its advocates that the underwriters reluctantly adopted the same. While conflicting interests naturally give rise in many cases to antagonistic feeling between underwriters and electric light men, attacks on the former should at least contain a semblance of fairness, which in this instance was not the case. It may be added that American engineers are not alone in favoring the grounding of distributing circuits, this practice for years having been general abroad. As was pointed out in the Cincinnati discussion, ill effects from the practice are chargeable, not to the grounding, but to an inefficient state of the main conducting system. In fact, it can safely be assumed that those who oppose grounding are in charge of lines and transformers that sadly need overhauling; or, to state the case in other words, they are maintaining circuits in a condition that may menace both life and property. Even if the usual reasons given for the desirability of

grounding could be successfully disposed of, its practice would still be justified on the score that it serves as a check on the insulation efficiency of a system as a whole.

Induction Motors on Lighting Circuits.

Our report of the N. E. L. A. discussion on the operation of induction motors on lighting circuits, abstracted elsewhere in this issue, throws some light on a much-mooted point, but leaves unsaid much that would have been of great interest and value. The discussion brought out in the most forcible manner the wide variety of opinion as to what constitutes good service and what variations of voltage are permissible. With few exceptions the general opinion seemed to indicate that induction motors frequently stopped and started were a nuisance and rarely failed to give trouble. On its face this is a serious indictment, but its charges lose somewhat of their force when one realizes that the two large companies which reported on the matter had no complaints to make against induction motors, either polyphase or monophase. Any sudden call for heavy circuit on any system whatever is likely to cause trouble with the voltage whether produced by motors or by other apparatus, either for alternating or for direct current. The vital point which determines immunity from serious difficulties is that such a call for current shall not vary the drop beyond the requirements of good regulation. Suppose one has, for instance, a two-wire direct-current circuit feeding 1,000 lights at a maximum drop of 5 volts. Now put a 25-hp motor upon the same circuit and at full load it will of itself produce a drop of 2 or 3 volts, and while starting under load, perhaps double that amount. That such a motor would seriously injure the general regulation admits of no debate. Now the induction motor adds its reactance drop to the ohmic drop just mentioned and may, if improperly installed or handled, call for considerable greater starting current than a direct-current motor of the same output. Hence whenever the latter might cause trouble the former certainly would.

To insure immunity from troubles of regulation under variable load the one condition which must be fulfilled is that the largest current required by the motor shall not increase the total drop on the circuit involved beyond the limits of good regulation. This is a simple enough principle, but in the case of alternating current circuits the drop in the primary and in the transformer is too often forgotten. One cannot load a secondary circuit indefinitely without taking the rest of the system into account, and it is a singular fact that in very few alternating current stations is the total drop and its distribution known with any approximation to accuracy. Installed with due regard to the demand for current, an induction motor need not cause any material difficulty even when running an elevator, but such an installation is most emphatically not a proper subject for guess work. In a few instances of the many brought out in the discussion, the induction motor even in small plants had been so carefully installed as to give no trouble, but we are bound to say that these seemed to be the exceptions. We have no doubt, however, that if direct-current systems were generally in use in small places, almost an equal amount of trouble would have been reported with motors under variable load. It was encouraging to note the satisfactory results now and then reported from the monophase induction motors. Obviously, however, if the starting current is adequately cared for, there is no reason why a monophase motor should not give fairly good results, particularly under load only moderately variable. It may have a power factor slightly worse than that of a polyphase motor, but the main trouble is in starting and not in running. The Continental practice of providing monophase motors with a loose pulley is strongly to be commended, and unless polyphase motors are supplied with adequate starting appliances, the same practice may with benefit be applied to them as well.

A polyphase motor with a proper starting resistance in its secondary circuit need never require a current much, or at all, in excess of its normal full-load current, but without this precaution is very likely to cause excessive drop. If adroitly installed with arrangements for starting at reduced primary voltage, it may still give good results if carefully handled, but must be started with considerable judgment to avoid excessive current during acceleration, and it never can give as great torque per ampere as a motor with a properly proportioned starting resistance. The most ominous feature of the reports on induction motors was the trouble produced in some cases in which the motors were on separate circuits, showing that the starting conditions were so bad as to react unfavorably on the generators. It is pretty clear from this that the polyphase induction motors even at the present time leave something to be desired in their properties at starting. Lack of a starting resistance is probably the commonest cause of such trouble, but it is likely also that the general starting conditions are less carefully watched when separate motor circuits are installed, and bad practice accumulates until even the generators are affected. We are inclined to think that a separate motor circuit in a polyphase motor system is a mistake, although separate transformers for the motors are frequently desirable. It is better to take up the motor installation with a full knowledge of the facts and make the conditions such that trouble will not ensue. Of course, now and then one finds a group of motors operating under conditions so severe that a separate circuit is desirable, as it might be on a direct-current system, but a distinct motor circuit tends to carelessness in installation and sooner or later this gets back to the generating plant. There was a fashion, too, a few years since, of putting in generators with bad inherent regulation under a mistaken idea of economy, and little good can be expected of such machines under a motor load. But, as a rule, if one takes good care of the individual motor installations the generators will take care of themselves.

Surges in Transmission Circuits.

Professor Baum's paper on this subject, recently read at the annual meeting of the Pacific Coast Transmission Association and reprinted in this issue, contains some interesting suggestions. On the Pacific Coast ideas of line length are different from those prevailing in the East. Here we look upon a thirty-mile transmission line as being long, by comparison with other lines near the Atlantic. There, a thirty-mile line is evidently regarded as a mere trifle, and a line is not long until its miles are written in three figures. The result is, however, that California is the place for studying surges and oscillations on long-distance transmission circuits in their natural wild state, and that they can only be studied in the East, either in actual miniature or in the laboratory, or on paper.

Professor Baum points out that where a long line is tapped at a number of points en route, as is usually the case in long-distance transmission, the surges that may accompany sudden disturbances on the line are prevented from attaining the intensity they might otherwise develop. Their energy leaks out through the various tapping points and branch circuits. This fact may have a marked influence in safeguarding actual transmission lines under working conditions. Theoretically, of course, short-circuits can be avoided, and switches can be opened and closed gradually through resistance of some kind, but sooner or later a short-circuit on the line will occur,

and the sudden interruption of this short-circuit will develop a series of electric surges, theoretically capable of generating a voltage of some 200 times the interrupted current strength in amperes. If a number of branch connections and branch circuits exist along the line, the surges will expend their energy into these channels without much danger. It might even be worth while installing such branch circuits at intervals, artificially, on a long line when no practical demand for power exists midway between the terminals, as, for example, by connecting transformers of small capacity, with which tests on the secondary pressure might also be available.

It is probable that high-pressure switches will be developed capable of safely opening and closing high-pressure transmission lines. Many engineers do not believe in high-pressure switches, and tie their lines permanently to the high-tension terminals of their transformers. It is always more convenient to manipulate low-pressure switches, and where high-pressure switches can be avoided it is, no doubt, good practice to do so; but cases must occur in which high-pressure switches are needed, and in such cases the long arcs at breaking circuit will doubtless be avoided by suitable construction. No high-pressure transmission system can be regarded as safe until a short-circuit can be made upon it without risk of surges, on the one hand, or of breaking the machinery by excessive mechanical strains, on the other. In other words, automatic circuit-breaking devices must be perfected for high-pressure lines, so as to work as certainly and safely as they now do on low-pressure lines.

The paper suggests that the limiting strength of current that can be transmitted over any one long-distance conductor is about 100 amperes, owing to the large inductive drop, or reactance-factor. This seems very reasonable. But the prospect is not thereby rendered discouraging. One hundred amperes at 50 kilovolts, a working or workable pressure at this date, is 5,000 kilowatts, and that is a comfortable unit of power. Three such wires in a three-phase system, with 50 kilowatts between wires, will carry 8.66 thousand kilowatts, and if more power than this is wanted there should be no difficulty in running extra wires, or even extra pole lines. On the three-phase system, therefore, each conductor may, perhaps, be limited to carrying about 3,000 kilowatts, for the purposes of long-distance transmission. Or, still retaining the 100-ampere-per-wire limitation, we may say that in the three-phase system each wire is limited to carrying 1,000 kilowatts at a pressure to neutral of 10 kilovolts, or a pressure between wires of 17.3 kilovolts, as in a 17,300-volt system. There are comparatively few waterfalls, however, that have many megawatts to spare.

The Hydrodynamic Analogue of Electrodynamic Transmission.

We reprint on page 127, Professor Eddy's recent paper before the A. A. A. S. The analogy presented in this paper between a hypothetical hydraulic system and actual electric transmission systems is very useful for presentation to the student, since the mind readily grasps the hydraulic phenomena on account of the sight-memories connected with the action of hydraulic machinery; whereas the electric phenomena are invisible, and produce no direct sight memories. On the other hand, it should be pointed out that, in general, care is required in applying mechanical analogies to electrical or similar phenomena, and above all, the lack of identity should never be lost sight of. Indeed, we very much doubt the value of analogies in science, and particularly in applied science, except to assist the layman who wishes to obtain what to him will answer as an intelligent idea of a phenomenon, or as a first step to assist the student in co-ordinating new ideas. He who wishes to obtain true conceptions must study actual phenomena, and while this course in some cases may require more time than if analogies were availed of, in other cases less time will be required, particularly if the seeker for enlightenment also lacks exact knowledge of the mechanical or other phenomena entering into the analogy. With the increased intellectual competition brought about by increase of technical education, the man who knows things at first hand is at an advantage with respect to one who is contented with knowledge by analogy.

The generator of Professor Eddy's analogy is a double-acting force-pump, delivering an alternating flow of water, through a hose of elastic walls to a distant oscillating motor-pump. The elesticity of the hose corresponds to electrostatic capacity, the inertia of the water to inductance, and the friction to resistance. The elasticity, inertia and friction co-operate hydraulically in essentially the same manner as capacity, inductance, and resistance in an electric transmission line. If the hose is uniformly leaky to a given desired extent, the analogy to the electric case is thereby also maintained. The application of the alternating watermotive force by the driving pump, produces a succession of impulses which travel around the hydraulic circuits in waves that would be visible to the eye by the pulses of the distending and contracting hose. The wave-length of these impulses would be adjustable by adjusting the elasticity of the hose or the density of the liquid. The attenuation of the impulses with time, or with distance from the source, would depend upon the friction, upon the elasticity, the density and the leakage. The formulæ would all be similar to those of the electromagnetic case.

The introduction of the receiving pump or motor, at the distant end of the line, would add new properties to the transmission. A new set of reflected waves or impulses would be set up from the motor. These, mingling with the outgoing impulses, would produce stationary waves. That is to say, while, before the motor was inserted, the waves were all progressive, so that the hose wall at any point alternately rose and fell with the frequency of the force-pump; the insertion of the motor-pump would be capable of producing a set of counter, or reflected waves, whose sum with the initial set would establish constant wave outlines, by which the hose pipe would no longer pulsate, but would distend at some places and contract at others, the distance between successive humps being equal to the stationary wave-length of the hydraulic circuit.

A similar analogy can be traced in the propagation of light through matter, and also in the propagation of waves in oscillating elastic strings. It is possible that the electric case can most readily be apprehended by the study of these material cases. A curious exemplification of the same principles is presented in the circulatory systems of animals. The heart is a cyclically-acting pump, with a frequency of from about one-third to five cycles per second, according to the size of the animal. The flow, however, is pulsating and unidirectional, not alternating. The arterial walls are elastic, and there are present, on the electromagnetic interpretation, capacity, inductance and resistance, without leakage. The inductance is constant, the density of the blood being sensibly invariable. The resistance varies markedly, being controlled in a remarkable manner, according to the needs of the organism, by the calibre adjustment of the arterials. The frequency is also a variable, being adjusted, within certain limits, to the needs of the system. Under these circumstances the arterial impulses, or pulses, have a definite wave-length and velocity of propagation, under given conditions of frequency and resistance. The electrostatic capacity, or arterial elasticity, diminishes with old age, thereby diminishing the transmisson power of the system. It mght be possible, perhaps, to define the degree of senile loss of arterial elasticity in terms of the wave-length, or wave-velocity of circulation, under definite frequency and resistance.

Meeting of the Edison Illuminating Companies.

Mr. Wilson S. Howell, the acting secretary of the Association of Edison Illuminating Companies, has issued the following notice:

The eighteenth annual meeting (23rd convention) of the Association of Edison Illuminating Companies, will be held at the Mount Washington Hotel, White Mountains, N. H., commencing Tuesday, September 9th. A number of valuable papers are in course of preparation on subjects pertaining to the business of the member companies, and already there are indications which point to the coming convention as probably the most valuable of a series of excellent conventions. The Edison Association was organized in 1885 by companies licensed under the Edison patents. It embraces all of the present licenses excepting only a very few.

The Edison conventions are noted for their close application to business, the absence of junketing and the higher beneficial results to its members. The place of meeting this year is selectd because of the absence of outside allurements, with the expectation that this convention will exceed all others in the strict attention to business, for which the conventions of the Edison Association have always been noted.

At the proper time a list of the papers presented and subjects discussed will be given to the technical press.

Following is a list of the officers of the Association: President, Mr. Louis A. Ferguson, Chicago, Ill.; Vice President, Mr. A. W. Field, Columbus, Ohio; Treasurer, Mr. Alex Dow, Detroit, Mich.; Secretary, Walter H. Johnson, Philadelphia, Penn.; Asst. Secretary, Wilson S. Howell, New York, N. Y.

Death of John W. Mackay.

A picturesque and attractive figure is taken from the field of American telegraphy and electrical development by the sudden death of Mr. John W. Mackay. It would appear by the dispatches from London that he was overcome by the extreme heat there last week, causing fatigue and resulting in pneumonia and heart failure. Although 72 years of age, he was vigorous and apparently much younger, attending actively to business affairs, and taking no small share in the development of his latest international enterprise, the Commercial Pacific Cable, for which, indeed, the last contracts were signed in London only a few days ago, just prior to Mr. Mackay's death.

Born in Dublin in 1831, but spending all his life in the United States, Mr. Mackay was fitly regarded as a typical American in every respect. In 1840 his father came to New York, and the boy not only played in City Hall Park, but lived almost on the very spot now occupied by the big building which constitutes the headquarters of the Postal Telegraph-Cable system. In 1851 he found his way to California, became a miner and after many trials and vicissitudes, "struck it rich" in 1865 at the Hale & Norcross mines with Flood and O'Brien. This was soon followed up by the discovery of the Bonanza mines at Virginia City, Nevada, out of which Mr. Mackay once stated that he had taken $150,000,000 in silver bullion. He followed up mining enterprises, married Mrs. Bryant, went into banking, soon became a celebrated international character, and went into a variety of other enterprises.

Several years ago, chiefly through his acquaintance with Stokes, friend and foe of Jay Gould, Mr. Mackay had become financially interested in some of the telegraph companies organized to compete with the Western Union Telegraph system. They went down in wreck, but with the able and brilliant assistance of Mr. A. B. Chandler, Mr. Mackay reclaimed the ruins and in a very few years had built up the Postal Telegraph Company, one of the best and most progressive concerns in the telegraph field this country has ever seen. No expense was spared to give good service, and the absolute confidence of the public was speedily won.

The next and almost inevitable step was the foundation of another submarine cable enterprise to work in co-operation with the Postal land lines. In this plan Mr. Mackay rallied to his aid a formidable ally in Mr. James Gordon Bennett, of the *New York Herald*, and a splendid lieutenant in Mr. George G. Ward. To quote the authoritative statement in that journal on the subject:

"It was through his identification with the Commercial Cable Company that Mr. Mackay's name became familiar as a household word to the people of Europe and America. Twenty years ago the men who then controlled the Western Union Telegraph Company and its appendant transatlantic cables tried to bring into a 'pool' with them all the existing British and French cable lines across the Atlantic, forming an absolute monopoly of telegraphic communication between this country and Europe. With the disappearance of competition the tolls were arbitrarily fixed at a high level and the monopoly held the commercial interests of both continents and the press of Europe and America at its mercy. Protests rose on all sides, but the cable monopoly, confident of its position, was arrogantly indifferent to all appeals. As always happens when competition is abolished, the service deteriorated. Worse still, complaints were soon heard that, with all the messages sent over the Atlantic placed at the disposal of the clique which controlled the pool, there was no longer any assurance of privacy of communication.

* * * * * * *

"But capitalists seemed to fear incurring the hostility of the powerful financial interests that were concentrated in the pool and held aloof, and it seemed that the *Herald* would alone have to supply the entire capital and lay the cables. Mr. Mackay's clear intellect, however, perceived both the necessity and the feasibility of the work, and with the absolute fearlessness that was one of his characteristics when his enthusiasm was aroused, he joined in the enterprise. It involved a long and hard fight with the monopoly and its agents, in public as well as private life, but the result was the establishment of the Commercial Cable Company (the Mackay-Bennett system), giving the people an invaluable increase in the rapidity of communication between the continents, together with a permanent decrease of nearly one-half in the charges for transatlantic messages. The public-spirited nature of the service thus rendered is not lessened by the fact that, through pluck and skill, aided by the hearty support of the business community on both sides of the Atlantic, the enterprise was made a financial, as well as a moral success. The wonderful development of the Postal Telegraph system of land lines auxiliary to the Commercial Cable Company and the preparations now under way for laying a cable from the Pacific Coast, via Hawaii, to the Philippines, without government aid or subsidy of any nature, alike bear witness to Mr. Mackay's broad views and rare executive ability."

In connection with his telegraph and cable work, Mr. Mackay added two fine new buildings to the architectural features of New York City, the Postal, on Broadway and City Hall Square, and the Commercial Cable, on Broad street, both affording in every respect typical examples of the furthest reach in telegraphic improvements, as well as in electrical equipment. It may be added that Mr. Mackay became interested in Mr. Frank J. Sprague's electric elevator work and did much to push it to commercial success.

Mr. Mackay was a most likeable man, and was loved by all who knew him closely, as well as esteemed by those with whom he came into business and social relationships. For many years Mrs. Mackay had a house in Paris, which was a center for American life in that city; while, since 1891, she has had a mansion in London, where she and Mr. Mackay, whenever he was in England, dispensed a lavish hospitality. Her daughter by Dr. Bryant, was married to and divorced from Prince Colonna, of Italy, and her sister married Count Telfener, a friend of King Humbert. Mr. Mackay had two sons, one of whom, named after him, was thrown from a horse and killed. The other, Clarence, is well-known as a leader in New York society and has been closely associated with his father in the electrical field. There is considerable speculation as to the effect that the death of Mr. Mackay may have on his various interests. His fortune is estimated at different figures, ranging from $50,000,000 up to $100,000,000. A close friend says that Mr. Mackay did not know his actual wealth within $20,000,000.

The Postal and Commercial Cable buildings in New York city and elsewhere have been draped in black, and General Manager W .H. Baker, of the Postal, has sent an expression of the heartfelt grief of all the employes to Mrs. Mackay, who is prostrated by her loss. It is understood that the interment will take place in Greenwood Cemetery, Brooklyn, where Mr. Mackay built a magnificent mausoleum some years ago. Mr. Clarence Mackay is on his way to England, and the directors of the Postal and Commercial Companies are to meet in New York City on Friday to take action regarding his father's death.

FIGS. 1 AND 2.—DAM FOR PIKE'S PEAK POWER TRANSMISSION.

Power Transmission in the Pike's Peak Region.

BY R. M. JONES.

THE Pike's Peak Power Company, whose general offices are at Victor, Colo., was organized in 1899, under the laws of Colorado. The company during that year purchased ranch property, placer claims and reservoir sites on West and East Beaver creeks, in Teller and Fremont counties, and also located, developed and patented placer claims along these streams. At this date it owns all the lands along these streams, including reservoir sites, and all water power privileges, over a distance of 1½ miles on Beaver, 7 miles on West Beaver and 3½ miles on East Beaver. These streams are noted for their excessive difference in elevation in short distances, and produce sufficient water to make of them valuable water power properties. One of the power stations contemplated by the company is completed, and has been in operation during the past year, and known as "Station A," located on West Beaver, in Fremont County, 2½ miles up the stream from the junction of East and West Beaver. The completion of this station has also accomplished much of the development and actual construction necessary for stations "B" and "C," by way of reservoir capacity and pipe line delivery of the water, serviceable to the two lower stations after having been used through "Station A."

FIG. 3.—A SECTION OF THE STAVE PIPE LINE.

DAM AND RESERVOIR.

The dam and reservoir are located 5½ miles east of Victor. Here is located the largest steel-faced, granite-back filled dam on record to date (Figs. 1 and 2). The structure is in length 405 feet along the cap, 220 feet length of base, 148 feet cross-section of base, and 20 feet cross-section of cap. The upper slope, being the steel face, is 30 degrees from the vertical, and the lower slope 50 degrees vertical. The height of the dam from bed rock to the top of the sixteenth plate (being the spillway) is 70 fe-. The spillway is 40 feet wide, cut in granite formation and passes around the northwest end of the dam. The granite back fill, to which the steel plate is laid, is carefully laid in "dry wall" of heavy granite boulders, usually 20 to 80 cubic feet each, as broken by heavy blasting, with loose, fine granite filling the intervening space.

The steel plate is built up of sheets 5 x 15 feet and ½ inch in thickness for the bottom, 8 plates in height. Continuing, the plate is reduced in thickness to ⅜ of an inch, and finally at the cap it is ¼ of an inch. The entire sheet is riveted with horizontal butt straps, and 4 x 5 x ½ inch angle bars are placed vertically the entire height of the dam across each interval of 15 feet for the entire length. The 5-inch leg of each pair of angle bars project into the reservoir and constitutes a standing joint seam, with an iron liner ⅜ x 2 inches riveted between the extreme outer points of these angle bars, thus making a thorough expansion joint for each section of 15 feet. The bottom and end connection of the entire sheet is concreted into a deep channel-way, quarried out of bed rock, and the bottom terminates in two pairs of 5 x 8 inch angle bars, which are

FIG. 4.—FORTY PER CENT. TRESTLE.

riveted through the plates. The end connections are prepared in exactly the same manner, but are applied vertically. The quarrying of the bed-rock channels was carried out horizontally in each case to a point rising to an elevation, and thence the rise was made abruptly in terrace form. The entire sheet is riveted up and calked in the same thorough manner as in boiler practice. A space of six inches was left between the steel plates and smooth surface of the granite back fill. This narrow space is taken up by sand, gravel

FIG. 5.—GENERAL VIEW OF POWER HOUSE AND MOUNTAINS.

and sedimentary deposit, the filling being applied with ample water and permitted to dry before water pressure was allowed to enter. The reservoir has a surface area of 130 acres, and holds 102,000,000 cubic feet of water.

WOOD AND STEEL PIPE LINE.

Water is taken into the wood stave pipe through a "Grizzley" 240 feet long, perforated, giving 30 times greater area than the pipe. The "Grizzley" and the main pipe line are connected to the steel facing of the dam by steel angle connections. The wood pipe is 23,200 feet long, 30 inches inside diameter, and is of 1½-inch redwood stave, banded with ½-inch steel bands and cast-iron lugs. The bands are spaced at intervals along the pipe at all distances between 2¼-inch and 8-inch centers as necessary for resisting the internal pressure; variations being caused by various inverted syphons along the line, two of which reach 215 feet pressure. This pipe line extends over fearfully rough country, about half of the grade being through original granite formation, many curves were on less than 100 feet radius, and one compound curve was 35 feet. The wood pipe passes through the Skaguay Tunnel, which is 1,535 feet in length, located at 21,000 feet from the dam.

From a point 200 feet below the Skaguay Tunnel, where the static pressure reaches 220 feet, the line consists of steel pipe 20 inches in diameter in various thicknesses of plates, ranging from ¼ to ¾ of an inch, as required to meet the internal pressure with an ample factor of safety. The total length of steel pipe, including the receiver, is 2,000 feet, on an incline averaging 38 per cent. It passes over grades constructed through a granite formation, tougher in respect to roughness than ever was encountered in railroad construction in Colorado. At one point it passes through an inclined tunnel 335 feet in length, just above which is a bridge 70 feet in height, both being on 40 degrees gradient, and at various points there are extremely deep open cuts. From the south end of the Skaguay Tunnel the pipe line is entrenched in the grade on which is constructed a 3-foot gauge railway leading from the Skaguay Tunnel to the power house, its grade being 1,165 feet vertical in 3,100 feet horizontal. This road is the only means of access to the power house. The cars are operated by a double-hoisting engine.

The upper terminus of the railroad lies under a vertical ledge 70 feet in height, and all machinery, apparatus and materials of all kinds were lowered by boom and derrick, taking loads from the wagon at the upper landing and lowering them 70 feet over the ledge to the cars, from which point the loads were lowered by friction brake on the hoist equipped with a ¾-inch steel cable; 1,400 tons of building materials passed down this peculiar railroad. Views of the pipe line, trestle, etc., are given in Figs. 3 and 4.

POWER STATION.

The power house, "Station A" (Figs. 5, 6, 7 and 8) has dimensions 38 x 98 feet, with two side wings 16 x 48 feet each, and is located on the summit of a granite projection surfaced off true to grade. The building is constructed of brick, with steel, corrugated-steel arched roof, concrete, tar and gravel covered; concrete floor, and is absolutely fire-proof. The building is provided with a 10-ton traveling crane. The hydraulic apparatus was manufactured by the Pelton Water Wheel Company, of San Francisco. Each unit consists of two steel disc wheels 66 inches in diameter, keyed to the same shaft, and working in the same wheel house. The base frames are built up in box pattern of the same type and general design as the generators, to which they are connected. The frames of the water wheels and generators are faced for accurate, rigid connection to each other by bolts and dowels. The connection of water wheel and generator shaft is effected by a 7,000-pound steel cast balance wheel, banded with a rolled-tire steel band, 4 inches in thickness. The wheel is 7 feet in diameter, and its hub forms the connection on the water-wheel shaft, and one-half of the hub forms the other half of face coupling keyed to the armature shaft, making an accurate and rigid direct connection of the shafts of the two machines.

The nozzles used with which to produce the required power, as applied under 1,160 feet effective head obtained, require only a diameter of one inch for 236 horse-power, including losses. The nozzles for each unit vary in diameter, one having the capacity of the generator, and the corresponding nozzles for the other wheel in the same unit being somewhat reduced. Each wheel in each unit will produce power for the full capacity of the generator connected. In operation, however, it is customary to install such a varied diameter or capacity of nozzles as to permit the operation of the full capacity of the load demand from time to time by the operation of nozzles under full pressure, and but slight loss in water due to regulation for low loads.

The nozzles are of the deflecting type, and work under full pres-

FIG. 6.—MASON'S PEAK AND POWER HOUSE.

sure at all times, which explains the variation in the diameters of the nozzles. The regulation is of the "Armstrong" type, owing to the fact that automatic regulation under existing conditions could be only a failure, without reference to the class applied. Due provision has been taken to extend the actual control and regulation of each unit to a point directly in front of the switchboard panel belonging to that unit. The receiver runs longitudinally through the building under the steel-concrete floor. The discharge or tail-race water returns directly under the receiver to the south or lower end

of the building, at which point it will later unite with water conducted from a point far above "Station A," where a catcher-dam is to be constructed, and the water diverted from the Beaver stream channel. There being a considerable accumulation of water between the dam and "Station A," it is the purpose of the company to unite the waters through "Station A" with the accumulation in the stream, and conduct the combined waters through a pipe line to a point 200 feet above the forks of the east and west Beaver Creek, at which point will be constructed "Station B." There will be built a small pipe line up the east Beaver to the same static level as the tail-race water of "Station A." The waters of both pipe lines will be united before entering the receiver. The pressure of "Station B" will be 1,257 feet, or 544 pounds pressure per square inch. With the added accumulation of water in the west Beaver branch, 3,500 hp will be obtained, and from the east Beaver branch about 2,000 hp, all of which may be developed at "Station B."

ELECTRICAL EQUIPMENT.

The electrical generators now in operation at "Station A" (Figs. 9 and 10) are four 400-kw General Electric machines, three-phase 30 cycles, 600 volts, with stationary armatures and rotary fields, making 450 r. p. m. As already mentioned, the generators are driven directly connected to the water wheels. Two 4-pole exciters, direct-current machines, have a capacity of 30 kw each, running at 675 r. p. m., producing an exciting current at 70 volts each, giving sufficient exciting current for all four generators while working at full load. In reference to the efficiency of the water wheels, it may be stated that they were guaranteed to develop 83 per cent. of power on their shafts at full load when the nozzles are in normal position. In considering the efficiency of the water wheels, the General Electric Company's generators were assumed to have a commercial efficiency of 94 per cent. at full, non-inductive load. Therefore, with every 33,000 foot-pounds of water, the wheels will produce in current one indicated horse-power less 17 per cent. loss in the wheels, and 6 per cent. loss in the generators, delivering 78-100 horse-power, or 582 watts, from the brush-holder terminals of the generators. These efficiencies have been fulfilled by tests. All water connections are tested to 800 pounds pressure to the square inch. In making the efficiency tests, measurements are made through the standard weir commonly used in the United States, verified by spouting tests by working water through the nozzles of known diameters. The developed power is measured by the best electrical instruments obtainable.

The switchboard apparatus (Fig. 11) is especially liberal in design, and is made up of one exciting current panel, four generator panels, two distributing panels, two high-tension panels and one paralleling or synchronizing panel. Each panel is made of Vermont marble, 62 x 36 inches, with a sub-base 28 x 36 inches, and 2 inches in thickness, with a complete equipment of indicating and recording instruments, switches and regulating apparatus. The main line switches from each machine are operated independently either for power or light. The circuits are arranged so that any or all of the machines may be applied on either circuit. The transformers are six 250-kw air blasts, of General Electric make, having 600 volts on the primaries and 12,600 on the secondaries. The 12 complete sets of lightning arresters are of the same make. The cable connections between the generators and switchboard, and from the switchboard to the transformers are all highly insulated, paper, rubber and lead, and laid in conduits in the concrete floor. Since the starting up of this station, it was found necessary to install some thorough system for combined arc and incandescent lighting, which has been fully accomplished by the installation of two 200-kw compensated, three-phase generators, 60 cycles, with their full equipment. These generators are 12-pole, and operate at 600 r. p. m. Each generator contains its own independent D. C. exciter, 12 poles, built directly on the revolving field shaft. These machines are also directly connected to impulse type water wheels.

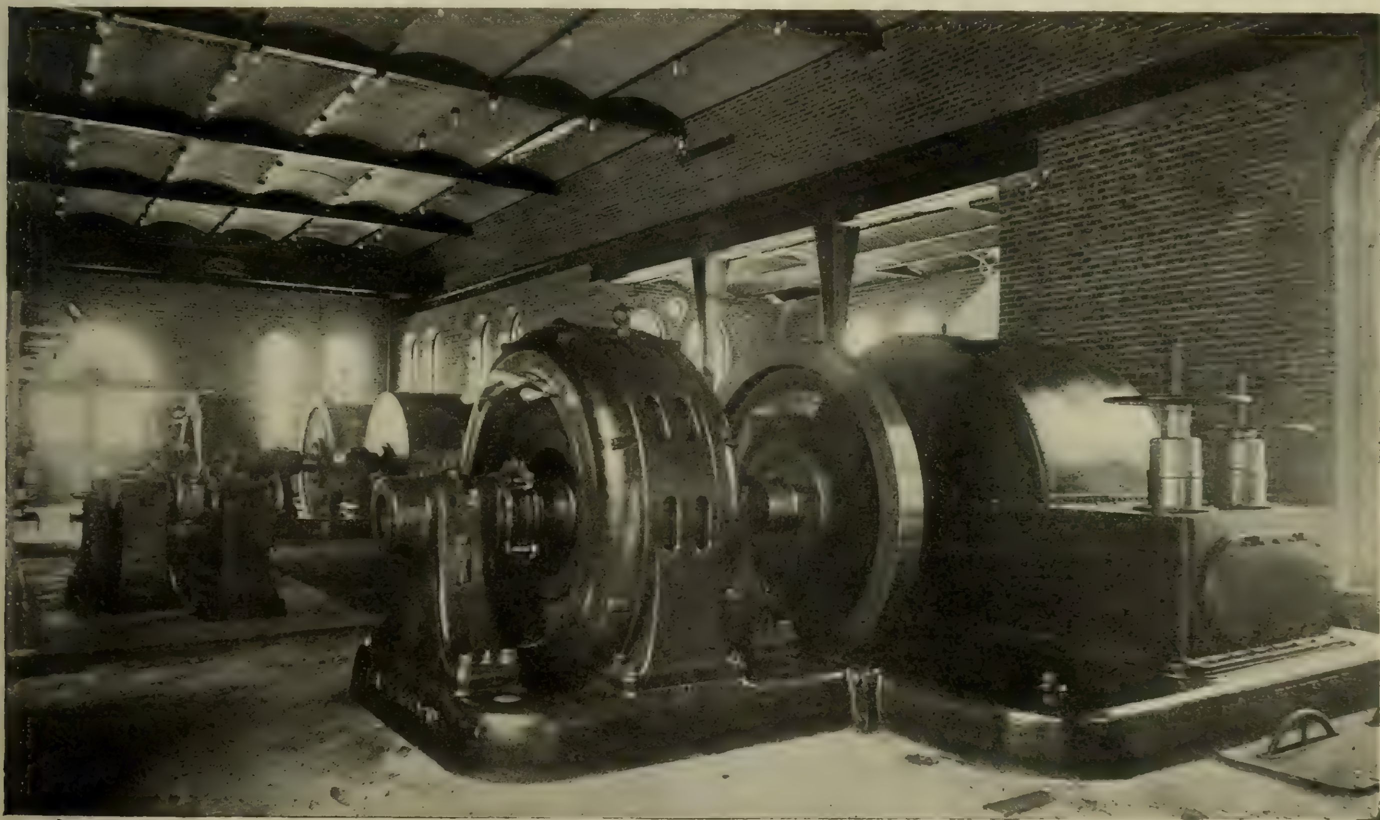


Fig. 9.—Interior View, Pike's Peak Power House.

LINE TRANSMISSION.

The line transmission from "Station A" to the center of distribution (at the Gold Coin Mine, at Victor) includes a distance of eight miles by pole line. The circuits consist of three power wires No. 4 B & S. gauge, and the lighting circuits of three No. 6 B. & S. gauge, which are ample to deliver 1,600 kw at less than a five per cent. energy loss. These lines are transposed at intervals of each one-half mile along the line. The poles also carry for telephone purposes two No. 10 galvanized iron weather-proof wires, transposed each 120 feet. The insulators were furnished by R. Thomas & Sons Company, of East Liverpool, Ohio. They are 5½ inches in diameter, of porcelain, and each is made up of three independent cups. In manufacture they were subjected to a 40,000-volt salt test. The line voltage is 12,600, both on 30 and 60 cycle lines.

SUB-STATION AND DISTRIBUTION.

The sub-station is a brick, steel, concrete structure, fire-proof, adjoining the Gold Coin ore house, in Victor. All transmission circuits

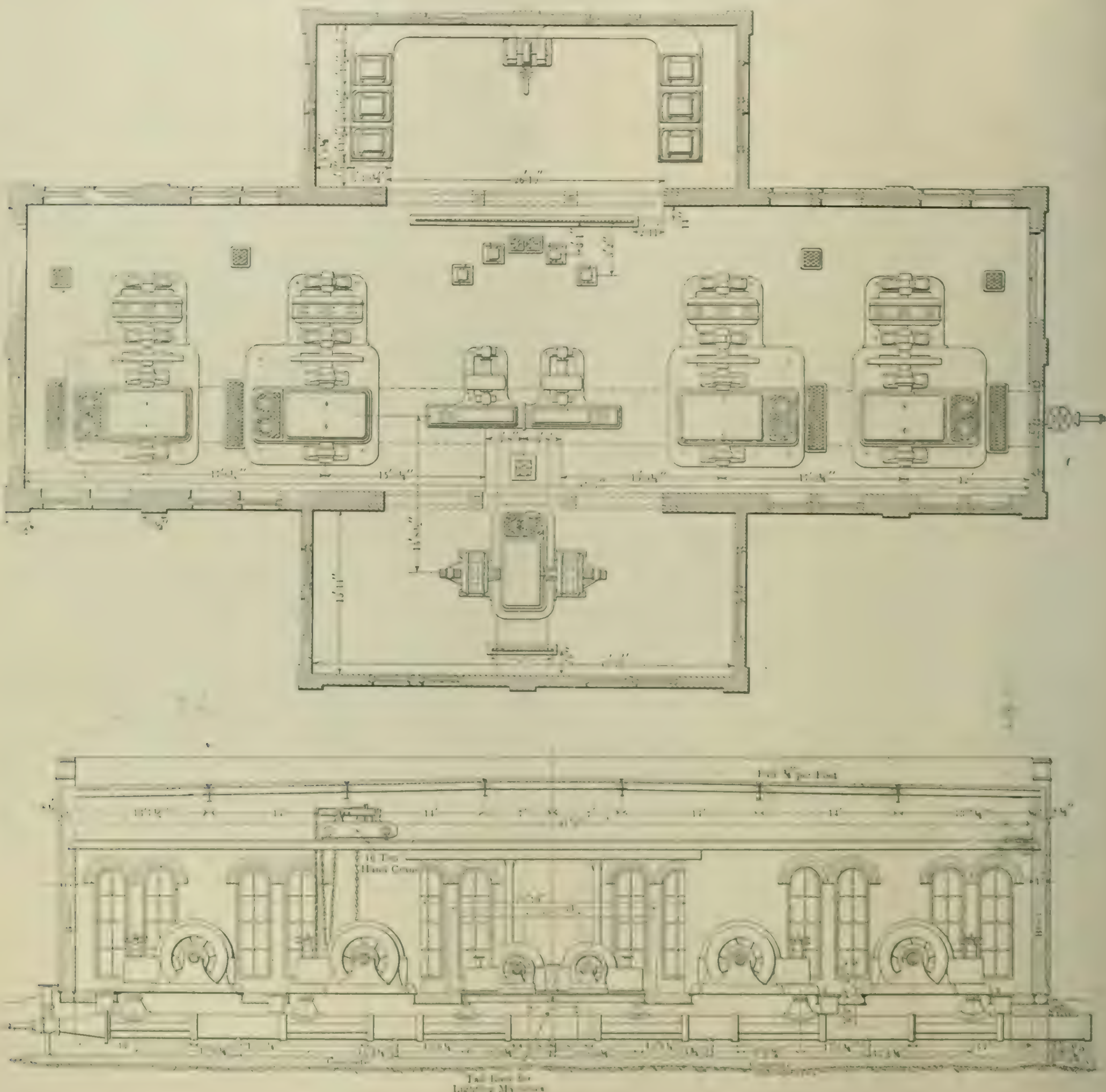
enter this building where the current is transformed through nine 50-kw oil transformers, General Electric type, 12,000 volts primary and 460 volts secondary, for local lighting distribution connected in the Y four-wire system, also, for local power work.

There is installed in addition a set of three 50-kw oil transformers, 12,000 to 350 volts, which operates a 120-kw rotary converter, which drives a locomotive in the United Mines Transportation Tunnel, for ore hauling from first level of the Gold Coin mine to the Economic Mill; and for the Bull Hill Tunnel haulage. High pressure distributing lines leave the sub-station in various directions (after first passing through 20,000-volt oil switches, making each line independent) to Economic Mill, where about 300 horse-power is delivered.

conda and the various mines in that vicinity—the Morning Glory, Doctor Jack-Pot and others. These lines also reach Elkton on the way to Anaconda, where lighting is also distributed. The Pike's Peak Power Company has just begun, in fact, to develop its various points of distribution. It has already reached all the places and properties mentioned with a good, series alternating system of 60 cycle arc lighting, which is distributed in three directions through one 70 and one 50-arc constant-current transformer, located in the Victor sub-station.

PLANS FOR EXTENSIONS.

It is the purpose of the company to construct an independent trans-



FIGS. 7 AND 8.—PLAN AND ELEVATION, PIKE'S PEAK PLANT.

To the Beacon Hill there is a power distribution for hoists, power and lights. To the Deadwood Mine is a line for a 100-hp air compressor, and a secondary 460 volts power circuit reaches Independence, Altman and the Wild Horse districts. Another primary line reaches Cameron and Gillett, after first passing through Goldfield, all for lighting service, and distributed in each of these towns through their local transformers connected in delta.

Two additional primary distributing lines reach Anaconda, where independent lighting and power are distributed to the town of Ana-

mission line from "Station B" to "Station A," and possibly an independent line to the distributing stations in Victor, including the connections through "Station A," thus permitting the use of the entire energy of both stations in parallel over either station's lines, or to work each station independently, as desired. It is also proposed that transmission lines shall be extended from these stations to other localities within reach. Thus, with two complete pipe lines, pole lines and generating station systems, the most unquestioned reliability of service may be counted upon. The distribution of light

and power, together with the company's independent telephone system, constitutes one of the most valuable systems of its kind in the country.

It is also the intention of the company to install a third station on the combined Beaver streams, at a point near the mouth of the cañon, and approximately two miles below "Station B," the lower one known as "Station C." Here the difference in elevation is but 373 feet, but the volume of water will, it is believed, develop 2,100 horse-power less losses.

The company owns also an excellent reservoir site on east Beaver,

FIG. 10.—GENERATORS, SWITCHBOARD AND TRANSFORMERS, PIKE'S PEAK PLANT.

at 1,700 feet elevation above "Station B," and but 2½ miles distant, which reservoir may be developed to excellent advantage in the near future.

PERSONNEL AND INVESTMENT.

It may be added that the Pike's Peak Power Company has a stock issue of $1,000,000 and an authorized bond issue of $150,000, all of which is owned by the Woods Investment Company, of Victor and Colorado Springs. The present cash value of the Power Company

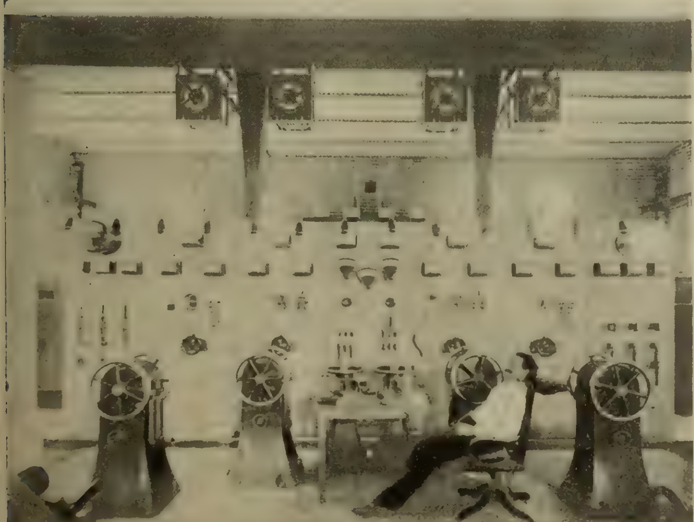


FIG. 11.—VIEW OF SWITCHBOARD AND GOVERNORS.

alone is over $1,000,000. It is represented by Warren Woods, president; H. E. Woods, vice-president; F. M. Woods, secretary and general manager, and R. M. Jones, engineer and general superintendent.

The company was organized and the property developed originally by The Woods Investment Company, for the purpose of supplying power and light to the milling and mining interests owned and controlled by them in the Cripple Creek mining district, but the work of construction was carried out on a basis of much larger magnitude than at first intended; hence the company is now supplying current to other properties and doing a large proportion of the lighting in the various towns in the district.

The engineering in every department of the construction, from the beginning to the present operation, was carried out by R. M. Jones, an old Edison manager, who will be remembered by many as the engineer of The Big Cottonwood Power Company and the "Jordan Narrows" Plant, described in these pages some years ago, both in the Salt Lake Valley, Utah, and prior to this was active in the construction of the central lighting plants and street railways in Wyoming, Montana, Utah and Nevada, beginning with the Laramie Edison Plant, in 1886.

Railroads and Telegraph Business.

Discussing the recent situation, in transferring Pennsylvania Railroad lines from Western Union to Postal Telegraph management, Mr. J. P. Altberger, superintendent of the Western Union in Philadelphia, says:

"The Western Union looks upon the whole affair as a matter of business. It is like the lease of one's house. It is about to expire. Notice has been given to vacate the premises. The Western Union will vacate. That is all. Our pike lines traverse practically the same territory as those on the railroad right of way; and these pike lines, instead of being in a state of decay, as has been reported, are in a far better condition than the railroad lines. We consider, and have always considered them, not only the best from a technical point of view, but also in a commercial way. In most of the towns where the Postal will succeed us in the railroad station we have offices, and will lose little business, and what we do get will be more profitable. The railroad company gets 50 per cent. of the receipts at all these stations. The operator is ticket agent and expressman as well. Naturally, having so much to do, the telegraph business is not given, right along, the best of attention. The message is sent when the operator gets time from his other duties. Besides, there are hundreds of messages for the railroad company sent every day, and these go free, taking the time of the operators at both ends without any profit to the telegraph company. In dollars and cents the Postal will not be better off than they were before they succeeded us. The cost of maintaining these lines quite equals the receipts."

Indiana Electric Light and Power Organization.

In response to a hundred or more invitations about 25 official representatives of the central station electric light and power companies of Indiana held a meeting at the Denison House, Indianapolis, a short time ago and organized the Indiana Electrical Association. Among the chief promoters of the concern are T. A. McReynolds, general manager of the Kokomo Electric Light and Railway Company, and Hal. C. Kimbrough, secretary of the Muncie Electric Light Company. The latter said that the main purpose of the organization was to afford the officers of the various companies an opportunity to become acquainted with each other for mutual information and assistance regarding the transaction of business and acquaint each other with the various methods in vogue. When asked if it was not also the purpose of the association to establish a uniform rate for electricity throughout the state, Mr. McReynolds said that question would be taken up later on. He said that prices throughout the state for light and power range from 5 cents to 20 cents a thousand watts. "After due allowance being made for the varying cost of fuel in different localities adjacent and remote from the coal fields the discrepancy is too great" said he.

The first regular meeting of the association will be held in Indianapolis, September 17 and 18. An interesting and instructive programme will be arranged. It is the purpose of the association to exchange technical information as well as to profit by each other's commercial experience. After adopting articles of association the following officers were elected: T. A. McReynolds, Kokomo, president; J. H. Harding, Laporte, first vice president; R. N. Parrett, Princeton, second vice president; Hal. C. Kimbrough, Muncie, secretary, treasurer; Executive Committee, S. E. Gard, Richmond; C. F. Hewitt, Elkhart; A. M. Barron, Franklin; W. F. Weyerbacker, Booneville. Finance Committee, A. M. Barron, J. H. Harding and C. F. Hewitt.

Surges in Transmission Circuits.*

BY F. G. BAUM.

A PAPER was presented by Mr. C. P. Steinmetz at the annual meeting of the American Institute of Electrical Engineers a year ago, discussing the subject of the causes and probable effects of the rise in potential over transmission circuits, but the paper was remarkably mathematical, and for that reason probably did not receive the attention it deserved. The subject has since been discussed by Dr. Kennelly[1] and by Mr. Percy H. Thomas.[2] These men are to be congratulated on their clear line of reasoning.

The subject is an interesting one to us, as we have all seen lightning arresters fused on account of the sudden opening of a circuit. I shall attempt to put the matter as briefly as possible, and in such a form that the rise in potential which we may get under the worst conditions may be easily and quickly determined. Three cases will be discussed:

a. Opening a line under a load or short circuit.

b. Closing a high potential line switch to charge the line.

c. Opening a high potential line switch to "deaden" the line.

(*a*) *Opening a Line Under Load or Short Circuit.*—Let us consider the case of a long line with a receiver load concentrated at the end. The line capacity will be assumed equivalent to a single capacity at the center of the line. We will consider one leg of a three-phase system. The self-induction of one wire from the generator to the center of the line, that is, up to the capacity, is L, and the capacity of the entire line as a condenser is C (C is the capacity between one line wire and neutral). A current, I, flows over the line and is suddenly interrupted. As is well known, the energy stored up in the magnetic field (due to the current I), between the generator and the center of line is $LI^2/2$. If the current is suddenly interrupted, this energy must flow into line condenser, since their is no other outlet. (It should be noticed that when the receiver is opened the line condenser is in series with one-half the line and the generator). If V is the resulting potential across the line condenser, the energy stored up in the condenser is $CV^2/2$. But this is the same amount of energy which was previously stored in the magnetic field, neglecting the small loss due to the current flowing over the line resistance in flowing over the line into the condenser. Therefore,

$$\frac{LI^2}{2} = \frac{CV^2}{2}, \text{ or}$$

$$I = V\sqrt{C/L} = VC\left(\frac{1}{\sqrt{LC}}\right) \qquad (1)$$

The current produced in a condenser of capacity C by an electromotive force having a frequency F is equal to (applied e. m. f.) $\times$ $C\,2\pi F$.

Comparing terms with (1) we see that $\frac{1}{\sqrt{LC}} = 2\pi F$,

in which F is the frequency of the current in the condenser. (1) may therefore be written:

$$I = VC\,2\pi F, \qquad (2)$$

in which F is the natural periodicity of one-half the line. What really happens then when we interrupt the current I, is that the same current, having its natural outlet cut off, flows into the line condenser and charges the line. But the line condenser cannot remain charged, and, therefore, the condenser discharges again into the line self-induction, and the energy again is in the form of magnetic energy. The magnetic field, then, again breaks down, giving up its energy to the capacity and the whole cycle is gone over again and again, until the resistance of the line consumes the energy originally stored in the line self-induction. The frequency of the give-and-take of energy between the capacity and line self-induction is determined by the natural periodicity of the circuit F. The frequency F in the equation (2) is, therefore, the frequency of the current I, after this current has been interrupted at the receiver. If the circuit is working normally at a frequency f, the current I changes from a frequency f to a current of frequency F, that is, from the normal impressed period to the natural period of the circuit.

The natural periodicity of a circuit may be easily found from the equation,

$$2\pi F = 1/\sqrt{LC}, \text{ or}$$

$$F = 1/2\pi\sqrt{LC}. \qquad (3)$$

For a three-phase transmission line we may take the self-induction for one-half line, for one wire, as .08 henries per hundred miles, or $L = .08\,H$, H being the length of line in hundred miles. C may be taken as two microfarads per hundred miles, or $C = 2H/10^6$ farads. Substituting for C and L in equation (3), gives us approximately,

$$F = 400/H. \qquad (4)$$

(This frequency will not differ much for different distances between wires, because an increase in the distance will increase L and decrease C, the product remaining nearly the same. The same is true for different sizes of wire.)

That is, a line 100 miles long has a natural periodicity of about 400; a 200-mile line a periodicity of 200, etc. If we are operating normally at 60 cycles, a 200-mile line has a natural periodicity of little more than three times the frequency of operation.

From (2) we get the potential across the line condenser due to interrupting the current I equal to

$$V = I/C2\pi F. \qquad (5)$$

Substituting for C the value $2\,H/10^6$, and for F the value $400/H$, we get the simple equation,

$$V = 200I \text{ (approximately)}. \qquad (6)$$

That is, the rise in potential is as a first approximation independent of the length of the line and equal to 200 times the interrupted current in amperes. If I is equal to 100 amperes (141 amperes maximum), and the current is interrupted when it has its maximum value, then

$$V = 28{,}200 \text{ volts} = 200 \times 100\sqrt{2}.$$

Interrupting 200 amperes would give us double this rise. This electromotive force will be superimposed on the line electromotive force, so the maximum strain possible for any interrupted current is

$$\text{Maximum strain} = E\sqrt{2} + 200\,I\sqrt{2}.$$

E is the voltage between line wire and neutral, and I is the current in amperes interrupted. It has been frequently noticed that a line having been short-circuited and the short-circuit broken, the short-circuit will frequently re-establish itself or a new short start at some other place between points across which the line voltage could not jump. The superposition of the oscillating electromotive force due to the removal of the short-circuit to the line electromotive force is no doubt the explanation. We have assumed that the current is instantly interrupted. An arc will always be formed which will reduce the rise in potential.

On account of the inductive drop over the line, it is very probable that the current to be transmitted over one wire of a long-distance transmission (100 to 200 miles) must be limited to about 100 amperes, unless the frequency is reduced below 60. One hundred amperes, at 60 cycles, transmitted over a line 200 miles long gives us an inductive drop of about 50 per cent. with 50,000 volts between wires. The generators will probably deliver four times full load current as a maximum on short-circuit. A short-circuit in the center of the line would, therefore, give us about twice full load current, so that the maximum rise in potential due to the interruption of the short-circuit would be about 56,000 volts. If the line is operating at 30,000 volts (equals 30,000 $\sqrt{2}$ maximum) between neutral and line wire, the strain would be a little more than twice the normal. Under certain conditions a greater rise may take place.

In the above we have assumed a long trunk line with a receiver at the end. When the receiver current is interrupted, the line current is forced into the condenser. On our long lines, however, we usually have loads distributed along the entire length, and if there is a load on at different points the line discharges a portion of its energy into the local distributing circuits, and the rise in potential is therefore limited.

The amount of energy stored in one-half of a 100-mile line is quite small. For 200 amperes it is

$$LI^2/2 = \frac{.08\,(200)^2}{2} = 1600 \text{ joules}.$$

That is, 1,600 watts for one second. This amount of energy can

* A paper read at the annual meeting of the Pacific Coast Transmission Association, San Francisco, Cal., June 18, 1902.

[1] "Surges in Transmission Circuits," by A. E. Kennelly, ELECTRICAL WORLD AND ENGINEER, Nov. 23, 1901.

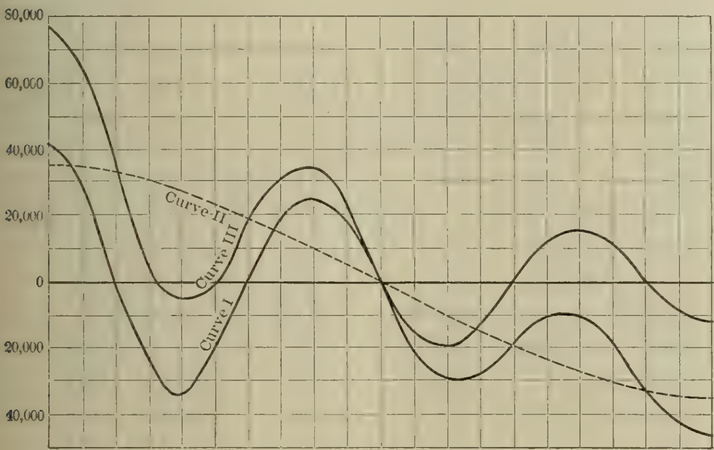
[2] "Static Strains in High Potential Circuits," by Percy H. Thomas, Transactions of the American Institute of Electrical Engineers, February, 1902.

be easily consumed by the local distributing systems and the line relieved of excessive strains. It is, therefore, important in a long line to have the loads distributed as much as possible, and then if we have even the worst conditions of a short-circuit no excessive rise in potential will probably take place.

(*b*) *Closing a High Potential Line Switch.*—On first closing a line switch on a dead line, a current will flow into the condenser. But this current to reach the condenser must flow over the line self-induction, and energy will be stored in the magnetic field. This energy will then discharge into the condenser and add to the charge already in it. The maximum rise in potential is double normal working value.

(*c*) *Opening Line Switch.*—If we open a line switch to deaden the line we have the condenser of the line discharging at the periodicity of the line across the switch terminals the moment they are separated, due to the charging current of the condenser, the potential of the line rises to its maximum working value at the normal frequency of the circuit. Before the switch jaws can be separated very far, the line potential due to the oscillating current in the line will be superposed on the potential across the switch due to the generator. This may cause the arc to re-establish itself several times before the line is finally dead. The maximum possible rise in potential in this case is double normal working value.

We see from the above that the most dangerous condition is brought about when we suddenly open a short-circuit. Curve I in



CURVES OF TRANSMISSION CIRCUIT.

the figure shows the oscillating potential due to interrupting 150 amperes on a line about 130 miles long. Curve II shows the generator potential, and curve III the resultant line potential. The voltage of the line is 25,000 between neutral and line wire, and the frequency 60. The current is interrupted so as to produce maximum rise of potential.

The resultant potential, we see, is very much different from the impressed generator pressure. If, we continue to lengthen our lines until the natural periodicity of the circuit becomes nearly equal to the impressed periodicity it is very probable that we will have some new problems to solve. It may be that this will prove the determining factor which will limit the distance of transmission. It is intended to carry on some experimental work in this direction in the near future to determine, if possible, what new problems would have to be met if our lines should reach a length of from 400 to 1,000 miles.

Church Service By Telephone.

Reports from Washington, Ind., state that the Central Union Co. at that place started a new kind of telephone service for the benefit of those who wish to listen to church services going on in the city, without actually attending. Transmitters are placed in front of the pulpit at the leading churches, and subscribers can be connected to hear the church service desired. The first test of the plan was made June 13, when telephone subscribers of Washington and surrounding country listened to the sermon of Rev. J. F. Floyd. The idea is a very old one, but seems never to have been sustained in "commercial" practice by exchanges.

Engine Speeds for Direct-Connected Alternators.

By Edgar Knowlton.

In the past two or three years there has been a marked increase in the number of direct-connected alternators, and the angular variation allowable for successful parallel operation has received much attention, the October meeting, last year, of the American Institute of Electrical Engineers being entirely devoted to this subject. This article will discuss the influence of speed on the amount of flywheel effect required.

For ordinary power work, assuming other conditions equal, the flywheel effect varies inversely as the square of the speed, while in engines driving alternators it varies inversely as the fourth power of the speed. The reason for this will now be taken up.

For successful parallel operation it has been found advisable to limit the phase displacement between two alternators to 5 degrees. This means that the revolving part of either machine must not vary from a mean position more than 2.5 electrical degrees. When a conductor passes from the influence of one pole to that of the next like pole, the value of the e. m. f. induced therein passes through a complete cycle of 360 degrees. Therefore, the angular displacement of the revolving part which corresponds to a phase displacement of 2.5 degrees is:

$$\phi = \frac{2.5}{\frac{No.\ poles}{2}} = \frac{5}{No.\ poles}$$

The angular variation is kept within the above limit by the inertia of the revolving parts. Since we are considering only the influence of speed, we will assume that engines of the same type have similar crank-pin efforts, and, therefore, the same relative tendency to speed variation during a revolution.

Let W = weight of the revolving part.
R = the radius of gyration.
S = revolutions per minute.
P = number of poles.
V_0 = average velocity in feet per second at the radius of gyration.
V_1 = maximum, ditto.
V_2 = minimum, ditto.
T = time in seconds elapsing during that speed variation which causes the greatest angular displacement. We will assume that this variation is above the normal.
K = the ratio of T to the time required for 1 revolution.

Then

$$T = \frac{60\,K}{S} \qquad (1)$$

The kinetic energy is given out by the revolving parts changing in speed from V_1 to V_2 is

$$K_e = \frac{W\,(V_1^2 - V_2^2)}{2\,g} \qquad (2)$$

$\frac{5}{360\,P} \times 2\,\pi\,R$ = number of feet that a point at the radius of gyration becomes displaced from a mean position.

$\frac{V_1 - V_0}{2} \times T$ = ditto.

This assumes a uniform increase of speed from V_0 to V_1, which, while not strictly correct, does not affect the general formula which is here derived.

$$\frac{V_1 - V_0}{2} \times T = \frac{5}{360\,P} \times 2\,\pi\,R$$

$$V_1 = V_0 + \frac{.175\,R}{T\,P}$$

$$V_2 = V_0 - \frac{.175\,R}{T\,P}$$

substituting the value of T as given in (1)

$$V_1 = V_0 + \frac{.0029\,R \times S}{P\,K}$$

$$V_2 = V_0 - \frac{.0029\,R \times S}{PK}$$

$$V_1^2 - V_2^2 = \frac{.0116\,R \times S \times V_0}{PK}$$

$$V_0 = \frac{2\pi R \times S}{60} = .1047\,R \times S$$

substituting this value of V_0.

$$V_1^2 - V_2^2 = \frac{.00122\,R^2 \times S^2}{PK}$$

substituting this value of $V_1^2 - V_2^2$ in (2)

$$K_e = \frac{W \times .00122\,R^2 \times S^2}{2g\,PK}$$

For engines of similar type this quantity, K_e, is practically a constant percentage of the foot lbs. of work done during one revolution. Let this percentage equal c, then

$$K_e = \frac{c\,Kw}{S}\text{, then}$$

$$\frac{c\,Kw}{S} = \frac{W \times .00122 \times R^2 \times S^2}{2g\,P\,K} \text{ and}$$

$$WR^2 = \frac{c\,Kw \times 52800 \times PK}{S^3} \qquad (3)$$

$$P = \frac{\sim 120}{S}$$

substituting this value of P in (3),

$$WR^2 = \frac{c\,Kw \times K \times \sim \times 6{,}336{,}000}{S^4}$$

The variables in the second member of this equation are

KW, $\sim$ and S^4

substituting A for the constants

$$WR^2 = \frac{A \times Kw \times \sim}{S^4} \qquad (4)$$

This shows that the flywheel effect varies directly as the Kw and cycles, and inversely as the fourth power of the revolutions per minute.

In a paper, entitled "Some of the Requisites of Modern Lighting Generator Sets," read by Mr. H. G. Reist before the Engine Builders' Association, and published in the ELECTRICAL WORLD AND ENGINEER, of Dec. 15, 1900, there is given this formula for obtaining the weight of the revolving parts of a direct-connected generating set, namely,

$$W = \frac{C \times Kw \times 100^2 \times 5000^2}{S^2\text{ (speed in ft. per minute at rad. of gyr.)}^2} \qquad (5)$$

The values of C for different cycles and types of engines were given as follows:

	Horizontal Tandem Comp.	Horizontal Cross Comp.	Vertical Cross Comp.
25 cycles.............	65	40	60
40 cycles.............	104	64	96
60 cycles.............	156	96	144

It will be noticed that for the same type of engine C varies directly as the number of cycles.

Changing the formula (5) to give the value of WR^2, we have

$$WR^2 = \frac{Kw \times O \times 10^9}{S^4} \qquad (6)$$

This is another form of formula (4).

$O \times 10^9$ being substituted for $A \times V$. When C has the values given above the values of O are as follows:

	Horizontal Tandem Comp.	Horizontal Cross Comp.	Vertical Cross Comp.
25 cycles...........	410	253	380
40 cycles...........	660	405	607.5
60 cycles...........	990	607.5	910

In addition to preventing too great an angular displacement during one revolution, the flywheel must be heavy enough to prevent too great a variation in speed during the interval between a change in load and the final adjustment of the regulator for that load. The amount of flywheel effect necessary to accomplish the latter bears no relation to the amount required for the former, and it is usually much less; but the author of the paper mentioned has informed the writer that he has occasionally found that formula (5) gives too light a flywheel for the latter requirement when used for the horizontal cross-compound engines driving 25-cycle alternators. It will be noticed that the value of C for such a case is much the lowest of any in the table.

The importance of selecting as high a speed as possible is shown by the following table calculated by formula (6):

Cycles	KW.	S	WR^2
60	600	100	3,640,000
60	600	120	1,750,000
60	600	150	720,000

To the advantage of the reduced weight of the revolving part is added that of making the alternator itself smaller and cheaper. With the usual type of generating set having the flywheel separate from the alternator the weight of the flywheel is kept down by using as large a diameter for the wheel as the stresses in the rim will permit. This causes the diameter of the flywheel to be considerably greater than that of the revolving element of the alternator. With a flywheel effect based on the foregoing formulæ the *approximate* weight of the separate flywheel varies inversely as the square of the speed.

Although high-speed is of considerable advantage in sets having a separate flywheel, it is of far greater advantage in the type where the flywheel is combined with the revolving element (usually the field) of the alternator. When this is done it is not advisable to use the same diameter for the flywheel that we would for a flywheel separate from the revolving field. The two principal reasons for this are that the mounting of the poles on the rim would cause additional stresses therein, and the large diameter would increase the cost of the alternator proper, especially the armature frame. For the greater the span the heavier must be the frame to prevent excessive deflection. It is customary to choose a somewhat smaller diameter and increase the section of the flywheel rim to give the required flywheel effect.

A consideration of the formula derived will show that the ideal machine for the flywheel type is one of the lowest number of cycles and the highest speed; and since a high voltage alternator must usually be made of larger diameter than one of low voltage, this might be added as a third requirement. This does not mean that flywheel machines cannot be built advantageously except they meet these requirements, but simply that in comparing the advantages of the flywheel and non-flywheel types, the flywheel type will appear to better advantage when the cycles are low and the speed and voltage high. For instance, the cost of a set of a given frequency, output and speed might be as follows for the different voltages and types:

15,000 volts. Flywheel type, cost represented by 1
15,000 " Separate flywheel, cost represented by 1.25.
480 " Flywheel type, cost represented by .9
480 " Separate flywheel, cost represented by 1.05

The high-voltage flywheel type set cost 20% less than the high-voltage separate-flywheel set, while the low-voltage flywheel set costs but 14% less than the low-voltage separate-flywheel. The question whether the flywheel or separate flywheel type is the most desirable can be decided only after a careful investigation of the costs and the advantages of each. But in either case as high a speed should be chosen as the reliability of operation of the engine will permit. In the Corliss type of engine the speed is usually limited by the valve action. In other types it is usually limited by the heating of the rubbing surfaces and by deterioration of the moving parts, too high a speed necessitating frequent shut-downs for repairs. The tendency is toward higher speeds and engines are now built for speeds that were considered prohibitive a few years ago.

The steam turbine, like the waterwheel, has no tendency to variations in angular velocity, therefore is an ideal engine in this respect. Its high speed makes it possible to secure a large output compared with its size and weight. But more than ordinary care must be exercised in the design of alternators driven by it on account of the centrifugal force of the revolving parts.

Attenuation and Distortion on Long Distance Telephone and Power Transmission Lines Regarded as Hydrodynamic Phenomena.*

BY HENRY T. EDDY.

THE analogy between a steady flow of water in a long pipe under the action of a constant head and a continuous current of electricity under some constant pressure such as is furnished by one or more cells of a battery, has often been employed to give a clear elementary physical conception of the mathematical relations expressed in Ohm's law. In this case the applied pressure is gradually consumed by the resistance experienced by the current, and in strict analogy with the flow of water, the loss per unit of length is proportional to the product of the square of the current and the first power of the resistance. So far as the mathematical relations are concerned the two problems are identical.

It is the object of this paper to extend this hydrodynamic analogy to the more complicated case of long-distance transmission by alternating currents in general.

Telephone transmission has been specifically mentioned in the title in order to include the general case of variable frequency. The importance of thus extending and enlarging this analogy will be evident when we reflect that all the complicated phenomena of long-distance electrical power transmission, by any combination of land lines and cables with their sending and receiving apparatus may be completely reproduced in all its details of operation by simple pumping machinery with its transmission pipes and air chambers, whose pipes and air chambers, whose manner of operation may be made clear to anyone without the aid of higher analysis. Let us first take the case of a double acting pump cylinder and piston in which the two ends of the cylinder are connected by a simple pipe or by-pass without valves. When this apparatus is filled with water and the piston is moved back and forth by a uniformly rotating crank, the water is forced through the by-pass alternately from one end of the cylinder to the other. If the by-pass is short, the resistance to motion may be taken as due to fluid friction only, since the inertia of the water may then be disregarded. This is in every particular analagous in the manner of its operation to a sinusoidal electromotive force acting in a circuit whose induction and capacity may be disregarded in comparison with its ohmic resistance.

But in case the pipe connecting the ends of the pump cylinder be made very long and the size sufficient to greatly reduce the friction, we may disregard this in comparison with the resistance due to the inertia of the water. The resistance due to inertia is proportional to the product of the mass of water moved by its acceleration. Since this acceleration is greatest at the beginning of the stroke and vanishes at middle of the stroke, where it changes to a retardation of amount increasing to the end of the stroke, it is evident that the phase of the current lags a quarter of a revolution or period behind that of the pressure, the pressure being a maximum at the beginning of the stroke, and the current a maximum at the middle of the stroke. During the retardation of the piston the inertia of the water acts to drive the piston forward, and (disregarding friction) as much energy is returned to the piston during retardation as is exerted by it during acceleration, so that on the whole no loss of energy occurs during the stroke. In these particulars this case differs from that previously considered, where the pressure is in phase with the current and energy is expended against resistance during the entire stroke.

Now suppose that fluid friction and inertia coexist in the connecting pipe; it is evident that their coexistence does not affect the separate actions which have been described. The current or flow back and forth is that due to the reciprocating motion of the piston, and the pressure is the resultant of the two pressures already described, differing in phase by quarter of a period. The lag of the current will, therefore, be less than a quarter of a period.

The inertia of the motor is entirely analogous to the self-induction of an electric circuit, and the case of combined fluid friction and inertia is mathematically in every particular the same as an alternating-current circuit having distributed ohmic resistance and self-induction.

Next let us imagine the short by-pass first considered to be sufficiently increased in diameter to make it a globular chamber as large or larger than the cylinder itself, and let it be furnished with an elastic diametrical diaphragm (of sheet rubber for example), which occupies a diametral position whenever the piston is at the middle of the stroke. It is evident that when the piston is at the beginning of the stroke the tension of the stretched diaphragm exerts a negative pressure or suction to force the piston forward in its stroke, which vanishes at the middle of the stroke, after which the pressure exerts a retardation whose amount increases to a maximum at the end of the stroke. But the total energy exerted by the diaphragm and restored to it are equal.

The action of the diaphragm differs from the action of the inertia of the water previously considered in the one particular only; it exerts its greatest forward pressure at the instant the inertia exerts its greatest back pressure, consequently when we disregard fluid friction, the phase of the current is one quarter of a period in advance of the pressure.

It thus appears that the effect of such diaphragm is opposite to that of the inertia of the water, so that a diaphragm having sufficient tension would completely destroy the effect of the inertia of the water. The general effect of this arrangement is to relieve to a greater or less extent the greater pressures, positive or negative, at each end of the stroke arising from the inertia of the water. Furthermore, it may be noticed that a somewhat different device from that just mentioned might be employed, whose resultant action would nevertheless be of the same nature. For example, instead of enlarging the by-pass let two equal air chambers be placed on it, one near each end of the cylinder. This is, in fact, the manner in which relief is actually obtained in pumping machinery, from the shock and greatly increased pressure at the beginning and end of the stroke arising from the inertia of the water. Mathematically, the effect is the same as that of the diaphragm previously described.

The operation of the diaphragm and air chambers just considered is strictly analagous to that of capacity in an alternating-current circuit, the diaphragm to capacity in series, and the two air chambers to capacity in shunt, and by these self-induction may be neutralized to a greater or less extent according to their relative amounts.

We have thus far considered merely the peculiarities of the transmitting or connecting pipes in their relation to the double acting force pump regarded as the source of energy. We need next to consider a receiving pump which shall take and utilize the energy not expended in fluid friction. Let the receiving pump be assumed first to be exactly like the force pump, and to actuate a crank, flywheel and other machinery on which energy is expended uniformly. The crank end of this second cylinder is connected directly by a pipe with the crank end of the force pump, and the other end likewise. In this case the energy expended in fluid friction and inertia may be neglected in comparison with the energy transmitted; this arrangement will transmit power from the driving crank to the driven crank much as would a belt or train of cog wheels. But suppose now that the second cylinder is connected to the first by very long pipes, miles long for example, in which the inertia of the water becomes a controlling factor of the transmission. It would evidently become practicably impossible to make the water oscillate with any rapidity in such a closed pipe under ordinary circumstances. But let there be a series of air chambers uniformly distributed along the entire length of the connecting pipes, or, what would amount to nearly the same thing, let the pipe be an elastic hose requiring equal pressures to enlarge or diminish its cross section.

This will at once entirely change the circumstances of the case, for the air chambers near the force pump will readily receive the water as it flows from the force pump and transmit it to those next along the line and so on, so that a wave of pressure will pass along the pipe and at the same velocity a wave of current will pass having its maximum flow at points where certain high pressure air chambers are discharging into those next along the line. By these progressive pressure and current waves, energy will be transmitted to the working cylinder, which need not in this case be of the same cubic capacity as the force pump. Several complete waves may be in progress of transmission along the pipe at once. The frequency of oscillation in the working cylinder will be equal to that of the force pump to an amount which may be completed in any given case. But it will lag in phase behind that of the force pump to an amount due to the number of waves and fractions thereof in progress of transmission along the line, and to all the inertia of the working piston, etc.

It is evident that when the two cylinders are equal in every respect, except that the piston of the second cylinder is of such large

* Paper read at the Pittsburg meeting of the A. A. A. S.

mass that its inertia is great, and when in addition we may disregard fluid friction, and the flywheel of the second cylinder is running idle, that no work is expended in the system. In this case the second piston will originate transmission waves precisely as does the first, but in opposite direction. The resultant of these equal and opposite progressive waves will be a system of stationary waves along the line. Whenever the amount of energy used at the working cylinder is small compared with the total energy, kinetic and potential, at and near the receiving apparatus, the waves originating there will approach the magnitude of those received by it. Any discontinuity of mass in the current flowing pipe, as for example mercury in place of water for some bent of the length pipe, will originate reflected or return waves. To insure good transmission, little or no discontinuity in the distribution of the inertia along the pipe should occur at any point of such as would be due to changes of size or otherwise.

All these results are equally true of alternating-current circuits.

It may be shown from elementary considerations that the progressive velocity of the waves in the transmission pipe under consideration is constant for all frequencies of oscillation in case of a pipe in which the friction may be disregarded, but that the velocity increases as the square root of the frequency in any case where the inertia of the current may be disregarded. The case of unequal velocity of the waves propogating the harmonic components of sounds in telephone transmission by reason of their difference of pitch, which is one cause of the distortion of sound in long-distance telephone transmission, has been treated at length in the researches of Dr. Pupin, who has investigated very fully the inductive (or inertia) loading necessary in order tő render lines practically distortionless. It is equally a hydrodynamic phenomena. The one question remaining for elucidation is that of the attenuation or gradual diminution of amplitude of waves as they progress along the line.

It may be readily shown that in both of the two extreme cases already considered, namely, those in which either friction or inertia is disregarded, that the logarithm of the reciprocal of the amplitude, or intensity of the wave at any point, varies directly as the product of the distance of the point from the source of the wave by its velocity. Since this velocity has already been shown to be constant in case the fluid friction may be disregarded, and to increase with frequency in case inertia is disregarded, it is evident that attenuation depends upon frequency in case of fluid friction without inertia, but is independent of frequency in case of inertia without fiuid friction. Such unequal attenuation in the telephone obliterates to a greater or less extent tones of high pitch before it does those of lower pitch. It is, therefore, necessary to distinct transmission that the self-induction of the line should be large enough to store a large amount of kinetic and potential energy in the wave motion along the line, which in all its aspects is strictly analagous to the wave motion propagated in the water in the apparatus just described.

Induction Motors.

The "Question Box" at the recent Electric Light Convention contained several queries relating to the operation of induction motors and these brought out a large number of replies which form a valuable contribution to the practical side of the subject. Below we give the various replies as offered in written communications or in discussion of the questions at the meeting.

In reply to the question: Is it possible to operate induction motors for elevator service and other intermittent use from lighting feeders without serious disturbance to electromotive force? Mr. Ralph D. Mershon said such induction motors can be used for elevators and other intermittent services, and if the proper type be installed will cause practially no more disturbance on the lighting feeders than would be caused by the corresponding direct-current shunt motor for the same service. Mr. W. T. Oviatt said his experience was that it is not possible to operate induction motors for intermittent service from lighting feeders without interference with the lighting. His experience includes single phase up to 7½ hp, three-phase up to 15 hp. The single-phase motors have been operated from a large system of secondary mains and separate transformers; the three-phase have been operated only from separate transformers, and in all cases it has been found that they produce a serious disturbance to the lighting. Mr. F. L. Sargent, of Malden, Mass., said that the motor business of his company is all three-phase and it does not allow any elevator service on the three-phase motors unless the motor is running continuously on tight and loose pulley, or in a case of a hydraulic elevator with a by-pass valve, as otherwise too much disturbance is caused in the e.m.f. on the generators. He added that all of the power service is on circuits independent of lighting circuits. The experience at El Paso, Tex., of Mr. J. E. Barker with induction motors for elevators has been that the frequent starting and stopping causes the line e. m. f. to fluctuate to such an extent that it is impossible to do a satisfactory lighting business from the same line. This is not so important if a special power circuit is run, but, as the starting current is often four times the full-load current, it is evident that large generators would be required to take care of a relatively small amount of business.

Mr. H. B. Geer, of the Chicago Edison Company, expressed the opinion that induction motors may be operated for elevator service and other intermittent uses from lighting feeders without serious disturbance of the pressure, under certain conditions. In Chicago this class of service is being carried on four-wire three-phase circuits operated at 2200 volts from neutral to phase wire, with 3800 volts between phase wires. The circuits carrying these motors carry the lighting ioad on one phase, the size of the wire on that phase and the neutral being designed to give 5 per cent. drop from the station to the distributing center. The other two-phase wires are No. 6 uniformly, the lighting wires being mostly No. 2. Such a circuit will carry elevators operated by 10 or 15 horse-power motors without serious disturbance in the pressure at a distance of two to three miles from the station or substation. Mr. J. H. Perkins, of Youngstown, O., considered that under certain relative conditions between generator and motors, and if the motor is supplied by an independent transformer or a bank of transformers whose capacity is large relative to the motor, it is possible to operate satisfactorily induction motors on elevator loads. Mr. Charles F. Scott said the answer to the question depends on conditions. In some stations where the conditions are favorable various classes of motors can be operated without interference to the lighting service. In other cases it is not true. The same statement might be made with regard to direct-current motors. The question might be put: Is is possible to operate direct-current motors for elevator service and lighting on the same service? I know of cases where the induction motor has been criticised for not doing good work on elevators where a direct current motor would not be used, and in such cases the induction motor is expected to do more than the direct-current motor would do.

Another question considered was as follows: What specification should prevail in purchasing induction motors to insure least disturbance to line electromotive force?

In reply Mr. Ralph D. Mershon said that the type of motor should be that having a rheostat included in its secondary circuit, the rheostat being such that it may be cut out by as great a number of steps as is necessary to keep the disturbance down to the point desired. In specifying the number of steps there shall be in the rheostat and the magnitude of each step, one should follow the course which would be followed in specifying the starting rheostat for a direct-current shunt motor for the same service as that which the induction motor has to meet. In addition, the motor should, of course, have as high a power factor at all loads, as is consistent with the maximum torque that will be required of it. Mr. Chas. F. Scott stated that specifications are sometimes presented which place the starting current as a certain fraction of the full load current, independent of the size of the motor. That is evidently not a fair thing, as a circuit which will enable a 10-hp motor to start with, say, its normal full load conditions—that is, taking its normal full load current at the start—would permit of a 1-hp or 2-hp motor being started with 2, or 3, or 4 times its full load current, and not make the same disturbance on the circuit that the 10-hp motor would starting with only its normal current. It would be better, therefore, in specifications of this kind, to place some limit upon the amount of current which can be taken from the circuit, or make different specifications for different sizes of motors instead of making a specification which refers alike to all motors. If the starting current is specified in terms of a full load current, then it may be that a poor motor would pass the specifications, and a good motor would not. For example, suppose two motors were used which took the same starting current, but one of them took a considerably greater running current than the other; the one with the greater running current would then be the poorer

motor, but as it takes less starting current it might pass the specifications where the other motor would not.

Another question, and one which elicited a large number of replies, was as follows: What has been the experience from the use of single-phase induction motors above one-horse power on lighting feeders?

Mr. Ralph T. Patterson, of Waterville, Me., said that his company has in use one 40-hp and one 15-hp and one 25-hp induction motors on its lighting service lines, with no bad results, although it is true that there is a variation of the voltage in starting and stopping them. Mr. F. L. Sargent, of Malden, Mass., said that before the power circuits of his company were completed, several single-phase motors were on our lighting feeders, from one and a half to five horse power, and they caused us no trouble. Mr. W. J. Greene, of Cedar Rapids, Ia., said that a 15-hp, single-phase induction motor caused no disturbance in regulation; at least no complaints were received that could be attributed to it. The motor was in use for five months prior to December 24th, 1901, for operating a stone-crusher. Mr. C. E. Burrows, of Walla Walla, Wash., said his company has a 15-hp Wagner single-phase induction motor running a pump, current being generated at a water-power station five miles away. Every time the motor is started or stopped every incandescent light in town is affected. It is a great nuisance. Mr. H. T. Gille of St. Paul, Minn., said that the largest induction motor on the St. Croix lighting feeders is three horse-power. No trouble has been experienced from motors up to this size interfering with the regulation on the lighting system.

Motors up to sizes of 20-horse-power, Mr. J. H. Perkins, of Youngstown, O., said, had been satisfactory in every way and they will do all that can be done with a polyphase motor. They have an advantage in requiring only two wires and one transformer, which makes the cost of installation less and makes it economical to reach out-of-the-way places as well as the point near the center of distribution. Motors that have been in service some three years have never had repairs or caused trouble. Mr. Perkins added that he would rather have ten alternating current motors on his line than one direct-current. His company operates 500-volt direct-current and both single and polyphase motors.

The Missouri Edison Electric Company reported that the entire alternating-current distribution of the company is single-phase. In the concentrated business district it has the transformer secondaries cribbed on a three-wire system, this network being fed from large transformers, the primary circuits of which are independently controlled from the station distribution switchboard. This network is of ample capacity for almost any demand that may be made upon it, and throughout this district it has been our practice to place no limit upon the sizes of single-phase alternating-current motors installed. Several hundred single-phase motors are operating with entire success on this underground network, a number of which installations have individual units as high as 35 horse-power, with individual customers taking as high as 75 to 100 horse power for motor service alone. Practically all of these motors are of the Wagner Company's type, wound for 208 volts. In starting they are thrown on 104 volts, on which pressure they run up to about two-thirds speed, and are then thrown over to the 208-volt feeders. No difficulty has been experienced in operating incandescent lamps on the same service feeders, and the use of single-phase motors in preference to other methods has enabled the company to very greatly simplify its general distribution system.

In the outlying districts of St. Louis, the alternating feeders are of 100 kilowatts capacity each. On these circuits the installation of single phase motors is permitted under the company's supervision, up to 10 and 15 horse power. In one particular instance a 15 horse power motor is operating satisfactorily at a distance of four miles from the station. It is the practice to require all these motors to be wound for 208 volts, and it is exacted that they start on 104 volts in exactly the same way as in the downtown districts. Where the motors are located at remote distances from the station, it is also recommended that they be started without load. By careful supervision of these outlying installations, the company has been able to take on a great deal of alternating current motor service without detriment to its lighting distribution, and in its opinion the single-phase motor of to-day is a thoroughly practical and satisfactory machine; and if installed with intelligent supervision, it affords a means of securing a very satisfactory alternating day load, from districts into which it would be expensive and inconvenient to carry either polyphase alternating or direct-current system of distribution.

The Quincy Gas & Electric Company reported that it has a number of these motors installed. By putting in sufficient transformer capacity, as recommended by the companies furnishing the motors, no difficulty or inconvenience is found in running them on lighting feeders, and their use beyond the regular power circuit is quite a help to the income account. Mr. H. B. Gear, of the Chicago Edison Company, said that single-phase motors of one to five horse power are being operated for general power work in large numbers in Chicago from lighting feeders. Such motors when started will often produce a dip of about five per cent. in the primary pressure; but as they are started usually not more than two or three times a day and at times when very little lighting is in use, there has been no difficulty with customers' complaints on account of these motors being on the same circuit. Motors of one-hp or larger are carried on separate transformers. In a few instances, installations of several two horse-power motors aggregate 10 to 12 horse-power. These motors have been found to affect the shape of the day load curve very noticeably. The Whitehall (Ill.) Electric Company reported that in the last three years it has installed seven of this type of motors and is very well satisfied with the results. It has two of 25 hp, three of 10 hp, and two of 2 hp. The two 25-hp motors have particularly hard service; one is used to pump water from the city reservoir to a tank, being run after midnight, without attendance, and lifting 15,000 gallons 150 feet high through 6,000 feet of six-inch pipe. The other is used to run a clay grinder in a pottery, and has to contend with a variation of from no load to 30 hp every half hour, and also a change of 6 hp in the load five times every two minutes. These motors are all run from a 60-kilowatt dynamo, and with one exception are all on the lighting feeders. The company has never had any trouble with the motors, and no complaints from its customers regarding the light furnished. The motors are in first-class condition and there is no reason why they will not continue to give good service for years.

In reply to questions, Mr. B. A. Behrend said that any polyphase motor gives its output with less material than the single-phase motor. You may consider a single-phase motor as a three-phase motor, one phase of which is cut out or interrupted. As to cost, there is a difference between cost and price. You have to compare shop cost and selling price on two entirely different bases. You may have to sell a three-phase motor for about two-thirds of what you would have to sell a single-phase motor. It is perfectly natural that a single-phase motor should cost more than a two-phase motor, because it contains more material. Mr. C. C. Badeau, of St. Louis, said that Wagner single-phase motors sell for less than two-phase motors. President Doherty added that the selling price is what the traffic will bear, and not what the apparatus actually cost. This is not always the case, but it is sometimes true.

Mr. Frank H. Taylor of Pittsburg, said that the experience of central station people with alternating current motors is about the experience that he used to have as a salesman for Yale locks. There was no apparent reason why Yale locks should cost more than Corbin locks or the locks of any good manufacturer; but anyone who bought a Yale lock was never sorry he bought it and paid the price which it cost. The same thing is true of induction motors. The price is not excessive and anyone who buys one motor will buy more.

In reply to a query, "What system of charging best lends itself to the supply of power with induction motors?" Mr. W. J. Greene, of Cedar Rapids, Ia., favored a two-rate system, in which allowance is made for the cost of increased investment in generator, transformer and wire capacity, due to the effect of the low power factor. Another opinion expressed was that a consumer should be charged for "readiness to serve," on basis of maximum demand of motor. The maximum demand should, in this case, be considered the demand which would blow a fuse of rated capacity, as distinguished from instantaneous demand.

Traction in London.

A cable dispatch says: The bills affecting the Morgan and Yerkes underground railroads in London have been passed to a second reading by the House of Commons. The House of Commons has passed the bill authorizing J. P. Morgan's London United Electric Railways. Mr. Yerkes opposed the bill.

New Telephone Patents.

The issue of the Patent Office for July 15 contains three telephone patents, one relating to a hook-switch and two to silence booths. A patent on a hook-switch (which part of a telephone set, by the way, is generally called a switch-hook) requiring no fewer than twenty-one claims to cover its varied details, will strike many telephone men as coming rather late in the day, but such is the progress of invention! The inventor, Mr. William W. Dean, of Chicago, claims that his method of mounting the switch-hook springs and contacts is more reliable than other methods, not subject to failure through warping or swelling of the woodwork, nor to bad contacts through including the hook itself or the spring in the circuit.

In the Dean device the hook is pivoted on a metal bracket which also carries the spring controlling the hook and the contact springs; these are insulated from each other and from the bracket, and are controlled by the movement of the hook by means of one of the springs having its free end projecting into a slotted lug on the hook. One of the accompanying figures shows the complete device, above which is illustrated a different form, in which the spring is mounted separately. It will be seen that the hook, spring and contact springs are all carried on the bracket 3. One of the contact springs, 17, projects into the slotted lug, 16, on the hook, so that when the hook rises contact is broken with the lower spring or springs, and the upper springs are forced together. A valuable feature of the invention is that the number of contact springs may be varied as desired to suit any circuit combination by merely adding or taking away springs either above or below the main operating spring, 17, no other change in the apparatus being required.

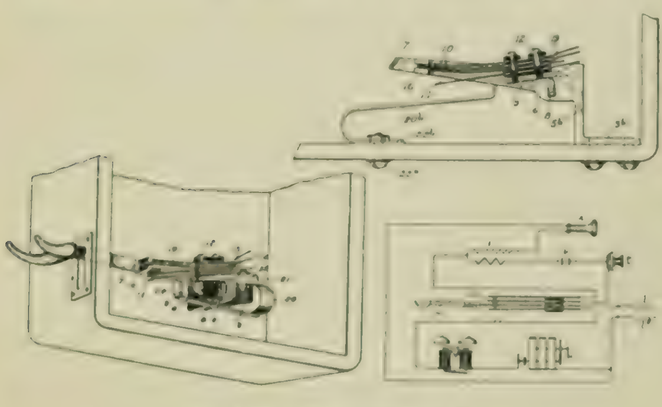


FIG. 1.—DEAN SWITCH HOOK.

A silence booth, built with regard to acoustic principles, is something of a novelty. Mr. Frank Leo Tufts takes out two patents on booths, Figs. 2 and 3, to protect his discovery that booths of circular or polygonal section do not transmit sound from one booth to another as readily as booths of rectangular shape. Mr. Tufts says that where several booths are placed in close connection "it has, heretofore, been found practically impossible so to construct the booths as to prevent conversation in one booth being heard in adjoining booths. To obviate this difficulty, great expense has been incurred in deadening walls and in making peculiarly constructed walls; but the effort has been unsuccessful, chiefly for the reason that sound travels in waves and that surfaces have a sounding-board effect, so that the sound waves are transmitted from booth to booth. I have discovered that the difficulty may be overcome in a very simple manner—to wit, by making the booths curved, and preferably cylindrical. By making the booths cylindrical or with curved walls the sound waves are not only more or less deflected, but it will be observed that such a booth is braced in all directions, and instead of one wall having the sounding-board effect and vibrating to the action of the sound waves the whole structure must respond, and this being braced in all directions is not likely to occur, so that a series of booths constructed in accordance with my invention, even though comparatively thin and cheap, have the quality of preventing the transmission of sound through the walls thereof." Fig. 2 fully illustrates Mr. Tuft's idea, and needs no description. The drawings show booths with flat tops, but to get the best possible effect the tops of the several booths should be made semi-spherical or dome-shaped, thus preventing any flat surfaces at any point within the booths.

In his second patent, Fig. 3, filed at a later date, Mr. Tufts says that he has been experimenting with sound transmission and finds "that a tube which is circular in cross-section will transmit high notes as well as, and perhaps better than, a tube which is flat-sided; but,

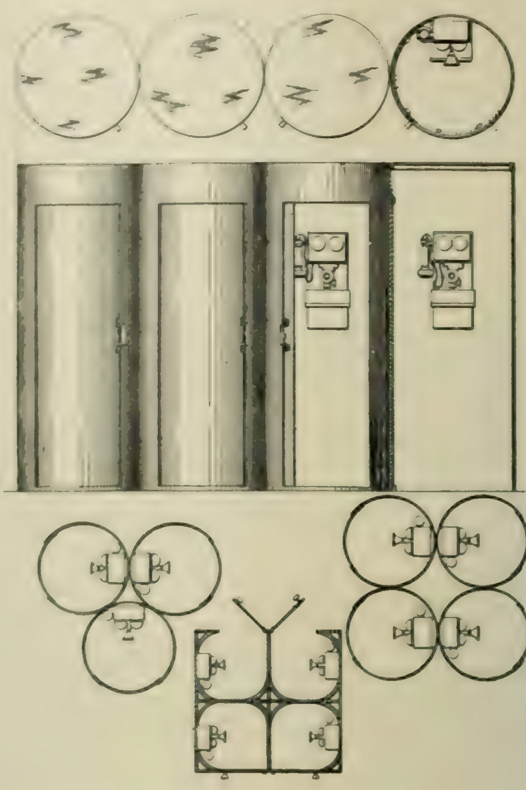


FIG. 2.—TUFTS TELEPHONE BOOTH.

on the other hand, the low notes are cut out by the circular tube, and the flat-sided tube carries them much better. In making these experiments I have found, too, that certain tones, and, perhaps, most tones, can be kept within a booth if it is made octagonal or

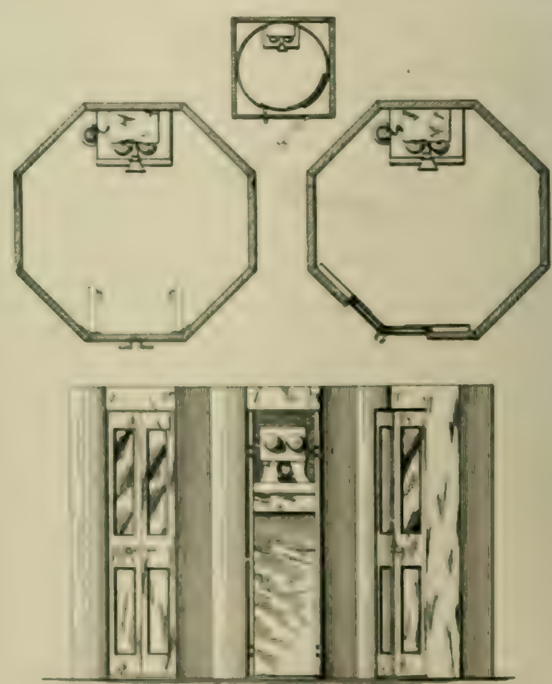


FIG. 3.—TUFTS TELEPHONE BOOTH.

polygonal in shape, or, in fact, if its broad sides are broken so as to be less than the sides of a rectangular booth in width. In carrying out this idea the walls are so braced in different directions as to prevent the vibratory and sounding-board effect. Further, as the circular form of booth cuts out certain tones and the flat-sided booth cuts out certain other tones, I have found that by combining

these two ideas and inclosing a circular booth within a structure having flat sides (even a rectangular outer structure will do), all tones are practically confined to the booth, and so the person using the telephone is in no danger of being overheard from without."

Mr. Tufts says that the octagonal form, as illustrated, is well suited for the intended purpose; but the effect is preserved if six sides are used, and obviously a greater or less number of sides can be made; but the structure must be polygonal or else the sounding-board effect is not overcome and the sound waves go through the walls. To preserve the greatest privacy, a booth of circular cross-section can be enclosed in one of a rectangular or polygonal form, as shown in one of the drawings.

To carry Mr. Tufts' theory to its extreme limit, the "silentest" booth would probably be achieved by making a circular inner booth of corrugated material, enclosed in a polygonal outer shell of which each side should be corrugated, or preferably formed of a series of pieces joined together at right angles. Such a construction would surely destroy all "sounding-board effect." The suggestion is advanced in the pure interest of the science of telephone-booth construction, without hope of future reward.

The Canadian and Niagara Falls Power Houses in Parallel.

By Arthur B. Weeks.

It is a fact not generally known that the Canadian Niagara Falls Power Company and the Niagara Falls Power Company have power lines that operate in parallel. This, however, has been the case for many months. The first line to connect the power houses leaves the bus-bars through a feeder switch to the transformers and panels, thence through subways and conduit, and part of the way overhead, to the Canadian power house. Fig. 1 shows the transformers and panel at the Niagara Falls power house.

The current is changed from two-phase to three-phase, no change in voltage being effected. The switches are single element, operated by a pole having a hook which engages in the eye of the switch blade. Circuit-breakers, one on each side on the four-wire side and separated by a marble barrier, effectually rupture the most severe arc. Round carbons, about 1¼ inch diameter, receive the arc upon opening, seldom burning the copper contacts. An ammeter is used on each wire of the three-phase system. Lamps upon the top of the

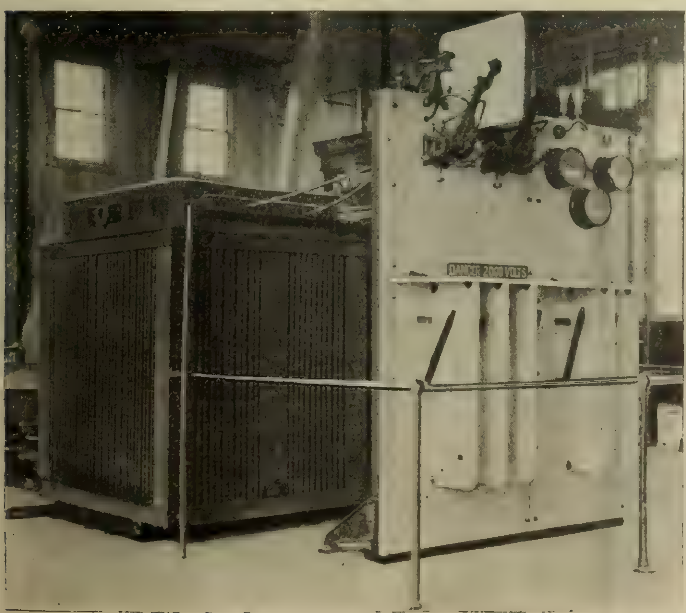


FIG I.—TRANSFORMER IN NIAGARA FALLS POWER HOUSE.

right-hand panels may be used to parallel the line at the Niagara Falls Power Company's plant, as follows:

The two-phase circuits are closed, first the breakers, then the switches; the next switch of the three-phase circuit is then closed. The lamps will then indicate the conditions that exist in relation to both power houses. When the lamps go out, the next switch is closed; then the next.

The synchronizing transformers are connected across the first two wires, and although there are no synchronizing connections, which are unnecessary, the last switch may be closed at any time after the synchronizing has been done. However, it is not practical to parallel at this end of the line, for it would necessitate a very long wait, perhaps hours, before they would be synchronism, and the speed of the large alternators would have to be changed to bring about the results sought; so for this reason, this operation is performed at the Canadian end of the line.

After receiving word by telephone that their switches are all open,

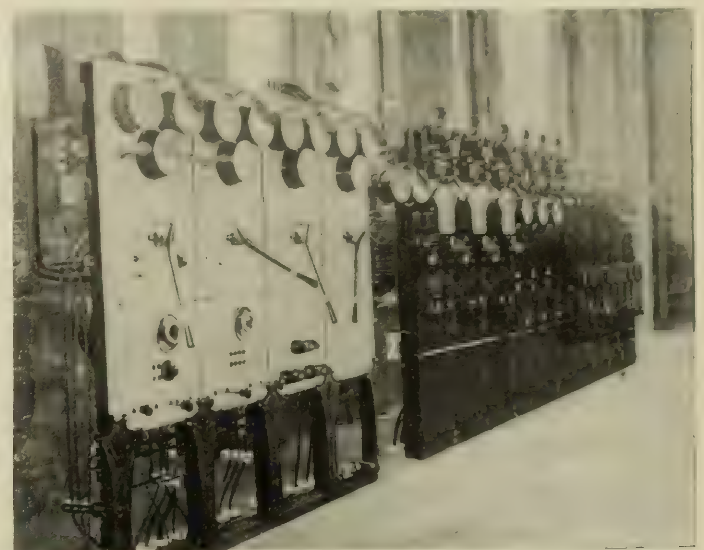


FIG. 2.—THE CANADIAN SWITCHBOARD.

the attendant at the Falls power house closes all circuits on the panels, and the Canadian Power Company is then notified that everything is O. K., when the synchronizing is done. The Canadian switchboard is shown in Fig. 2.

There are several important plants receiving current over this line from the Canadian branch, the principal one being the Niagara Falls, St. Catherine's and Toronto Railway Company. The Canadian alternators are illustrated in Fig. 3.

There is another transmission line to the Canadian power house, which carries current at 11,000 volts, three-phase. The current is taken from a panel which also supplies the Union Carbide Company with its several thousand horse-power. This current goes

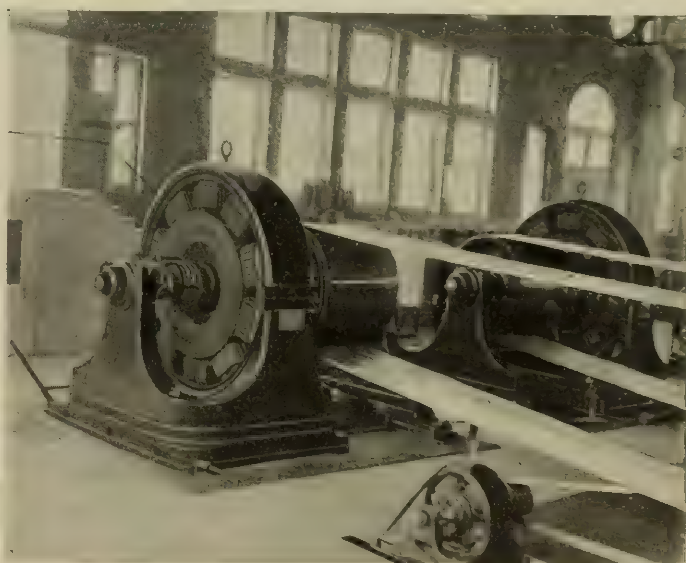


FIG. 3.—ALTERNATORS ON CANADIAN SIDE.

to an oil switch, motor actuated, thence to Canada. A three-wire cable is used throughout. A Thomson polyphase integrating wattmeter occupies a panel near by, which also carries the relay that opens and closes the oil switch.

The paralleling of this line is also performed at the Canadian power house. This line supplies current for A. C. Douglass, contractor, to operate a large motor for supplying air for the drills in tunneling.

The several transformers and panels at the Canadian power house in connection with this line were in use by the General Electric

Company at its lighting plant for the Electric Tower and other buildings at the Pan-American. No less interesting is the fact that the above-mentioned oil switch and panel were also a part of that famous lighting plant. It will be remembered that the oil switch was stationed on the top of its brick enclosure, back of the lighting panels. The cables from the water rheostat, in the "house on stilts," by means of which rheostat the Tower lights were dimmed and the beautiful effect of the gradual illumination of the grounds accomplished, came directly to this switch.

Within a few months, the paralleling of these power houses will be on a larger scale, and the present system but a detail of the whole.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

SULPHURIC ACID BY ELECTROLYSIS.

Faraday and a host of subsequent experimenters have investigated the electrolytic oxidation of sulphur dioxide in aqueous solution, and have found that under normal conditions one-half the oxide undergoes oxidation to sulphuric acid at the anode, the remainder appearing as sulphur or sulphureted hydrogen at the cathode. In 1895, however, Dr. Leonard Wacker succeeded in rendering the oxidation quantitative by the concurrent use or production of carriers of oxygen, such as the persulphates, or even the halogens. Mr. Charles B. Jacobs now finds that the same result may be accomplished by a judicious application of the principle that oxidation is facilitated by a concentrated solution and low current density at the anode. In Jacobs' apparatus the anode is a porous composition

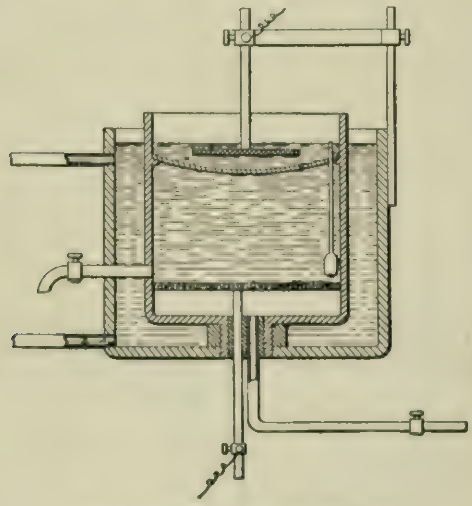


FIG. 1.—SULPHURIC ACID PROCESS.

through which the gas is injected in a continuous stream into the cell; and the anode area is 33 times that of the cathode. The accompanying Fig. 1 illustrates the arrangement used: the vessel is provided with horizontal electrodes, and an interposed diaphragm. The porous anode constitutes a partition near the base of the cell, and into the lower compartment so formed sulphur dioxide is injected through the pipe, passing through the previous anode and undergoing oxidation therein. An outlet is provided for withdrawal of the sulphuric acid when the hydrometer shall indicate that the desired density has been reached. A refrigerating jacket is provided in order that advantage may be taken of the increased solubility of sulphur dioxide at 0° C.

Jacobs, like Wacker, finds that by continuously injecting sulphur dioxide, the sulphuric acid may be brought to standard concentration. While, as stated, the reaction, chemically considered, is quantitative, all of the sulphur dioxide being converted, the electrolytic efficiency is given as 54 per cent.; this result is attained with a potential difference of two volts and a current density of 15-20 amperes per square foot of anode surface.

SOLUTION WITH CHANGE OF VALENCE.

According to Brown and Neil, tin is extracted from its ores or separated from scrap by solution in ferric chloride, the resultant mixed solution, comprising chlorides of tin and iron at their lower valence, then undergoing an electrolytic treatment to separate the tin and oxidize the iron; to this end, in the preferred procedure, the solution is caused to flow successively past the cathodes and insoluble anodes of a cell provided with a diaphragm. In the negative compartment tin is plated out, and at the anode the solvent salt is regenerated by return to its higher valence. This method is novel as applied to the treatment of tin, although it bears a resemblance to the Siemens copper process. In these questions, however, analogies are unsafe guides, for the commercial value must depend largely upon reaction velocities, and analogy affords no indication of these.

A case in point is the related method patented years ago to the late Dr. Carl Hoepfner, its purpose being to treat complex sulphide ores with cupric chloride, and subsequently to regenerate the solvent by the precipitation of one half of the contained metal. In practice the plan has developed defects, among them the slow and incomplete solvent action and the general unsuitability of the resultant solution for electrolytic purposes; for it is practically impossible to obtain a homogeneous electrodeposit of copper from cuprous chloride solutions in the presence even of traces of cupric chloride or of iron.

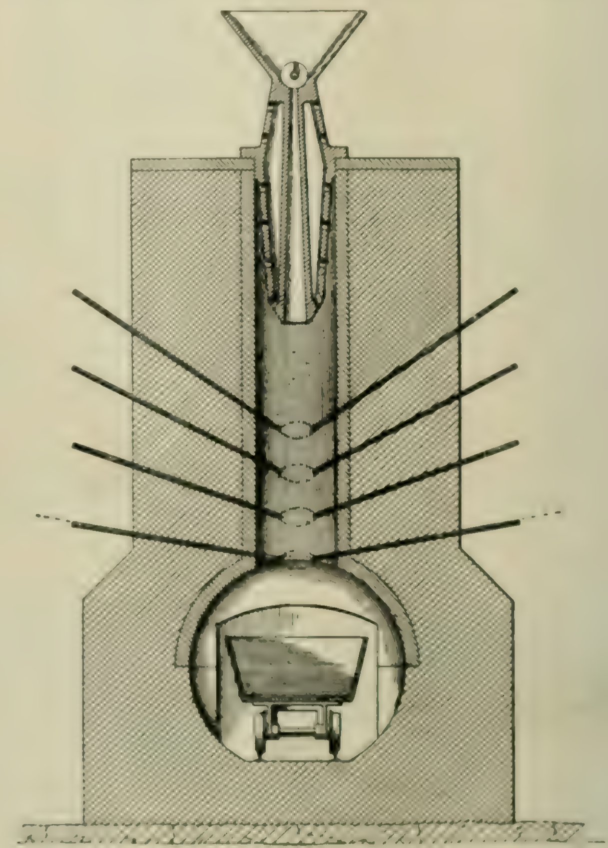


FIG. 2.—ELECTRIC FURNACE.

In a patent of current issue, granted to the administrator of Dr. Hoepfner, it is stated that these defects may be remedied by reducing the proportion of alkali metal chloride, added in the process of the earlier patent for the double purpose of dissolving silver and lead from the ores, and of holding in solution the cuprous chloride formed during the leaching; by such use of more dilute alkali chloride solutions it is found that an increased concentration of the solvent may be obtained, and hence more complete and rapid solution and deposition.

ELECTRIC FURNACES.

In one of the earliest of described electric furnaces, patented in 1853—a patent remarkable in that in days when the voltaic cell was the most available source of electric energy, the electrodes being of such enormous dimensions as would tax the resources of a modern power house—the mixed charge for reduction is described as falling freely and in succession through a series of arcs. This principle reappears in the smelting furnace recently patented to Dr. Frederick C. Weber, of Chicago. In Weber's construction the electrodes are arranged in several superposed rows, each comprising a number of opposing pairs of carbons, and the whole forming a vertically and laterally extended heat zone or sheet of arcs through which the pulverized charge is permitted to fall, the intention being to so adjust proportions and temperatures as to insure complete action. To fur-

ther this end the temperature of the several arcs may be graduated from above downward, independent current modifying means being introduced in circuit with each arc. An interesting though subordinate feature, useful because of the varying terminal voltage of the several arcs, is the divergent arrangement of the electrodes in both vertical and horizontal planes, with the purpose of avoiding current leakage through the heated walls. The accompanying diagram of the furnace is self-explanatory.

A patent to Hudson Maxim is identical in disclosure with that referred to in the issue of Oct. 19, 1901; in the present case, however, the claims cover the structure. The furnace is a rotary drum of complicated construction, wherein the fused carbide is said to be held against the inner periphery in the form of an incandescent bed, to which the charge may be fed, the excess of carbide floating out as formed from the open end of the drum. The main interest of the patent lies in the fact that it dates back to June, 1895, being a division of the earlier application filed at that time, and that the claims appear to cover, in words at least, the continuous operation with an incandescent body of carbide. One of these claims is as follows:

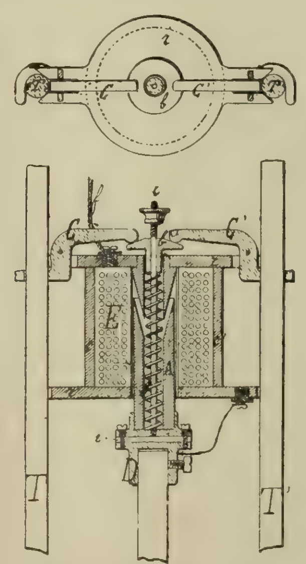
"In an electrical apparatus, for making calcium carbide, an electric circuit, a carbide conductor included in said circuit, whereby said conductor is maintained incandescent, and means moving the calcium carbide from the heating-field as fast as formed."

The Froment Enclosed Arc Lamp.

By P. LETHEULE.

The recent appearance of a French enclosed arc lamp may be a matter of interest to Americans who have witnessed in their country such a rapid development of the same type of lamp. In the Froment lamp to which this refers, the inventors have done away with the usual pulleys, gears, rods and air dash-pots. The regulating mechanism is as follows: Rerferring to Figs. 1 and 2, between the frame rods, *TT'*, slides an electromagnet, *E*. The passing of current in its winding lifts the moving core, *A*, which compresses the spring, *i*. This spring in its turn tends to lift the bushing *C*, which presses against the clutch levers *cc'*. These grip against the rods *TT''*, and they maintain the magnet in position as long as the current is kept on.

The action of the mechanism is as follows: The moving core, *A*, supports the upper carbon *D*, and the lower carbon is fixed on a cross-bar connecting the lower part of rods *TT'* and completing the



FOMENT ENCLOSED LAMP.

frame downward. When no current is passing the upper carbon rests on the lower one. If current is sent through the magnet, *A* lifts the upper carbon and strikes the arc, the length of which depends on the regulation of the springs. The lengthening of the arc increases the resistance in circuit, thus decreasing the current and allowing the spring *i* to lower down the armature *A* and carbon *D*. When the pressure is low enough on the bushing *C* and clutch levers *cc'*, the magnet *E* slides down a small distance, and the same regulation takes place again, following the wear of the carbons.

Following are the comparative prices of lamps and accessories for a 110-volt system, according to the manufacturer's figures:

OPEN ARC LAMPS.		FROMENT'S LAMPS.	
2 lamps at 100 francs..	200 fr.		
1 rheostat	20 fr.	1 lamp	100 fr.
1 switch	8 fr.	1 rheostat	[illegible] fr.
Installation of 2 lamps..	50 fr.	1 switch	[illegible] fr.
(Comprising the necessary material).		Installation	20 fr.
Total...............	278 fr.	Total...............	128 fr.

The life being 150 hours, the saving in carbons is stated to be $1.30, the cost of a pair of carbons being estimated at 5 cents. A fact which should be mentioned is that time of trimming is neglected in the comparison. The estimate, therefore, appears rather liberal and well in accordance with the European conditions which subordinate cheap labor to cost of lamp and carbons.

Recent Storage Battery Patents.

In the Patent Office issue of July 15 the storage battery is represented by six patents, four of which relate to new types of plate, one to a forming process and one to a separator. The patentee of the latter is Hugh Rodman, the device described having already entered largely into commercial use. The material of the separator is wood, which is stated to possess unique and remarkable properties which adapt it to the purpose. Wooden sheets are arranged or formed so as to provide vertical passages to permit of free circulation on both sides, which is stated to be productive of remarkable results in increasing the efficiency, durability and capacity of a storage battery. A fibrous and porous wood such as bass is used, and the thickness of the diaphragms may be one-eighth of an inch more or less. Several forms of diaphragms are illustrated, some of which consist merely of wooden sheets grooved vertically or at a slight angle from the vertical in order to avoid ribbing the separator parallel with the grain. In still other cases a plain sheet of wood is used in connection with distance pieces.

A process of forming Planté plates is the subject of a patent issued to H. M. Martin, the principal feature of which is a cooling arrangement for keeping the electrolyte during the formation, below 115 degs. F. It is stated that by this means the peroxide produced in the factory formation can be made uniform and of the same kind. A patent issued to Victor Cheval and Jos. Lindeman, of Brussels, Belgium, relates to improvements of the type of battery in which the negative pole electrode is a single mass of active material having cylindrical or other suitably-shaped openings distributed throughout its mass, in which cartridge-like positive pole electrodes may be easily fitted, the intervening space being filled with the electrolyte. The positive pole electrode consists of a perforated insulating envelope having short exterior vertical wings extending from the corners. Within is a central conducting rod between which and the walls of the casing is packed active material.

Hermann Heinicke is the patentee of a peculiar form of plate which is corrugated vertically and supplied with horizontal strips inclining inward and connecting the outer portions of each groove formed by adjacent walls. J. B. Entz describes a metallic support constructed of rolled antimonious lead which is malleable by reason of the rolling, about 8 per cent. of antimony being contained. One form of plate is exceedingly thin, the thickness being only one millimeter more or less. This plate is bent so as to form ribs, the completed support having a corrugated appearance with flat intervals between the ribs or corrugations, which latter alternate on the two sides of the plate; in another form tangs, keys or projections made by punching project on either side of the plate. Both sides of the plate are finally pasted with active material of a depth sufficient to cover the projecting ribs or tangs.

A patent issued to Edward G. Steinmetz describes an improvement on the chloride type of storage battery. A salt of lead such as the chloride or acetate is pressed between dies in a stamping machine with sufficient pressure to make a solid block; or is mixed with water or other suitable medium and moulded to a shape and allowed to set and harden like cement. These blocks are then placed in a mould and a grid cast around them in the usual way. It is stated that the product obtained by this means is greatly superior to that obtained by the usual casting process, as the item of shrinkage in the mould does not need to be taken

into consideration and patterns or blocks are obtained of absolute uniformity, both as to structure and shape, with a freedom from the blow-holes apt to occur when the blocks are cast.

Meetings of State and National Contractors.

According to the programmes which were duly given in these columns, the New York State and the National Electrical Contractors' Association held their annual conventions last week, the State body gathering at Schenectady, where they were hospitably entertained by the General Electric Company, and the National, at the Franklin Institute, Philadelphia. As the proceedings are held with closed doors, in executive session, no regular report is available, but we are able to present some notes of what was done at the meeting.

At the Philadelphia meeting of the Board of Directors called to order by Chas. L. Eidlitz, chairman, at 10 A. M., Wednesday, July 16, there were present the entire board with the exception of E. T. Cooke, of St. Louis, who sent a letter stating he had sprained his ankle two days prior.

The roll call showed the following present: National President, Chas. L. Eidlitz, New York City; 1st vice-president, G. M. Jones, Minneapolis, Minn.; 3d vice-president, H. K. McKay, Baltimore, Md.; treasurer, Geo. R. Mathieu, Pittsburg, Pa.; secretary, W. H. Morton, Utica, N. Y.; sergeant-at-arms, J. C. Stearns, Buffalo, N. Y.; directors, M. L. Barnes, Troy, N. Y.; E. D. McCarthy, Buffalo, N. Y.; J. Hilton, Syracuse, N. Y.; H. A. Loeb, Philadelphia, Pa.; E. McCleary, Detroit, Mich.; W. I. Gray, Minneapolis, Minn.; J. K. Howe, Baltimore, Md.; E. E. Newbury, St. Louis, Mo.

The detail work was taken up with reports of committees on finance, publication and membership. The application of the Florida and Indiana Associations for membership were approved. Material generally was prepared for the meeting of delegates in the afternoon.

At 2.30 the meeting of delegates was called to order at the Franklin Institute by the chairman. Credentials were presented and Indiana and Florida were elected members. The committees were duly appointed. No fewer than 172 firms were represented out of a total of 206. Routine business was transacted for the remainder of the afternoon. The next meeting was called to order at 2 p. m. in the middle pavilion of the Steel Pier, Atlantic City, July 17, by the chairman. The appointment of several important committees was the first matter taken up. The entire constitution and by-laws were gone over and revised to meet the increased membership and changed conditions. The election of officers for the ensuing year resulted as follows: President, C. L. Eidlitz, New York, N. Y.; 1st vice-president, G. M. Jones, Minneapolis, Minn.; 2d vice-president, E. T. Cooke, St. Louis, Mo.; 3d vice-president, H. K. McKay, Baltimore. Md.; treasurer, G. R. Mathieu, Pittsburg, Pa.; secretary, W. H. Morton, Utica, N. Y.; sergeant-at-arms, J. C. Stearns, Buffalo, N. Y.; directors, E. D. McCarthy, Buffalo, N. Y.; J. Hilton, Syracuse, N. Y.; H. A. Loeb Philadelphia, Pa.; E. McCleary, Detroit, Mich.; W. I. Gray, Minneapolis, Minn; J. K. Howe, Baltimore, Md.; E. E. Newbury, St. Louis, Mo.; G. F. Sanborn, Indianapolis, Ind.; H. Anderson, Washington, D. C. There was considerable jealousy on the part of the Detroit and Minneapolis delegations, each wishing to have the convention for 1903. Minneapolis finally allowed Detroit to get it for July, next year.

The meeting was adjourned at 7.30 p. m. after a continuous session of 5 hours and 20 minutes with plenty of hard work.

The directors met again at 8 P. M., at the hotel parlors, settled some details and also met an important committee from another organization, of supply dealers. The directors agreed to meet in February 1903, at Buffalo, N. Y. The meeting adjourned at 10.45 p. m.

The New York State body came down the Hudson river on Tuesday evening, banqueted on the boat and joined the National party in New York on Wednesday morning, taking the excellent special train over the New Jersey Central arranged by Mr. Alex Henderson, master of transportation. The trip was highly successful and altogether too brief.

Following the afternoon meeting, a special boat was taken from the Arch street wharf, Philadelphia, for Washington Park, the "Coney Island" of the Quaker City, and, incidentally, a view was afforded of Cramp's shipbuilding yard. At the park, an admirable and luxurious dinner was provided, to which about 175 sat down, and it was not until about 12:30, midnight, that the majority returned to headquarters at the Hotel Walton. The local convention and reception committees are to be heartily congratulated upon the warmth and profuseness of their hospitality. These committees comprised Messrs. W. C. McIntire, H. A. Loeb, M. R. Mucklé, Jr., E. R. Keller, J. F. Buchanan, H. D'Olier, Jr., W. L. D'Olier, S. A. Jellet, H. G. Kepler, A. A. Lowry, F. E. McIntire, C. W. Pike, T. C. Smith, G. S. Smith I. C. Walker and R. C. Williams.

On Thursday a special train was provided in the morning which took the entire party to Atlantic City, where a good time was enjoyed while a larger amount of serious business was dispatched.

Not only were the contractors out in remarkable force, but manufacturing and supply concerns mustered strongly, making the affair an altogether notable one.

Power Plant on the Susquehanna.

Plans have been formulated for the erection of a new electric light and power plant on the Susquehanna River, near Conowingo Falls. It is not the first time that this affair has been put forth, but new life has been injected by Philadelphia, New York and Baltimore capitalists for the purpose of harnessing the Peach Bottom Rapids from a point just below McCall's Narrows.

On the rock-blasted islands on the river at that point the projectors will erect three enormous power houses, each of which will generate 50,000 horse-power. If this statement is correct, which is given out by the projectors, they will generate twice as much as the $3,000,000 power plant now being constructed by Judge W. F. Bay Stewart, of York, and Mr. Henry L. Carter, of New York City, at York Haven.

Engineers have been working at the problem for the past two years, and they now have their plans matured. The current, they allege, will go to Baltimore principally, and to Wilmington and other smaller towns en route. A large dam will be constructed about 1,400 feet long and 140 feet above tide water. Another will extend from the lower end of Piney Islands to Bare Island, a distance of 4,400 feet and a head race with a depth of 25 feet. This will pour into the great wheels 16,000 cubic feet per second. In each of the power houses will be installed ten 5000-h.p. electrical units. For each unit there will be three pairs of 48-inch turbine wheels.

It is stated that $12,000,000 will be needed to construct the great plant. Among those who have given their expert opinions on the work are: Dr. Coleman Sellers, of Philadelphia, president of the Niagara Falls Power Company; Clemens Herschel and John Bogart, consulting engineers on the Niagara works. At the head of this great undertaking is S. Davies Warfield, president of the Continental Trust Company, of Baltimore. Bonds will be floated in that city by the different banking institutions, and from the promises made this great project will be matured within the next two years.

Phonograph Evidence.

In a recent article the Nashville, Tenn., *Banner* notes the following: In a prominent residence locality in this city around a building which has been lately erected for the accommodation of a large number of renters, a stone quarry has been opened, where a squad of stone breakers are breaking up the rock, commencing their work daily at 4:30 o'clock A. M. By their noise they awake the denizens, and sleep thereafter is an impossibility. An injunction bill is being prepared, and, as it is almost impossible to describe in language the character of the noises produced, a phonographer has been employed to take the sounds on the spot. The phonographic tubes will be filed as exhibits, and when the case comes up in court they will be placed in an instrument and an auricular demonstration given, so as to enable the court to take in the thing complained of. It is believed that this is the first time that such an experiment has been resorted to in a legal proceeding." We may add that a similar use of the phonograph has been made in New York City. The test in New York, however, related as much to concussive and vibratory effects as to sound, and for this work variations of earthquake recorders or seismographs were found to be preferable. The latest Edison phonograph will record thunder, but is hardly equal yet to the [illegible]

Floods and Power Houses.

The past week or two have been notable for tremendous storms, and many power houses have been seriously flooded.

During the recent freshet at Waterville, Me., the power house of the Union Gas and Electric Company, of that place, was flooded, and the three large S. K. C. generators with which the station is equipped were completely submerged for 24 hours. The accompanying cut is from a photograph taken when the water was at its highest. The water is seen to be almost to the top of the windows of the first floor.

The water subsided slowly, and it was several days before access could be had to the floor of the dynamo room. The generators were then carefully dried out and very thorough tests were made to determine if the insulation had given out at any point. No short circuit or other defect was found, and the machines were started.

FLOODED POWER HOUSE, WATERVILLE, ME.

To the great satisfaction of the company's officials, the generators were found to be absolutely uninjured, and they have been running ever since with their original normal efficiency. This is a typical instance of the effects of the heavy rains this season.

Telephone Meters.

The New York *Sun*, usually very intelligent in technical affairs, has the following note on the introduction of telephone meters:

"They have gas meters in your cellars which are supposed to register the amount of gas you consume, whether in or out of town. Now, a genius is at work on a telephone meter, which is to register the number of calls you have consumed under your contract. You are allowed, under this contract to have so many calls a year, but you have no idea how many you have consumed, and are dependent upon the telephone people entirely. In the proposed telephone meter you will have a machine which in some degree, like the gas meters, may tell you where you stand and then again it may not, just as a gas meter sometimes gets wobbly in summer time and registers just the same amount of gas consumed whether you are in town or not."

The great difference between a telephone meter and a gas meter is that the former will not be at the subscriber's station, but at the telephone company's central office. While this may seem off-hand like an arbitrary proceeding on the part of the telephone company, aimed at keeping the subscriber in ignorance of his use, it really has practical reasons that are easily explained. Gas that is used is burned either for lighting or heating, and, without disastrous consequences, cannot be used otherwise. The consumer expects to pay for light and heat; in other words, for all the gas that passes through the meter since all of it is used effectively. The meter can register his individual use only if it is connected to his individual supply pipes; therefore, the proper place for the gas meter is on the consumer's premises.

The telephone user, however, does not expect to pay for calls that do not result effectively. Many telephone calls do not result in effective messages, for a variety of reasons; the line wanted is "busy" or does not answer, a wrong number has been called, or the number called has been changed or discontinued, and so forth. Now, an automatic telephone meter would register simply calls and could not be expected to select for registration only those calls which result in effective messages. Consequently, since the telephone user pays for messages and not for calls, the place for the meter is not at the subscriber's station where it would register, whether operated mechanically by the rise of the switch-hook or electrically by the closing of the circuit, simply the number of times the telephone was used—a quantity always greater than the number of effective messages.

The telephone subscriber's line at the exchange end is just as much for his exclusive use as it is at the station end, or as the telephone instrument itself is, and the exchange end of the line is obviously the proper place for the meter. A selective meter which shall automatically distinguish between non-effective calls and completed connections is a practical impossibility, so it is necessary that the meter shall be operated selectively by some external agency, and the only means of doing this is to have the operator complete the operation of registering the message at the time she completes the connection which constitutes a message. The meter being at the exchange, besides ensuring an accurate record of the service rendered on each line, also much simplifies the work of reading them and of compiling the subscribers' accounts. Even under the present arrangement of recording by hand the use of each line it is not the fact as the *Sun* note states, that the user has no idea how many messages he has consumed, for it is the practice of telephone companies supplying measured service to notify each subscriber monthly of the state of his contract, giving the number of messages used during the month and the number remaining to the subscriber's credit at the end of the month. Presumably, this practice will be continued even when the use of meters becomes general.

CURRENT NEWS AND NOTES.

PARIS TROLLEYS.—A cable message states that Paris streets have just had a narrow escape from the introduction of a trolley system. The Est Parisien Company applied to the municipal council for permission, provisionally, to install overhead trolleys until it could change the existing plates, which have been electrocuting men and horses for two years past. The municipality fortunately remembered that in France *"Rien ne dure comme le provisoire,"* and refused the insidious proposal.

RAILROAD TELEPHONE LINE.—The Illinois Central Railroad's telephone line, which has been under construction for several months, is now completed and in operation through from Chicago to New Orleans, 922.65 miles; from St. Louis to Carbondale, Ill., 94.51 miles; between Grenada and Water Valley, Miss., 28.62 miles. This is a total now in operation of 1,045.78 miles of long-distance telephone line owned and operated exclusively by the Illinois Central Railroad for railroad business.

POWER ENTERPRISE FOR CHICAGO.—A special dispatch from Chicago, of July 22, says: City Electrician Ellicott is working on a plan for the development of the power from the flow of water in the sanitary channel, and its conversion into electricity for the operation of the lighting and water-pumping plants of Chicago, which plan he believes will solve the complicated question without a bond issue. Mr. Ellicott says there is a syndicate of Chicago capitalists figuring upon the matter, and it is probable that a proposition will be submitted to the Council during the Fall. The scheme contemplates the building of the development and transmission plant by private capital under a contract with the municipality, under which contract the city binds itself to pay as a rental for the use of the power developed a sufficient sum of money to guarantee a fair percentage on the actual investment. Any earnings aggregating more than this amount under the plan are to be turned over to the city, which reserves the right at any time to acquire the plant by the refunding of the bonds of the private corporation. According to Mr. Ellicott's plan, the city would not incur any greater obligation in the matter of rental than the cost of the coal bills of the city for the same purpose.

LABOR PROBLEM CONFERENCE.—A notice has been issued of the national conference of employers and employed. The dates are Sept. 22 to 26, inclusive, and the place is Minneapolis. On the local executive committee are Cryus Northrop and Thomas Lowry.

SIGNALS SENT FOURTEEN HUNDRED MILES.—A cable dispatch from London, of July 15, says: Marconi, who is on board the Italian flagship "Carlo Alberto," at Cronstadt, Russia, has cabled to his London office that he has received wireless signals from the Cornwall station, about 1,400 miles distant, partly overland. Complete messages were received so far as Skagen, Denmark, about 850 miles from Cornwall.

PLEASURES OF CABLE LAYING.—It is stated that the cable steamer "Anglia" while laying recently the Norfolk Island to Fiji section of the Australasian cable encountered a cyclone which lasted ten hours. No one could pass along the deck, the speed of the ship was reduced, although full power was maintained, and all had to remain at their posts. The cable was not lost, however, but the course was preserved and the work done creditably. An experience of this kind is a good test of the training of a cable ship's staff and crew.

TECHNO-LEXICON.—As announced some months ago in these columns, the society of German engineers (Verein Deutscher Ingenieure) has undertaken the compilation of a technical dictionary in English, German and French, and asks for the collaboration of American engineers. By addressing the editor in charge, Dr. Hubert Jansen, 49 Dorotheen Strasse, Berlin, collaborators, will be supplied with note-books and full information as to the plan of the work and the information desired.

WIRELESS PLANS.—A cable dispatch from London, of July 17, says: As soon as Marconi returns to this country from Italy, in about three weeks, steps will be taken to establish a regular service between Poldhu station, in Cornwall, an Amèrican station at Cape Cod, and a Canadian station at Cape Breton. Marconi believes that if all goes well he will be in a position before Christmas to send ordinary messages to Cape Cod or Cape Breton at sixpence, and press messages at twopence halfpenny a word. Connection of distant towns in Africa is also promised in the near future.

CONTRACT FOR PACIFIC CABLE.—The Commercial Pacific Cable Company signed a contract with the Telegraph Construction and Maintenance Company, in London, last week for the manufacture and laying of its cable from Honolulu to Manila, touching midway at Guam. The construction company guaranteed to complete the cable by June, 1903, if furnished with the necessary soundings. In the event that these cannot be furnished, the company agrees to finish the cable laying within such time thereafter as is necessary to take the soundings. Having two steamers capable of carrying 6,000 miles of cable, the company is able to complete within a year the work which would take other contractors two years to do. The steamer "Silvertown," at Woolwich, is now loading the San Francisco-Honolulu cable, 2,400 miles long, and is expected to sail for San Francisco in August. Eighteen hundred miles of this section have already been manufactured and are being taken on board the "Silvertown." The Cable Company has asked the United States government for its soundings, and has offered reduced rates for all official messages.

GOVERNMENT TELEPHONY.—The New York *Evening Post* notices the following incident: One of the dangers of the telephone where the service is in the hands of the government has been curiously illustrated in Germany. An association, of which a well-known German "captain of industry" is a member, recently found it necessary to ask him by telegraph if he was satisfied with a certain resolution passed by the society. The telegram was forwarded to Cologne by means of the telephone, and on its way the word resolution became revolution. This was enough to make the operators at the Cologne central turn over the dispatch to the secret police. With their customary wisdom, the latter saw in the message plain proof of a widespread anarchist conspiracy to overturn the Government, particularly as it was signed by an organized body. Forthwith two detectives rushed to the hotel and arrested the captain of industry on sight. Since the latter's name is known throughout Germany, he found it easy to prove his innocence and to explain the message. But what would have become of him had be been a foreigner, or an inconspicuous person from a far-off village, is something about which the knowing prefer to remain silent and look wise.

HORSE TRAINING has been undertaken by the Automobile Club of America, which has issued an instructive circular, or what perhaps might better be called a circular of instruction, to its members on the subject. One paragraph remarks: "It is far better to take a little trouble than to cause an accident which outside of damage to property may produce pain, suffering, and even loss of life. Horses that are used in or about large cities, and in towns where there are trolley roads, are but little frightened by automobiles. When, however, a horse unaccustomed to automobiles meets one in a quiet country road he is frequently frightened, he shies, sending the wagon into the ditch, or he turns around short and upsets the wagon. To accustom horses to automobiles in the country, some of the members of the club have with considerable success undertaken the training of horses in the communities where they reside. We desire to call this matter to your attention, and to ask every member of the club who can, either himself, or his mechanic (if he employs one), to devote an hour every morning to the training of horses in his vicinity during the next few weeks, and to report on Sept. 1st to the secretary the number of horses he has succeeded in training, and the effect his work has had on the community where he resides."

TROLLEYS IN MAINE.—It is stated that a remarkable expansion of the electric railway systems of Maine is promised within a year. The line from Bangor to Hampden is to be extended to Winterport, seven miles further down the river, and it is expected that ultimately this road will be extended to Frankfort, where are large granite quarries, and down the bay to Fort Point and Belfast. The Penobscot Central line, which for two years has been in operation from Bangor to East Corinth, 15 miles, has this summer been extended to Charleston, 21 miles from Bangor. In Kennebec County two roads are projected—one from Augusta to Waterville and Winslow, the other from Augusta to Belgrade Lakes and Oakland, the combined mileage of the two being 39 miles. Companies have been organized for the construction of these lines, and the capital stock, $200,000 in each case, has all been subscribed. A line from Augusta to Winthrop is nearly completed. A line is in process of construction between Portland and Brunswick; lines are being surveyed in Hancock and Aroostook Counties, and the project in which Governor Hill is largely interested, is for the construction of a road across the State from the Kennebec River to Penobscot Bay, by means of which passengers can be carried from Augusta to Rockland in two hours. At present there seems to be a prospect that within five years all the important cities and towns in Maine from Bangor to Biddeford will be connected by electric railways.

AUTOMOBILE ASH CARTS.—The street cleaning department of New York City may soon have automobile ash carts. Commissioner Woodbury is devoting a great deal of time to a study of the question. Three firms of automobile manufacturers are now at work on the problem of concentrating in one vehicle cheapness and serviceableness, and although the task is not an easy one the commissioner has hopes. The new automobile ash cart is to require the services of only one man, who will act as chauffeur and garbage collector simultaneously. It is to be covered with canvas, self-rolling, on a cylinder, on the same principle as a window shade, and is to have a top opening corresponding exactly in size with new garbage cans which it is the intention of the department to have adopted by all householders in the city. The new cans will be furnished with grappling irons, which, when suspended to a transverse bar on the cart, would act as hinges. Thus the can could be dumped with the same ease with which the lid of a box is lifted. The opening in the cart being exactly of the size of the can no ashes would be spilled, and immediately the can is emptied the canvas top, by rolling back automatically shut, would prevent the dispersion of ashes by the wind. The idea is borrowed from a bulky ash cart model submitted by a Berlin inventor, which only has the disadvantage of requiring four horses to move it and three men to operate it. By applying electricity as a motive power the necessity of the four horses is removed, and by reducing the bulk and the ash pockets the service of two of the three men are dispensed with.

ST. LOUIS FAIR.—Work was begun July 12 on the foundation for the tower which will carry the wires from the electric subway to the switchboard of the second-story gallery of the Palace of Machinery, at the St. Louis World's Fair. The foundation is to be nine and one-half feet below the floor of the building and to occupy a space 14 feet wide by 22½ feet long. All the current to be used for the light and power of the Exposition will be concentrated at the large switchboard. The current to be supplied by the Citizens' Company will be carried to the switchboard, and the current manufactured by the Westinghouse Company will also be concentrated at that point.

GERRYCIDE?—Mr. N. Seaver, writing to the New York *Times* from Pittsfield, Mass., has the following apropos of Noah Brooks' article on "Purists and Words" in *The New York Times Saturday Review of Books,* of July 5: "I have had it in mind a long time to request *The New York Times Saturday Review of Books* to denounce the use of "electrocute," invented by some callow or careless reporter. I use the word electrocide (like suicide) as a noun or verb and was annoyed recently when it was changed to cute in a published article by a "compo" who knew what I meant better than I did. The same "compo" printed cross for crass. The sentence might read "shall be put to death by electrocide." In view of the fact that execution by means of electricity was devised and advocated by Elbridge T. Gerry, many electrical engineers call it "Gerrycide."

A BEEHIVE CABLE BOX.—While wax is an insulator, honey would seem to be a pretty good medium for a short circuit. When A. P. Green, manager of the Postal Telegraph Company, at Chester, climbed up to the cable box on top of a 50-foot pole in front of his office last week looking for trouble, and opened the box, he found there a mass of buzzing bees, a "million of them," is the way he expressed it. A swarm of bees had taken possession of the box and were filling it with wax and honey. Mr. Green slammed the door shut and got down in record time. He immediately reported the matter to headquarters, and now the officials of the telegraph company were last reported trying to get some thick-skinned or fearless man to ascend the pole and fish out the bees and honey, for it is said that they have stuck the Chicago and St. Louis wires together.

LETTERS TO THE EDITORS.

Long Distance Wireless Telegraphy and Hertzian Waves.

To the Editors of Electrical World and Engineer:

Sirs.—The first paragraph of Mr. Lee De Forest's discussion of July 5, of my article of June 14, is a clear and positive admission that *he* is familiar with "*popular* literature" upon the subject in hand. He then proceeds to attribute my "confusion of ideas" to that kind of literature. He presents no showing that I have ever read one word of "popular" literature.

As he brought up the personal element, and as it is only fair for me to correct this mistake concerning my course of reading, it may prove, in this connection, of some advantage to initial investigators, to present a partial summary of literature that I have come across. Numerous personal investigations required the most searching examination of every original work of scientists and inventors. I procured all of the 83 copies of United States patents, and I have devoured them. I examined the 100 British patents granted. Your standard ELECTRICAL WORLD AND ENGINEER stands at the top of all magazines as containing valuable contributions. Of special value is the Digest for putting one upon the track of articles in other periodicals. Among books are Fleming's "Electrical Oscillations and Electric Waves" (Cantor lectures of 1900); Fahie's "Wireless Telegraphy," useful especially as containing the first publication concerning Hughes experiments on electric waves, and Branly's paper on coherers. Prof. Jones' and other translations of Hertz's papers are essential. Finally, the investigator cannot be well posted until he has waded through the files of all *leading* American and foreign periodicals, and the translations of engineering societies.

Coming now to the main subject matter of the discussion, Mr. De Forest treats solely of a theory of the manner in which Hertzian waves or oscillating currents travel, or are conducted, or pass, or run, or walk, or jump, or slide (phraseology will not alter the fact that the waves get there) over, or in, or upon, or near, in the water skin deep, or in the ether in the water, or partly under the water, or in the ether which is near the water. My article admitted (see page 1046, paragraph 2) that my argument was independent of the manner in which the oscillatory current travels upon the sea. My argument was also independent of the inherent nature of aerial Hertzian waves.

My position is this: In addition to this form of energy, conveniently called oscillatory currents, crawling over the surface of the ocean, there is another form of energy, namely, the isolated electromagnetic aerial Hertzian waves, entirely detaached from all conductors, shooting like a ray of light tangentially to the earth and heavenward from the transmitting station, but not through the earth to a point 1,500 miles distant. My diagram on page 1047 will make my meaning plain. Mr. De Forest was neutral on this point as I understand him. I hold it as proved, and not a theory, that there are two distinct forms of energy—the one transmitted over the surface of a conductor, and the other propagated absolutely independently of conductors. Aerial Hertzian waves are as truly propagated in a rectilinear direction as Röntgen rays, or light, or heat. Fleming positively stated in his classical lecture, referred to hereinbefore, "We have then, in the first place, to notice the proofs that have been given that electric radiation sent out from a Hertz or similar oscillator resembles in all respects plane polarized light. . . . Moreover, this plane polarized light is susceptible of reflection, refraction and of producing interference with other rays." Being then, like polarized light, let us notice the consequence. Light would not follow the curvature of the ocean for 1,500 miles, nor could refraction or reflection bend it downward the required calculated distance of 16 miles or so.

We say that Röntgen rays travel as far as the most sensitive detector will indicate their presence. I say that aerial Hertzian waves will travel as far as a coherer will answer without a conductor. If the ocean is used as a conductor, for a distance of 1,500 miles around the curve of the earth, I say that the coherer is not operated by aerial Hertzian waves. I do not find that Mr. De Forest dissents from this conclusion.

In answer to Mr. S. M. Kintner's discussion (in the ELECTRICAL WORLD AND ENGINEER of July 12) of my article of June 14, I have little rebuttal, for the simple reason that he and I seem to agree that in regard to long-distance transmission, "It is time the Hertzian wave idea, as far as the rectilinear propagation is concerned, was abandoned." However, neither does he deny the existence of the overhead aerial Hertzian waves.

Having written my article, and having answered the published discussions, I now wish the opportunity of answering the silent objectors —those who listen but do speak not. They probably ask, "Of what practical advantage is it to know that aerial Hertzian waves fly up, and oscillatory currents remain below?" Shakespeare said, "Words without thoughts never to heaven go." Wireless messages do go heavenward, and hence it follows that all this radiant energy is lost. Is there not a problem presented, therefore? How can this radiant energy be saved and sent over the guiding ocean? An analogy may be observed in heat phenomena. In a boiler plant, radiant heat is saved by well-known expedients.

NEW YORK CITY. EDWARD P. THOMPSON.

Standardization of Advertising Literature.

To the Editors of Electrical World and Engineer:

Sirs.—Probably the greatest inconvenience experienced by those obliged to retain the numerous catalogues which are received, is caused by the fact that there are so many different sizes. There is really no good argument in favor of this large variety of shapes and forms other than perhaps the artistic effect which is occasionally secured.

For flyers, the size should be made 3½ in. x 6 in., but when it comes to standard catalogues where they cover lists, code words, etc., that are expected to be referred to from time to time and must be filed for reference, it is extremely essential that the 6 in. x 9 in. size of the book be considered if the best results are to be secured.

We have on file in our office about 3,500 catalogues and pamphlets and I find that there are more than 500 different sizes. It is self evident that to file these catalogues so that they will be convenient for reference is a most difficult matter and if they are not filed so that they can be conveniently referred to the

manufacturers represented are the losers. It would seem, therefore, that this fact alone would cause manufacturers to think well before they decide to use a mongrel size when making a catalogue.

Three sizes have been decided upon by, I believe, a committee appointed by the steam railroads a number of years ago, namely, 3½ in. x 6 in; 6 in. x 9 in. and 9 in. x 12 in. If all literature conformed to these three sizes the files of those who are obliged to keep them would be vastly improved and it would facilitate the finding of data concerning any particular product to an incalculable extent. The saving in time alone would be a very large item. Many times owing to the fact that catalogues have not been properly filed, days are sacrificed writing for a duplicate copy and an order is lost to a manufacturer that would have otherwise received the business had his literature been available.

Since coming with the Bullock Electric Manufacturing company I have rigidly adhered to standard sizes for all publications. I have never had occasion but in one instance to use the 9 in. x 12 in. size. All of my bulletins are made 6 in. x 9 in. and flyers have been 3½ in. x 6 in. These two sizes when proper attention has been given to the preparation of cuts would serve almost any purpose. Of course there are cases where perhaps the 9 in. x 12 in. size would be the more desirable, but at any rate there seems to be no good excuse for departing from these three sizes.

I believe that if the technical press of this country would take the matter up vigorously through their editorial departments, and by drawing the attention of manufacturers to the subject in various ways it would finally result in standardizing this class of literature, and the gain to manufacturers both to the seller and to the purchaser would be very great indeed.

CINCINNATI, OHIO. FRANK G. BOLLES.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Twenty-five Thousand-Volt Direct-Current Dynamo.—SOULIER.—An illustrated description of the high-tension, direct-current dynamo designed by Thury and used for testing purposes on one of his direct-current series system transmission plants, as recenly noticed in the Digest. A revolving field and a stationary armature are used. The field is bipolar, the exciting coils are connected to two slip-rings, and obtain the exciting currents from a small separate dynamo. The fixed armature is outside and has 48 coils, each consisting of 500 turns of wire of 0.8 sq. mm. cross-section. The machine gives 1 ampere at 25,000 volts, at a speed of 600 r. p. m., the internal armature resistance being 700 ohms. In the commutator, which has 48 segments, air insulation is used; as the voltage between two segments may become 750, it is necessary to prevent the formation of sparks between the segments under all circumstances. A pair of movable brushes which are revolved from the field system and insulated by means of several insulating materials in series, conducts the high-tension current to two very well insulated slip-rings, from where it flows to the terminals of the machine. Essential devices for the prevention of sparks are air blast and condensers; the air blast consists of a fan mounted on the shaft of the machine so that its action is the stronger, the greaer the speed and the higher the tension. Condensers are connected each to two consecutive segments of the commutator. All insulations are made with the greatest care.—*L'Ind. Elec.*, June 10.

REFERENCES.

Equalizing Connections on Direct-Current Armatures.—ARNOLD.—An illustrated English translation in abstract of his German paper, noticed before in the Digest.—Lond. *Elec. Eng.*, June 13.

Direct-Current Armature.—EICHBERG.—An illustrated article on some practical applications of a graphical method for representing the potential of direct-current armature windings.—*Zeit. f. Elek.*, April 27.

Alternators in Parallel.—An account of the work done by a committee of the International Society of Electricians in Paris, concerning the governors of steam engines for driving alternators. There is a long paper, illustrated by diagrams, by Guilbert, on the influence of the engine governors upon the operation of alternators in parallel. There are also shorter notes, by Blondel, Rateau, Miet, Guilbert, van der Stegen, Picou, Vigreux and Brillie and Chevrier.—*Bull. de la Soc. Int. des Elec.*, April.

LIGHTS AND LIGHTING.

REFERENCES.

Train Lighting.—JACQUIN.—The first part of a very long paper read before the International Society of Electricians in Paris, in which he gives a summary of the different methods of electric train or car lighting. He first discusses the lighting of trains by storage batteries only: either the whole train is supplied with current from one or two batteries, or the single cars have individual batteries. Different installations are described: first such in which the batteries are charged in a station, and then such in which they are charged on the train. He then discusses those systems in which dynamos are used on the trains. The following systems are dealt with: lighting of a total train from one or two dynamos mounted in hte car wheels; lighting from dynamos, driven by special prime movers, with or without the use of a battery.—*Bull. de la Soc. Int. des Elec., May; L'Eclairage Elec.*, June 7, 21. In the second part of his paper he describes the systems of Stone, Vicarino, Aubert and improvements introduced by himself.—*Bull. Soc. Int. des Elec.*, June.

Arc Lamps.—HOPPE.—An article in which he gives numerous tables of comparison of the economy of enclosed and open arc lamps. He shows that all claims that enclosed arc lamps consume less energy per cp than open arc lamps are wholly unfounded.—*Elek. Anz.*, May 14.

POWER.

Electric Power for Agricultural Purposes.—HAAS.—An abstract of a paper in which he discusses the use of electric power in agricultural districts, with special reference to the experience gained in connection with the electric tramway in operation in Hanover, Germany. There are 48 villages connected to the distributing network of the Hanover tramways, and 35 of these, with a population of 37,500 persons, have no system of gas lighing at their disposal. The results obtained from these localities are as follows: At the end of 1899 motors of a total of 440 hp were connected to the mains, and at the close of 1900 these had increased to 1,251 hp, while at the end of 1900 a further advance to 2,049 hp had been made. The greatest demand of electric power was for the operation of thrashing machinery, and to a less degree for driving pumps, hay presses, straw cutters, etc. Of the total hp installed, 77 per cent. represent purely agricultural operations and 8 per cent. factories, although the former only yields 53 per cent. of the receipts. On an average the annual revenue per hp installed amounted to about $7 (as compared with from $17.50 to $37.50 in towns) at a price of 4.8 cents per kw-hour, and the average period of use did not reach 150 hours, as against 500 hours in towns. Electric light in agriculture is not of the same importance as electric power. The lamps are installed in fair numbers, but are not used; farmers retire early and rise early; it happens that in the case of an installation of 30 lamps in one house only a single 5-cp lamp is regularly used. In towns the revenue per lamp installed amounts to about $3.50 per year with a lighting period of 450 hours, whereas in the 35 villages the average sum realized reaches only $1.62 per lamp installed, and a consumption extending to 260 hours. He concluded from the experience in the Hanover district that satisfactory results are possible in agricultural operations only, where cables already exist for the transmission of power or for the operation of electric tramways, and which can readily satisfy the small and occasional demand for agricultural purposes.—Lond. *Elec. Rev.*, June 27.

REFERENCES.

Steam and Gas Engines.—WITZ.—A long comparison of steam engines and gas engines, concerning their price, the certainty and regularity of operation, and the consumption of water. He concludes that the gas engines can compete advantageously with steam engines under certain conditions, if they are carefully installed and treated and chosen wih regard to the service that they have to render.—*L'Eclairage Elec.*, May 24, 31.

Electric Pumping.—FRY.—An illustrated description of an electrically-driven pump, recently installed at the Oneida mine, at a 1,300-foot level. It is geared to a 100-hp, 440-volt, three-phase induction motor, running at 580 r. p. m. The pump lifts 197.5 gallons per minute to the surface.—*Jour of Elec.*, June.

Electric Pumps.—BOWIE, JR.—A paper, with map, on the proposed electric pumps for stock wells of the Kern County Land Company for irrigation. It is proposed to distribute current at 3,300 volts, single-phase to the different pump stations, where it is to be stepped-down to 110 volts.—*Jour. of Elec.*, June.

Oil as Fuel.—An article giving data from New Orleans, Mobile and other cities regarding the utility and efficiency of Beaumont oil as fuel in street railway power stations, with some data on the saving secured, and on the oil burning apparatus.—*St. R'y Rev.*, June 20.

TRACTION.

Electric Tramways.—RIDER.—His presidential address to the Brit. Municipal Electrical Association. He points out the economies resulting from combined lighting and traction stations. There are now in England 36 electric street tramways in operation, which are owned by the municipalities, and 16 others in progress; 28 of the former are supplied with current from a municipal combined lighting and traction station, and 11 of those in progress will be so supplied; there are also four instances in which the municipal station is supplying current to tramways owned by companies. He then compares the trolley and the conduit systems; he thinks a conduit system is justified only when the traffic over the lines is so great that the heavy capital charges do not make any serious addition to the cost per car-mile; this is a condition of things only met with in metropolitan cities, and even then there is no reason why the overhead system should not be used. The conduit system becomes necessary under such circumstances only when the rights for the tramway can be obtained only on the condition that the conduit is used; or when the system of lines is so complicated that the overhead construction becomes cumbersome and dangerous. Concerning guard wires, he says that they may be a protection in some few cases, but in most of them they are the means of causing the very accidents which they are intended to avoid. Neither guard wires nor any of the numerous similar devices strike at the root of the matter, which is to prohibit entirely uninsulated wires of any kind crossing the trolley wires. If telegraph and telephone wires must be erected overhead they should be allowed to cross the streets only at right angles, the spans should be kept exceedingly short, and the wires carried as high up as possible, in order that a broken wire may not reach the street. They should be insulated at such crossings, and if guards are insisted upon, in addition to the above, they should be in the form of a netting or similar arrangement under the telephone wires. —Lond. *Elec.*, July 4.

REFERENCES.

Electric Railways.—LEON GERARD.—A very long paper read before the Belgian Society of Electricians, and occupying the entire April number of 100 pages of the *Transactions*. It is, in some respects, almost a treatise on certain parts of the subject of electric railways. The first chapter is on a comparison of steam and electricity for traction, the result of his comparison being favorable to electricity. The second chapter is devoted to road beds of electric railroads. The third and last chapter deals with the lines, systems, motors, etc. In some general conclusions he discusses the probable substitution of electricity to replace steam on the present steam roads, coming to favorable conclusions. At the conclusion there are a few tables, in which electric railways are classified in various ways, each class being accompanied by some data. The paper contains numerous illustrations. It it too long to be abstracted here; it appears to be a very good collection of information concerning European electric railways. It seems to refer very largely to other systems than the typical trolley system of this country; there are frequent references to polyphase traction. The paper contains but few references to electric railroads in this country.—*Bul. Soc. Belge. d'Elec.*, April.

Conductivity of Rails.—WOODFIELD.—An article giving data on the conductivity of track and collector steel rails as affected by their chemical composition.—Lond. *Elec. Rev.*, June 27.

Baltimore.—An illustrated article on the increased power facilities for the United Railways and Electric Company, of Baltimore, Md.—*St. R'y Jour.*, June 20.

Measuring the Power of Automobiles.—MUELLER.—An article in which he discusses the proper method of defining and measuring the power consumption of an automobile. He criticizes unfavorably a method proposed by Gasnier.—*Centralbl. f. Accum.*, May 15, June 1.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

REFERENCES.

Haggerston.—An illustrated description of the new electric station of Haggerston, which is designed on a large scale, although only two units have at present been installed, each being a steam engine coupled to a 800-kw, 1,100-volt, d. c. dynamo.—Lond. *Elec.*, June 20.

Salford.—The first part of an illustrated description of the Salford municipal lighting and traction plant. The direct-current system was adopted with a declared pressure of 220 volts for lighting, on the three-wire system, which permits power to be supplied to motors at 440 volts. The same generators are also used to supply power to the tramways at 500 to 550 volts. The capacity of the plant is 6,400 kw.—Lond. *Elec. Rev.*, June 27.

German Central Station.—An illustrated description of the electric lighting and power station in Erfurt, a city of 86,000 inhabitants; 3,000-volt, 50 period, three-phase current is used for transmission to a converter substation. The e. m. f. of the direct-current system is 100 volts.—*Elek. Anz.*, June 1, 5, 8.

No-Load Losses in Transformers.—WINKLER.—An illustrated review of various suggestions which have been made to diminish the no-load losses of transformers in alternating-current systems.—*Zeit. f. Elek.*, May 4. Some notes by Schlatter and Winkler on the same subject in *Zeit. f. Elek.*, June 1.

High-Tension Switches.—VOGELSANG.—A long illustrated description of new high-tension switches, cut-outs, automatic circuit breakers, fuses, etc., made by Voigt & Haeffner. In all of them the arc is distinguished by the well-known action of bent horns.—*Elek. Anz.*, June 19, 22, 26, 29.

WIRES, WIRING AND CONDUITS.

High-Tension Cables in Frankfort.—SINGER.—An abstract of a paper read before the Frankfort Elec. Society, on high-tension cables. At Frankfort, concentric cables have been used for transmitting 3,000-volt alternating current. Troubles which have been experienced have been found to be due not to the quality of the cables but to the fact that the outer conductor has a tension of 80 volts against earth, while the central conductor has nearly 3,000 volts against earth. Many accidents were due to earths of the central conductor. A careful double insulation has been applied with success. In the past few years, however, it has been decided to use "stranded cables" instead of "concentric" ones for high-tension transmission, and since that time there have been no more bad accidents.—*Elek. Rundschau*, May 15.

"Sparklet Fuse."—An illustrated description of a so-called "sparklet" fuse devised by Partridge for breaking a 10,000-volt spark between contacts ½ inch apart. The "sparklet" is a small steel capsule containing liquid carbonic acid under considerable pressure. It is so placed that if the arc continues, the cap of the sparklet is melted off, and the carbonic acid gas coming off under pressure effectually blows out the arc. Partridge proposes to use the "sparklet" on switches and automatic cut-outs in place of the carbon break.—Lond. *Elec., Elec. Rev.*, July 4.

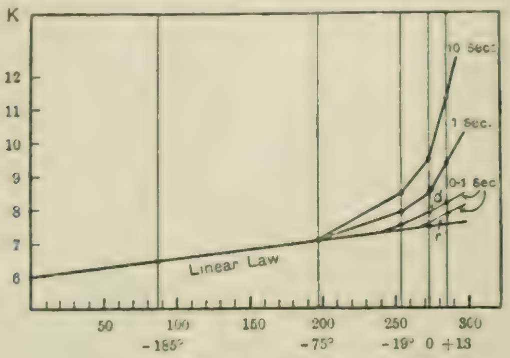
Capacity in Transmission Lines.—SARTORI.—An article in which he shows that the capacity of a wire at a given distance from the earth is twice that which would be due to another wire at twice the distance. He works out numerically the case of an overhead transmission line of three wires, and shows that neglecting the effect of the earth and considering only the effect, of the wires on one another, may lead to an error of over 50 per cent.—*Electricista*, Feb.; abstracted in *Science Abstracts*, June.

REFERENCE.

Oscillations in High-Tension Lines.—POMEY.—A mathematical note on oscillations of very high potential which may occur on high-tension lines.—*L'Eclairage Elec.*, May 10.

ELECTRO-PHYSICS AND MAGNETISM

Dielectric Constant.—CURIE AND COMPAN.—An account of a determination of the dielectric constants of various glasses, mica, ebonite and quartz, all at low temperatures. It appears that for instantaneous charges the dielectric constant is a linear function of the absolute temperature. For temperatures above —75° C. a charge lasting for one second, and still more if it lasts for 10 seconds,

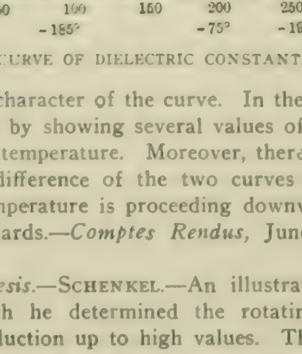


CURVE OF DIELECTRIC CONSTANT.

entirely alters the character of the curve. In the adjoining diagram this is brought out by showing several values of the dielectric constant for the same temperature. Moreover, there is some hysteresis indicated by the difference of the two curves *d* and *r*, where *d* means that the temperature is proceeding downwards and *r* that it is proceeding upwards.—*Comptes Rendus*, June 2; abstracted in Lond. *Elec.*

Rotating Hysteresis.—SCHENKEL.—An illustrated account of experiments in which he determined the rotating hysteresis as a function of the induction up to high values. The rotating hysteresis increases slowly at first, then more quickly, then again more slowly, and reaches a maximum at the induction B = 16,000. It then decreases very suddenly and seems to approach asymptotically the value zero. At $B = 23{,}000$ it is already so small that it is only 8 per cent. of the maximum value.—*Elek. Zeit.*, May 15.

Electrostatic Effect of Magnetic Variation.—CREMIEU.—A description of a new experiment, which, like the others described by him before, is intended to show the incorrectness of Maxwell's theory. He appears to prove that the making or breaking of a magnetic circuit produces no impulse upon an electrostatic charge placed at its center. In the adjoining diagram, a closed magnetic circuit *A S S A*, excited by the coils *I I I I*, contains an iron tube,



ILLUSTRATING ELECTROSTATIC EFFECT OF MAGNETIC VARIATION.

A A, in which a light metallic rod, *T T*, is supported by a thin wire, *F*, and held by a silk thread *F'*. Suitable openings in the iron tube allow six light horizontal bars, *o o'*, to penetrate the walls, and to the outer end of each bar is attached a metallic sphere 15 mm. in diameter, or a sector of 20 degrees. The spheres or sectors are charged through the wire *F*, and every time the coils are excited an impulsive deflection should theoretically be shown by the spheres or sectors. The result, which according to Maxwell's theory should be very perceptible, is always nil. He, therefore, maintains that no electric force is created in dielectrics by magnetic variations.—*Comptes Rendus*, June 16; abstracted in Lond. *Elec.*, July 4.

REFERENCES.

Lag and Lead.—RHODES.—A mathematical article in which he discusses the exact meaning of the terms: phase difference, lag and lead for any wave form.—Lond. *Elec. Rev.*, June 13.

Arc.—JANET.—An article on the peculiar physical properties, and especially of the acoustic properties of the Voltaic arc.—*Rev. Gen. de Sc.*, May 15.

Rotation of Electrolytes in Magnetic Fields.—DRUDE.—A final reply in his polemics with Urbasch. He maintains that the latter was mistaken in the observations in his experiment.—*Zeit. f. Electrochemie*, April 24.

Atmospheric Electricity and Lightning Protection.—A very long article summing up a very large amount of experience which had been collected in recent years by numerous investigators. A summary is also given of the various theories of atmospheric electricity. The main result is that nothing certain is known yet. Concerning lightning conductors, it is shown that among various people there are rather inconsistent ideas on the duties of a lightning conductor. The rules given by various individuals and committees for the best construction and arrangement of lightning conductors are summed up.—Lond. *Eng'ing*, May 30, June 13, 20.

Cyclone Theory of Magnetism.—COTTRELL.—The first part of an illustrated article describing the experiments of Weyher, who tries to explain the facts of magnetism by an analogy with cyclonic motions. His investigations in their inception were extensions of experiments undertaken to reproduce the meteorological conditions attendant on all cyclonic motions in the air, and in any other gaseous or liquid medium.—Lond. *Elec. Rev.*, June 27.

ELECTRO-CHEMISTRY AND BATTERIES.

Welsbach Storage Battery.—MUGDAN.—A discussion of an accumulator, recently patented by Auer von Welsbach, the inventor of the incandescent gas light mantle and of the osmium lamp. His cell consists of zinc amalgam, zinc sulphate, cerous and ceric sulphate carbon. The amalgamated zinc electrode is at the bottom of the cell, the carbon electrode is at the top of the cell and consists of a fabric or of sheets of elastic graphitized carbon. During discharge zinc dissolves and ceric sulphate is reduced to cerous sulphate. During charge the reverse action takes place. An arched diaphragm of parchment or porous clay is used; it prevents any pieces of carbon from falling down upon the zinc plate, it also prevents mixing of the electrolytes, and causes any bubbles of hydrogen gas which arise, to escape upwards along the sides. The e. m. f. is not given, but is said to be higher than that of the lead accumulator; the inventor also claims that the capacity is a multiple of that of the lead cell. Continuous stirring is necessary. When the cell is used on automobiles, the vibrations of the carriage are sufficient; but for stationary purposes mechanical stirring devices are required. The large surface of the carbon electrode gives such a good depolarization that even at rapid charging scarcely a gas bubble is developed, but some gas is then developed at the amalgam electrode. The writer thinks that the cell seems durable, with the only exception of the carbon fabric, which he thinks may be easily replaced. The efficiency may be poor, on account of the diaphragm and the poor conductivity of the electrolyte. There is also a slow action of the zinc amalgam upon the electrolyte; the inventor thinks, therefore, that his cell is best suitable for purposes where the discharge follows the charge immediately. If a small particle of carbon would fall upon the zinc plate it would prove very serious, as it would produce a small short-circuited cell, acting continuously.—*Zeit. f. Elektrochemie*, May 3.

Point of Cut-Off in Accumulator Discharges.—BIENAIME.—Referring to a reprint of an A. I. E. E. paper on this subject by Hering, he describes the method used by his company. He admits that it is incorrect to adopt the usual method of stopping at 1.8 volts when discharges of the same accumulator, but at different rates, are compared with each other, or in comparing different batteries with each other. He believes the method which he uses overcomes the difficulty. It consists essentially in measuring the difference of potential, not only on closed circuit but immediately upon interrupting the circuit, the circuit being interrupted momentarily at each reading; this measurement gives him the e. m. f. at that moment, that is, it does not include the drop of e. m. f. due to internal resistance. The discharge is then continued until this e. m. f. on open circuit has decreased to a certain value which is the same for all tests (but he does not say what it is). This short article is accompanied by a set of curves taken from an actual case, giving the e. m. fs. on open circuit, the potential differences on closed circuit, the internal resistance calculated therefrom, and the density of the acid for all the points of a five-hour discharge.—*L'Ind. Elec.*, May 25

Storage Battery Discharge Curves.—M. U. SCHOOP.—An illustrated account of an experimental investigation of the condition under which the first part of a discharge curve of a storage battery shows the following feature: When the discharge begins the e. m. f. drops suddenly to a minimum, increases again a little, and then decreases continually. By a great many discharges under varied conditions he investigated the various factors which determine the appearance of the e. m. f. minimum. As the thickness of the plates has great influence upon the phenomenon, he concludes that it is caused by the diffusion of the solution of lead sulphate. He thinks that the following explanation, given by Dolezalek, is the most probable. When the discharge begins, the acid is used up for the formation of sulphate, and the concentration of the acid decreases in the pores of the plates which causes a decrease of the e. m. f. Sometimes, but not always, a minimum of e. m. f. follows, "which may, perhaps, be caused by the formation of an over-saturated lead sulphate solution; the solubility of lead sulphate in acid of about 20 per cent. decreases considerably with the dilution, so that it is quite possible that for a short time an over-saturated solution is formed at the beginning of the discharge when there is only a little solid lead sulphate; the increase of the lead sulphate concentration would then cause a diminution of the e. m. f."—*Centralbl. f. Accum.*, April 15, May 1.

Calcium Carbide.—ROTHMUND.—A paper on the temperature of formation of calcium carbide. After some theoretical discussions, he finds that 1,620° C. is the lowest temperature at which carbide can be formed; conversely at 1,560 degrees finely powdered carbide is changed back into calcium oxide and carbon, in the presence of carbon monoxide.—*Nachr. Ges. Wiss. Goettingen*, May 29.

BORCHERS.—An abstract of a lecture, in which he describes experiments made in a special furnace. He concludes from them that calcium carbide is not formed at a temperature below 2,000° C.—*Zeit. f. Elektrochemie*, May 29.

An illustrated article giving brief descriptions from patent specifications of numerous improvements in the industrial manufacture of calcium carbide.—*Zeit. f. Elektrochemie*, May 29.

GRUA.—The cost of calcium carbide per ton, $30.05, is made up as follows: Lime (950 kegs), $2.85; coke (750 kegs), $4.20; electrodes, $8; power, $10; wages, $5.—*Jour. de l'Electrolyse*, No. 139; noticed in *Elec. Chem. & Met.*, May.

Calcium Silicide—MOISSAN AND DILTHEY—An abstract of a paper on calcium silicide $Ca\ Si_2$ The material they obtained is similar to that prepared by Woehler, Chalmot and Jacobs The silicide prepared by the last named, however, reacts upon water in the same way as calcium carbide. Moissan treats 35 grammes of lime and 35 grammes of pure silicon in a carbon tube with 600 amperes at 60 volts. The crystals obtained are grey, sp. gr. 2.5; "they react very slowly upon water, yielding up hydrogen without the formation of silicon."—*Jour. de l'Electrolyse*, No. 138; abstracted in *Elec. Chem. & Met.*, May.

Electrolytic Production of Alkalies and Chlorine.—HARDEN—A brief summary. He first gives some data on the cost and then discusses the difficulties arising in practice. As the current is very great, about 2,000 amperes in an industrial bath at 3.5 to 4 volts, the conductors to the baths are difficult to make, and expensive. In general 30 to 40 boxes, each containing 6 to 8 cells in parallel, are connected in series across the 120 to 160-volt bars; any number of such series may be connected across the bars. One of the greatest difficulties is with the electrodes; in general artificial carbon is used; in smaller plants, platinum-iridium anodes are sometimes used, but it is not yet proved that they really resist any attack by chlorine; the author believes they are attacked; as they are very expensive, such an attack would be fatal. Ferro-silicium anodes are also said to be used at some plants, but no distinct information concerning them is available. Concerning diaphragms, he says that a really good one is not yet known.—*Elek. Anz.*, May 18, 22.

Electrolytic Production of Chromate of Lead.—LE BLANC AND BINDSCHEDLER.—An account of an experimental investigation on Luckow's electrolytic process of making lead chromate; he uses a 1.5 per cent. aqueous solution of a mixture, consisting of 80 parts chlorate of sodium and 20 parts chromate of potassium; the anode is of soft lead, the cathode of hard lead; the electrolyte is neutral; the e. m. f. for a distance of 1.5 cm. between the electrodes, is about 1.8 volt; the current density 0.005 ampere per square centimeter. During electrolysis the electrolyte is kept neutral, and both water and chromic acid are added carefully. The authors state that the formation of lead chromate takes place in a very satisfactory way. From the anode the lead chromate which is formed, drops down like an avalanche, the anode itself remains bright and is not covered with a layer of lead chromate or peroxide of lead. The ampere-hour efficiency is between 98.5 and 99 per cent. The authors then changed the relative proportion of the sodium chlorate and sodium chromate, while the total concentration was kept constant at 1.5 per cent; the effect is very remarkable; with 65 per cent. of chlorate and 35 per cent. of chromate, the electrode was covered with an adherent layer of lead chromate, mixed with peroxide of lead, the efficiency being 46 per cent. With equal parts of chlorate and chromate there was strong evolution of oxygen with an adherent film of chromate and peroxide on the anode, the efficiency being nearly zero. They tried to find why the addition of chromate is necessary for a good production of lead chromate with a high efficiency; they believe that in this case the molecular layers in the immediate neighborhood of the anode soon become poor in $Cr\ O_4$ ions, and that, therefore, the lead chromate is not found in this case immediately on the surface of the electrode. The principal point is, therefore, the constitution of the layers of electrolyte immediately at the electrode surface. They found that mechanical stirring apparently has an unfavorable effect.—*Zeit. f. Elektrochemie*, May 1.

Electrolytic Production of Persulphates without a Diaphragm.—MUELLER AND FRIEDBERGER.—An account of an experimental investigation, in which they found that persulphate can be made conveniently without a diaphragm process, while the voltage is considerably lower, being 5.9, as against 8 volts. Persulphate of potassium can be made in acid solution without a diaphragm with an ampere-hour efficiency of about 35 per cent. at a high cathodic current density. Persulphate of ammonium can be made, with an addition of chromate, at an ampere-hour efficiency of 80 per cent. by starting from a neutral solution and adding sulphuric acid to neutralize the ammonium hydroxide which is being formed.—*Zeit. f. Elektrochemie*, April 24.

Platinum and Platinum-Iridium Anodes in Hydrochloric Acid.—BRAN.—An account of experiments which show a great influence of the current density upon the chemical resistivity of platinum and platinum-iridium anodes in the electrolysis of hydrochloric acid. It is curious to note that the lower the anodic current density used, the more are the anodes attacked. If the current density is different at different points of the anode, it is attacked to a different degree at the different points.—*Zeit. f. Electrochemie*, April 10.

Cathode Pulverization in Alkaline Solutions.—HABER AND SACK.—An account of an investigation of the experimental fact that lead, tin and other metals, when used as cathode in alkaline solutions, pulverize; zinc and cadmium do not show this phenomenon. They show that an indeterminate step, preceding the pulverization, is the formation of an alloy of the cathodic metal with the alkaline metal, and a loosening of the cathodic surface. Alloys of lead and sodium, or tin and sodium, made by chemical means and placed in water, show the same phenomenon of pulverization; zinc does not, because it forms no alloy with sodium. The mercury cathode and the behavior of sodium amalgams were also studied by the authors.—*Zeit. f. Elektrochemie*, May 1

Direct Combination of Chlorine with Carbon.—LORENZ.—A note referring to the article of Bolton, recently abstracted in the Digest. He remarks that a direct combination of chlorine with carbon has been observed before. For instance, Woehler's method of estimating carbon in steel.—*Zeit. f. Elektrochemie*, April 10.

REFERENCES.

Steel Direct from the Ore.—The conclusion of the illustrated description of the Harmet electric furnace process, for the production of steel direct from the ore.—*Elec. Chem. & Met.*, May.

Electrolytic Reduction.—TAFEL AND SCHMITZ.—An account of an experimental investigation of the reduction of organic substances which are difficult to reduce, in sulphuric acid solution, at lead and mercury cathodes. For such reductions the choice of the proper cathodic material is very important. They compared the reducing action at mercury and lead electrodes; also at vertical and horizontal lead electrodes. They also studied the reduction at amalgamated lead cathodes and at tin amalgam cathodes.—*Zeit. f. Elektrochemie*, May 8.

Electro-Analysis.—BINDSCHEDDLER.—An account of some experiments concerning the electro-analysis of mercury in mercuric chloride.—*Zeit. f. Elektrochemie*, May 29.

Electrolytic Analysis.—ARTH.—An article on Koch's method of estimating copper contained in iron, and of Mueller's method of the analysis of iodine in the presence of bromine and chlorine.—*L'Eclairage Elec.*, May 24.

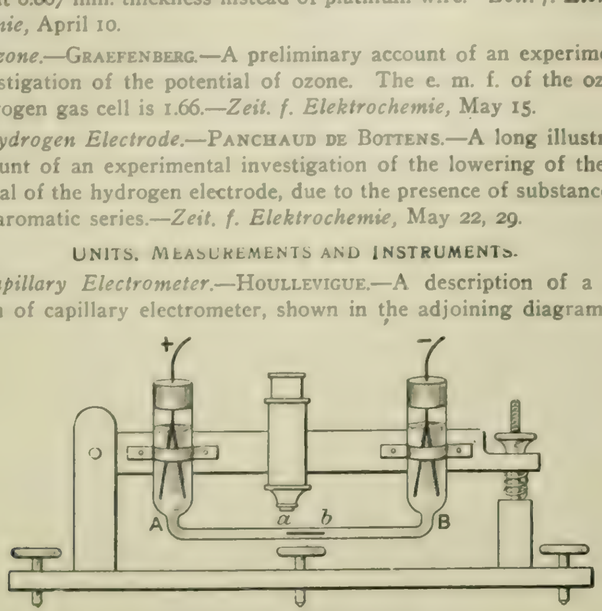
Electric Laboratory Furnace.—HERAEUS.—A description of an electrically-heated laboratory furnace for high temperatures; it is of the resistance type. For the heating spiral he uses sheet platinum of about 0.007 mm. thickness instead of platinum wire.—*Zeit. f. Elektrochemie,* April 10.

Ozone.—GRAEFENBERG.—A preliminary account of an experimental investigation of the potential of ozone. The e. m. f. of the ozone-hydrogen gas cell is 1.66.—*Zeit. f. Elektrochemie,* May 15.

Hydrogen Electrode.—PANCHAUD DE BOTTENS.—A long illustrated account of an experimental investigation of the lowering of the potential of the hydrogen electrode, due to the presence of substances of the aromatic series.—*Zeit. f. Elektrochemie,* May 22, 29.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Capillary Electrometer.—HOULLEVIGUE.—A description of a new form of capillary electrometer, shown in the adjoining diagram. A



CAPILLARY ELECTROMETER.

drop of mercury, *a b,* is placed between two columns, *A B,* of the acidulated water, the current being introduced through platinum electrodes. An e. m. f. of 0.00005 volt suffices to bring about a legible displacement of the mercury, and the apparatus may be rendered even more sensitive by reading; "not the actual displacement, but the rate of displacement on tilting, which undergoes a perceptible acceleration or retardation on applying the e. m. f." For getting rid of bubbles, etc., the drop is brought into the wide tubes. *Jour. d. Phys.,* June; abstracted in Lond. *Elec.,* July 4.

REFERENCES.

Testing Insulators.—RITTER.—An illustrated description of the installation of the high-tension testing plant of a German porcelain works and of the methods used there for testing the porcelain insulators for transmission lines. Insulators which are to be used at 5,000, 10,000, 20,000, 50,000 volts, are tested at 20,000, 30,000, 50,000 and 100,000 volts, respectively.—*Elek. Zeit.,* May 29.

Brake Dynamometer.—GRAU.—An illustrated description of an electric brake dynamometer for measuring up to 5 hp. It is a larger piece of apparatus of the same type as described by him before, and noticed several years ago in the Digest.—*Elek. Zeit.,* May 29.

Standardizing Tests of Sheet Iron.—BENISCHKE.—A long communication in which he criticises several points of the standard rules proposed by the hysteresis committee of the German Society of Electricians.—Eng. *Elek. Zeit.*. May 22.

Wattmeters and Meters for Alternating Current.—ARMAGNAT.—An article giving brief ilustrated descriptions, mainly from patent specifications, of several new instruments: the Duncan wattmeter; the device of Steinmetz for taking into account the wattless current; the Johnson meter; the Siemens & Halske modification of Ferraris meters; a three-phase meter of the General Electric Company, of Berlin, a four-wire, three-phase Aron meter; a Siemens & Halske three-phase meter, consisting of two Ferraris wattmeters.—*L'Eclairage Elec.,* May 17.

Measurement of the Internal Resistance of Cells.—WEBER AND ROBERJOT.—An illustrated article on new methods for measuring the internal resistance of cells. They discuss the use of the Kelvin double bridge, and of the Wheatstone differential bridge, and the influence of polarization.—*L'Eclairage Elec.,* May 10.

Hot-Wire Instruments.—REYVAL.—An illustrated description of the Chauvin and Arnoux hot-wire ammeters and voltmeters, which have been noticed before in the Digest.—*L'Eclairage Elec.,* May 10.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Telegraphy and Telephony.—The quarterly summary of progress and new inventions, giving brief descriptions taken from patent specifications and descriptions in journals.—*Elek. Anz.,* May 25, 29.

Submarine Cables.—DEVAUX-CHARBONNEL.—A long illustrated article on the determination of the dimensions of a submarine cable for a given purpose; and on the propagation of the current and the speed of transmission.—*L'Eclairage Elec.,* April 26, May 3.

MISCELLANEOUS.

Fusion of Quartz.—HUTTON.—An illustrated description of some experiments. He first used an open arc; when quartz is fused in the arc, reduction takes place in the immediate neighborhood of the are and causes a black stain on the surface which disappears when the heated mass is held for a short time away from the center of the flame; in fact the working of quartz in the arc flame much resembles the working of lead glass in the ordinary blow pipe, excepting that there is an immense difference of temperature. He then fused quartz in closed electric furnace. A Moissan arc furnace was modified by cutting passages in the sides, so that a carbon support charged with quartz could be passed under the arc and at right angles to it. A current of 300 amperes at 50 volts was usually employed. To produce thick-walled tubes of quartz, with a core of about ⅛ inch a rough mold is made of carbon with a carbon core, resting at each end on carbon supports; the mold is filled with broken-up quartz not too finely powdered. The tubes obtained in this way can easily be separated from the carbon support and the core be withdrawn. He has not yet succeeded in preparing tubes quite free from bubbles, but the general appearance can be greatly improved by re-heating under the arc, preferably with mechanical rotation.—*Elec. Chem. & Met.,* May.

REFERENCES.

Steel.—HAHN.—An article in which he gives a summary of the magnetic properties of the sorts of steel used in electrical engineering.—*Elek. Anz.,* May 4, 8.

Heating Apparatus.—An illustrated description of new electric heating and cooking apparatus of the General Electric Company, of Berlin.—*Elek. Mitt.,* April.

Dusseldorf Exposition.—An article giving brief description of the various electrical exhibits.—*Elek. Anz.,* May 8, 11.

New Book.

ELECTRICAL AND MAGNETIC CALCULATIONS. By A. A. Atkinson, M. S. New York: D. Van Nostrand Company. 310 pages, 45 illustrations and wiring tables. Price, $1.50.

This excellent book is one of the really helpful additions which have recently been made to the technical literature of its subject matter; and it raises to the dignity of serious consideration what in the past has been rather unpretentiously represented by the electrical arithmetics of sundry writers. Some 12 or 15 years ago, when our educational institutions were beginning to organize courses of instruction in electrical engineering, Cumming's "Theory of Electricity" was a typical textbook used; and those familiar with such books will recall that the theory was largely imparted through computations. Though the problems were usually absurdly academical, still the method must be confessed to have been most practical. Following this stage the tendency seemed to have been toward a descriptive statement of theory and applications; and this in turn has developed into the precise mathematical statements which characterize the late books. In these changes computation seems to have been largely lost sight of, and skill in its use has been left in some sort to the practice of engineering to impart. Professor Franklin seems to have been cognizant of this tendency, for in his second edition of "Alternating Currents," 1901, he has added "a very complete series of practical problems with answers." No doubt every technical course of study in electricity does now include more or less computation; but there is reason to believe that its relative importance in the work of instruction has been suffered to decline.

For reasons that are not difficult to discover, in our most practical country the definition of the "practical" has come to be laid in "experience"; but the broader view is slowly obtaining that the "practical" man is he who knows the available theory of his subject and has the needed skill for its application. And following out the suggestion in the routine of instruction in technical electricity, or its acquisition by self-instruction, the progress in the theory of electricity and magnetism should be enforced step by step with sufficient computation to acquire needed skill and mastery. It must be remembered, too, that the most elaborate mathematical statement of theory is not quantitative until every phase of it has been gone over

in actual computation. In fact, no portion of mathematical or descriptive theory is of much consequence to the engineer until it can be applied with ease and certainty in calculation.

This book by Professor Atkinson thus makes a valuable contribution to electrotechnical literature in that it covers the definite theory of electricity and magnetism, and enforces each phase of it with admirably clear and practical computation. Though the book is the outgrowth of class work and will prove especially valuable to the schools, yet the engineer will find in it a helpful means for review and clarifying what has been heretofore vague; while for those who are pursuing self-instruction, the book will be one of the most helpful aids that can be obtained.

The book is introduced by a discussion of units and their numerical relations. The work proper covers the subjects of resistance, current, electromotive force and energy; alternating currents; wiring for light and power; batteries; magnetism and the relation of magnetic quantities, and the calculations involved in dynamo and motor design. One of the most noticeable things in the early portion of the book is the clear and precise discussion of compound circuits, and it is doubtful if anything approaching it in excellence can be found on the same subject. As illustrative of the methods of the book, Chapter IV, on electrical energy, after a satisfactory treatment of energy in general, is given to the calculation of the fuse; the efficiency of transformation and transmission, of generators and plants, and of luminous translating devices. The following chapter on alternating currents takes a middle ground in its theoretical exposition. The simplified formulas are stated though not derived, and their terms are defined; and this is done with such clearness and precision that those who are familiar with the complete analysis of periodic phenomena can read the chapter with interest, and by following the computations will, doubtless, derive benefit; while those who are debarred from such knowledge will be enabled to apply the formulas in calculations with a degree of confidence and intelligence.

More than one-third of the book is given to the development and discussion of the principles of design of magnetic apparatus, especially of dynamos and motors, both alternating and commutated. In the quantitative or numerical treatment this portion of the work is to be preferred to similar discussions in the books of Professor Sheldon or Jackson, while for purposes of instruction it is superior to the too diffusive treatment of Wiener. The letter-press of the book is tasteful and pleasing, and the paper and binding are excellent, and are an improvement over the similar features of books published by this firm. An exhaustive index adds greatly to the value of the book.

The style of the author is clear and pleasing, and the very numerous problems which illustrate the text are so fully worked out that no one can well fail to understand the theory here presented; while the large numbers of problems for solution are judiciously selected, most of them being seemingly original with the author. The book purports to have been developed in class work, in which the problems and theoretical statements have been tested and revised. The technical fraternity is under obligations to Professor Atkinson not only for the large amount of labor involved in the preparation of such a work, but for the successful manner in which it has been accomplished.

Variable Speed Motors for Direct Drive.

A constantly increasing demand for the direct driving of individual machine tools, as well as many other classes of machinery requiring independent direct drive, has made necessary a study of construction which will result in a motor that will stand up under a wide, varying range of work, be compact and of such a design that it will adapt itself to this class of work. Compactness, durability and high efficiency are some of the features that must be complied with to meet these requirements. These considerations have been followed in thedesign of the Storey motor. It is cylindrical in shape and its compactness in proportion to its hp. output makes it specially adaptable for direct connection to all classes of direct driven machinery and tools. Notwithstanding its small dimensions, entirely enclosed and both dust and moisture proof, there is no undue heating even under full load and continuous operation. It has no external magnetism and can be placed in any position regardless of other surroundings.

One of the peculiarities of this machine is the varying of the speed directly through the field of a straight shunt-wound motor. These machines are in every day use with a varying speed of 200 per cent. through controlling or cutting out the field by means of an ordinary field control, the same as used to control fields of generators, but of high resistance sufficient to cut out the field to give the required speed. The claims for these motors are that they will maintain the same horse-power at any point throughout the full range of speed variation of 200 per cent.

That the Storey Company has confidence in its product is demonstrated by the way in which it has applied it to the driving of the main tools in its machine shop. Fig. 2 shows one of the motors applied to a large slotting machine, made by the Betts Machine Co., of Wilmington, Del. Fig. 3 shows the motor applied to driving a Reed lathe, 29 in. swing. This lathe is equipped with a 3-hp motor which is 12½ inches in diameter and has a variation of speed of 200 per cent., giving it a slow speed of 500 and a high speed of 1,500 revolutions. This variation of speed with the Storey system of direct drive of lathe gives a range of speed at the spindle of the lathe from 3½ revolutions to 300 revolutions, and the lathe can be operated at any speed from the lowest to the highest. There is no multiple of voltages, no multiple of field control and no resistance in the armature circuit. The motor is always operating on a direct line at full voltage, thereby

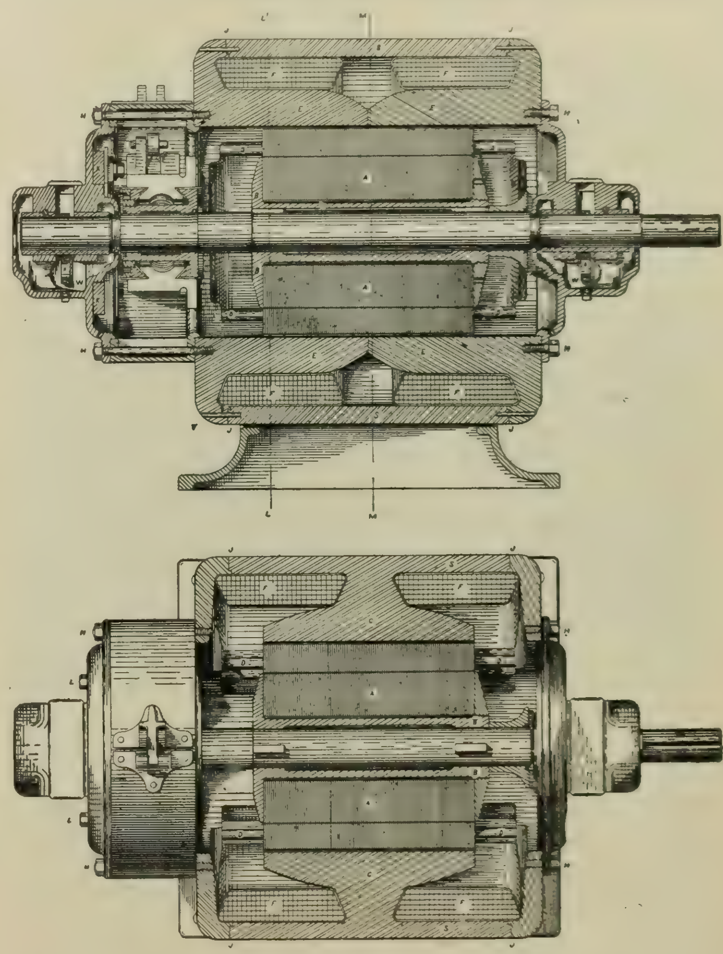


FIG. 1.—STOREY MOTOR, SECTIONAL VIEWS

attaining the highest efficiency. There is a small field control on the front of the lathe (in easy access to the operator) in series with the field circuit, whereby the operator can cut out and cut in the current in the field to attain the required speed. This lathe is provided with a suitable mechanism, whereby it can be stopped and started from the tool carriage, a great convenience, which will be much appreciated by the machinist. The motor can be reversed, running the lathe in either direction. This is done through a reversing starting rheostat having a double pole, quick-snap break switch, operated from the front of the lathe or the carriage. A safety stop is provided which cuts off the current before the carriage travels too far to do damage.

In the case of the motor driving the large slotting machine, which is a 3½-hp, 110-volt shunt motor, the field current of 1.55 amperes is reduced to .20 ampere by steps, the speed increasing from 600 revolutions to 2,400. Although the speed of the motors may be varied repeatedly between these limits, there is no perceptible sparking at the commutator. There is a constant increase in load from the lowest to the highest speed, due to the fact that the quick

return of a slotting machine requires more power than the cut, and this increases constantly as the speed increases, working the motor at the highest horse-power output at the highest speed, a rather unusual performance for a motor of this size and capacity.

The motor is very largely used for driving portable drills or apparatus of similar character, and is equipped with a special starter. The lever of this starting box can be controlled by a cord which can be manipulated in any desired manner. The operator can pull the lever slowly over to the full speed running position, thereby starting the motor. An additional pull of the cord draws the lever somewhat farther along and disengages a catch, thereby allowing it to fly to the off position and cut off the current.

Fig. 4 illustrates a variable speed electrical tool grinder. Attention may be called to the starting device, which comprises a lever and push button. The motor is started by turning the lever, which is pulled upward and caught by a trip. This trip is held by an ingeniously arranged solenoid magnet which would instantly release it should the motor lose its current or its field in any way; or should the motor become overloaded from any cause, another action comes into play, releasing the trip and allowing the lever to fly back to its off position. Pressure on the push button effects the same result mechanically, thereby stopping the motor. Below the push button is located a little knob which controls the field rheostat and enables the speed of the motor to be varied within wide limits.

The motors on the larger tools are controlled by a convenient form of controller, shown in Figs. 5 and 6. This controller consists of a cylinder containing appropriate resistance coils, and quick-break

FIG. 2.—MOTOR DRIVING SLOTTING MACHINE.

switches which are properly manipulated by the mechanism for starting and stopping and reversing, the handle being moved to the right for rotation in one direction and to the left for rotation in reverse direction.

The application of the motor to other machine tools is quite as satisfactory, owing to its compact and convenient form, high range of speed, etc., and it is the intention of the company eventually to equip all of its machinery with independent motors. At present the interior of the machine shop, a building 55 x 115 feet, presents a marked contrast. One side is driven entirely by independent motors, while the other has the old system of belts and counter shafting. This room, illustrated in Fig. 2, represents an appearance which very forcibly illustrates the advantage of individual motor driving.

The motor has only two field coils, which are circular in shape and surround the armature concentrically. The field coils are wound on spools and then wrapped with three layers of muslin soaked in linseed oil. After thoroughly drying they are wrapped with three more layers, similarly treated, and then baked. It may be remarked here that the use of vegetable insulating compounds, especially tapes treated with vegetable oils, are to be preferred on account of the greater dielectric strength. This is particularly necessary in field coil work, because of the reactive kick of the field coils when suddenly open-circuited.

The armatures, on the other hand, are mica insulated, with a view to having the structure resist high voltages. The armature coils are form wound and put in the slots of the core in mica troughs. The armature coils are taped automatically by an ingenious taping machine. All of the machinery in the winding department is driven independently by separate motors, thus doing away with belting and counter shafting. In the testing room each machine is given a thorough test, being run at full load for three hours, and subsequently light for two days.

The field frame of the motor consists of a cast-steel cylinder with two poles cast on the inner surface in diametrically opposite positions. In Fig. 1 is shown a cross-section of these poles, which

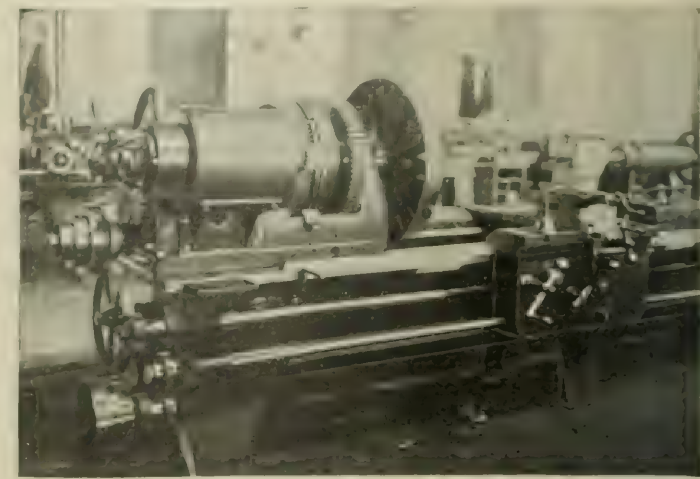


FIG. 3.—MOTOR DRIVING 29-INCH LATHE.

are lettered *C*. At 90 degrees removed from these poles are two other poles, lettered *E*, cast on flanges which form the ends of the fields and which, with the before mentioned cast-steel cylinder, complete the magnetic circuit. Field coils, lettered *F*, surround the armature and polar structure, the magnetic circuit being from *E* through the cylinder *S* to *C*, and through the armature back again to *E*. This makes a very short and effective magnetic circuit, particularly adapted to the compact and enclosed type of motor which the manufacturers aim to produce.

The bearings of the motor are castings bolted to the pole pieces and are self-oiling. The commutator bearing is extended beyond the frame far enough to accomodate the commutator and brushes, and the open places between the supports are surrounded by a circular steel band clamped together by a suitable clamp, which renders the commutator and bearing accessible. The bearings can be rotated with reference to the frame by simply altering the bolts securing them in position, thereby enabling the motor to be run either hanging from the ceiling or side walls or upon the floor, the moving of the bearings being simply to keep the oil wells in proper position.

The armature is built in the usual way of discs clamped on the

FIG. 4.—MOTOR FOR PORTABLE APPARATUS AND TOOL GRINDER.

shaft with paper insulation, except that the discs are assembled on a sleeve, which is keyed to the shaft, thereby making the latter removable without taking down the laminated structure. The commutator is mounted on a separate sleeve and keyed to the shaft also; it is liberal in dimensions and well insulated with mica.

The motor is now built in sizes from one-half to 50-hp. It is largely used for grinding, buffing and polishing, for which purpose the smaller sizes are used. The special design of this motor makes it particularly valuable for buffing work. The speed is con-

stant under varying loads or overloads, and the high speed necessary for this class of work is easily acquired with this motor, without any undue heating. The manufacturers claim that the heat rise is only from 60 to 70 degrees F., when the buffs are running at a speed of 3,300 to 3,500 r.p.m., and the machines are in constant use from ten to twenty hours per day.

The Storey Motor & Electric Co., of Harrison, N. J., has been producing motors for a number of years, and its enclosed type of motor has figured so largely in electric installations as to make the name well known. The company has been steadily increasing its facilities and now has at Harrison, N. J., a well equipped factory for producing its product in sufficient quantities to meet the growing demand.

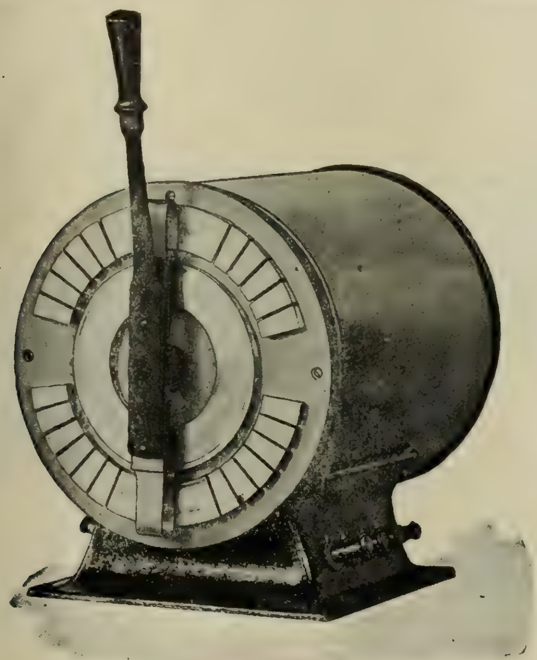


FIG. 5.

The factory is built in the shape of a large T, having a total floor space of about 17,000 square feet. One of the rooms of the T is devoted to the offices, drafting room and pattern shop. In the other arm are located the winding and testing rooms, while the stem of the T is devoted to machine shop and dynamo room facilities. The winding and testing room is combined, forming a space 60 x 66 feet, and equipped with a 5-ton traveling crane. In this room are wound the armatures and field coils of the motors.

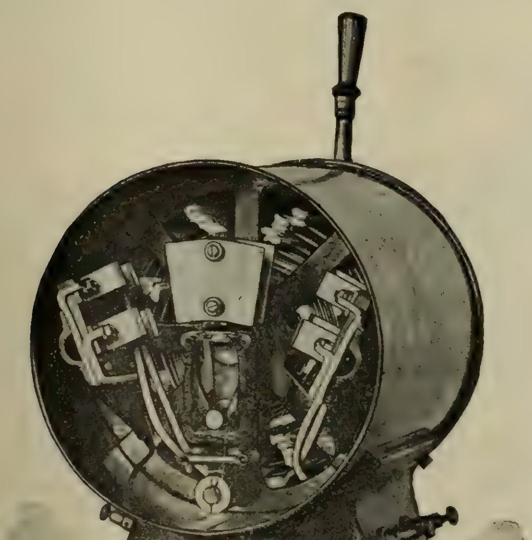


FIG. 6.

The De Forest-Smythe Wireless Telegraph System.

ABOUT a year ago a new American system of wireless telegraphy was announced, which was invented and up to that time developed in Chicago. Since that time the De Forest Wireless Telegraph Company has been incorporated under the laws of the State of Maine, by New York capitalists, laboratories and workshops have been opened in Jersey City, two regular stations equipped on opposite shores of New York Bay, between which messages have been exchanged daily for some months; another station for long-distance communication with ocean-going and coast-wise vessels has been opened at Coney Island, and others are now in progress of erection. Two boats of the Knickerbocker Steamship Company are being equipped with the system, while the Ward Line ship "Morro Castle" carried on board an outfit on her last trip to Havana.

The receiver, or "responder" as it is aptly called, depends on an electrotyptic principle for its action. It is claimed that this receiver will respond with absolute certainty and regularity to a spark of one-sixty-fourth inch length from a small coil 40 feet distant, driven by one cell of storage battery with a 2-foot antenna at receiver and coil, and without ground connection at either end.

FIG. I.—WIRELESS TELEGRAPH STATION, STATEN ISLAND.

The De Forest transmitter does away with induction coils, all interrupters, and make-and-break devices, as it has been found that a large per cent. of uncertainties and failures in wireless messages is due to the imperfections and irregularities of these devices.

A special key, very like the ordinary Morse key, has been devised with a view especially to high-speed work. The make-and-break is under oil, and the operator is fully protected from contact with high voltage wires. The key also automatically switches the upright conductor, or antenna, from receiver to sender, so that the operator is enabled instantly to "listen in" after sending, and at the same time it is impossible to close the primary circuit while the receiver is connected to the antenna.

By virtue of the automatic quality of the responder it is possible to use a telephone in circuit with the device, and the employment of a relay is rendered unnecessary. By this means a speed of 40 words per minute can be obtained, and under ordinary circumstances a speed of 25 to 30 words is regularly accomplished. One hears in the telephone as it were the sound of the sending spark, be this a high or low frequency, in dots and dashes. An ordinary Morse operator can learn to read with the new apparatus with a few days'

practice. The sending requires no special knack other than a firm touch, with dashes clean cut.

Although, as the accompanying illustration shows, the operator reads from the head telephone, a relay or recording device can be substituted therefor; only there is always this condition, that inasmuch as the responder, unlike the coherer, is a quantitative device, and the telephone and ear the most sensitive signalling device known, at the extreme range messages can be clearly read which are altogether too weak to operate any relay. Thus, through the extreme sensitiveness of the responder an operator with head telephone can receive messages many miles further than a coherer (all other arrangements at transmitter and receiver being the same), can record them.

FIG. 2.—RECEIVER.

As illustration of this, an interesting test may be cited which was made Feb. 22, when signals from the "Etruria" were heard at the Jersey City station, from a mast but 30 feet above the roof, when the steamer was fully 90 miles distant. This was without any "jigger" or transforming device whatever at the receiving end, and represents remarkable sensitiveness in this new "responder."

By virtue of the automatic quality of the receiver, whereby the sound impulses as heard are identical in frequency with that of the transmitter spark, the relay or "call" in use employs a reed attuned to a certain frequency per second. Thus only when the calling station uses a frequency of spark in tune with this reed will the "call" respond and summon the listening operator. This feature thus involving a system for a mechanical or acoustic syntony, in distinction from and in addition to the electrical syntony, is highly significant.

During the last month a regular station and school for operators has been opened by the De Forest Company on the roof of the Chesebrough Building, 17 State Street, New York. Here, as any visitor can see, is a house built of glass over an iron frame, and fully equipped with sending and receiving apparatus. The antenna here is 60 feet in height. The companion station is located at Hotel Castleton, Staten Island, the first hotel in the world, by the way, to be equipped with a wireless plant.

The most important land station yet established by the De Forest Company is that at Steeplechase Park, Coney Island. This enjoys the distinction of having the tallest mast in America, a fine stick of four pieces, standing 210 feet high. This station is supplied with 60-cycle alternating current, at 110 volts, from the street mains. This is stepped-up in two transformers to 25,000 or 50,000 volts, as desired, and applied direct to the spark terminals These latter are of special construction and connected with the condensers give a spark of exceptional clearness and power.

On June 14th, the first day the Coney Island station was operated, the first communication with a vessel equipped with the De Forest system was also established. On the Ward Liner "Morro Castle," bound for Havana, a moderately high (60-ft.) antenna had been rigged, and transmitter and receiver installed. M. F. Stires, secretary of the company, and Mr. Barnhardt, operator, were aboard, and messages to and from ship and shore were exchanged, until the vessel was 50 miles from port.

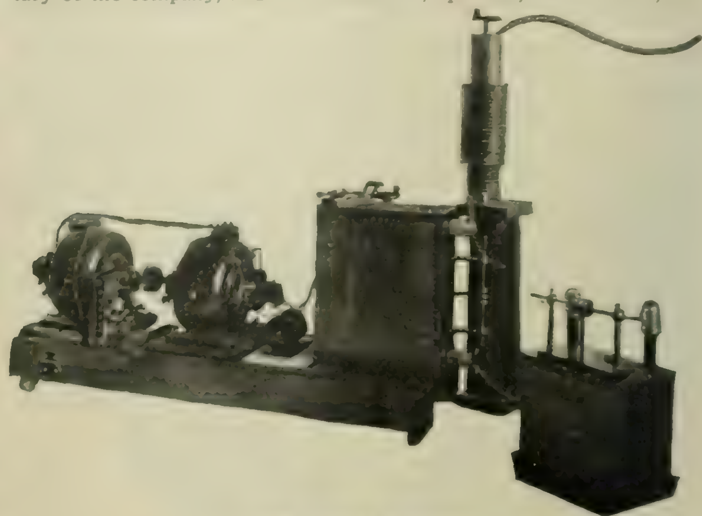
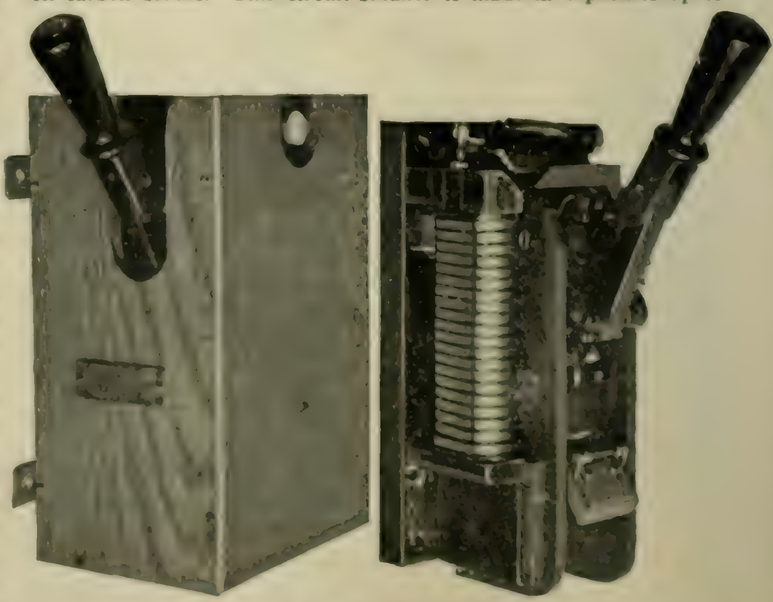


FIG. 3.—TRANSMITTER.

Previous to this test the Staten Island station had maintained communication with the Hamburg-American liner "Deutschland," on her last trip East, up to a distance of 70 miles. The "Deutschland" was equipped with the Slaby-Arco system, but there was little trouble in inter-communication between the two systems.

Car Circuit-Breaker.

The car circuit-breaker, illustrated herewith, is being placed upon the market by the Cutter Company, of Philadelphia, and represents the latest development in devices of this nature. It has laminated copper contacts and a magnetic blow-out, which breaks the final arc on carbon blocks. This circuit-breaker is made in capacities up to 450 amperes, and in larger sizes for interurban cars. It is compactly encased in a strong wooden box, the dimensions being 12 inches long, 8⅝ inches wide and 5 inches deep. The instrument is designed to be placed on the hood of the car directly over the head of the motorman. The illustrations show the circuit-breaker with and without the case.



FIGS. 1 AND 2.—CAR CIRCUIT BREAKER.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—During the past week, in spite of various conditions that might reasonably be regarded as unfavorable, but not to any extreme degree, the stock market was steady and strong. While good crops now appear to be assured, the bad weather that has so persistentlly hung on all through the summer has done considerable harm, and has hurt many people and industries that depend upon sunshine as an asset in their business affairs. During the week the new stock of the General Electric came on the market, and while the old was quoted at 314-315, the new was quoted at 189-190, which is considered to represent about a parity. Western Union which has been in a fluctuating condition, rallied on dealings in 8,160 shares, and opening at 86 closed at 88½. In the street traction group, Brooklyn Rapid Transit, on sales of 118,000 shares climbed from 67¾ to 72⅛; Manhattan on 100,600 shares rose from 131¾ to 136¼; and Metropolitan Street Railway on 28,800 shares rose from 148 to 150½. In the New York "outside market" New Orleans Street Railway sold at 17, and the new-fangled Manhattan Transit, represented automobile speculation by rising from 6⅞ to 7⅜. One of the subjects of inquiry and doubt has been the effect on the market and on Postal Telegraph and Commercial Cable specifically of Mr. John W. Mackay's death. In London the effect was adverse, but in New York the tendency is to wait and see what happens. Electrical people have also been waiting to see if anything happened in Stanley Electric and Electric Storage Battery, but nothing definite came off apparently last week in the proposed line of consolidation. Below are the closing quotations of July 22:

NEW YORK.

	July 15.	July 22.		July 15.	July 22.
American Tel. & Cable.	—	—	Hudson River Tel....	107	—
American Tel. & Tel..	—	142½	Metropolitan St. Ry...	148¼	150¾
American Dist. Tel....	36	—	N. E. Elec Veh. Trns.	—	—
Brooklyn Rapid Transit	68¾	71¼	N. Y. E. V. T. Co....	12	—
Commercial Cable	160	—	N. Y. & N. J. Tel....	175	—
Electric Boat	25	30	Tel. & Tel. Co. Am....	—	—
Electric Boat pfd......	40	50	Western Union Tel...	86½	88½
Electric Lead Reduc'n.	2⅝	3	West. E. & M. Co......	212	205
Electric Vehicle	6*	6	West. E. M. Co. pfd..	213	213
Electric Vehicle pfd ...	14½*	14			
General Electric	192	188½			

BOSTON.

	July 15.	July 22.		July 15.	July 22.
American Tel. & Tel...	165	142½	Mexican Telephone	2	2⅜
Cumberland Telephone .	—	—	New Eng. Telephone ..	—	142½
Edison Elec. Illum....	—	—	Westinghouse Elec.	—	—
Erie Telephone	—	—	Westinghouse Elec. pfd.	—	—
Western Tel. & Tel....	—	29½			
Wsetern Tel. & Tel. pfd.	—	102½			

PHILADELPHIA.

	July 15.	July 22.		July 15.	July 22.
American Railways	46	46½	Phila. Traction	99⅛	99⅞
Elec. Storage Battery..	95½	93	Phil. Electric	5⅛	5⅝
Elec Storage Bat'y pfd.	94½	—	Pa. Elec. Vehicle......	1	—
Elec. Co. of America...	6	8¾	Pa. Elec. Vehicle pfd...	3	—

CHICAGO.

	July 15.	July 22.		July 15.	July 22.
Central Union Tel......	—	—	National Carbon pfd...	102	101
Chicago Edison	—	180	Northwest Elev. com....	35⅝	—
Chicago City Ry......	208	210	Union Traction	15	16⅝
Chicago Tel. Co........	—	—	Union Traction pfd ...	49	—
National Carbon	29¼	29			

*Asked.

NEW ALBANY, IND., CONSOLIDATION.—Under the skillful management of Mr. Samuel Insull, a consolidation has been effected of the entire gas, electric light and heating systems in the city of New Albany, Ind., and the only gas system in Jeffersonville, Ind. The company will also supply the towns of Silver Grove, Port Fulton and Clarksville, lying between the two cities, serving a population in excess of 35,000. There is no competition. The capital stock is $1,000,000, and the net earnings with the four old plants were $41,480. The new United Gas and Electric Company, which will enjoy the services of Mr. Insull as president, has just issued $400,000 first mortgage 5 per cent. bonds out of an authorized $750,000, and the consolidated plants will be extended, economies effected, etc. The company has a street lighting contract for eight years to run and a street railway current contract.

MEMPHIS LIGHTING CONSOLIDATION.—A special telegram from Memphis, Tenn., states that the Billings-Brady syndicate, composed of Anthony N. Brady and C. K. G. Billings, of New York, and other Eastern capitalists, which recently purchased the Memphis Light and Power Company and the Memphis Equitable Gas Light Company for about $2,000,000, has struck a snag in its effort to consolidate the two companies. Secretary of State Morton has refused to grant the application for an amended charter, on the ground that the Equitable Company is chartered under Tennessee laws for the purpose of doing all things permitted gas companies by law and cannot take upon itself the rights of another corporation like an electric light company chartered for a different purpose.

NATIONAL CARBON.—Advices from Chicago say that there are persistent rumors afloat that the General Electric Company is buying into the National Carbon Company, with the view of ultimately controlling that property. General Electric has for a long time been the largest individual holder in the company, and the recent acquisition of both classes of stock have been for these interests. This is conceded by the head of the brokerage house through which the stock has been bought. It is said that whether or not control of the property changes, a dividend on the common stock cannot be far distant.

MICHIGAN BELL TELEPHONE.—The following is a statement of the income account of the Michigan Telephone Company for year ended Dec. 31, 1901: It will be noted that for the year ended Dec. 31, 1901, there was a deficit after expenses and interest payments of $292,368. The balance sheet shows a floating debt of above $2,500 and a profit and loss deficit of $487,115. Year ended Dec. 31, 1901: Gross receipts, $1,328,681; expenses, $1,180,914; net, $147,767; interest, $440,-135; deficit, $292,368. The company recently defaulted on its bonds.

ST. LAWRENCE POWER.—The St. Lawrence River Power Company, of Massena, St. Lawrence County, has been incorporated with a capital of $7,000,000. The directors are Henry P. Davison, of Englewood, N. J.; Mark T. Cox, East Orange, N. J.; Samuel E. Potter, William J. Wilson, New York, and Thomas A. Gillespie, Massena. This company will, it is presumed, take over the Massena enterprise.

HUDSON RIVER POWER.—A certificate has been filed in the Saratoga County Clerk's office increasing the capital stock of the Hudson River Electric Company, owning the mammoth new concrete dam at Spiers Falls, from $1,000,000 to $3,000,000. The company expects to begin transmitting power to the General Electric Company's plant, at Schenectady, on Sept. 1.

DIVIDENDS.—The directors of Chicago Edison Company have declared the regular 2 per cent. quarterly dividend, payable August 1st. The Minneapolis General Electric Company has declared a regular semi-annual dividend of $3 on preferred stock, payable to stockholders of record July 22.

MACON CONSOLIDATION.—The Macon (Ga.) Consolidated Street Railroad and the Macon Electric Light and Railway Company are to be consolidated and operated under the direction of the Railways and Light Company of America.

Commercial Intelligence.

THE WEEK IN TRADE.—Weather, crop and industrial developments have been largely favorable, and coupled with the greater ease of money make for an optimistic feeling in trade and speculation, says *Bradstreet's*. Railway earnings continue satisfactory, June returns of nearly 100,000 miles of road showing an aggregate gain of 8 per cent. over last year. In the matter of actual business, improvement is noted in the demand for finished products of iron and steel, and lumber seems to be recovering from the temporary depression noted at the beginning of this month. Iron and steel trade conditions seem surprisingly good, heavy sales of finished material being reported from Chicago and Pittsburg. Special activity is noted in bar iron, structural material, rails, and, in fact, all of the heavier forms. The industrial situation has improved considerably, many strikes having been settled. The business failures for the week aggregated 174 as against 195 the week previous and 208 the same week last year. The copper market is quiet, buyers showing some interest at the lower prices. The quotations are 11⅞ @ 12c. for Lake, 11¾ @ 11⅞ for electrolytic in cakes, wire bars and ingots, and 11½ @ 11⅝c. in cathodes.

MIDDLETOWN, N. Y.—The Orange County Gas and Electric Light Company has passed into the control of the Henry Floy Company of New York. The new officers are: Henry Floy, president; M. C. Kimball, vice-president; L. L. Lewis, secretary, and C. Fitzgerald, treasurer. The company has a contract with the Neversink Light & Power Company for the construction of a power plant near Cudebackville, work on which is now progressing. From this plant, which will have a capacity of 1,000-hp, electrical energy will be transmitted to Port Jervis and Monticello for lighting and power purposes.

ORDERS FOR SPRAGUE APPARATUS.—The Sprague Electric Company has been securing many important contracts for its motors and generators, and both its Watsessing factory and New York conduit factory are rushed to the utmost. In addition to its foreign orders and many orders for small size apparatus, it has recently made the following sales: Atlas Portland Cement Company, Hannibal, Mo., seven 35-hp motors and eight 15-hp motors; Atlas Portland Cement Company, Northampton, Pa., one 30-hp motor and two 35-hp motors; E. W. Bliss, New York City, fifteen 10-hp motors, seventeen 25-hp motors and one 50-hp motor; Lehigh Portland Cement Company, Wellston, O., one 300-kw bolted generator, one 230-hp motor and six smaller motors aggregating 100-hp; Emery Bird Thayer Dry Goods Co., Kansas City, three split pole engine type generators, 60-kw, 100-kw and 350-kw, respectively; Mergenthaler Linotype Company, Brooklyn, one 150-kw split pole engine type generator; Government Printing Office, Washington, D. C., contract for ventilating plant consisting of direct connected American Blowers and the following motors, one 5-hp motor and one 10-hp motor, two 15-hp motors and eight 20-hp motors; Chas. Scribner and Son, New York City, seven motors of 3 and 4-hp; American Sugar Refining Company, Brooklyn, six 20-hp motors; Hatzel & Buehler, New York City, one 125-hp motor for New York *Herald;* The Alliance Press, New York City, nine motors for printing presses; Lackawanna Steel Co., West Seneca, N. Y., one 3-ton trolley hoist; The John Simmons Company, New York City, one 50-kw bolted generator and two motors, 20 and 25-hp respectively; Shoreham Hotel, Washington, D. C., three split-pole engine type generators to develop 50, 75 and 100-kw respectively; Baltic Mills Company, Baltic, Conn., one 75-kw split pole belted type generator; Gorham Mfg. Co., Providence, R. I., one 40-hp motor; Utica Steam and Mohawk Valley Cotton Mills, Utica, N. Y., two 100-kw split pole belted generators; Duluth Printing and Pub. Company, Duluth Minn., one 25-hp motor; Gray Lithograph Co., New York City, three motors, two 5-hp and one 20-hp; New York Life Insurance Company, New York City, two 50-kw split pole belted generators; Arthur Frantzen Company, Chicago, one 5-hp and two 20-hp motors; James Wilson, Pittsfield, Mass., one 150-kw belted generator and two motors, 20 and 25-hp, respectively; 50-hp motor and one 15-hp motor; Pennsylvania Steel Company, Steelton, Pa., ten 5-ton trolley hoists; Sigourney Tool Company, Hartford, Conn., one 75-kw split pole engine type generator; Lindell Hotel Company, St. Louis, one 60-kw and one 75-kw split pole belted type generator; Treasury Department, Bureau Engraving and Printing, Washington, D. C., one 20-hp motor; American Can Co., New York City, one 75-kw engine type generator and one 35-kw belted generator; Lewis Institute, Chicago, one 75-kw split pole engine type generator; George A. Fuller Co., New York, for the ventilating system in R. H. Macy's new store, four 25-hp motors and one 10-hp motor. Miller, Tompkins & Co., New York City, one 15-hp motor; Hibbard-Rodman-Ely Safe Co., Plainfield, New Jersey, two 25-hp motors; Goes Lithograph Co., Chicago, 20 motors, various sizes; Chas. Schweinler, New York, fifteen 5-hp motors; Tucker Elec. Construction Co., for The National Meter Company, Brooklyn, N. Y., one 75-kw split pole engine type generator.

ALLIS-CHALMERS ENGINE ORDERS.—During the month of June, the Allis-Chalmers Engine Company, of Milwaukee, made the following sales of large engines, all of the Reynolds-Corliss type, and either of the 1890 frame or the girder frame: W. F. Stewart Co., Flint, Mich., 18 in. x 36 in.; Russel, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y., 22 in. x 48 in.; Brown, Cary & Woodruff Co., Salt Lake City, Utah, 12 in. x 36 in.; Tyee Copper Co., Ladysmith, Vancouver Island, 14 in. x 36 in.; Kioto Traction Co., Kioto, Japan, 16 in. and 32 in. x 36 in., cross compound direct coupled; P. A. Peterson, Rockford, Ill., 10 in. x 30 in.; Park City Sampling Mills, Park City, Utah, 16 in. x 36 in.; Hudson River Lumber Co., Kansas City, Mo., 20 in. x 42 in.; International Paper Co., New York City, N. Y., 16 in. x 42 in.; Virginia Carolina Chemical Co., Richmond, Va., one 16 in. x 42 in., one 20 in. x 42 in.; Janesville Cement Post Co., Janesville, Wis., 14 in. x 36 in.; Geo. T. Houston, Chicago, Ill., 28 in. x 48 in.; Twin City Rapid Transit Co., Minneapolis, Minn., 46 in. and 94 in. x 60 in., vertical cross compound direct coupled (third order); West Allis Malleable Iron and Chain Belt Co., West Allis, Wis., 12 in. x 30 in.; John Q. Gantz, Elon College, N. C., 18 in. x 48 in.; London United Tramways, London, Eng., 26 in. and 54 in. x 48 in. vertical cross compound direct coupled.

PRODUCTION OF MICA.—According to a bulletin of the U. S. Geological Survey, issued by Director C. D. Walcott, the total amount of plate mica produced in the United States during 1901, as reported to the Survey, was 360,000 pounds, valued at $[illegible]8,850, as compared with 456,283 pounds, valued at $92,758, in 1900. There was a large falling off in the amount of scrap mica produced in 1901, estimated at 2,165 short tons, valued at $10,710, as compared with 5,497 tons, valued at $55,502, in 1900. The importation of mica from Canada and India tends to curtail the production in the United States, especially the Indian mica, which can be imported at a cost lower than that for which it can be mined in this country. There was an increase in the production of plate mica in North Carolina, but a large falling off in the production of scrap mica. The imports of mica in 1901 were valued at $335,054, as compared with $319,560 in 1900, and with $275,984 in 1899. The use of mica in sheets for stove, chimneys, etc., has increased greatly, but still more the use of small circular disks and rectangular pieces of mica for insulation purposes and for electrical apparatus. Ground scrap mica is used in the manufacture of wall papers, lubricants, etc. Scrap mica, also, arranged on a wire net coil, and then pressed into proper shape, is used very satisfactorily as a boiler tube covering, mica being a non-conductor of heat.

THE PELTON WATER WHEEL COMPANY, of San Francisco and New York, report an unusually large number of both foreign and domestic orders for the last month, notably water-wheel plans for the Clark Electric Company, of Ophir, Utah, which will require 2,000-hp for driving its generators, which will generate power for the mines and towns about Tooele county, Utah. The Pacific Portland Cement Company, of Spokane, Wash., is about to install Pelton wheels to operate its entire plant. A foreign order of unusual interest, from its inaccessibility and magnitude, and competition from all the manufacturers of Europe, has just been received from the Spanish Cement Mills, near Barcelona, Spain. This order calls for several miles of heavy sheet, steel-riveted pipe, and water wheels to generate power for their entire plant, which is one of the largest of its kind in the world. Among other orders might be mentioned those from the Salvador Mining Company, Rix Compressed Air & Drill Company, Ledge Mining & Milling Company, Lahaina Plantation Company, Ouray Electric Light & Power Company, and the Ardjassarie Electric Power Transmission Company, of Batavia, Java.

EQUIPMENT FOR WESTERN GLASS WORKS.—The Great Western Glass Company, of Ottawa, Ill., has just placed a substantial contract for equipment to be used for lighting and power transmission in its new glass works. The contract calls for a 75-kw generator, direct connected to a 12 in. x 12 in. engine and a 50-kw generator direct connected to a 11 in. x 10 in. engine. The generators will be built by the C. & C. Electric Company. The engines will be of horizontal type and are to be furnished by the Ames Iron Works of Oswego, N. Y. There will also be 11 C. & C. motors varying in size from 2-hp to 35-hp; a large three panel switchboard; 50 arc lamps and 500 incandescent lamps.

SIX-HUNDRED H.-P. HORIZONTAL GAS ENGINE PLANT.—The Consolidated Industries Company of New Jersey, which concern owns the electric light and power plant at Batavia, N. Y., has placed a contract with Westinghouse, Church, Kerr & Company for a 600-hp gas engine plant, to operate the entire machinery in the station. The equipment, which will consist of two horizontal, double-acting, tandem type engines of 250-hp, each of recent design by the Westinghouse Machine Company, and one 80-hp; also a 20-hp one, will be the first plant of horizontal gas engines of any importance in the country.

HAVANA PLANT TO BE EXTENDED.—The Spanish-American Light and Power Company, to which some reference was made in these columns recently, and of which T. J. Hayward, of Bartlett, Hayward & Co., Baltimore, Md., and 100 Broadway, New York, is the president, is about to extend its Havana electric lighting plant. The new equipment will consist of three 600 k.w. generators. The contract will be let direct from Havana. Mr. E. Zorilla is general manager of the company. Mr. Charles Woodriffe is the chief engineer, and Mr. R. Jimenez is the engineer of the electric plant.

EQUIPMENT FOR ST. LOUIS RAILWAY PLANT.—The East St. Louis (Mo.) Suburban Railway Company, which has acquired the franchises formerly held by the St. Louis, Belleville and Suburban Railway Company, is placing contracts, through Lichter & Jens, Chemical Building, St. Louis, for various equipment to be installed in its new plant at East St. Louis. The latter company's plant is being removed from St. Louis proper to East St. Louis, and considerable additions are to be made thereto. John A. Mead & Company will furnish some coal and ash handling machinery.

STORAGE BATTERY PLANT FOR OTTAWA.—The Ottawa Electric Street Railway Company, Ottawa, Ont., will install a storage battery plant adjacent to its powerhouse at Chaudiere Falls. The battery will take care of the "peak" of the load on the station. It has been purchased of the Electric Storage Battery Company, of Philadelphia, and, it is stated, cost $75,000.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from for the week ended July 19: Antwerp—3 pkgs. machinery, $257; 7 Republic—4 pkgs. machinery, $683; 36 pkgs. material, $1,693. Antwerp—2 pkgs. machinery, $150; 12 pkgs. material, $768. Azores—2 pkgs. material, $36. British Australia—20 pkgs. material, $170; 2 pkgs. machinery, $87. Brazil—13 pkgs. material, $739; machinery, $165. Brazil—206 pkgs. material, $6,825; 155 pkgs. machinery, $10,433. Bremen—3 pkgs. material, $53. Baku—1 pkgs. material. $200. British Guiana—9 pkgs. material, $440. dies—5 pkgs. material, $96. Constantinople—2 pkgs. machinery, $59. Central America—28 pkgs. material; $447; 1 pkg. machinery, $100. Cuba—10 pkgs. material, $223. Christiania—3 pkgs. material, $1,355. Central America—36 pkgs. material, $424. West Indies—7 pkgs. material, $87. Dutch East Indies—13 pkgs. material, $228. Egypt—6 pkgs. material, $500. Ecuador—4 pkgs. material, $81. Glasgow—11 pkgs. material, $699; 31 pkgs. machinery, $1,575. Genoa—31 pkgs. material, $275. Havre—11 pkgs. machinery, $1,660; 12 pkgs. material, $242. Hamburg—5 pkgs. machinery, $3,266; 29 pkgs. material, $1,156. Liverpool—367 pkgs. machinery, $23,308; 951 pkgs. material, $6,530. London—92 pkgs. machinery, $1,492; 102 pkgs. material, $7,666. Manchester—496 pkgs. machinery, $46,980; 1 pkg. material, $92. Mexico—199 pkgs. material, $3,315; 31 pkgs. machinery, $915. New Zealand—1 pkg. machinery, $97; 34 pkgs. material, $2,153. Portsmouth—3 pkgs. material, $300. Peru—10 pkgs. machinery, $450; 13 pkgs. material, $365. Rostoff—3 pkgs. machinery, $162. Southampton—1 pkg. material, $17; 1 pkg. machinery, $135. U. S. Colombia—8 pkgs. material, $207. Vienna—4 pkg.s machinery, $220. Venezuela—2 pkgs. material, $16.

WESTINGHOUSE, CHURCH, KERR & COMPANY during the last month have received a large number of orders for Westinghouse steam engines and turbines, including two of the largest engines in existence for power service. The New York Edison Company have ordered two more 6,000-hp vertical 3-cylinder compound engines in addition to the eight of this same type now running and under course of erection at their Waterside station. The Rapid Transit Subway Construction Company, New York, has just placed an order for three 1,250-kw turbo-generator sets for installation in their new power house, and also two 400-hp Westinghouse vertical marine type cross compound engines. The turbines will be used for lighting the power station and subway and stations, and the compound engines, which are built to run on high-pressure, superheated steam, direct connected to Westinghouse generators, will be used as the main exciter units for the power station.

NITROGEN FROM THE AIR.—The Atmospheric Products Company of Niagara Falls have broken ground for their first building on the lands of the Niagara Falls Power Company, to be the construction plant for the apparatus to be used by the company in equipping their contemplated large factory adjacent. Within a short time the Atmospheric Products Company will start their second building, which will be the first factory in the world in which products are to be manufactured from air as the raw material, the company having accomplished the fixation of nitrogen. This second building will be 500 feet long and 50 feet wide. Mr. C. S. Bradley has been spending considerable time at Niagara on this work, whose success was shown experimentally to Lord Kelvin while he was here in May.

TOSSIL CREEK POWER PLANT.—The Arizona Construction Co., which lately incorporated at Prescott, Ariz., is starting one of the largest enterprises ever attempted in the southwest. This company will build a large power generating plant on Tossil Creek, and transmit power to Prescott, Jerome, Big Burg, Lynx Creek, Groom Creek and the many adjacent mines. Several large sub-stations will be located at the centers of the various mining districts. Tossil Creek is about 52 miles from Prescott. This will be the first long-distance transmission plant in Arizona, except the 25-mile line at the Phœnix Light and Power Co. and will be the beginning of a series of like developments. Mrs. I. E. Tutt, the manager, has plans for several more, ranging in size from 2,500 to 1,200-hp.

BELL TELEPHONE OUTPUT.—The instrument statement of American Telephone and Telegraph for the month of June and also since Dec. 20 shows as follows:

June:	1902.	1901.	1900.
Gross output	96,653	96,300	55,613
Returned	41,741	34,221	25,671
Net output	54,912	62,079	29,942
Since Dec. 20, 1902:			
Gross output	589,109	469,923	346,146
Returned	226,267	194,569	132,660
Net output	362,842	275,354	213,486
Total outstanding	2,888,854	2,228,170	1,793,991

LIGHTING PLANT FOR JAPAN.—The Japanese house of Takata & Company, 10 Wall street, has just placed a contract for one of the smallest complete electric lighting plants ever installed in the Far East. The outfit, which is intended to be utilized in the Osaka Club Hotel, Japan, will consist of a 17½ k.w., 125 volt, Westinghouse engine type generator, direct connected to a 7½x17 inch Westinghouse standard automatic engine, 390 r. p. m.; a special duplex feed pump 3x2x3 inches, to be furnished by the Knowles end of the International Pump Company; a Wainwright vertical pattern overflow heater; a Babcock & Wilcox water tube boiler, etc.

ONONDAGA DYNAMOS IN SEWAGE PLANT.—An interesting sewage disposal plant, with a capacity of 2,000,000 gallons of sewage per day, located near Bergen's Landing, on Jamaica Bay, Long Island, is about ready to go into operation. The plant, which is said to be the largest ever constructed on this system of precipitation, will be operated and lighted by electricity, furnished by a 50-hp Onondaga generator, made by the Onondaga Dynamo Company, Syracuse, N.Y. The generator will be belted to a 60-hp Westinghouse "Junior" engine. The Onondaga Dynamo Company will also supply the 10 motors which are being installed throughout the plant.

MAGNETIC SEPARATOR PLANT.—One of the oldest magnetic ore separating plants is increasing its equipment, namely that of Witherbee, Sherman & Co. at Port Henry, N. Y. They are installing a large central power plant for which the General Electric Company is furnishing the generators. There are to be three separating plants requiring current, with four new electric hoists, and an air compressor plant driven by electricity.

THE STANDARD STEEL CAR COMPANY is equipping its new plant for electric driving throughout. A recent purchase from the Westinghouse Electric & Mfg. Co. comprises two 375-kw, A. C. generators, one 400-kw, D. C. generator, and a 300-kw rotary converter for use as a connecting link between the two. This company has, also, purchased about fifty induction motors which will be used largely for direct connection to machine tools.

BALL ENGINE PLANTS.—The West Virginia Reform School at Fetterman, W. Va., is installing an electric plant. The engine will be furnished by the Ball Engine Co., Erie, Pa., and the generator by the Westinghouse Elec. & Mfg. Co. Sanger Bros.' dry goods house at Waco, Texas, will have their own electric plant, the engines being furnished by the Ball Engine Co.

ELECTRICITY IN STEEL MILLS.—Jones & Laughlins, of Pittsburg, Pa., are continually making additions to their electrical equipment and have just recently ordered from the Westinghouse Electric & Mfg. Co. one 800-kw D. C. generator, two 150-kw, motor-driven, two-phase alternators, and two 125-light, motor-driven arc generators.

CONTRACT FOR SWITCHBOARD.—The contract for building a new 9-panel high potential, alternating switchboard at the plant of the Fitchburg Gas and Electric Co., Fitchburg, Mass., has been secured by S. B. Condit, Jr. & Co., Boston. This board will be equipped with the Elden remote-control oil circuit breakers, made by this firm.

TELEPHONE EQUIPMENT.—Mr. J. D. Morris of Roxboro, N. C., is interested in a telephone enterprise to be incorporated to establish an exchange in that town and vicinity. The exchange will have a capacity of about 50 subscribers. Mr. Morris would like prices for construction material and outfit of instruments.

MESSRS. S. C. FARNHAM, BOYD & CO., LTD, engineers and ship builders, of Shanghai, China, having added an electrical department to their business, would be much obliged for catalogues and terms from manufacturers of and dealers in electrical supplies and accessories of every description.

MR. G. M. GEST, the well known conduit contractor, has just received through his Cincinnati office the contract for the underground work of the Bell Telephone Company of Cincinnati. This will amount to nearly one hundred thousand duct feet.

A RIDGWAY PLANT.—McClave, Hamilton & Co., New York City, have been awarded the contract for the new electric plant in the department store of A. D. Mathews & Sons, Brooklyn. Ridgway dynamos and engines will be installed.

THE CARBORUNDUM COMPANY at Niagara Falls, N. Y., are enlarging their plant and putting up a new three-story brick building 50 x 225 feet. The production of carborundum in 1901 was nearly 4,000,000 pounds.

JACOB MILLER, SONS & CO., of Philadelphia, have recently purchased, through their engineer, Dr. W. A. Drysdale, a 180-kw Westinghouse, 2-phase, belted alternator, complete with direct-connected exciter.

General News.

THE TELEPHONE.

PUEBLO, COL.—The Colorado Telephone Company will install an entire underground system in Pueblo.

BLUE RIDGE, GA.—The Blue Ridge Telephone Company, of which John H. Carter is president, is now in active working order. About 60 telephones have already been put in here, five or ten at Mineral Bluff, several at McCays, Tenn., and about 15 at Morganton. Besides these about 25 or 30 more have been ordered.

CHICAGO, ILL.—The Chicago Telephone Company will spend $16,000 on a telephone exchange building at Chicago Heights. It will be two-story, 24 by 75 feet. The same company has begun the construction of an exchange building at Laflin and Nineteenth Streets, the cost to be $30,000.

INDIANAPOLIS, IND.—The Knox County Home Telephone Company has incorporated with a capital of $125,000.

SOUTH RAUB, IND.—The South Raub Co-operative Telephone Company has been incorporated with a capital stock of $4,000.

INDIANAPOLIS, IND.—The New Telephone Company has opened its new branch station for the south side. The switchboard has a capacity of 1,800 lines.

SYRIA, IND.—The Syria & Orleans Telephone Company, capital stock $540, has been incorporated. Directors: A. J. Pickens, Jas. L. Nebbitt, H. McCoy and others.

INDIANAPOLIS, IND.—The Akron Telephone Company has incorporated with a capital stock of [illegible] is secretary.

BRICK CHAPEL, IND.—The Brick Chapel Telephone Company has been incorporated to establish and operate a telephone system in Putnam County. J. M. Allen, R. A. Tulboll and J. M. Jones constitute the board of directors.

INDIANAPOLIS, IND.—The Whiteland Telephone Company, of Whiteland, has increased its capital stock to the amount of $10,000; and the Eastern Indiana Telephone Company, of Winchester, has increased its capital from $5,000 to $15,000.

PIERCETON, IND.—The Pierceton Telephone Company, of Pierceton, has been incorporated. Capital stock, $20,000. The corporation proposes to establish telephone systems in Kosciusko, Whitley, Noble, and Wabash Counties. J. T. Brosnahan, D. W. Strause and Harry Humrichouser, are the incorporators.

INDIANAPOLIS, IND.—At a conference here on July 5 between President Sherrin of the New Long Distance Telephone Company, of Indianapolis, G. H. Hendren and J. F. Slickard, of Bloomfield, D. A. Yoder, of Vicennes, J. H. Klinger and M. J. Murphy, of Brazil, Guy Bush, of Clay City, and C. P. East, of Worthington, contracts were signed connecting large territory with the New Telephone Company's system. Most of these independent lines will connect with the long distance system at Spencer.

DENISON, IOWA.—The Crawford County Telephone Company has been incorporated with J. B. Romans, president, and J. F. Glenn, secretary.

DEXTER, IA.—The Dexter Mutual Telephone Company, capital $5,000, has been incorporated by W. W. Brown, S, F. Lenacker, E. B. Yaple and J. M. Gordon.

SIOUX CITY, IA.—The Sioux Valley Telephone Company of Cherokee has given notice to the Secretary of State of an intention to issue $25,000 of preferred stock in addition to the same amount of common stock.

DES MOINES, IA.—The Iowa City and West Branch Mutual Telephone Company, Scott township, Johnson County, has been incorporated. Capital, $2,000. President, J. T. Struble; vice-president, Geo. Hunter; secretary, J. J. Murphy; treasurer, James Douglas.

PORTLAND, ME.—The New England Telephone & Telegraph Company has added a new section to its switchboard at Belfast to accommodate the toll business, which calls for an increase of the office force to five persons. New direct lines to Bangor and Portland have recently been put in.

ANGUSTA, ME.—The Stone Telegraph & Telephone Company with a capitalization of [illegible], has filed a certificate at the office of the Secretary of State. The company was organized at Portland. The promoters are Alexander Porter Browne and [illegible], of Boston, John Stone, of Cambridge; and John W. Anderson, A. G. Berry, M. Warren and Wm M. Bradley, of Portland.

THREE RIVERS, MICH.—The Three Rivers Telephone Company has increased its capital stock from [illegible] to [illegible].

MENOMINEE, MICH.—The Wisconsin Telephone Company will expend about [illegible] on improvements and reconstruction of the line at Sturgeon Bay. New and larger cables are to be put in and old poles reset and fixed and the line extended to the outskirts of the city.

PONY, MONT.—The Citizens' Telephone Company, of Pony, has been incorporated. Capital, $3,000. H. Z. Schreiner, Blazet Tinsley and others are the incorporators.

JEFFERSON CITY, MO.—The state board of equalization July [illegible] a resolution directed to the telephone companies in the State, ordering them to report to the board at once the amount of certain kinds of property owned by them, in order that the property may be assessed for State taxes.

JERSEY CITY, N. J.—At the recent annual meeting of the American Union Telegraph Company of New Jersey these directors were elected: R. C. Clowry, T. F. Clarke, B. Brooks, A. R. Brewer and J. B. Bertholf. The directors elected the following officers: R. C. Clowry, president; T. F. Clarke, vice-president, and A. R. Brewer, secretary and treasurer.

ITHACA, N. Y.—The Lyons Telephone Company and the Wayne County Telephone Company have been consolidated.

ALBANY, N. Y.—The Crosby and Barrington Telephone Company of Yates County has been incorporated. Capital $5,000, and directors: C. E. Guile and H. S. Fullager, of Penn Yan, and A. P. Mortimer, of Dundee.

TROY, N. Y.—The Hudson River Telephone Company has sold its Pennsylvania lines to the Pennsylvania Telephone Company, of Harrisburg, Penn. It is understood the price was [illegible]. The franchises are located in Wayne and Pike Counties.

URBANA, OHIO.—The Urbana Telephone Company has increased its capital stock from [illegible] to [illegible].

HARRISON, OHIO.—The New Baltimore & Venice Telephone & Telegraph Company has secured a franchise in Harrison.

WAPAKONETA, OHIO.—The Wapakoneta Telephone Company has increased its capital stock from $25,000 to $40,000. About 500 subscribers are now served by the company.

COLUMBUS, OHIO.—The East Springfield Telephone Company, East Springfield, Jefferson County, has been incorporated with a capital of $6,000 by H. L. Fiscus and others.

FINDLAY, OHIO.—The People's Telephone Company has been incorporated with $25,000 with J. M. Crawford, Columbus Grove, president; Milton May, Mt. Blanchard, secretary-treasurer; Nora Samson, manager. The headquarters are at Mt. Blanchard and the company is operating exchanges at Mt. Blanchard, Arlington, Forest, Martin and Jenera.

OTTAWA, ONT.—The Canadian Machine Telephone Company has been incorporated by Hon. G. E. Foster, M. P. Ludwig and J. A. Phin, of Toronto, and J. E. Ganong and J. D. Chapman, of St. Stephens, N. B. The capital is $250,000 and the headquarters will be in this city.

OTTAWA, ONT.—The mayor of Ottawa, Ont., has received from the Elektrisk bureau, Christiana, Norway, a tender for the establishment of a telephone system in Ottawa with a minimum of 2,500 and a maximum of 5,000 subscribers. The tender is merely for the apparatus and central. The figures are withheld for the present by the civic authorities in view of the uncertainty of the telephone situation of the city.

AUSTIN, TEX.—The North Texas Telephone Company of Pecan Gap, Delta County; capital stock $5,000 has been incorporated by W. A. Cockrell, W. R. James and J. H. Sardin.

SALT LAKE CITY, UTAH.—The Colorado Telephone Company will extend its lines from Cripple Creek to Salida, taking in the towns of Whitehorn, Turet and other intermediate mining camps.

SALT LAKE CITY, UTAH.—The Sunset Telephone Company has bought out the local telephone company operating in the El Cajou section, Calif. New lines will take in Lakeside, Dehesa, Jacumba, Santeé, Descano, La Mesa, Alpine and a few small towns.

PRAIRIE DU CHIEN, WIS.—The Union Telephone Company, of Prairie du Chien, has increased its capital stock from $1,000 to $5,000 and the number of directors from five to three.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Edison Electric Company, of Los Angeles, Calif., has completed the sale of bonds to the amount of $10,00,000, the proceeds of which will be devoted to completing its great electric power system. The plans which were completed some months ago, include the transmission of electric power from power stations to be installed along the Kern River, to Los Angeles; duplicate power lines for the transmission of current from Kern County to Los Angeles and other cities, and auxiliary steam power generating stations.

DENVER, COL.—The branch power house of the Denver Gas & Electric Company, at Montclair, was entirely destroyed by fire on June 27.

HARTFORD CITY, IND.—The National Rolling Mill Company is to put in a new electric light and power plant.

CALUMET, MICH.—The electric plant at the Baltic Mining Company, Houghton County, Lake Superior, Mich., went in commission July 12. This is one of the plants installed by Frederick N. Bosson, Consulting Engineer, and who is the electrical engineer for the Calumet and Hecla Mining Company at Calumet.

BUTTE, MONT.—An ordinance will be introduced in the city council to require all overhead wires to be placed underground.

HELENA, MONT.—In the organization of the Helena Power & Light Company, which was sold under order of the United States Court recently, the corporation is to take the name Helena Light & Traction Company. The capital of the new company will be $100,000. The directors are Thomas A. Marlow, Henry M. Parchen, Albert L. Smith and Norman B. Holter, of Helena and Kenneth Clark, of St. Louis, Mo.

RATON, N. M.—The present capacity of the electric light plant is 3,000 lights and it will be increased to 5,000. A 200-hp engine will be added and a new building will be erected. The cost of the improvements will be about $25,000.

ALBANY, N. Y.—The West Seneca Light, Heat and Power Company, of West Seneca, has been incorporated, capital, [illegible]. Directors, E. B. Smith, C. A. Hahl, H. N. Kraft, Buffalo.

WEST SENECA, N. Y.—The West Seneca Light, Heat & Power Company has been formed under the laws of New York with a capital stock of $200,000. The directors are E. B. Smith, C. A. Hahl and H. N. Kraft.

CLEVELAND, OHIO.—The Cleveland Pneumatic Tool Company, H. W. Cole, secretary and treasurer, is to erect and equip a new plant driven electrically.

BATAVIA, OHIO.—The village of New Richmond has issued $4,000 worth of bonds for the purpose of increasing the capacity of its lighting plant.

COLUMBUS, OHIO.—The East Columbus Heating & Electric Lighting Company has been granted a 25-year franchise. Current will be furnished at 15 cents per kilowatt with a graduated rate of discount.

EATON, OHIO.—The council is taking preliminary steps to secure a municipal lighting plant. The contract with the present company expires in a few months. The question will be submitted to popular vote.

MASSILLON, OHIO.—G. A. Myers, of Massillon, who has secured the franchise for illuminating the town of Navarre, announces that work of building the plant will start at once. A 40-kw generator, an 80-hp engine and an 80-hp boiler will be required.

BOWLING GREEN, OHIO.—The Citizens' Light, Heat and Power Company of this city has consolidated with the Lake Erie, Bowling Green and Napoleon Electric Railway. A new company will be organized under a new name.

BAKER CITY, ORE.—F. S. Baillie, H. S. Bowen and J. L. Rand, as incorporators of the Consolidated Power Company, of Baker City, have filed incorporation papers. Capital stock, $100,000.

BAKER CITY, ORE.—The installation of two electric plants at Baker City will be accompanied by the irrigation of a large area of land near that city, it being proposed to use electric power to operate large pumps to supply the water.

DOYLESTOWN, PA.—The Doylestown Electric Company, of Doylestown, Pa., has recently contracted with the Westinghouse Electric & Manufacturing Company for two 100-kw, engine-type, two-phase alternators with direct-connected exciters, complete with switchboard. The engineer for the work is Dr. W. A. Drysdale, of Philadelphia.

DENISON, TEX.—The "Katy" railway company will build a large electric light plant in connection with other improvements at Denison.

SALT LAKE CITY, UTAH.—The Adder mining property at Silver City, Idaho, will install an electric light and power plant.

MERCUR, UTAH.—The recent fire here totally wrecked the new sub-station lately erected by the Telluride Power Company. The loss is $8,000.

SALT LAKE CITY, UTAH.—There is talk of utilizing Owens River, in Nevada, for generating electric power for transmission to Tonopah, Nev., for operating mine and mill machinery. The point where the plant is to be built is 100 miles from Winnemucca, and here 10,000 hp can be generated at all seasons.

NEWPORT NEWS, VA.—Work has been begun on the large electric power house to be erected in Phoebus by Mr. W. S. P. Shields, of Philadelphia. It will cost about $150,000.

DAVENPORT, WASH.—C. O. Green, of Ritzville, Wash., has applied to the city council here for a franchise for the Davenport Electric and Power Company.

SPOKANE, WASH.—The city council of Spokane will make a deal with a new corporation for utilizing the waste water power at the up-river station. A power plant will be erected to supply the city with electric lights.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The North Shore Railroad Company has specifications out for the equipment for its 2,000 hp electric generating station that is to be constructed at Corte Madera, between Sausalito and San Rafael, Calif. The plant will be operated by steam power. A large proportion of the electric power used on the electric division of the railroad will be supplied from the Bay Counties Power Company's transmission lines. At least one unit of the steam plant will always be kept in operation, however, to prevent interruption of the service in case of accident to the transmission system. The estimated cost of the power plant is $225,000.

CHICAGO, ILL.—The Ridgeland power house of the Consolidated Traction Company, at Ridgeland Avenue and Lake Street, was partly destroyed by fire recently at a loss estimated at $125,000.

WARSAW, IND.—The Winona, Warsaw, Elkhart & South Bend Traction Company has been incorporated with a capital of $400,000. S. P. George is president; S. A. Collins, secretary.

PRINCETON, IND.—The Jasper, French Lick, West Baden and Northwestern Traction Company has been organized with a capital stock of $100,000, which will be increased to $500,000.

LEAVENSWORTH, IND.—The Leavensworth Electric Railway Company has been incorporated. The capital stock is $100,000. T. P. Elsworth, S. A. Beale and O. E. Hawn are directors.

INDIANAPOLIS, IND.—The Indianapolis & Greenfield and the Indianapolis & Eastern Electric Railway Company have merged by filing articles of consolidation and reincorporation under the latter name, with $1,200,000 capital.

INDIANAPOLIS, IND.—There is a well grounded belief that all the interurban lines entering this city are to be merged. That the Indianapolis lines are to be included is generally disbelieved, but this may be accomplished later on.

COLUMBUS, IND.—A franchise has been granted to J. I. Irwin and W. G. Irwin to extend the Indianapolis, Greenwood & Franklin Railway through the county to Columbus, making a 22-mile extension. The company has purchased a site for a power house.

INDIANAPOLIS, IND.—The Southern Indiana Traction Company has filed articles of incorporation to build a line from Vincennes to Jasper, through Knox, Pike and Dubois Counties. The capital is $100,000. The incorporators are R. M. Gray, Herman Eckert, S. N. Chambers, Sol. Frank and E. F. Cox.

WARSAW, IND.—The Winona, Elkhart & South Bend Electric Railway Company has asked the city council for a 50-year franchise. The project includes the building of a line from Nappanie to Warsaw and Mona Park immediately. The promoters are S. F. George, Dayton, O.; George W. Scott, of Troy, O.; and J. A. Norris, Baltimore, Md.

MARION, IND.—The City Council has declared the Marion Transit Company's franchise, owned by the Union Traction Company, forfeited and instructed the city attorney to bring suit against it in the name of the city for $50,000 damages. This culminated from the action of the Union Traction Company in tearing up 38th Street and putting in a connection at that point without permission.

PARIS, KY.—The Bourbon Fiscal Court has declined to grant a franchise to the Blue Grass Traction Company for a line between Paris and Lexington.

PADUCAH, KY.—The reorganization of the Paducah Street Railway Company has been effected. The company will issue $600,000 in bonds and will make extensive improvements. Officers have been elected as follows: George C. Thomas, president; George C. Wallage, vice-president; A. L. Rich, Cincinnati, secretary-treasurer; H. L. Porter, Cincinnati, superintendent.

NEW ORLEANS, LA.—The New Orleans Railways Company has filed a certificate in New Jersey increasing its capital from five million dollars to forty million dollars. Henry H. Pearson, Jr., is president of the company, which was organized last January.

PORT HURON, MICH.—The directors of the Detriot United Street Railway Company have completed the purchase of the Port Huron Suburban Railway. The price paid was $800,000 and the Port Huron line will be merged with the Detroit United. This inaugurates the entry again into business enterprises of the Everett-Moore syndicate, which controls Detroit United. Having met their obligations to bankers, they will now proceed with the enterprises which were checked by their troubles of last winter.

CAMDEN, N. J.—The People's Traction Company, chartered to build and maintain street railways within the State, has been incorporated here. It is capitalized at $175,000, and among its incorporators is T. R. Sweigart.

NEW YORK CITY.—Efforts have been made by city health authorities to suppress the storage battery cars on West Thirty-fourth Street on the ground that the sulphuric acid fumes from them cause discomfort and are a serious menace to the health of the passengers.

PIQUA, OHIO.—The Dayton & Troy Electric Railway has transferred its general offices from Dayton to Piqua.

LOUDONVILLE, OHIO.—The Mansfield & Wooster Electric Railway has secured a franchise through this town.

STEUBENVILLE, OHIO.—The Steubenville Traction & Light Company has increased its capital stock from $700,000 to $1,000,000.

TOLEDO, OHIO.—The directors of the Toledo & Monroe Railway have decided favorably on the proposition of extending the road to Detroit.

COLUMBUS, OHIO.—The Appleyard syndicate is planning to extend the Columbus, Grove City & Southwestern Railway from Morgan Station to Mt. Sterling and Washington C. H.

COLUMBUS, OHIO.—The Urbana, Mechanicsburg & Columbus Railway Company has secured a 25-year franchise enabling it to reach the center of Columbus. The company agrees to carry city passengers at the rate of 33 tickets for $1.

COLUMBUS, OHIO.—Tucker, Anthony & Co., owners of the Columbus, Buckeye Lake & Newark Traction Company, have taken formal posssesion of the Newark & Granville Railway and the Newark City lines which they recently purchased. A number of improvements will be made to both properties.

NORWALK, OHIO.—The City commissioners have taken matters into their own hands and are removing the rails of the Sandusky, Monroeville, Bellevue & Norwalk Railway from the streets. The company's franchise was declared forfeited a few days ago because of failure to complete the road.

CLEVELAND, OHIO.—Except for the bridge at Birmingham the Norwalk extension of the Cleveland, Elyria & Western Railway is completed. This bridge is one of the largest ever built by an electric railway in Ohio. It has two arches, is nearly 500 feet in length and the track will be 82 feet above the water.

BOWLING GREEN, OHIO.—The promoters of the Lake Erie, Bowling Green & Napoleon Railway have purchased the plant and business of the Citizens' Light, Heat, Power & Ice Company of Bowling Green. The lighting plant is to be enlarged and new engines and generators will be installed to take care of the railway load.

AKRON, OHIO.—The Cleveland, Richfield & Akron Transit Company has purchased a site in Akron to be used for a power house. The company has made a bid for a franchise over the route mapped out by the city commissioners. It looks as if this second line between Cleveland and Akron will be built in the near future. In the meantime the Northern Ohio Traction Company is spending an immense amount of money in double tracking and otherwise placing its road in condition for fast time.

CLEVELAND, OHIO.—The Cincinnati, Dayton & Toledo Traction Company has filed in the several counties traversed by its lines, a trust mortgage for $5,000,000 given to the Cleveland Trust Company to secure an issue of $5,000,000 worth of 5 per cent. 20 year bonds. The mortgage covers all the property recently consolidated to form the company mentioned. A portion of the money derived will be used for the purpose of absorbing other lines to complete the through line from Toledo to Cincinnati.

IRONTON, OHIO.—It is announced that the Camden Interstate Railway Company has sold out to a syndicate headed by John J. Henry and William North, of Philadelphia, and John Graham and Edmund McCandish, of Newville. The property includes the electric railways extending from Huntington, W. Va., to Central City, Creedo, and Kenova, W. Va., Catlettsburg and Ashland, Ky., and Ironton, O. It is reported that these people propose to purchase other lines in the Ohio valley with a view of forming a continuous line from Cincinnati to Pittsburg.

MONTREAL, QUE.—The Montreal Street Railway Company has voluntarily decided to give its employees an increase on the present scale of wages. All men who have been in the employ of the company for two years and over, will get from 15 cents to 16½ cents an hour, and those who have been in its

service under two years will receive from [illegible] to [illegible] cents per hour. This increase will mean an extra charge upon the company of $50,000 annually.

KNOXVILLE, TENN.—The power plant for the Knoxville-Sevierville Electric Railway will be located on Holston river.

NASHVILLE, TENN.—The city council has finally granted franchises to the Nashville and Gallatin Electric Railway and the Nashville and Columbia Electric Railway.

TATE SPRINGS, TENN.—W. T. Coffee, of Tennessee, will, it is said, build an eighty-mile electric railway from Tate Springs, Hawkins County, Tenn., to Gate City, Va. Hawkins County has voted $100,000 bonds to aid in the undertaking.

PERSONAL.

MR. THEO. T. JACKSON, of Chicago, has been appointed manager of the Evanston Garyan Company, of Evanston, Ill.

PROF. G. F. SEVER, of Columbia University, N. Y., has been making a photometric test of the electric lights at Norwalk and South Norwalk, Conn.

MR. J. C. MOULTON, formerly connected with Stanley & Patterson, of New York City, is now identified with the Fort Wayne Electric Works and is stationed at their New York office.

MR. GEORGE WESTINGHOUSE has received the unusual honor of being elected an honorary fellow of the American Association for the Advancement of Science, which has recently held an annual meeting at Pittsburg.

MR. R. T. LOZIER, who went to Cincinnati recently to take charge of the sales department of the Bullock Electric Manufacturing Company is in New York and the East attending to some important matters for the company.

MR. GEORGE A. NISBET, of the selling forces of the General Incandescent Arc Light Company, has just returned from a very successful Southern trip and last week greeted his many friends at the Electrical Contractors' Convention in Philadelphia.

MR. WILLIAM F. WARDEN, general manager Burt Manufacturing Company, Akron, Ohio, was a visitor to this office last week. He reports large sales for the Cross oil filter with a steadily increasing demand for it. The export trade has grown surprisingly.

MR. A. E. WINCHESTER, the electrical commissioner of South Norwalk, Conn., where he has brought the municipal plant to a high standard of efficiency and success, has resigned as commissioner, but will continue for the present to serve as superintendent of the system.

DR. CARY T. HUTCHINSON requests us to state that an alleged interview with him in the New York Journal, on the Manhattan electric railway system "was false in every particular, and completely misrepresented what I said to the reporter, which was, briefly, that the system was a perfectly safe one."

MR. TOM J. GARDNER, of Las Animas, Col., is now installing an electric light and power plant of about 100-kw capacity in his town. Mr. Clay Belsley, of Peoria, Ill., is consulting engineer, and Mr. W. H. Banes, formerly of Villisca, Ia., is superintending the erection of the plant prior to assuming the management.

MR. WILLIAM H. WARREN, who has for the past two years been connected with the Sprague Electric Company in the capacity of factory electrical engineer, has recently become associated with the Western Electric Company. Mr. Warren will be located at the factory in Chicago, and take charge of the engineering work for all motors. Mr. Warren was formerly with the Westinghouse Company in its draughting department and also with the Bullock Electric Company as chief draughtsman and later as assistant engineer.

MR. LUTHER STIERINGER has been called into consultation to create some original lighting for the new Hudson Theatre near Central Park, N. Y., which is being built by Mr. G. G. Heye. There is much speculation in electrical circles as to what special decorative and stage illumination will be attempted. It is sure to be novel and effective. It is rumored that virtually not a single lamp for direct lighting will be visible anywhere in the house. Stage lighting will also receive attention along new lines. The electrical work is in the hands of Mr. Benjamin Beerwald, of the Pennsylvania Electric Equipment Company, of Philadelphia.

MR. ROBERT I. TODD, second vice-president of the Cincinnati Traction Company, has tendered his resignation to accept a position with the United Gas Improvement Company in Philadelphia, in connection with their traction interests. Mr. Todd is a native of New Jersey, having been born near Lakewood, Nov. [illegible], 18[illegible]. He graduated from the Johns Hopkins University in the class of 1893. His first connection with street railway work was as assistant superintendent of the Eckington and Soldiers Home and Belt Railway Companies, Washington, D. C. Later when these lines and others were merged into the City and Suburban Railway Company, he was made general superintendent and electrical engineer, resigning from this position in the spring of 1899, to take charge of the experimental work of the Compressed Air Company in New York City, on the Metropolitan Street Railway lines. Mr. Todd resigned this position in July, [illegible], to accept the position of mechanical engineer of the Consolidated Traction Company of Pittsburg, which position he held until February, 1901, when he accepted the position of general manager of the Cincinnati Traction Company, under the Elkins-Widener-Dolan-Morgan Syndicate. In January, 1902, he was promoted to the position of second vice-president of that company. Mr. Todd's work in these various cities has given him experience with all the latest methods of street car propulsion, horse, storage battery, air, underground electric, single and double trolley, and his wide practice in the traction field has peculiarly well fitted him for the work which he now assumes.

NEW INDUSTRIAL COMPANIES.

WALTER MOTOR & POWER COMPANY has been formed at Pontiac, Mich., under the laws of Delaware, with a capital stock of $1,[illegible], to make and sell all kinds of motors.

HUGHES TELEPHONE MANUFACTURING COMPANY has been incorporated at Philadelphia, under the laws of Delaware, with a capital stock of $100,000 to make telephone apparatus.

THE ELBLIGHT COMPANY OF AMERICA, of New York, has been incorporated with a capital of $150,000. Directors; Russell Spaulding, Aulton McMahan, New York; C. W. Bonfils, East Orange.

THE FOX & CALLAHAN ALARM AND ELECTRIC SUPPLY COMPANY, Milwaukee, Wis., capital stock, $50,000, has been incorporated. Benjamin O. Fox, John D. Callahan, Thomas E. Callahan and W. J. Delaney.

THE GENERAL ELECTRIC SIGNAL MANUFACTURING COMPANY, of Newark, N. J., has been incorporated; capital, $50,000. Incorporators: Morris B. Allen, Irvington, N. J.; Edward T. Casebolt, Newark, N. J., and Ernest C. Lum, Chatham, N. J.

BERG AUTOMOBILE COMPANY has been formed under the laws of New Jersey to make automobiles, with a capital stock of $400,000. The incorporators are J. C. Hayes, of Camden, N. J.; and John Wiley and Augustus Treadwell, of New York.

THE KENTON CONSTRUCTION COMPANY, Kenton, Ohio, has been organized for the purpose of engaging in the construction of telephone plants. The capital stock of the company is placed at $10,000. Joseph Timmons, John W. Fulton, J. B. Seymour, James Bastable and F. D. Bain are interested.

AUXILIARY TELEPHONE COMPANY.—The Auxiliary Telephone Company has been incorporated at Newark, N. J., with a capital stock of $100,000, divided into 1,000 shares at $100 each. The concern will manufacture and deal in mechanism for telephone use. The incorporators are Egbert A. Reynolds, of New York, Henry C. Ware, of Orange, N. J.; and C. G. Colyer, of Newark.

GUM CARBO COMPANY.—A charter has been filed in the Secretary of State's office, Austin, Tex., for the Gum Carbo Company, with a capital stock of $10,000,000. The concern will manufacture a substitute for rubber by refining Texas oil combined with cotton seed oil. The incorporators are Robert Bowie, of Chicago, W. F. Enue, of Biloxi, Miss.; R. E. Humphreys, Thomas C. Swope and George C. Waddill, of Beaumont.

STONE TELEGRAPH & TELEPHONE COMPANY.—The Stone Telegraph & Telephone Company, $10,000,000 capital, has filed a certificate at the office of the Secretary of State of Maine. The company was organized at Portland by Alexander Porter Browne and Brainerd Judkins, of Boston; John Stone, of Cambridge, and John W. Anderson, A. G. Berry, M. Warren and William M. Bradley, of Portland. The company will experiment with and develop instruments relating to wireless telegraphy.

LEGAL.

TELEPHONE SWITCHBOARDS.—The Western Electric Company, of Illinois, has brought another suit against the Keystone Telephone Company, of Philadelphia, regarding improvements in multiple switchboard systems.

CLEVELAND FRANCHISES.—Attorney General Sheets began quo warranto proceedings in the Circuit Court at Cleveland to oust the Cleveland City Council, and demanding that members of that body show by what right they hold office. Judge Caldwell of the Circuit Court granted an order restraining the council from granting further franchises or special privileges until the case is heard and decided. Attorney General Sheets holds that inasmuch as the Federal plan of municipal government has been declared unconstitutional by the State Supreme Court, the City Council is an illegal body.

WIRELESS TELEGRAPH SUITS.—It is stated that action has been instituted by the Marconi Wireless Telegraph Company, of America, against the De Forrest system for infringement. Mr. De Forrest asserts that the announcement of the action begun by the Marconi Company was probably premature, as no notice of the suit had been served. Representatives of the Marconi Company, Mr. De Forrest said, had been invited to inspect his equipment. Their experts accepted the invitation and after the inspection he declares, spoke most favorably of the merits of the system. The United States Patent Office has allowed fifty-eight claims to the De Forrest system, and the rights to these patents have been pronounced by legal authorities exceptionally strong. The De Forrest system has offices at No. 17 State Street, No. 13 Battery Park, the Castleton Hotel on Staten Island and at Steeplechase Park, at Coney Island, where the tallest signal mast in the world has been erected. It is reported that the action begun against the De Forrest system is the beginning of a legal battle by the Marconi Company against other companies in this country interested in wireless telegraphy.

Trade Notes.

STANDARD ELECTRIC COMPANY, of Charlotte, N. C., has been incorporated under the laws of Pennsylvania and has changed its name in doing so, becoming the Federal Electric Company.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, reports that it has just received an order from London, Eng., for 28 Cross oil filters and 111 of their exhaust heads. The shipment made one solid carload and constitutes orders placed by its London agency.

THE FARR TELEPHONE & CONSTRUCTION SUPPLY COMPANY, in a recent trade publication has departed somewhat from the usual lines of such publications. Instead of a bound catalogue there is a cover, between which are loose sheets illustrating and describing the various styles of telephones manufactured by the company. A separate folder gives an account of "Chicago Pay Stations."

TELEPHONES.—With this title the St. Louis Electrical Supply Company has issued a handsome 32-page catalogue devoted entirely to telephones, telephone switchboards, telephone construction and supplies. Numerous types of telephones are illustrated and also types of small exchange and toll line switchboards. The latter part of the catalogue is devoted to telephone accessories, construction tools and construction materials.

THE JEFFREY MANUFACTURING COMPANY gave its seventeenth annual picnic at Idlewild Park, Newark, Ohio, on Saturday, July 12. Special trains, three in number, took the employees of the company and its other guests from Columbus, Ohio. The day programme included fifteen entries, among which were a ladies' thread and needle race, a girls' egg race, a potato race and the prize awards. In the evening an amateur theatrical entertainment was given.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, report that they are meeting with unusual success in selling their Scheefer Integrating wattmeters for direct and alternating current. This meter embodies a number of new and novel improvements. It is thoroughly dust and bug proof, is very highly sensitive and accurate, and is not affected by alternations or lag. Prices and descriptive matter will be given on application.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agent for Gutmann integrating alternating current wattmeters, announces that it is about to supply these wattmeters with a glass case instead of the regular aluminum case, where ordered. This allows of a close observation of the meter in operation without exposing the parts to dust or dampness. It will be instructive to the managers of lighting plants to have at least one of these.

GENERAL ELECTRIC BULLETINS.—Bulletins Nos. 4,290 and 4,291 of the General Electric Company relate, respectively, to electric railway apparatus and to compensated revolving field alternators. The first-mentioned bulletin is a reprint, with extra illustrations, of a paper read last year by Mr. E. J. Berg at the Buffalo convention of the American Institute of Electrical Engineers. In the other bulletin the details of a compensated revolving field alternator are described and illustrated.

A BOOK OF CURVES.—The Electric Storage Battery Company has made a valuable contribution to the literature of the storage battery in the form of a book giving about two-score curves relating to the operation of storage batteries. The operation of a battery on railway systems is particularly well illustrated by these curves, which exhibit the excellent function which a storage battery performs in taking up load fluctuations and regulating the circuit voltage. Other curves relate to the use of storage batteries on central station systems and also on lighting plants, supplying both lights and motors.

THE KINSMAN ELECTRIC & RAILWAY SUPPLY COMPANY, 91 Liberty Street, New York, has recently entered the supply business with the intention of securing a share of the trade now being offered in the domestic and foreign market. The manager and treasurer, Mr. F. E. Kinsman, has been intimately associated with the electrical and railroad business since 1876. He has made an enviable reputation in connection with the telephone and electric light business, as an originator of the telephone multiple switchboard, and as the person who introduced the arc lamp, both alternating and direct, on the incandescent, or multiple arc circuit, in this country. He can claim a long practical experience as a conservative and successful contractor, supply man and engineer, and is fully qualified to secure the trade and confidence of careful buyers of reliable goods. Within the last few years Mr. Kinsman's experience in steam and electrically operated railroads has been extensive and places him at an advantage with those engaged in that line of business, either as an adviser or supply man. Mr. Samuel A. Wood, the president of the company, is a man of large means and shrewd business acumen, but has heretofore been unknown in the electric business. Mr. W. H. Van Arsdale, the secretary, is a mining engineer of national repute as well as a man of large business experience and means. His acquaintance with electrical matters has been gained through his ownership and management of large smelting and refining plants in Chicago, Aurora, Denver and Leadville, prior to his selling out to the American Smelting & Refining Company. His specialty will be in connection with the copper wire department of the Kinsman Company, which they expect to make a feature of their business. In selecting a New York agent, manufacturers should not overlook the fact that the name Kinsman stands prominent among those of men engaged in electrical enterprises. The new firm wishes to represent manufacturers in New York City and carry a general line of supplies and equipments for steam and electric roads, central stations, etc.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 15, 1902.

(Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.)

704,495. ELECTRIC ARC LAMP; A. M. Arter, Hammersmith, England. App. filed Jan. 12, 1899. The regulating solenoid pulls on a cord which passes over the hub of a pulley and rotates the pulley against a spring; this movement is communicated to the electrodes.

704,496. AUTOMATIC CIRCUIT BREAKER; H. Ballantyne, Sumpter, Oregon. App. filed Aug. 8, 1900. Details.

704,513. DISPLAY DEVICE; S. L. Campbell, Kalamazoo, Mich. App. filed Aug. 22, 1901. A rotating device carrying a number of lamps which are shifted into and out of circuit automatically.

704,525. ELECTRIC ARC LAMP; H. Etheridge, McKeesport, Pa. App. filed Dec. 30, 1901. The carbon rod is provided with notches with which parts of the clutch engage to make the action of the latter positive.

704,543. ELECTRICAL MEASURING INSTRUMENT; E. B. Jacobson, Pittsfield, Mass. App. filed Feb. 11, 1902. An instrument for measuring the voltage and amperage of circuits, comprising a pair of electro-magnets the respective circuits of which are connected at one end to a single terminal and at the other end to an independent terminal.

704,573. DEVICE FOR GENERATING ELECTRICITY ON RUNNING CARS; Richard Pintsch, Berlin, Germany. App. filed Nov. 14, 1901. The transmission of power between the car axle and the generator is effected with the aid of an electromagnetic coupling.

704,575. CENTRIFUGAL COUPLING; Richard Pintsch, Berlin, Germany. App. filed Nov. 14, 1901. The coupling is designed to go into operation only when the driving shaft is rotating slowly, and to become disengaged automatically as soon as the shaft exceeds a certain predetermined speed; it is intended for use in connection with a generator driven by a car axle.

704,589. SPARKING COIL CASING; C. F. Splitdorf, New York, N. Y. App. filed April 30, 1902. A sparking coil casing comprising a shell of tough non-conducting material and an inner lining therefor of material possessing the quality of non-conductivity to a higher degree.

704,595. THERMO-ELECTRIC ELEMENT; C. B. Thwing, Galesburg, Ill. App. filed June 14, 1901.

704,596. THERMO-ELECTRIC GENERATOR; C. B. Thwing, Syracuse, N. Y. App. filed Oct. 21, 1901.

704,597. POWER TRANSMISSION REGULATOR FOR ELECTROMAGNETIC COUPLINGS; Richard Pintsch, Berlin, Germany. App. filed Nov. 14, 1901. Provides means whereby the speed of the driven member may be rendered independent of that of the driving shaft, irrespective of the load on the driven shaft. An auxiliary electromagnetic field opposes a permanent field.

704,616. SAFETY DEVICE FOR MOTOR VEHICLES; H. Charles, Kofa, Arizona Ter. App. filed Feb. 7, 1901. When the seat is occupied the pressure thereon closes the motor circuit.

704,620. SELF-WINDING CLOCK; C. M. Crook, Bristol, Conn. App. filed Sept. 26, 1901. A construction for preventing friction at the contacts from operating as resistance to the running of the train.

704,639. LEACHING AND EXTRACTION OF METALS FROM THEIR ORES; C. Hoepfner, Frankfort-on-the Main, Germany. App. filed Sept. 27, 1899. (See page 132.)

704,649. ELECTRICAL FURNACE FOR TREATING HIGHLY REFRACTORY SUBSTANCES; H. Maxim, Brooklyn, N. Y. App. filed Oct. 30, 1901. (See page 132.)

704,665. CONTROLLING APPARATUS FOR ELECTRIC MOTORS; W. J. Richards, Milwaukee, Wis. App. filed Nov. 16, 1901. An arrangement of various electro-magnetic switches and circuits for automatically starting and stopping an air compressor.

704,670. ELECTRICAL CONNECTOR; A. J. Wayman, Dubois, Pa. App. filed Jan. 16, 1902. Details.

704,671. MOPPING DEVICE; H. F. Ackerman, Cleveland, O. App. filed May 13, 1901. The invention consists of the construction of a reel upon which the conducting cable is coiled and allowed to pay out and be taken up as the movements of the mopping device require.

704,675. PROCESS OF RECOVERING METALLIC TIN; David H. Browne, Cleveland, Ohio, and James M. Neil, Toronto, Canada. App. filed July 27, 1901. A material containing tin is subjected to a solution of ferric chloride, whereby a solution of chloride of tin and ferrous chloride is formed; this solution is then successively carried past a suitable cathode to electro-deposited tin and soluble anode to regenerate the ferric chloride solution, being then returned to the tin bearing material.

704,694. SYSTEM OF DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Sept. 11, 1901. In a system of distribution for railway trains, a generator and current-utilizing devices and a pneumatic device affording delivery of current to the current-utilizing devices always in the same direction, the said pneumatic devices being actuated by a change in the direction of the pressure in a pneumatic system on the train.

704,695. COMBINED ELECTRIC AND GAS CAR LIGHTING SYSTEM; J. L. Creveling, New York, N. Y. App. filed Jan. 18, 1902. A series of train lighting units, each comprising a mutually independent gas and electric lighting system, and a gas engine and dynamo forming a connection between the gas lighting and electric-lighting systems whereby the same are rendered interdependent.

704,696. MEANS FOR REGULATING THE OUTPUT OF DYNAMO ELECTRIC MACHINES; J. L. Creveling, New York, N. Y. App. filed June 12, 1901. A dynamo electric machine combined with means for regulating its output comprised in part by a heat-influenced element in heat receiving relation with the machine.

704,697. TELEPHONE HOOK-SWITCH; Wm. W. Dean, Chicago, Ill. App. filed May 9, 1901. (See page 130.)

704,739. SECONDARY BATTERY; J. B. Entz, Philadelphia, Pa. App. filed Oct. 3, 1900. (See page 133.)

704,744. ELECTRIC ACCUMULATOR; H. Heinicke, Schoeneberg, near Berlin, Germany. App. filed April 28, 1902. (See page 133.)

704,745. GAS BURNER; A. M. Hewett, Chicago, Ill. App. filed Aug. 26, 1901. Details.

704,749. TROLLEY POLE ATTACHMENT; C. P. Lapham, Houghton, N. Y. App. filed Feb. 7, 1902. The journals of the wheel are set in half disks permitting the wheel to swing laterally.

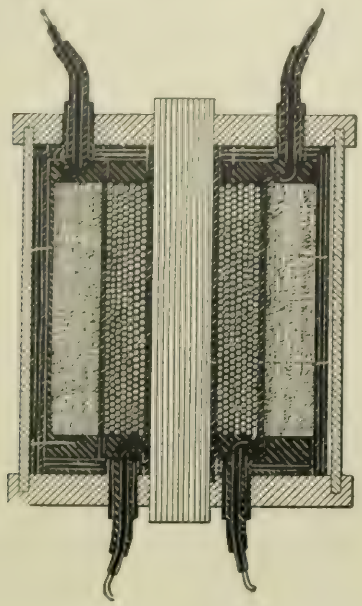
704,759. STORAGE BATTERY SEPARATOR; H. Rodman, Philadelphia, Pa. App. filed July 29, 1901. (See page 133.)

704,751. MANUFACTURE OF SECONDARY BATTERY PLATES OF THE PLANTE TYPE; H. M. Martin, Philadelphia, Pa. App. filed July 30, 1901. (See page 133.)

704,767. SECONDARY BATTERY; E. G. Steinmetz, Philadelphia, Pa. App. filed Sept. 29, 1900. (See page 133.)

704,788. CABLE HANGER; S. Du Perow, Cleveland, Ohio. App. filed May 28, 1902. The suspending hook engages with notches in the strap which embraces the cable.

704,797. RAILWAY HEATER SYSTEM; S. H. Harrington, New York, N. Y. App. filed Jan. 3, 1901. The brake and the switch controlling the car heaters and so interconnected that the circuit through the heaters is closed only while the brakes are applied.



704,589. Coil Casing.

704,800. SIGNAL; R. Herman, Crafton, Pa. App. filed Oct. 11, 1901. Electrically actuated shifting devices to shift the semaphore to caution and danger positions, controlled by track circuits and a separate circuit controlled by train movements to act as a choke for the signal when tilted.

704,803. ELECTRIC CONTROLLER; A. E. Hogrebe, Philadelphia, Pa. App. filed Dec. 12, 1901. A controller casing having a hinged door or cover upon which the controller cylinder is carried, whereby the latter can be easily inspected.

704,831. PROCESS OF MANUFACTURING SULPHURIC ACID FROM SULPHUR DIOXID IN AQUEOUS SOLUTION BY ELECTROLYSIS; C. B. Jacobs, East Orange, N. J. App. filed June 1, 1901. (See page 132.)

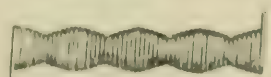
704,851. ELECTRIC LAMP; H. W. Beecher, Jr., Port Townsend, Wash. App. filed Feb. 6, 1902. A multiple filament lamp in which the filaments are successively thrown in and out by altering the distance which the neck of the lamp projects into the circuit.

704,859. ELECTRIC ACCUMULATOR ELECTRODE; V. Cheval and J. Lindeman, Brussels, Belgium. App. filed Nov. 21, 1901. (See page 133.)

704,863. SYSTEM OF ELECTRIC DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Aug. 30, 1900. A centrifugal governor on the armature shaft of a train lighting machine, varies a rheostat to alter the voltage in accordance with the speed.

704,864. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Dec. 7, 1900. The object of the invention is to provide means for automatically preserving a practically uniform flow of current through the lamps of the system and at the same time for protecting the system against waste of energy or other loss under the widely-varying conditions to which the system is, in operation, subjected.

704,865. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Dec. 7, 1900. A regulator in the working circuit of a car lighting system, dependent upon the speed of the armature combined with independent means for nullifying the regulator whenever the generator is ineffective.



704,869. Wire Coupling

704,869. COUPLING FOR WIRES, CONDUCTORS, OR THE LIKE; J. Fischer & H. Schneider, Solothurn, Switzerland. App. filed Jan. 22, 1902. A flexible sleeve of helically wound wire, the coils of which in their free state are spirally shaped, so that when the ends of conductors are inserted into the sleeve, they will be gripped thereby.

704,917. TRANSMITTING APPARATUS FOR ELECTRIC TELEGRAPHS; T. D. Penniman and H. H. Wiegand, Baltimore, Md. App. filed Feb. 18, 1902. In a system in which signals are transmitted by sending a succession of electrical impulses of alternate polarity, a transmitter is adapted to shift the line connection from one set of terminals to another whereby an impulse is sent to line opposite in polarity to that which would have been sent had not the transmitter acted.

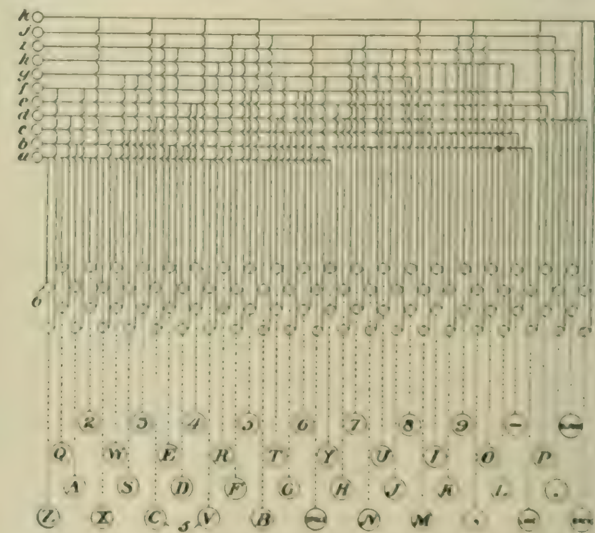
704,925. RECORDER; C. J. Roach, Hartford, Conn. App. filed Oct. 2, 1901. Details.

704,927. KEYBOARD FOR USE IN TELEGRAPHY; H. H. Rowland, Baltimore, Md. App. filed July 24, 1901. A claim describes the invention as follows: In a transmitting keyboard for electric telegraphs, the combination with a group of conductors leading into said keyboard, a series of electrical contacts of greater number than said conductors, permanent electrical connection between said contacts and said conductors by which said contacts and conductors are connected in prearranged combinations, and means for operating circuit through said conductors and sets of said contacts.

704,928. TELEGRAPHIC DISTRIBUTION; H. H. Rowland, Baltimore, Md. App. filed July 24, 1901. According to this invention several operators at central may simultaneously transmit messages to all of various substations and simultaneously receive messages from all of them, or several operators at central may send messages to several corresponding substations simultaneously and at the same time record at central the messages transmitted.

704,929. MEANS FOR PRODUCING AND MAINTAINING SYNCHRONOUS MOTION; H. H. Rowland, Baltimore, Md. App. filed July 24, 1901. The invention consists generally in providing means whereby any change of the phase relations between the dynamo or other body to be synchronized and the dynamo or other body with which synchronism is to be maintained results in a change in the amount of energy absorbed by the dynamo or other body to be synchronized and a consequent maintenance of synchronism.

704,930. MEANS FOR IMPRESSING PERIODICALLY-VARYING ELECTRIC CURRENTS UPON TELEGRAPH OR OTHER CIRCUITS; H. H. Rowland, Baltimore, Md. App. filed July 24, 1901. In working a telegraph line duplex it is generally necessary to locate at each end of the line a source of signalling current to operate the receiving relay of other main line instrument at the distant end, and when these sources of signaling current are alternating current dynamos this necessitates the employment of a dynamo at each end of the duplex line. The present invention contemplates the employment of means whereby either one or both of these dynamos may be done away with and the signaling current derived from a circuit in which the current is relayed from a source of direct current.



704,927. Telegraph Keyboard.

704,948. AUTOMATIC ELECTRICAL SIGNALING APPARATUS FOR RAILWAYS; J. E. Spagnoletti, London, Eng. App. filed May 16, 1902. Details.

704,956. ELECTRIC GENERATOR; W. H. Cotton, Chicago, Ill. App. filed Feb. 5, 1902. The invention comprises a generator and a transformer, the primary coil of which is in connection with the armature, and means located in the connection for cutting out of the circuit the primary coil of the transformer, the parts being so related that the current developed in the armature will be disrupted when the current therein is at maximum, whereby a current of high potential will be induced in the secondary coil of the transformer.

704,974. AUTOMATIC MAGNETIC CIRCUIT BREAKER; W. M. Scott, Philadelphia, Pa. App. filed Feb. 23, 1900. A base, main fixed terminals located thereon, one vertically above the other, the engaging face to one terminal being in a vertical plane, and the engaging face of the other terminal in a horizontal plane, a laminated bridging member pivoted to the base, an actuating member pivoted to the base, an actuating member and toggle lever connection between said actuating member and the bridging member.

704,975. ARMATURE; F. L. Sessions, Oakpark, Ill. App. filed May 20, 1899. Means for ventilating the armature.

704,986. TELEPHONE BOOTH; F. L. Tufts, New York, N. Y. App. filed Nov. 5, 1901. (See page 130.)

704,987. TELEPHONE BOOTH; F. L. Tufts, New York, N. Y. App. filed Dec. 24, 1901. (See page 130.)

704,993. ELECTRIC SMELTING FURNACE; F. C. Weber, Chicago, Ill. App. filed Jan. 8, 1900. Renewed May 16, 1902. (See page 132.)

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CONTENTS.

UNIVERSAL CONDITIONS.

Possibly one of the reasons for the rapid introduction of modern electrical inventions and apparatus has been the universal adaptability of the new agent, rendering it easy to satisfy the purchaser the moment he is found. Of many goods it is but too true that they are salable in only one market and have to be changed for another, or indeed have to be substituted by something else; and among the duties of consular agents is that of telling shoe manufacturers or producers of hardware just how to turn out their goods so as to sell. But when it comes to electrical apparatus, little, if any, modification is ever necessary. The same style of lighting plant that does for a New York office building suits very well in a Korean palace. The same kind of trolley car that suits Chicago is good for Bangkok or Bombay. Fan motors need no "sea change" or otherwise to enable them to do their work as well in Shanghai as in Montreal. The telegraph apparatus used in Manila is just as effective in the city of Mexico; and the telephone system that meets approval in New York will be found in Tokio or Paris, in Melbourne or in London.

These universal conditions are pre-eminently in favor of export trade, and should account for the fact that even with all the manufacturing of American electrical apparatus that is now done abroad, the export this year from the United States bids fair to show up between nine and ten million dollars. We are fain to believe that even such a large amount can be greatly increased and even doubled in a few years by persistent and intelligent pushing, for the whole world is still wofully in want of electrical facilities. Moreover, the very principle referred to makes easy the immediate introduction into and utilization by the United States of any electrical novelty or new principle discovered abroad; and the rest of the world is just as keen as we are in the pursuit of the numerous new arts waiting in the near future, that will bear an electrical name.

FIXATION OF ATMOSPHERIC NITROGEN.

Of unusual interest is the report we publish this week on the fixation of atmospheric nitrogen. The mere possibility of producing artificially nitrates and nitric acid on a commercial scale is of immense theoretical interest, and even if the product should not compete on even terms with nature's output, the result would still be most notable. Nitric acid lies at the very root of chemical industry. Hardly a single branch of chemical manufacture could continue at all, let alone on a commercial basis, were the supply of nitrates cut off. Hitherto we have had to depend entirely upon the nitre beds in which, with almost inconceivable slowness, the strange micro-organisms that produce nitrification have wrought the change from an inert gas to an invaluable solid. For centuries man has been drawing on the meagre nitre beds, at first slowly, and then, as civilization has grown, with reckless speed, until, if the truth were known, it would seem that the store of nitrates is in more imminent peril of exhaustion than even the coal supply. And the results of its exhaustion would be only less serious than the loss of fuel. A scientific romance of strange interest might be written around the annihilation of the nitrate supply. It might be speculated that the whole of the chemical arts would vanish; that war as we know it would be no more, for there would be an end of explosives, and when nations struggled for supremacy, sword and pike, battle-axe and cross-bow bolt would clash again on armored legions.

Doubtless, artificial culture of nitrate beds would be made to yield some commercial results, and new sources of nitrates would be unearthed, but the nitrate supply is of fundamental importance for

modern civilization. The claim of Mr. Bradley that he has worked out a practical method of drawing a supply of nitrates from atmospheric nitrogen is, therefore, of the greatest interest. Unfortunately, the article lacks sufficient details as to the power and general plant required to enable one to pass judgment on the probable cost of nitric acid produced by this method. Doubtless, the yield, at present very small, can be materially increased after some experience with the process on a large scale, and there may be here the basis of a very important industry, or rather group of industries; for it is hardly to be supposed that the method will stop with the production of nitrates. There are many useful reactions known to be produced on an exceedingly small scale by the electric spark. With Mr. Bradley's apparatus every such reaction can be carried on upon a scale capable of industrial application, so that it may be able to open up fields hitherto almost unknown, doing for gaseous raw material what the electric furnace does for solids. It is too early yet to predict the success of such methods as compared with those now in use, but even if they fail to compete with nature in nitration, they may lead to short cuts to other rarer products of great value from the purely commercial standpoint. At all events, the apparatus furnishes a new and immensely powerful engine of research, capable of startling results in theory or industry, or in both. We shall await with the keenest interest further news of Mr. Bradley's experiments, which are as interesting and promising as anything that the dawning century has yet shown.

Theories of Wireless Telegraphy.

Much discussion has appeared in our correspondence columns during the last few months as to the nature of the waves employed in wireless telegraphy. Some maintain that these are "Hertzian waves"; others that they are "sliding waves"; others, again, that they are "oscillatory currents through the earth," and still others that they are "electrostatic effects." In this issue, Mr. Collins advocates the "rectilinear propagation of free waves." We think that, in a certain sense, all these varied views are correct, and that the subject of discussion is rather a question of definition and nomenclature than of principles or phenomena.

In the first place, it should be noted that while, in free space, a Hertzian wave may be a disturbance moving at the speed of light in a straight line, like a single puff of smoke emitted from the stack of a locomotive, or a soap-bubble detached from its source and thrown into the air, yet when Hertzian waves encounter conducting substances, such as wires or conducting planes, they undergo great modification, according to the physicial and geometrical conditions of impact. They may be reflected back like billiard balls from the cushion, or be absorbed altogether; or undergo neither reflection nor immediate absorption, but take the intermediate course of skimming along the conducting surface with the wave front perpendicular thereto. Hertz studied both kinds of waves; *i. e.*, the detached kind following a rectilinear path, or what we may call the puff-of-smoke waves; and also the skimming kind, or those that run along and are guided by conductors. He showed, for example, that a resonator formed of a circlet of wire with a minute spark gap, would respond much farther from the oscillator, or source of electric disturbance, when a pair of parallel wires extended from the neighborhood of the oscillator to the neighborhood of the resonator, so as to form a pair of rails, along which the invisible wheels of the disturbance might run from the source to the receiver.

The theory of the experiment has always been that the waves emitted by the oscillator would natura'ly have advanced into free space with accompanying expansion in the absence of the wires; but when each wave struck the wires, the "Faraday tubes of force" or "lines of electrostatic displacement," or simply the "electric lines," caught hold of the wires, converged on to them at each side, and then ran along these wires at the speed of light. The lines of electric force would be in planes roughly perpendicular to the wires, but stretching from one wire to the other. The magnetic lines of displacement would be perpendicular to these or would form circles around each wire, and these invisible cobwebs of electric lines in warp and magnetic lines in woof would rush along the wires toward the receiver. The cobwebs would be prevented from expanding and weakening; for, neglecting absorption into the substance of the wires by reason of imperfect conductivity, the cobwebs would travel unchanged, and undiminished, for an indefinite distance. Consequently, the lines of magnetic force would cut the resonator loop, with sufficient density to induce a spark impulse therein, at a much greater distance from the source than when the parallel wires were removed. It is unfair to Hertz, therefore, to say that Hertzian waves are waves disconnected from conductors, or free-space waves only. Besides, we do not live in free-space, but on the earth, and to restrict Hertzian waves to pure nonconducting regions is, in a certain sense, to banish them from our presence and consideration.

In the case just considered of the waves between parallel wires, studied by Hertz, the phenomena are in all known respects the same, so far as the wires are concerned, as when electric discharges or oscillations take place around a conducting circuit formed by the wires. In other words the same series of waves and the same geometrical cobweb structure of electric and magnetic lines, could be produced in and round the wires by substituting for the oscillator in their neighborhood a Leyden-jar connected to the wires, and producing from them into the wires a certain definite series of oscillating discharges. The wires in the presence of the oscillator would become the path of true oscillating electric currents, which would have been communicated to them by "electrostatic induction" from the oscillator. The ideas and phraseology of the pure wave student thus merge into the ideas and phraseology of the student of electric currents in wires. It would be idle, therefore, to discuss whether in such a wire-wireless arrangement the waves were strict Hertzian waves between the two parallel wires, or whether they were oscillating currents in the wires. Both contestants would be right. A complete statement of the phenomena would include both the waves in the ether and air around the wires, and the oscillating currents in the wires themselves.

Next considering a Hertzian oscillator in free space remote from all conductors, it is evident, by symmetry, that if we take the axis of the initial spark discharges, or the line joining the induction-coil knobs, as origin, the waves will be emitted symmetrically with respect to the midplane, perpendicular to this line, half-way between the knobs. Whatever positive electric force, or electricity, or displacement, exists at one side of this infinite plane, in any wave or series of waves, must also exist at the same instant as negative force, electricity, or displacement at the corresponding point on the other side. The waves on each side of this plane will be a plane counterparts of each other. Moreover, this plane will be a plane of zero potential, being half-way between the positive and negative sides. But by a known general theorem in electricity, which becomes self-evident on due reflection, any such zero equipotential plane may be occupied by a perfectly conducting surface without disturbing anything. Inserting the conducting surface, or supposing the plane to become perfectly conducting, we immediately have two complete distributions of waves, one between the positive side and the midplane conductor, and the other between the negative side and the same midplane, to match. Either of these distributions may now be extinguished or suppressed at will without disturbing

the other, because no disturbance can be transmitted through a perfectly conducting surface. If we suppress one side, say the negative, and keep the positive side at work, we have a unilateral complete Hertzian system of waves, no longer in free space, but between free space and a flat conducting sheet, which sheet carries oscillating-current waves, as we ordinarily understand that term.

The vertical antenna of wireless telegraphy is the active side of such a unilateral Hertzian oscillator. The other side, its image underground, is imaginary. The waves emitted from the real antenna run out into surrounding space just as they would on the corresponding side of a complete double-oscillating system in free space. Only the comparison is imperfect because the earth's surface is not a perfect conductor, and consequently the distribution above ground is disturbed by this fact. The feet of the running electrostatic lines get entangled in the incompletely conducting ground surface, burrow deeper, carry energy in, and get expended, thereby weakening the distribution overhead. At sea, on a surface of better conductivity, there is less disturbance of this kind. Moreover, the waves bend over the earth's convex conducting surface, just as they bend around turns in conducting wires. If the earth's surface were perfectly conducting, the oscillating currents in the surface would be of infinitesimal depth, but of great intensity. With lessening superficial conductivity the oscillating currents go down deeper into the earth, with diminished local intensity or amperes per square inch.

It seems, therefore, unnecessary to discuss whether wireless telegraph waves are electromagnetic waves in the air and air-ether, or are oscillating currents in the earth's crust. They are both. One phenomenon cannot occur in a unilateral Hertzian distribution without the other. The student with his gaze bent on the earth will see nothing but the oscillating currents below. The student gazing above, will see nothing but the waves chasing each other overhead. The main fact arrived at by all the co-operative scientific and practical work of the last century is that when a "current flows in a conductor," there must be electric waves in the environing insulator; and conversely, although waves may run through insulators indefinitely with displacement currents only, as distinguished from conducting currents; yet, when waves run near conductors the conductors have electric currents in them.

The Alleged Fallacy of the Second Law of Thermodynamics.

We have so frequently seen the second law of thermodynamics impugned, that the outcry surprises us no more than the populistic slogan of "Down with the Trusts." Yet both the Trusts and the Second Law of Thermodynamics are still doing business. The second thermodynamic law has been variously expressed by different writers, but it includes the fact that no heat engine can yield mechanical work except by taking in heat at a higher temperature and rejecting heat at a lower temperature; or, in other words, by virtue of an established difference of temperature. This is as axiomatic to the theory of heat engines, as difference of level is to the hydraulic motor. Just as the water motor can only do work by allowing water to descend from an upper level to a lower, from a higher pressure to a lower, or from an up source to a down sink, so the heat engine must have its upper temperature source and its lower temperature sink of heat. A water motor would be impotent in an ocean of water without a difference of level. A heat motor is powerless in a world of heat without a difference of temperature. Uniformity, like *ennui* to the soul, is collapse to the heat engine.

The enormous importance of this innocent-looking law to human beings is apparent when we consider that when the sun's heat has once warmed all bodies in a given vicinity to practically the same temperature, no engine can yet be conceived of which can turn any appreciable part of that heat into work. The surrounding air and water and solids may all be hot, and possess abundant stored-up heat energy, capable of being reckoned in foot-pounds, and yet because these bodies are all equally hot, none of this heat, none of these foot-pounds, can be converted into mechanical power. Any heat engine, to be practicable under such conditions, would have to be big enough to reach out, either to a hotter place, or to a colder place, to an upper or to a lower temperature. When a solar heat engine works, it is because some substance is locally raised by the sun's heat to a higher temperature than the surrounding bodies, and a portion of the heat in flowing from the hot level to the surrounding level of temperature is converted by the engine into mechanical work. If it were not for the law, millions of hp-hours of energy in the oceans of air and water on our world stored from the sun's heat might be available for driving man's machinery.

Of course, the hypothetical heat engines which could extract the heat energy out of, say, ocean water, might be uncommercially expensive to operate, supposing that the second thermodynamic law were repealed, in which case humanity would not be benefited by the repeal. But if this were not so, and the imaginary heat engines were cheap to make and work, the repeal of the second law, the removal of this temperature-difference limitation, might perhaps be worth more to the civilized world in money value than all the existing wealth of nations put together. The total stock of solar heat energy in the materials on the surface of our planet, now unavailable by reason of a substantial uniformity of temperature, might, if made available, make coal worthless rubbish, and give mankind enormous resources in power. In science there is no penalty attached to heresy. In fact, much scientific advance has often been made by heretics in science. But the heretics were supported by facts and observations, and were able to demonstrate the soundness of their positions, after which the science was modified, while heresy and orthodoxy changed places. Consequently, no man is to be blamed for refusing to believe in the second thermodynamic law. But it is the duty of all recalcitrant heretics to make good their doctrines by sound evidence before they seek to proselytize.

We have before us a pamphlet purporting to have been presented before the recent meeting of the American Association for the Advancement of Science, entitled "The Fallacy of the Second Law of Thermodynamics, and the Feasibility of Transmuting Terrestial Heat into Available Energy." This paper boldly stands for the feasibility of converting terrestrial heat into mechanical work without any difference of temperature. It does not claim that there is any existing engine which works on this plan. It merely describes a theoretical heat engine, for which, by a fallacious process of reasoning, this result is claimed. The same reasoning would, under slightly modified conditions, involve the production of mechanical work without any absorption of heat energy whatsoever, *i. e.*, would contravene the conservation of energy, as well as the second thermodynamic law. The fallacy is the old one of a working substance alternately in the gaseous and liquid conditions, and is avoided when the entropy-temperature diagram is substituted for the volume-pressure diagram. A paper of this sort is liable to produce much trouble and distress, because, being couched in scientific phraseology and purporting to have been presented before a scientific body, it might be regarded as unimpeachable by business men inexpert in thermodynamics.

The Space and Power Policy of the St. Louis Exposition.

By C. T. Malcolmson.

No exposition worthy of the name has depended on the receipts from space and power rentals to achieve even a financial success, and a financial success is among the last things an exposition should aim for. Success, like office, will more often come to worth than to the chronic candidate. Economy, prudence and conservative business principles must be observed, but if pure money making constitutes either the expressed or concealed purpose of an exposition then it is fore-doomed to failure. The amusement features and the fakirs are always ready to pay more money for space and facilities than exhibitors can afford and an alleged exposition conceived and operated as a money making scheme becomes a midway with an exhibit annex, and the annex is thickly sprinkled with fakirs to the annoyance and disgust of legitimate exhibitors.

In the interests of success, an exhibition should be run for exhibitors almost by exhibitors, so sensitively in touch ought to be the management with the exhibitors. An International Exposition to succeed must be organized and operated on the very broadest lines of intelligent public policy, else it will fail to realize the cause for its being—the collection and exhibition of objects which will practically illustrate the resources and the arts and industries of the world as they exist at the period of the exposition. Everything must be done to attract the support and good will of every nation and of every art, craft and industry, and nothing must be done to excite suspicion or reasonable criticism, and above all every act must be performed as if it were to be later subjected to the fullest scrutiny before the bar of public opinion. In addition to all this the exposition must have abundant capital, since to prepare and present even a compendium of the present state of the world requires the outlay of a vast amount of money—very much more than can be had from private subscriptions alone.

Through the generous and wise provision of congress and the approval of the President, $5,000,000 have been added to the $10,000,000 already raised for the St. Louis Universal Exposition by the city and citizens of St. Louis and large appropriations have been made for specific exhibitions by our National Government, by foreign governments and by states and corporations. It is estimated that when the gates of this Exposition are opened in 1904, a sum of over $40,000,000 will have been expended on buildings, utilities, decorations and amusement features, and that the exhibits will represent an additional value of over $100,000,000.

In what has been stated will be found the reasons which actuate the management in abolishing charges for space and for facilities. By this statement it must not be understood that the Exposition will give space, power, light, etc., in unlimited quantities to all who ask, for it will do none of these things. It will charge no exhibitor for space(none can be bought at any price), and it will make no charge for such facilities as it deems necessary for the operation of any exhibit, but it will select from the applications those which promise best to illustrate the natural resources of the world and the achievements of mankind. To those selected, such space and facilities will be allotted free, as in the judgment of the executives the circumstances warrant and the most interesting presentation of the subjects demand. If exhibitors feel that for display purposes they require more light or power, their demands will be satisfied at a reasonable and uniform rate.

Visit of the Transportation Co[...] Board of Aldermen to [...]

The broad subject of a complete reor[...] the local transportation facilities of Ch[...] ation for some time by the authorities [...] port of the committee on local transp[...] men, which went very thoroughly into [...] the railway companies, and which out[...] the opinion of the committee, was pr[...] cember. Briefly, the report recommen[...] town terminals so that an interchange [...] surface lines could be effected, and th[...] which the congestion on some of the [...] duced by the removal of the railway li[...] plan was approved by Mayor Harriso[...] to the city council, in which he also [...] which, if carried out, will demand a [...] transportation system of the city. R[...] taking any radical action in the direc[...] was advisable to investigate the tra[...] cities, the city authorities decided to s[...] its committee on local transportation [...] being done in the East. The cities [...] Boston and Washington, and the pur[...] interview the gentlemen who have been [...] of the transportation lines in those citi[...] which would be suitable to the needs o[...] which would combine the best experie[...] struction relating to transportation, w[...] cities to be visited.

The committee on local transportati[...] ing and most successful business me[...] Frank I. Bennett, chairman, and Me[...] Werno, E. F. Herrmann, H. W. Butler[...] F. D. Connery, Wm. Mavor and T[...] tractors; W. J. Raymer, John Minweg[...] facturers; and W. S. Jackson, of the [...]

These gentlemen reached New York [...] from Chicago. On Friday, July 25, [...] Railway system. In the afternoon, [...] Greatsinger, of the Brooklyn Rapid [...] trip in a special car over the lines of th[...] station and other points of interest. [...] of inspection was made of the constru[...] Street Railway Company. On Monda[...] on William Barclay Parsons, chief e[...] Subway, and later made an inspection [...] that road, now under construction, a[...] work. On Monday evening they w[...] McGraw, president of the McGraw Pu[...] at Sherry's, at which President H. H. V[...] Manager Root, of the Metropolitan S[...] tractor John B. McDonald and Chief [...] Transit Subway, as well as others, wer[...] ing the committee left New York for [...]

The committee is being accompanied [...]

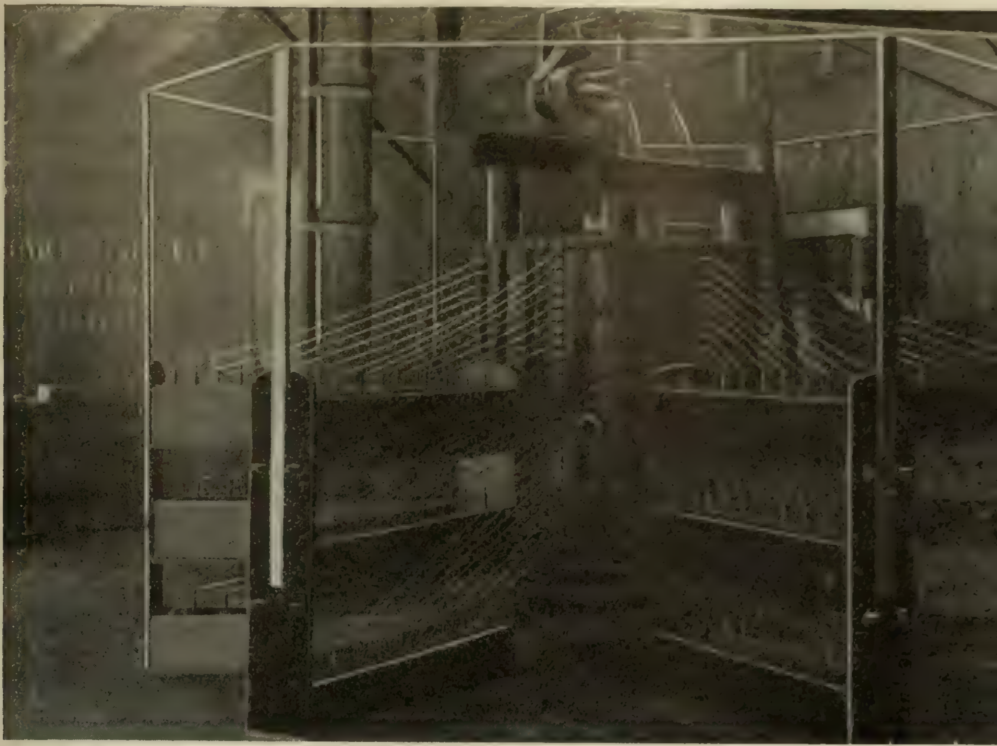


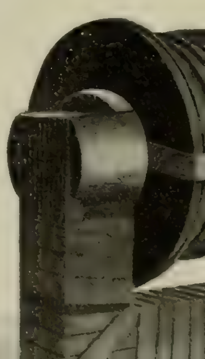
FIG. 1.—PROCESS OF ELECTRICAL FIXATION OF ATMOSPHERIC NITROGEN, NIAGARA FALLS,

The Fixation of Atmospheric Nitrogen.

The Atmospheric Products Company, of Niagara Falls, is developing what promises to be an electrochemical application of extraordinary importance. The enterprise was referred to in an Institute paper, read this spring by Mr. L. O. Jacobs, and has been recently brought into public prominence by the interest which Lord Kelvin in his recent visit to America displayed in, and the comments which he made on, the process in question.

that the pungent odor which obtai electric spark is due for the most pa

Air, it will be remembered, is a of oxygen to eight of nitrogen, and oxygen and nitrogen to unite, forn NO_2 or nitrogen peroxide. Of co nitrogen peroxide thus encountered been in very minute amounts, and n while to investigate how much nitri a given amount of power, and whethe gases could be made a commercial Bradley took up this problem in 189 Mr. B. R. Lovejoy, and together th



producing the desired result, and a great deal of money was spent in finding out just what form of electric spark would produce a maximum chemical union of nitrogen and oxygen in the air. Alternating and direct-current arcs of different voltages were tried, and the result has been emphatically in favor of the high-voltage, direct-current arc. It has been found best to use a voltage of about 10,000 and allow it to jump electrostatically through the air a short distance, thereby establishing the arc, and then rapidly separating the contacts until the arc breaks.

To produce this power, a different character of machine from any yet made was necessary, and to provide a machine for their immediate needs, Mr. Bradley took a large direct-current series arc machine and rearranged its circuits to suit his purposes. This machine is shown in Fig. 4. The fields are separately excited, and the arcs are connected in multiple with the terminals of the machine. In each arc circuit is placed an inductance coil, Fig. 3, which is carefully adjusted for best results. This prevents the arc forming a short-circuit on the machine; and as the motion of the arc drawing contact is exceedingly rapid, the load of an arc drawn in this way is very light indeed. One of the inductance coils is shown in Fig. 3.

The machine shown in Fig. 4, readapted, as noted in the foregoing paragraph, is capable of operating a Bradley-Lovejoy device making 414,000 arc per minute. The device itself, shown in Fig. 5, consists of a box of metal provided with openings to admit the air and properly circulate it, and containing rows of fixed contacts. Each of these contacts is insulated with great care and to each is connected a wire passing first to an inductance and thence to the positive pole of the dynamo. The negative pole is a revolving cylinder equipped with properly spaced projections which come very near but do not touch the fixed contacts in the surrounding box. A diagram of the electrical connections is shown in Fig. 6. This cylinder is driven by a vertical electric motor at 500 revolutions per minute; and as there are six sets of contacts in line with the fixed contact on the wall of the cylinder, each fixed contact therefore provides 3,000 arcs per minute. The air is driven through the apparatus at the rate of about five cubic feet per arc contact per hour. In the apparatus shown in the figure there are 138 contacts, six rows of 23 each. It may be well understood that the exact voltage, the correct amount of inductance, the number of breaks per minute, and the arrangement of the contacts with reference to the air circulation, and last, but not least, the proper state of the arc, are matters which involved an infinite amount of careful investigation.

The air passing from this machine emerges laden with 2½ per cent. of oxides of nitrogen, and by simply leading these gases through water in sprinkling towers well known to chemical processes, there results nitric and nitrous acid. The latter rapidly evaporates and recombines with water again, the result being that ultimately all of

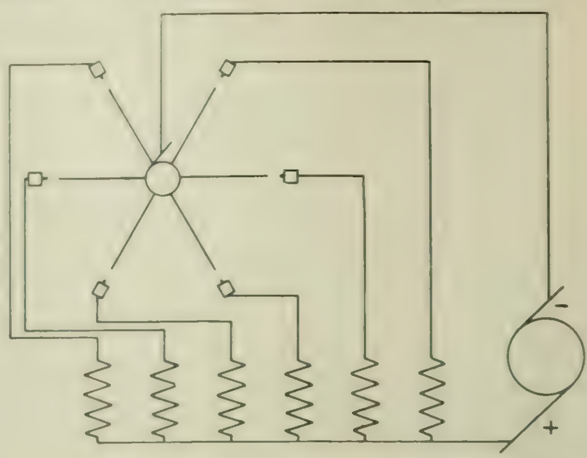


FIG. 6.—DIAGRAM OF CIRCUITS.

the fumes are converted into nitric acid. If these gases are brought into contact with caustic potash, $K\ O\ H$, saltpetre, $K\ N\ O_3$, is the result; and if brought into contact with caustic soda ($Na\ O\ H$) nitrate soda $Na\ N\ O_3$ is the result. In fact, it is easily possible to form almost any of the nitrates by this simple combination with appropriate bases. When it is remembered that the nitrates form one of the most important classes of chemical reagents, it will be readily

FIG 4.—SPECIAL GENERATOR.

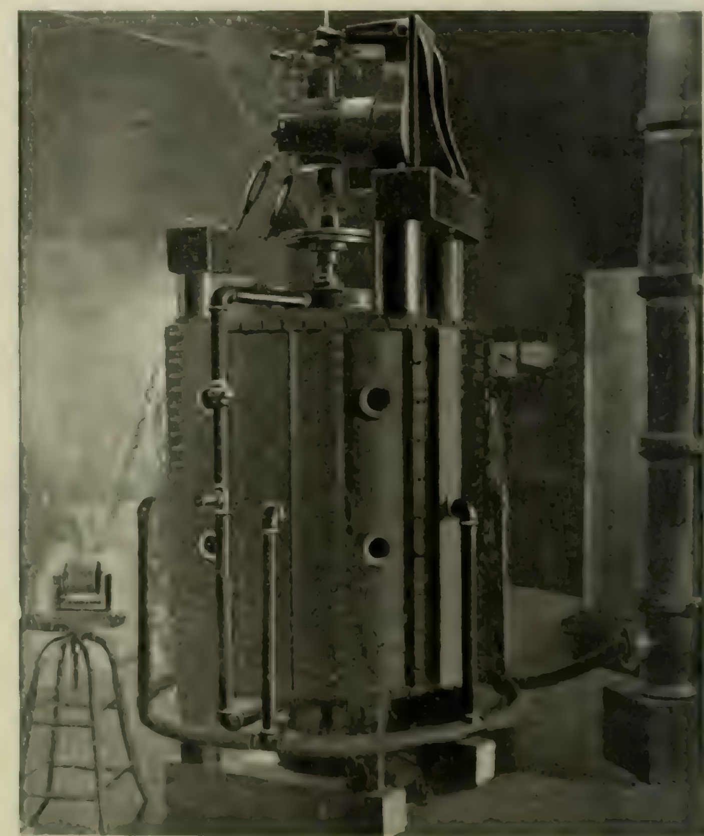


FIG. 5.—APPARATUS STRIPPED.

seen that this process reduced to one of commercial profit will be one of the most important developments of the period.

Over one million tons of nitric acid are manufactured every year by treating natural nitrates with sulphuric acid, and as the promoters of this enterprise claim that they can produce the same product at figures which will control this business, this field alone makes the enterprise of the greatest importance, especially as the nitric acid thus produced is chemically pure, which is by no means the fact with commercial nitric acid to-day.

The nitrogen compounds have heretofore been made only by trespassing on the fixed nitrogen in combination as found in nature. That is to say, if nitric acid is to be made, nitrogen in combination

must be taken from the earth in the form of Chili saltpetre and distilled with sulphuric iacd. The nitric acid thus formed disappears in the arts and in a thousand ways is made practically unrecoverable as a fixed nitrogen compound; and, consequently, as we have been for years taking from the earth a most important compound which is limited in supply. Upon these compounds, namely the fixed nitrates, vegetation of all kinds depends, and some of the far-seeing scientists have stated that very shortly nature will cease to honor these drafts upon her fixed nitrates—that twelve million tons a year of fixed nitrates will be required to bring the wheat crop in 1930 up to the amount required. These are serious matters, and, therefore, it is very important that means be sought to produce fixed nitrates without drawing on nature's reserve supply, by utilizing the free nitrogen in the air around us. This has been the object of Messrs. Bradley & Lovejoy, and long before the time the extraordinary necessity for large quantities of fixed nitrates develop it is expected that the process will be on a sufficient scale to enable it to meet the problem successfully.

Results With Electric Canal Towage in Belgium.

About two years ago attention was directed in these pages to a system of electric canal haulage installed in Belgium, for which it seemed good results might be expected. The subject is one of considerable importance for any country possessing an extensive canal system ,and hence there need be no surprise at the frequent efforts made to bring canal methods up to the level of other improved transportation systems, by the adoption of electric power. The results now reported from Belgium by one of our staff contributors afford much encouragement as to the future of work in this still unoccupied department of electric power and traction.

FIG. 1.—A SUB-STATION.

The company operating the system is the Societé de Traction sur les Voies Navigable, who adopted the plan of M. Leon Gerard, the well known Belgian electrical engineer. The present installation is used on a canal between Brussels and Charleroi, which has a length of 50 miles. Three-phase currents at 6,000 volts are generated. The line has two circuits of bare conductors; three primary wires for 6,000 volts, and three secondary wires for 600 volts; every three miles there is a 36-kw transformer. By means of a triple trolley the current is supplied to the 5-hp, 6-pole, 3-phase motors on the tractors. A leather pinion, with 12 or 16 teeth, is fixed to the axle of the motor and drives a shaft, on which there is a clutch, with which it is possible to drive a chain connected with the driving axle or with a conical winch on the other side. The extra power gained by the use of the winch is of great service at certain times. Each tractor runs only over its own section of ground; it can draw five boats, each laden with 70 tons, at a speed of a little over two and one-half miles an hour. In places where the pathway is too narrow to admit of passing, the tractors simply exchange boats and return on their own road. For passing through towns where the river banks are covered with warehouses, or in going through crowded locks, electric tugs or launches are used. The company supplies electricity also for lighting and motor purposes to the villages in the neighborhood, there being eleven communes along its lines.

The main generating plant visited comprises three dynamos of Brown Boveri design, delivering 15 amperes at 6,000 volts. The transformers receiving the current for canal work are of the same make; while those for lighting and distribution are Schuckert. The total output is 30,000 kw hours per day for lighting and power. The charges on the canal are 19 centimes per kilometer for hauling an empty boat, and the cost for an average fully loaded boat of 70 tonnes figures out 38 centimes per kilometer. It is stated that the charge made for hauling a loaded boat by horses is 39 centimes. The charge made by the company for lighting is 55 centimes per kw-hour, and for motive power, 25, 20, 18 and 15 centimes, according to different conditions. The lighting current is reduced in the sub-stations

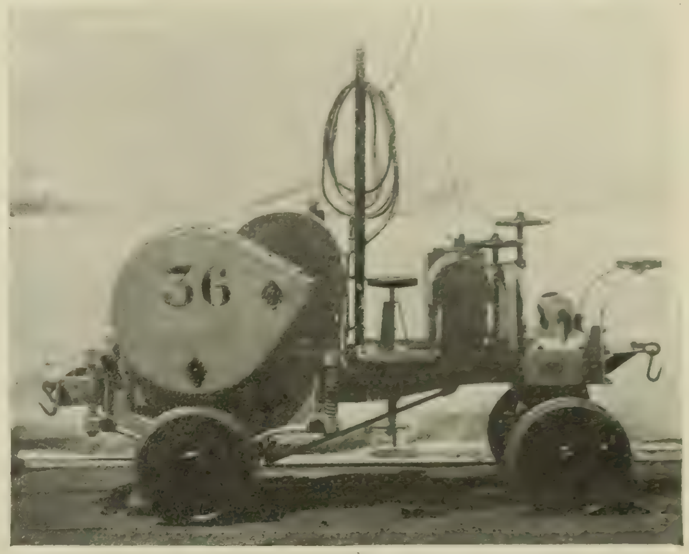


FIG. 2.—MECHANISM OF TRACTOR, LATEST TYPE.

or transformers' houses by separate transformers to 220 volts.

One of the sub-stations to which canal current is delivered every 4.7 kw is seen in Fig. 1. Side and front views of tractors in active service are shown in Figs. 3 and 4, with the three trolley conductors delivering current to the three-phase motor on the tractor. Fig. 2 is a view of a tractor stripped, showing the operative parts as explained above. Each tractor has

FIG. 3.—TRACTOR TOWING TWO CANAL BARGES.

been proved to be powerful enough to haul from 4 to 5 boats, but the Belgian government, for some reason or other, connected probably with fears of disintegration of the bank by the effort of the tractor or the "wash" of the boats, does not allow this. Hence the boats are hauled singly, which is a more expensive method, especially as regards the item of labor. The

motor car wheels are 70 cm. in diameter, and have a tire 20 cm. broad. The trail wheels are 16 cm. in diameter, and have a tire 15 cm. broad. The wheels last about a year. All wheels are mounted on ball-bearings.

It appears that the cost to the company per boat kilometer was as follows:

1900 fourth quarter	fr. 0.206
1901 first quarter	" 0.233
" second quarter	" 0.132
" third quarter	" 0.112
" October quarter	" 0.106
" November quarter	" 0.116
" December quarter	" 0.125
1902 June quarter	" 0.120

This includes simply station charges. From April 1, 1901, to April 1, 1902, the company did a business of 127,721.5 empty boat kilometers and 359,067.9 loaded boat kilometers. The company has sixty tractors, of which 45 are now in regular service, and there are 6 of the electric tugs for use within city limits. Coal, by the way, costs the company 14 to 15 francs per tonne, delivered.

The company has been hampered in its development of the system from the fact that the government owns the canals and the tow-paths, and will not keep the latter in good condition. It is also slow about giving the company facilities for the extension of its service. The tow-paths are sprinkled with broken stone where the tracteurs run. The commercial speed of hauling is 4 kilometers per hour, including the passage through the bridges. The speed with horses is between 1.9 and 2 kilometers per hour. Each tracteur covers a distance of about 3 to 4 kilometers, when the boat is transferred to another tracteur. Boys are used for running the tracteurs, and they work about 14 hours a day.

From the last annual report before us, of 1901, it would appear that the receipts for haulage were 131,000 francs, as compared with 167,400 francs in 1900, a difference due to an interruption

FIG. 4.—SIDE VIEW OF TRACTOR ON TOW PATH.

of 62 days while structural repairs were being made by the department of roads and bridges, and partly to the memorable strike at the Antwerp docks. The loss of traffic is estimated at 85,000 francs. On the other hand, the auxiliary revenue from lighting and stationary motors rose from 75,000 francs to 79,000 francs, and is still increasing. The company had reckoned on a service of 5,000 lamps or their equivalent, but has reached 6,000, and expects now to connect up at least 8,000. The company started in 1898 with a capital of 1,200,000 francs, and began work on Christmas Day, 1900, in distributing current from

FIG 5.—MAP OF REGION.

its central station at Roux. It now has a second generating plant at Oisquercq, the first in Belgium where polyphase alternators, driven by steam engines, have been put in parallel, and the capital account has been increased to 2,977,513 francs, while it holds now no fewer than 37 communal concessions, opening the way to further canal work, as well as considerable incidental supply for light and power from at least three central plants.

Relations of Telegraphy and Telephony.

In a recent discussion of the Western Union situation and of telegraph property as an investment, the *Boston News Bureau* remarks: "Formerly between two cities in Massachusetts 40 wires were humming with Western Union messages; to-day 40 telephone wires are doing the business, and two telegraph wires could take care of all the telegraph messages between those two cities and yet the Postal Company is there dividing what little telegraph business there is left. The Western Union compared with the telephone system is a stage coach in comparison with the railroad.

"A few years hence the American Telephone and Telegraph Company will be in a position to do what little telegraph business is required in this country at a minimum cost as a mere incident of the telephone business. At present the Telephone Company is having its hands full with the construction of new lines to meet the demands of its enormously expanding business.

"Nearly one-half the population of the United States is in cities, and this means that in the future more than one half the people of the United States will be within easy reach of the telephone, and this one-half will be the active half of the population, and the people who use the telegraph will be a decreasing number.

"The Western Union Company is laden with such leases and water-soaked capital as to make impossible to consider an enlargement of itself into the telephone field, while the Bell Telephone system of the country is doubling and quadrupling all the telegraph lines. The Telephone Company has not only a telephone system paying expenses and a fair interest upon the construction cost, but it has a telegraph system at absolutely no cost, and which is now unused, for you can telephone and telegraph on the same lines at the same time without interference. It has, furthermore, the great necessary adjunct of the telegraph service—a messenger system, for the collection of dispatches, and this messenger system is its 1,500,000 telephone stations in the United States."

Telephony in Australia.

A government report of nearly 200 closely printed quarto pages, containing the deliberations, investigations and recommendations of a committee of the Australian Post and Telegraph Department, appointed to inquire into the condition of the telegraph and telephone systems of the states of the commonwealth, gives some interesting information regarding the status of telephony in Australia, and the proposals for the reconstruction and development of the telephone systems of the commonwealth. The committee was instructed to make a thorough inquiry into the existing systems of telephony, with a view to submit recommendations aimed at the removal of defects of construction, maintenance, working and management. Under "construction," all branches of a telephone system were to be dealt with, and the preparation of standard specifications for all material and necessary works was included. Under "management" was included the vexed question of telephone rates. The instructions to the committee advised that "in dealing with the whole subject as well as with the detailed objects thus placed before the committee, it must be remembered that the principal objects to be attained are: greatly increased efficiency as compared with the existing systems and greater economy in construction, maintenance and working, together with the largest measures of uniformity available."

The committee, consisting of Sir Charles Todd, K. C. M. G., deputy postmaster-general and superintendent of telegraphs, South Australia; Mr. J. Y. Nelson, chief electrician, New South Wales; Mr. H. W. Jenvey, chief electrician, Victoria, and Mr. J. Hesketh, electrical engineer, Queensland, carried out its work in a very thorough manner, holding sittings both in Melbourne and in Adelaide, making thorough investigations of the existing telephone systems in Melbourne, Brisbane, Sydney and Adelaide, and securing full reports on the telephone systems of Victoria, New South Wales, Queensland, South Australia and Tasmania from the officers in charge. In 1899 and 1900 Mr. T. Howard, assistant electrical engineer of the department, made a tour of the world to investigate telephone conditions in the United States and Europe, and his report and evidence were of great value to the committee in arriving at the recommendations made in the report. Mr. Arthur Williamson, the representative of the Western Electric Company, also gave highly useful evidence regarding the various features of the common battery system.

The committee as a result of its deliberations on the reports and evidence presented recommended the adoption of the common battery system for large exchanges, *i. e.*, exchanges of over 2,000 lines. For smaller exchanges, the bridging system was deemed adequate to meet the conditions. The complete reconstruction of the telephone systems of the three larger cities, Sydney, Melbourne and Adelaide, is recommended. The Sydney system, including suburban exchanges, had, at the time the report was made, 8,555 stations connected, with a spare capacity in the switchboard of but 290 lines. The existing switchboard had been in use but 18 months, but for various reasons the committee recommended its abandonment in favor of a complete common battery system, at an estimated total cost, including the necessary alterations to the central office building, of $234,000. In recommending the adoption of the common battery system, the committee was much exercised over the question of subscribers' instruments, as the cost of new instruments for every subscriber's station adds so largely to the total cost of the change. It was recommended that if possible the existing instruments be converted into common battery sets. The reconstruction of the Sydney system, recommended by the committee, involves also an expenditure of $186,000 for new outside work, and $45,000 for new switchboards for the smaller central offices, making a total expenditure of $465,000, to be spent at the rate of about $155,000 a year, for three years.

For Melbourne, an even more thorough and complete scheme of reconstruction is recommended than for Sydney. The present overhead wire distribution is to be replaced by a complete underground system, starting with a tunnel from the central office. The tunnel will run about 1,200 yards through the center of the city and from it, with branch conduits in various directions, to carry the cables along the different routes to the distributing points. Underground conduits are to be built even out to various suburban points. The main central office is to be equipped with a common battery switchboard, having a present capacity of 5,000 lines and an ultimate capacity of 10,000 lines. The existing system at Melbourne comprises about 3,100 lines with 1,800 extension stations. The total cost of the extensive reconstruction recommended is about $1,132,000, of which $777,000 is for tunnel conduits and cables, $150,000 for the exchange equipment, $120,000 for subscribers' instruments, $50,000 for alterations to the central office building, and $35,000 for labor and supervision. The expenditure is to be spread over three years, about $320,000 being allotted to the first year, $410,000 to the second year, and $402,000 to the third year. The report says that the committee appreciates the magnitude of the expenditure recommended, but points out that the whole of the Melbourne system requires immediate and complete attention if a satisfactory service is to be given. No part of the work recommended can be omitted without marring the whole scheme. It is not practicable to take any half measures, and it is impossible to stand still.

For Adelaide, an underground distribution system and a new common battery exchange are recommended, at a total outlay of $450,000, the expenditure to be spread over three years, as in the other cases.

The committee points that its drastic recommendations for reconstruction might lead to the inference that the selection of telephone systems in Australia had originally been ill-advised and the construction bad, but this is not really so. The systems adopted were, at the time, standard throughout the telephone world. What was done in Australia was being done in all other countries, and the action now recommended is likewise the action necessary not only in Australia, but necessary and being taken in every system of importance elsewhere. For example, in the annual report of the American Bell Telephone Company for 1900 occurs the following: "In the larger exchanges the old type of multiple switchboards is fast being replaced by relay boards equipped with electric lamp signals and central battery plant installed in buildings specially designed for the purpose and owned by the companies." So that the work recommended for Australia is only another illustration of the universal telephone habit of rebuilding, and incidentally an application of the national motto—"Advance, Australia!"

As regards underground work, cables, conduits and so forth, the recommendations of the committee followed American practice pretty closely, as it will have been seen they do in regard to central office equipment.

In long-distance work, little is done in Australia. In New South Wales the longest line is that between Sydney and Bathurst, 155 miles; in Victoria, between Melbourne and Bendigo, 102 miles; and in Queensland, between Brisbane and Warwick, 155 miles. Some of the lines pay well and others do not, taking into account the loss of telegraph revenue caused by their competition. The committee recommends the construction of a line between Sydney and Melbourne, 625 miles, at a total estimated cost of $250,000, using 30-foot poles and 600-lb. copper wire. Taking the working capacity of the line at 70 three-minute conversations a day, the line, if it were used to the extent of half its full capacity, would yield an annual revenue, at a rate of $1.62 for three minutes' use, of $17,060 a year, or a profit of $3,810 over the estimated working expenses of $13,250. In estimating the probable revenue, the committee have adopted the most disadvantageous view of the expected business in order that they may be on perfectly safe ground in recommending the construction of the line. The fact is referred to, in considering the probable effect on the telegraph revenue, that the establishment of a telephone line between large cities creates business which did not previously exist, while it has almost always followed that the telephone receipts steadily increase year by year. The Australian long-distance rates are based on the English rates, the tariff for three-minute conversations being as follows: For a distance of 25 miles or less, 12 cents, the rates rising by 6 cents for each additional 25 miles. The public station rate for a local message is 6 cents.

The committee went very thoroughly into the subject of rates, and emphatically endorsed the message rate system, recommending a scheme of message rates, which is not to be introduced, however, until the reconstruction of the principal exchange is sufficiently advanced to cope with the increase of subscribers expected to result from the adoption of message rates. The existing rates in Australia are all flat, ranging from $45 a year for business service in Melbourne and Sydney to $30 a year in smaller places. Mileage is charged on lines extending over a mile from the exchange; in some cases the mileage charge applies to lines over half a mile long, but the one-mile radius is the usual practice. Having discussed fully the existing Australian rates and the practice regarding telephone rates followed in other countries, the committee declared in favor of the message rate or toll system, being of the opinion that "the

most equitable system of charging is that which makes a fixed annual charge to each subscriber to cover interest and sinking fund on the average capital outlay, together with a minimum number of free calls, and an additional charge for each call beyond the minimum." The committee further pointed out that "the fixed charges should vary with the mileage and with the size of the exchange within certain limits, seeing that the average capital outlay per subscriber varies with the length of the line and is greater with a large than with a small exchange. It must also be remembered that the value of the service to a subscriber on a large exchange is greater than that on a small one."

The scheme of rates recommended by the committee comprises a minimum rate dependent on the size of the system, the minimum rate including 300 calls. Additional calls up to 1,000 are to cost 2 cents each, from 1,000 to 5,000 1 cent each, and from 5,000 upward ½ cent each. The minimum rates are for exchanges up to 5,000 lines, $22.50; for exchanges from 5,000 to 20,000 lines, $25, and for exchanges of over 20,000 lines, $30. At these rates 1,800 calls a year, say six a day, will cost, in a 5,000-line system, about $48, a little over the present rate. The present average daily traffic per line in Melbourne and Sydney is between 13 and 14. There are some lines, having a very large use. One line sent 163 calls in a day. Another gave a daily average of 103 for six days, and another, in Brisbane, gave a daily average of 86 for ten days.

The reasons for recommending the adoption of the message-rate system in place of the present flat rates are summarized in the report as follows: (1) The committee are convinced of the impossiblity of giving a thoroughly satisfactory service in any large exchange, with the existing rates of subscription and an unlimited number of calls, without an increase in the operating and working expenses out of proportion to the present revenue. (2) Unnecessary conversations are avoided. (3) Subscribers pay amounts proportional to the use they make of the system. (4) The service is improved by the reduction of unnecessary calls, and, therefore, of the frequency with which lines are reported "engaged." (5) The service would be further improved by the calls to be answered by each operator being reduced.

Cross-Section of Electrical Conductors.

By Thos. Griswold, Jr.

The total annual cost of using electrical conductors may be taken as the sum of the watt and interest losses. The yearly investment loss per 1,000 feet of conductor is expressed by the equation,

$$l = fkw, \tag{1}$$

in which w is the weight of conductor per 1,000 feet, k the cost per lb. erected, and f is the assumed combined rates of interest, depreciation, taxes, etc.

The annual watt loss per 1,000 feet of conductor is expressed by the equation,

$$L = 8.76\, nKI^2R, \tag{2}$$

in which R is the resistance of 1,000 feet of conductor, I is the current, K the cost per kw-hour, and n the percentage of time the conductor is used.

Taking D as the diameter of the conductor in mils and m and p as constants,

$$R = \frac{m}{D^2} \tag{3}$$

$$w = p\, D^2 \tag{4}$$

Substituting (3) and (4) in (1) and (2),

$$l = fkpD^2 \tag{5}$$

$$L = 8.76\, \frac{nKI^2m}{D^2} \tag{6}$$

then,

$$l + L = fkpD^2 + 8.76\, \frac{nKI^2m}{D^2} \tag{7}$$

For a particular value of D, $l + L$ will be a minimum. Differentiating (7), equating to zero, transposing and eliminating,

$$fkpD^2 = 8.76\, \frac{nKI^2m}{D^2} \tag{8}$$

which expresses the conditions determining a minimum value of $l + L$. By comparing (8) with (5) and (6) it will be seen that the total annual loss is least when the investment and watt losses are equal.

From (8),

$$D^2 = I\sqrt{\frac{8.76\, nKm}{fkp}} \tag{9}$$

For copper of 97 per cent. conductivity and 8.93 sp. gravity, at 75° Fah.,

$$p = .003041. \tag{10}$$

$$m = 10832. \tag{11}$$

For aluminum of 61 per cent. conductivity, 2.68 sp. gravity at 75° Fah.,

$$p = .0009129, \tag{12}$$

$$m = 17223. \tag{13}$$

Substituting these values of m and p in (9) and distinguishing the two metals by their chemical symbols in subscript, we have,

$$D^2_{Cu} = 5586\, I\sqrt{\frac{nK}{fk}} \tag{14}$$

$$D^2_{Al} = 12856\, I\sqrt{\frac{nK}{fk}} \tag{15}$$

These last two equations give the circular mils cross-section, in the use of which for the current I the annual loss will be the least.

By putting $I = 1$, we have,

$$D^2_{Cu} = 5586\sqrt{\frac{nK}{fk}} \tag{16}$$

and,

$$D^2_{Al} = 12856\sqrt{\frac{nK}{fk}} \tag{17}$$

Equations (16) and (17) give the circular mils per ampere for least loss.

Since the corresponding increments of l and L in (7) are of opposite sign, small variations in D^2 produce even smaller variations in $(l + L)$. For this reason the use of a commercial size cable or conductor nearest to the theoretical size given by the formulas will entail an annual loss but slightly in excess of the theoretical least loss.

For bus-bars, straps and bare work generally the formulas will be found to give current densities well within the insurance rules. With cheap power and high interest charges, expensive circuits and limited periods of use, results should, of course, be checked with the insurance rules and tables of safe carrying capacities.

Telephony in Iowa.

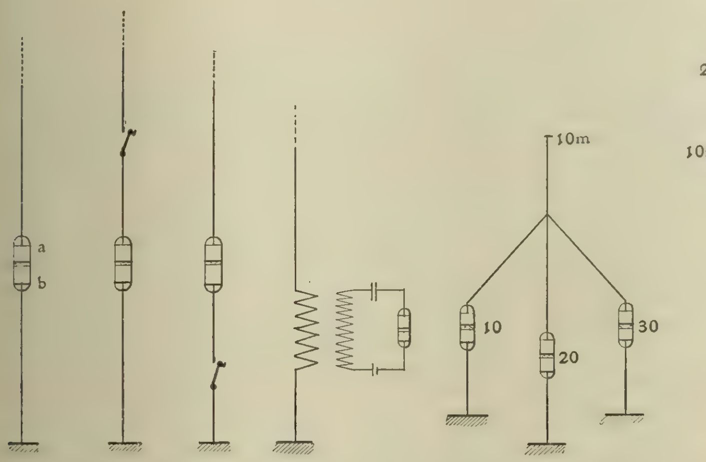
It is stated that over 600 telephone companies in the State have made reports to the State auditor. The largest is the Iowa Telephone Company, of Davenport, the Bell Company, with 15,942 telephones connected. The Mutual, of Des Moines, reported 1,938 telephones. Other big companies reported as follows: Cedar Rapids and Marion, 1,668; Cedar Valley, of Waterloo, 1,603; Ottumwa, 1,043; Marshall Telephone Company, 663; Greene & Western, of Mason City, 1,040; Dubuque, 1,000; Standard, of Waukon, 1,354; Western Electric, of Mason City, 701; Northern Iowa, of Cresco, 642; Nebraska, of Omaha, 934; Musses Bros., of Atlantic, 336; Mississippi Valley, of Keokuk, 273; Martin Telephone Line, of Webster City, 300; Hawkeye, of Perry, 758; Hawkeye, of Belle Plaine, 860. But few of the companies report large mileage of wire. The Cedar Valley has 688 miles, the Green and Western, 327, the Mississippi Valley, of Keokuk, has 273, and the Vinton and Benton, 263.

Wireless Telegraphy in Meteorology.

By Emile Guarini.

SINCE wireless telegraphy passed from the laboratory to the practical stage, means have steadily been sought to eliminate the disturbances produced by atmospheric electricity in the receiving apparatus. While these disturbances do not prevent transmission they are none the less annoying, since they require that the signal intervals be lengthened beyond what would be necessary if such disturbances did not occur.

It is well known that the difference of the potential between a point in the atmosphere and the earth is very variable, both with respect to time and to different places. Assume that Fig. 1 represents an antenna connected to earth through a coherer. The difference of potential between the coherer at *a* and *b* depends upon the difference of potential between the earth and the upper terminal of the antennæ. If this difference of potential is sufficient, that is to say, if it exceeds the critical tension of the coherer (we follow Prof. Blondel in using the term "critical tension," which expresses the minimum tension under which the coherer will become conductive), the latter becomes conductive, and the apparatus which it actuates (a galvanometer, a bell or a register operated, for example, from a relay) will register a signal. Sometimes when in normal condition the coherer is not influenced, but, as was proved in the Brussels-Maline-Antwerp experiments,[1] if there is a break either between the antenna and the coherer (Fig. 2), or between the coherer and the earth (Fig. 3), it is influenced.[2] The writer and Lieutenant Poncelot attributed this to an atmospheric current traversing the antennæ from the peak to the earth; this current would be insufficient to actuate the coherer normally, but it will actuate it when through an interruption of the circuit extra currents are set up.



FIGS. 1 TO 6.—COHERER CIRCUITS.

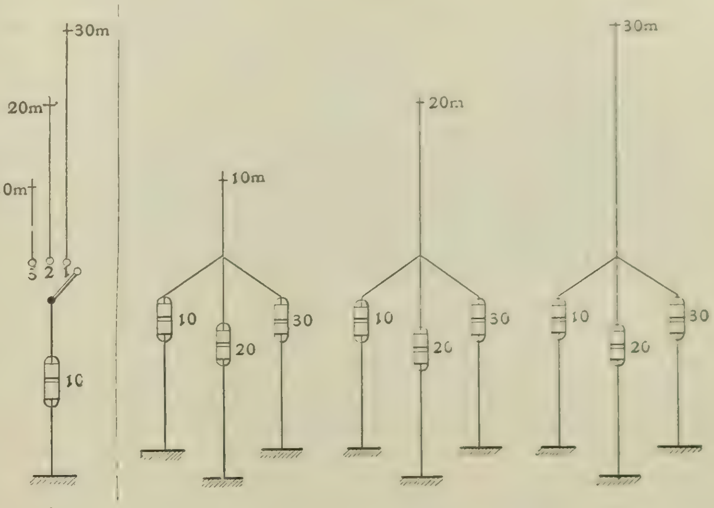


FIG. 7.—MULTIPLE COHERER CIRCUITS.

It is known that when the weather is calm the potential of the air is always positive, and that it increases in value about in proportion with the height from the earth. It will thus be seen that there may be disturbing effects if, as some experimenters consider necessary, long vertical antennæ are employed, the length increasing with the distance between stations.

There are several means of diminishing the untoward effects of atmospheric electricity on wireless telegraph receivers of the imperfect contact form. Thus, for example, very short antennæ may be employed, points avoided, or a coherer employed of only medium sensitiveness, that is to say, having a low critical tension. But the means which up to the present seem to be the most efficacious against atmospheric electricity is that employed by Mr. Marconi. That is to say, instead of connecting the antenna directly to the coherer, it is connected to the primary of an induction coil, in the secondary of which is the coherer and a condenser (Fig. 4).

Let us consider for an instant what occurs with this disposition. The direct grounding of the antennæ permits the continuous flow to earth of the charge which the antennæ take up under the influence of atmospheric electricity. This phenomenon[3] was observed at Wimereux in signaling across the English Channel, in 1899; one day during a storm it was possible to draw sparks from the antenna when its end was disconnected from the apparatus; but as soon as the end was reconnected to the primary of the induction coil, no effect was produced at the receiver, which acted as well as ordinarily. However, when there was a significant variation in the potential of the antennæ (which depends on the variations in the potential of the peak of the antennæ, and especially that of the earth when the latter, which ordinarily is negative, becomes positive, as when it rains), there is induction in the secondary coil and the coherer will be influenced. Thus, for example, in experiments[4] which the Marconi International Marine Company made between Antibes and Biot, April, 1901, notwithstanding the arrangement of Fig. 4 was used, it was possible, especially during the warm hours of the day, to register parasitic currents that at times attained a strength which interfered with communications.

Moreover, the receiver is influenced when lightning occurs within a certain range, but it should be remarked that lightning and brusque variations of potential at the extremities of the antennæ only occur at infrequent intervals, and thus transmission is not interfered with any more than in the case of ordinary telegraphic and telephonic transmission.

There are physicists, however, and already quite a number, who are working along lines quite different from those of Marconi and others, namely, meteorological physicists. Instead of endeavoring to protect receiving apparatus from the influence of atmospheric disturbances they seek not only to make evident and record such effects, but to do so over the greatest possible distance. Wireless telegraph apparatus may thus serve to detect and record atmospheric electrical phenomena in normal weather, and also to register thunder strokes, and consequently the course of a storm.

Though not much progress has been made in the way of applications, following are some examples: Referring to Fig. 5, suppose there are connected with a single antenna having, for example, a height of ten meters, three coherers, the critical tensions of which are 10, 20 and 30 volts, respectively. These three coherers, which are at the same distance from the two terminals of the antennæ, are grounded, either directly or through relayed bells having different tones, or through registers indicating hours. If the difference of potential between the top of the antennæ and of the earth is greater than 10 volts and less than 20 volts, the receiver 10 will be influenced, while with higher voltages either the receiver 20 or the receiver 30 will be actuated, the latter, of course, at all voltages greater than 30. The fact is not of importance that the other two receivers are actuated at the same time as the receiver 30. Besides, it would not be difficult to make arrangements whereby when the relay of receiver 30 is actuated the other receivers would be locked; this could

[1] Electrical World and Engineer, April 3, 1901.

[2] *Electrical Review*, London, July 12, 1900, page 43.

[3] Les Ondes Electriques et La Telegraphie Sans Fil, by J. Boulanger G. Ferrie.

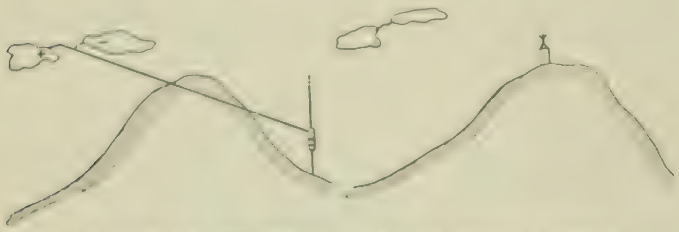
[4] *Eclairage Electrique*, July 26, 1901.

be done by placing the armature stop of relay 30 in series with the registers 10 and 20. By making use of a larger number of instruments, one would be enabled to construct diagrams giving curves of difference of potential between the earth and a point situated at a definite altitude.

Let us next examine the arrangement of Fig. 6. In this case there is a coherer having a critical tension of 10 connected on the one side to earth and the other to the arm of a three-point switch, the points of which are connected, respectively, to three vertical antennæ of different lengths, namely, 10, 20 and 30 meters. Now move the arm over the points until the coherer is actuated. Suppose, for example, that the coherer is actuated when connected with point 2. It will then be known that at a certain instant the difference of potential is 10 volts at an altitude of 20 meters.

FIGS. 8 AND 9.—ARRANGEMENTS FOR THUNDER STORMS.

Fig. 7 represents a combination of the arrangements of Figs. 5 and 6. Here there are several coherers of different critical tension, each connected to an antennæ of different length; that is to say, there are three coherers having critical tensions of 10, 20 and 30 volts, respectively, one being connected with an antennæ having a height of 10 meters, the other to an antennæ having a height of 20 meters, and the third to an antennæ having a height of 30 meters. It is possible with such an arrangement to obtain indications wherewith to construct curves of the difference of potential at different heights.



FIGS. 10 AND 11.—ARRANGEMENT FOR THUNDER STORMS.

The applications to registering thunder storms are more limited, but present a greater interest, since they enable us to obtain data pertaining to tho state of the atmosphere within a given region, and even enable us to follow thè progress of a storm; that is to say, to know with some degree of approximation if a storm will visit a certain place. In the case of hail storms, this is under some circumstances of the utmost importance.

Referring to Figs. 8 and 9, suppose that at a certain instant the difference of potential between the cloud, *A*, and the earth, *B*, (Fig. 8), or between the cloud, *A*, and another cloud, *E* (Fig. 9), is sufficient to give rise to a discharge, *C*, in the direction *A* toward *B*, or *A* toward *E*; a vibrating movement is then produced in the ether, and the receiver *D* will be actuated. As to the distance over which storms can be signalled by such an arrangement, this depends upon the height of the antennæ, on its surface, on the elevation where it is erected, on the strength of the atmospheric discharge, on the distance of the latter from the apparatus, and the height at which it is produced.

Referring to Figs. 10 and 11, suppose an obstacle is interposed between the coherer and cloud, as, for example, a mountain top, the transmitting distance is then, as in the case of wireless telegraphy, greatly diminished. If an antenna 6 meters high is situated on an elevated point (Fig. 11), from which the horizon can be seen, this distance is at least 60 miles.

It is sufficient to register the hour and the number of discharges to construct a diagram such as that of Fig. 12, which gives the number of lightning discharges registered in the month of July by apparatus in the observatory of the Technical Institute of Girgenti, which will be described further on. If it is the desire to follow the courses of a storm, the following arrangement may be used: From what has been said before, it is easily seen that as long as the storm is a great distance from the apparatus only the electrical waves produced by the more powerful discharges reach the apparatus at an intensity sufficient to influence the coherer. As a consequence, it is only at long intervals that the bell is operated. As, however, the storm approaches, the intensity of the waves increases and the apparatus is actuated at shorter intervals. When the storm is near or over the place, the bell is in continual operation. When the bell rings at comparatively long intervals the prospects are that a storm will arrive in some hours. As the intervals become progressively shorter the storm either is increasing in strength or approaching. If the number of signals should then commence to decrease progressively, it would signify that the storm is receding or decreasing in strength.

MM. Popoff, Tommasína, Poggio Lera and Lancetta are those to whom credit is particularly due in connection with apparatus for registering thunder storms. The apparatus of M. Popoff, professor

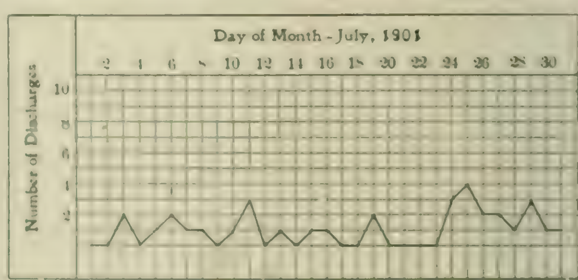


FIG. 12.—DIAGRAM OF DISCHARGES.

of the Naval School at Cronstadt, Russia, consists (Fig. 13) of a coherer in a circuit including a battery and a relay; another circuit contains a bell, and the relay contact is in shunt with the first at the binding posts of the battery. The hammer of the bell is so arranged that it can strike the coherer at each vibration. A graphic record is obtained by means of a Richard register mounted in shunt with the bell. To avoid the effect of sparks at the bell and relays, the coherer is surrounded by a double metallic case, in which there is a narrow slip that allows the electric waves to enter.[5]

M. Popoff was the first (in 1895, that is to say, before the first Marconi patent, which was filed in England, June 2, 1896) to construct a complete and practical receiver on the imperfect contact system to detect electromagnetic waves. He employed his arrangement first to register thunder discharges, and afterwards in the transmission and reception of wireless telegraph signals; the details of this latter work, however, have not been published. M. Popoff connected one of the extremeties of the coherer to a lightning rod, or simply to a metallic wire on a long mast, the other terminal of the coherer being put to earth (Fig. 14). This constituted an arrangement possessing all of the essential parts of a wireless telegraph system, namely, coherer, antenna, earth connection, relay, tapper and recorder. The operation of the apparatus is evident. At each series of waves produced by the lightning the coherer is affected—to a greater extent if an antenna is employed—

[5] *Voisenat, Annales Telegraphiques*, March-April, 1898.

the relay apparatus operates, the register records a point, and as the hammer of the bell taps the coherer everything is returned to a normal state.

Prof. Thomas Tommasina, of the University of Geneva, as early

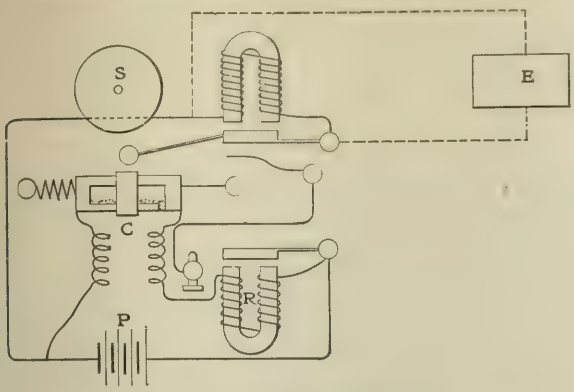


FIG. 13.—POPOFF ARRANGEMENT.

as 1898 (publication made Jan. 5, 1899, in a communication to the Société des Sciences Physiques et Naturelles de Genéve) experimented with a very simple apparatus, consisting of a coherer connected on the one side with an antenna and on the other side with

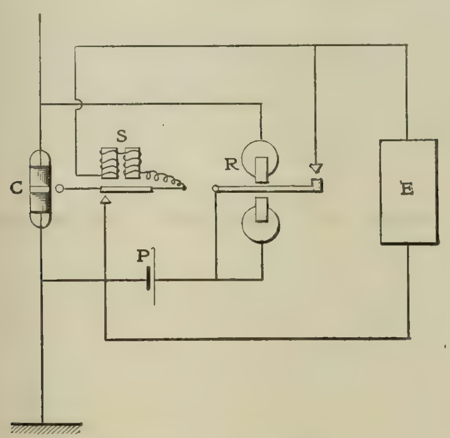
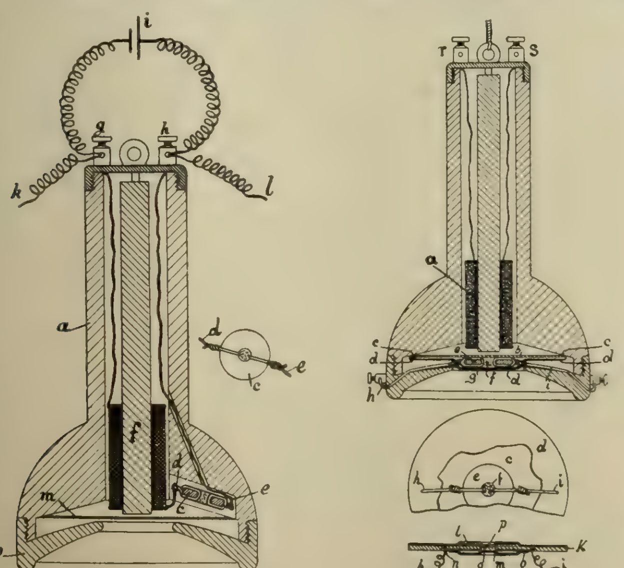


FIG. 14.—POPOFF ARRANGEMENT.

the earth in series with a battery and a telephone, the coherer being inserted within the telephone. Sometimes Prof. Tommasina used filings coherers, in which case the telephone diaphragm took the place of a tapper (Fig. 16), but more often the telephone was sup-



FIGS. 15 AND 16.—TOMMASINA TELEPHONE COHERERS.

plied with a carbon decohering coherer without any metallic contact (Fig. 15).

Referring to Fig. 16, *a* is the telephone coil; *b*, telephone diaphragm; *c* and *d*, insulation; *e*, coherer insulation; *f*, filings cavity; *g*, mica sheet; *h* and *i*, coherer electrodes; *k*, insulating membrane; *l*, iron plate; *m*, filings; *n* and *o*, silver plates; *p* and *q*, mica, and *r* and *s*, telephone terminals. A photographic view of the telephone-receiver is shown in Fig. 17.

The electro-radiaphone, as the apparatus has been called by Prof. Tommasina, not requiring adjustment is very adaptable for making observations on the progress of distant storms. There are required only a single cell of dry battery and some exterior wires, which may even be placed horizontally; but it is necessary to have great care as to the insulation of the ends of these wires, which constitute the receiving antennæ.

Prof. Tommasina has made many observations, both at Intra, on

FIG. 17.—TOMMASINA TELEPHONE RECEIVER.

Lake Maggiore, in Italy, and at his laboratory near Geneva, in Switzerland, and he has found that the electro-radiaphone gives forth a number of sounds, which together produce the illusion that one has been transported to the vicinity of the storm and is following it in all of its phases.

The laboratory of Mr. Tommasina has an elevation of only six meters above the ground. The receiving antennæ (Fig. 18) consists of three copper wires; outside of the window through which they pass, these wires are spread out and extend over a roof terrace open on all of its sides. The exterior end of the three wires, terminated in rubber tubes, are secured to paraffine glass insulators, both inside and on the masts, thus preventing the final four meters from becoming wetted by rain. The insulators are 12 feet from the earth and two meters distant from each other; each wire is 30 meters long. In the laboratory the circuit is grounded on water pipes, and finally, in order to avoid all danger both to persons and apparatus, when the storm is near at hand connection is broken both with the earth and with the aerial wires, which are then insulated at both ends. A telephonic receiver in the office and one in the bedroom, together with a signal bell, enable Prof. Tommasina to follow day

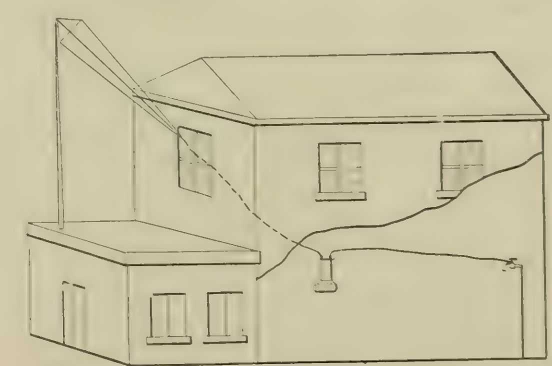


FIG. 18.—TOMMASINA LABORATORY.

and night the intensity and progress of distant storms without much inconvenience.

"On Sept. 29, 1900, exactly at midday," Professor Tommasina relates, "the weather was very fine, but the electro-radiaphone in the morning continued to indicate by various sounds and distinct shocks that discharges were certainly occuring at great distances. Toward 2 o'clock the sounds became more and more energetic. Some resembled strong and prolonged thunder claps at frequent intervals.

"Finally, the intervals between the signals became shorter, and at half-past three o'clock the sounds were incessant. The lightning at this time became visible and large clouds commenced to form; no thunder, however, was yet heard, but in the telephone the noise

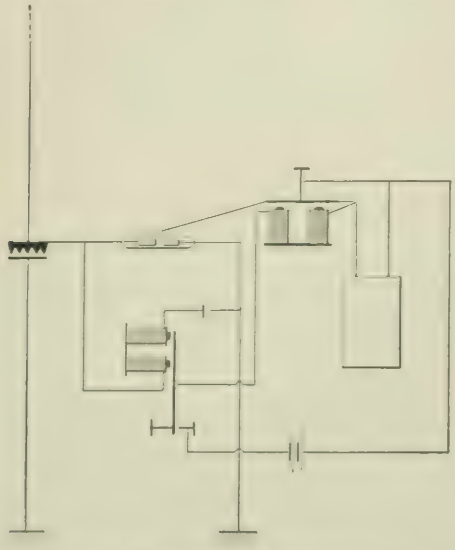


FIG. 19.—LERA ARRANGEMENT.

became progressively more intense. Suddenly it was modified and a sharp and continuous crackling was heard. Some instants later the rain commenced to fall, and at the same time the first stroke of thunder was heard. I scarcely had time to disconnect the appara-

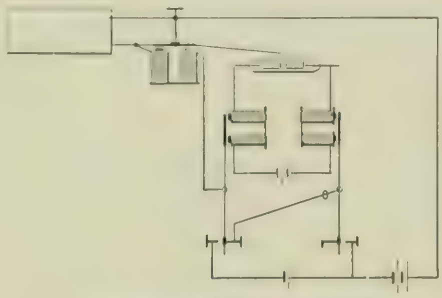


FIG. 20.—LERA ARRANGEMENT.

tus when a storm of extraordinary force burst forth. The streets were filled with water, lightning occurred without interruption, and several strokes took effect in the vicinity. Later I could hear in my apparatus the last discharges at a great distance."

M. Poggio Lera, of Catania, has successfully employed several dispositions. First he used the arrangement shown in Fig. 19. In

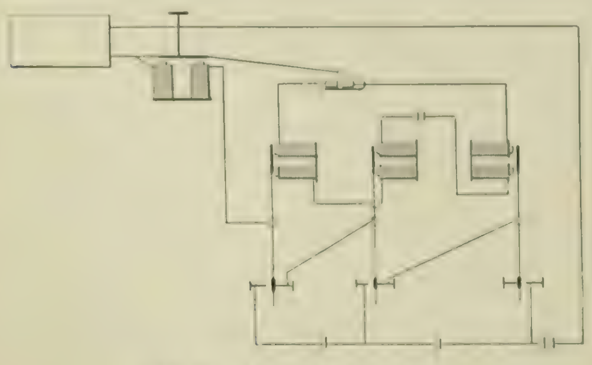


FIG. 21.—LERA ARRANGEMENT.

this arrangement there is an antenna connected to the earth through a coherer, and having in its circuit a toothed-lightning arrester and a mica condenser. The coherer is in circuit with a battery and relay, which latter closes the circuit of another battery and actuates a register and a tapper, the former being in shunt with the binding posts of the latter. Later M. Lera, relying on the fact that the lowering of the resistance of the coherer, and consequently the strength of the current in the relay, battery, coherer circuit, varies to a certain extent with the strength of the electromagnetic waves, by means of a series of relays of different sensitiveness acting progressively (Figs. 20 and 21) according to the conductivity acquired by the coherer, was enabled to devise an apparatus tracing shorter or longer lines according to the intensity of the distant discharges. Later M. Lera simplified these arrangements and employed an apparatus which differs little from that of Fig. 19. This apparatus, which is employed in several meteorological observatories in Italy, notably in Sicily, consists of an antenna connected to the earth through a toothed lightning arrester and having in circuit a coherer; a sub-

FIG. 22.—LERA RECEIVER.

stantial but sensitive relay in circuit with a coherer and a battery, actuates a bell which serves as an alarm and tapper, on the outgoing stroke the tapper striking a bell and on the ingoing stroke tapping the coherer (Fig. 22).

The coherer apparatus of Prof. Lancetta, of the Royal Technical Institution of Girgenti, and which the inventor has named the "Electrographe," consists of a grounded coherer connected with an antenna, and having in circuit a battery and a galvanometer coil, the needle of which when deflected causes a small piece of platinum to close the circuit of a battery and a bell. The armature of the bell

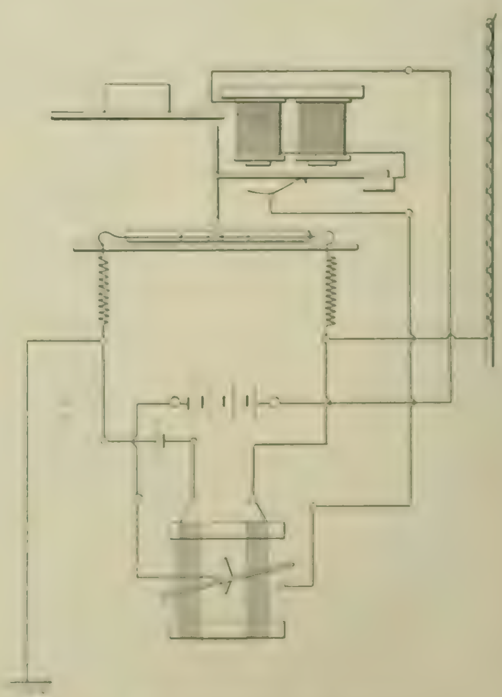


FIG. 23.—LANCETTA ARRANGEMENT.

carries on the one end a pencil and on the other a hammer. The register is completed by a dial on which the hours are marked, but in inverted order as compared with the ordinary clock dial; the dial is caused to move by clockwork, a complete revolution being

made in 24 hours (Fig. 11). When there is a stroke of lightning the coherer is influenced, the galvanometer closes the circuit of the bell, the armature of which in its motion one way makes a mark on the record and on the return movement taps the coherer. A record made by this instrument is shown in Fig. 12.

In view of the simplicity, the automatic operation and the inexpensiveness of the apparatus above described, it is to be hoped that they may come into general use, particularly in the meteorological observatories of the world.

Improvement in Electric Transmission by Wires.

By Chas. E. Fritts.

THE writer has just had issued to him letters patent on a method of suppressing the inductive resistances which are usually encountered in telegraph and telephone lines and cables, particularly those of any considerable length, and as the subject is one of considerable importance at the present time, an account of the principles involved in the system may be of some interest.

These resistances are mainly static charge and retardation in the case of telegraphic and like currents, and self-induction in the line in the case of alternating and telephonic currents. The troubles caused by them and the advantages which would result from their suppression are familiar to every engineer and practical electrician.

Although their suppression has hitherto been considered impossible, the method is simple and easy, and is equally applicable for removing them from existing lines, and for preventing them when constructing new lines; and in either case the expense is very small. The same general method is employed for suppressing both retardation and self-induction in the line. For illustration, the method of dealing with an existing line to remove the retardation will be described.

It may first be briefly stated as follows: The continuity of the line or circuit is broken up by dividing it into disconnected sections or parts. These sections are made of certain lengths, depending on the conditions in each case. The sections are then connected in series through suitable inductive devices, such as condensers or inductance coils, thus forming a virtually discontinuous line, in which the electrical impulses are transmitted over the junctions by induction and over the separate sections by conduction, the final result being the same as with the usual continuous conductors, i. e., the receiving apparatus reproduces the signals or impulses sent forth by the transmitter.

By breaking up the continuity of the line, cumulation of the retardation is prevented. As is well known the retardation increases as the square of the length of the line. A line or cable 1,000 miles in length will have a million times as much retardation as a line one mile long. The reverse is also true, and the retardation decreases as the square of the reduction in length, so that we can make the retardation in a conductor as small as we wish by reducing its length. By dividing it into sections so short that the retardation in each section is practically nil, and forming a line with such sections, the whole line will also be free from retardation, no matter how long it is, provided we connect the sections by devices which will transmit the signals or impulses, but on the other hand will not permit the cumulation effect in the composite line.

That can be accomplished by electrical condensers or equivalent devices, among which may be mentioned self-inductive coils. When condensers are used, the ends of the adjacent sections are properly connected to the opposite armatures of the condensers. A section thus freed from retardation is called a "non-inductive" section, and a line composed of such sections arranged in series according to the patented system, is a non-inductive line or cable, meaning one which is practically free from inductive resistances, or sufficiently so to answer the purpose in the given conditions.

The line (that is to say, the portion which is between the terminals which are operating at the time) is connected to earth through the station apparatus at each end, but it has no earth connections between those terminals, no matter how many stations it passes through or how many lines are connected in series. All intermediate calling, relaying, receiving and other instruments are inserted in the line without grounds, unless the grounded station is to become a terminal.

Owing to the absence of inductive resistances in the conductor, the possible length of line which can be operated by this system is many times greater than by the present systems. It can be relayed, however, and the new line may be organized either on that system or on the present system, as preferred. By adhering to this system, it can be relayed as often as desired, and messages can be automatically repeated to any required distance without interference by the usual inductive difficulties.

This system has been practically demonstrated. The following is believed to be a correct explanation of the theory of its operation. The first effect of the transmitter is to produce a wave or impulse of electric induction, or inductive influence, which travels over the whole line instantaneously (at the rate of 186,000 miles per second), and polarizes it, giving the condensers what may be called kinetic potential [i. e., having the power to draw currents in until fully charged, thus making them actual potentials] corresponding to the signals or impulses sent out—but, as yet, no current passes over the line. The actual flow of current over the several sections to their respective condensers comes later, in consequence of the polarization of the line and the difference of potential in the condensers, before referred to; and this flow continues till the condensers are charged up to that actual potential. That flow of current is not instantaneous, but requires time.

The time depends on the ohmic resistance of the section (supposing that the inductive resistances have been removed) and on the electrostatic capacities of the condensers. The less the resistance the larger the current flow; and the greater the capacities of the condensers the longer the time required to charge them up to the proper potential. As all of the condensers were polarized at the first instant, these currents flow into all of them simultaneously, not consecutively, and the time required to charge all of them is the same as for one.

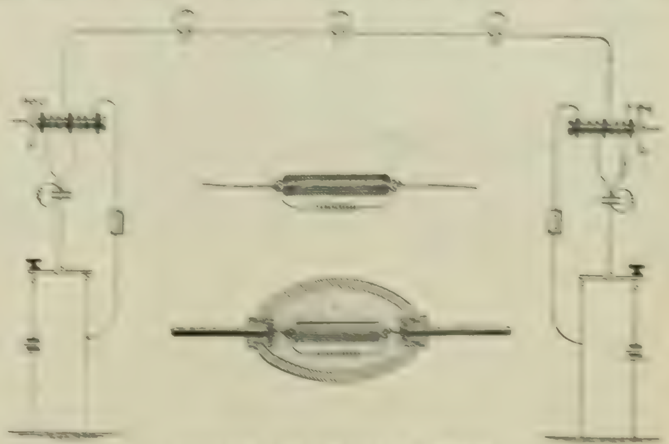


DIAGRAM AND DETAILS OF CIRCUIT.

For the same reason no cumulation of [illegible] is possible, and the retardation on the whole line is numerically equal to that of a single section. This last statement, about the value of the line retardation, has not been verified by measurement, but it is believed to be correct.

It is not always necessary to remove the retardation completely, as in some cases a moderate amount of inductive resistance would be of small practical consequence. The theoretically correct amount can be ascertained by calculation, and the required approximation to perfection can be found by experiment. The amount so found will be the standard or proper inductive resistance which may be allowed in the sections of that line or circuit. The inductive resistance must not exceed that amount in any section; but it may be less than that in one or more sections, without injuring the performance of the line.

In the same way, the ohmic resistance in any one section of the line must not exceed the standard, which is normally the ohmic resistance of the section containing the transmitting apparatus, and which should properly control the action of the entire line. The frequency and rate of charge and discharge of the transmitting condenser (the one to which the generator is connected) compel a like action in all other condensers of the line. The condensers do not charge and discharge suddenly, as some might suppose, but precisely in accordance with the form of the wave of impulse given out by the transmitter. The ohmic and inductive resistances of that section are, therefore, the standard or maximum resistances allowable in the sections of that line.

The electrostatic capacities of the condensers must be sufficient to become charged to the desired potential by the current flowing through the given resistances for the time occupied by the longest signal, impulse or current wave which is to be transmitted. The electromotive

force of the generator must be high enough to send through the given resistances a current large enough to charge the condensers as described—all of which will be readily understood by those familiar with the properties of condensers.

As all the sections must conform to these limitations, it is evident that the greater the inductive resistances are in any particular line or cable, in the given conditions, the shorter the sections of that line must be cut when dividing it up, in order to conform to the principles of this system. No matter how great the retardation or the self-induction may be, it can be entirely removed by simply making the sections short enough. In case different lines are connected in series, as, for instance, a submarine cable in series with a pole line, the cable sections would have to be much shorter than those of the pole wire, although both are in the same line; and if the line is organized according to the principles of this system, it will operate satisfactorily.

It is worthy of note that this method is not limited to extended conductors only, but is equally applicable to long conductors in the form of coils or solenoids, etc. When the conductor is properly divided into sections connected by condensers or equivalent devices, the retardation and self-induction are suppressed, without interfering with the dynamic induction of each turn upon the others. The legitimate and proper action of the coil is thus greatly increased and improved, by the removal of the obstruction previously caused by the inductive resistances. This will be specially useful in the long secondaries of induction coils, by winding the coil in sections, and connecting their terminals through suitable condensers. A coil is to be treated as a part of the line or circuit which contains it, and the sections of the coil must come within the same section-standards or limits as the other sections of the line.

The foregoing is the normal arrangement of the line for alternating, telephonic, undulatory and similar currents; but with intermittent, interrupted and like currents, which terminate abruptly, such as those commonly used in telegraphy, there would be a discharge or return current flowing back over the sections at the termination of each signal or impulse, like the currents which produce the false signals or "kicks" on the ordinary telegraph lines. To prevent this in cases where such return current would be objectionable, a strongly self-inductive coil (or the equivalent of that) is arranged in shunt around the condensers.

When the current or impulse arrives at each condenser the counter-electromotive force generated by the coil prevents its passage through the shunt until the condenser is charged up to the potential of the impulse. The potential of the impulse ceasing to rise, the counter-electromotive force of the coil disappears, and the opposite charges on the two sides of the condenser then flow freely through the shunt and coil and neutralize each other therein, thus preventing any return currents flowing back over the line, which is completely freed from all static charge immediately after the passage of each signal or impulse.

As all the condensers discharge at once, the line is freed from charge at as many points as there are condensers, all acting simultaneously, making the discharge of even the longest line very rapid and perfect. The inductance coil should be such as will stop the impulse as described, and its ohmic resistance should be as low as it can be and yet have the necessary inductive power. Of course, the inductance is not to be removed in the shunt coils, but magnified.

In this modified form (after the first instant, during which the condensers are charged) the current actually flows over the line from end to end, passing through the shunts around the several junction condensers. This arrangement has the further advantage that it permits the use of a very small condenser with a large current. The arriving impulse first charges up the condenser as before described and sends on an equivalent impulse by induction through it; then the remainder of the impulse flows through the shunt resistance as long as the signal continues. With this arrangement of the sectional line and small condensers, telegraphic messages can be sent over long ocean cables with ordinary Morse instruments as slowly or as rapidly as the operator can work the key. This alone would be a valuable improvement, but it is one of the least of the advantages of this system. The accompanying illustration shows a line arranged as above described.

The shunted lines or cables can be used for all currents, but the line without shunts is for alternating, telephonic, undulatory and like currents, or for cases where "return currents" on the line are not objectionable.

As before stated, the same method is employed for removing or preventing self-induction in the line as that described for retardation. The proper lengths and resistances for the line sections can be ascertained by calculation, or, if necessary, by direct experiment. The greater the frequency and the more abrupt the rise and fall of the current waves, the shorter the sections must be. The other details of the method have already been sufficiently described.

If line wires of iron or steel are used, the ohmic resistance should be low and the sections shortened to correspond with its self- inductance, as compared with copper.

When inductance coils or other equivalents of condensers are used as the inductive connections, the foregoing explanations need no change, except the omission of the condensers.

The control of the entire line by the transmitting condenser, as before mentioned, will also result in largely freeing the line from the action of external inductive influences, such as earth currents, telephonic cross-talk, and the like.

It will be observed that this method has nothing in common with the inventions of Professor Pupin for a similar purpose. He adjusts the resistances of the line in such manner as to cause it to respond to currents or impulses of certain periodicities. This method *removes* the inductive resistances entirely and leaves the line open for the unobstructed passage of currents having any periodicities that may be desired. In a case where his method would require eight divisions of the cable per mile, this system would make the sections from forty to fifty miles in length, which shows a wide difference in the principles of the two methods. Moreover, this application for patent was filed more than ten years before Professor Pupin began his researches.

Existing lines can easily be altered to this system by calculating the proper length for the sections and inserting the condensers or other connections at or near the proper points in the line. In land lines the ordinary ready-made condensers are suitable and can generally be located and sheltered in some station or house near the proposed junctions.

For cables, the condensers (and the shunts, when used) can be enclosed in suitable water-tight junction boxes, which are then laid with the cable. There are no moving parts, nor any adjustments required, after the parts are constructed and connected as described. In altering a cable already laid, junction boxes, with condensers, etc., are prepared beforehand. The cable is underrun at the proper points and brought to the surface, the junction boxes are connected in, sealed and wrapped, and the cable lowered to its former position. Drawings and descriptions are given in the patent.

This line can be worked simplex or duplex, and with a single wire or a complete wire circuit, as preferred. With suitable modifications and additions, it can also be quadruplexed. The patent shows the duplex and simplex arrangement. For telephony, the telegraphic instruments there shown are replaced by telephonic transmitting and receiving apparatus of any desired kind, with or without the usual induction coils.

But it is especially valuable for long-distance telephony and telegraphy, and for very rapid telegraphic transmission, both automatic and synchronous. It not only admits of sending signals, impulses or waves having any desired frequency, but it actually operates better, the greater the frequency. This multiplies almost indefinitely the number of messages that can be sent over one line wire arranged on this system. The "frequency" mentioned refers to the number of the current alternations, waves or impulses—not to the etheric vibrations. It will, of course, be understood that this system is not designed for the transmission of unbroken and unvarying direct currents, but is for interrupted, alternating, undulatory, or other *varying* currents, which are subject to obstruction by inductive resistances.

When the conductor is thus freed from inductive resistances, it is reasonable to suppose that telephony will also be practicable over the longest ocean cables, and on underground and other lines through which now not a word can pass.

At first thought it appears strange to send impulses or currents over discontinuous lines or conductors, i. e., without any electrical conductor connecting the operating stations. But, as a matter of fact (with the exception just noted), practically everything that can be done on a continuous line can be done *better* on a discontinuous one, and any ordinary continuous line will operate better when altered over to this system.

Another advantage is that this system is to a great extent untrammelled by the many limiting and interfering patents which hedge about the continuous conductor systems. It is not impossible that sectional may soon supersede continuous conductors, as largely as alternating have superseded direct currents—if not more so.

Considering the many advantages of this system and the conse-

quences which must necessarily follow from the suppression of inductive resistances in electric lines and circuits, it would seem to be a very important practical improvement in electrical transmission by wires—almost a new art. It is useful for many purposes besides telegraphy and telephony, which cannot be explained at present.

Switchboards in the Astoria Power Plant, Long Island.

Some time ago the New York and Queens Electric Light and Power Company were faced with the problem of increasing their plant at Astoria, L. I., so that it could provide for the growing needs of that section, and also of supplying the necessary power for the plants at Flushing and Jamaica. The section of Greater New York which lies between Astoria, Flushing and Jamaica is one which is growing rapidly, and it was deemed advisable to abandon the direct-current arc system installed at these stations and operate all classes of business from 2,200-volt, 60-cycle, two-phase circuits. As most of the circuits are overhead and on public highways, it was not deemed advisable to transmit from the generating station at Astoria to the sub-stations at a higher pressure than 6,600 volts, although the maximum distance to be transmitted in some cases is as great as 10 miles.

The Astoria station contained two alternating-current generating units, one of 300 and one of 400-kw capacity, direct connected to vertical engines, and two horizontal Corliss engines of approximately 600-hp each, belted to a jack-shaft and to T-H arc dynamos, located on a gallery at one side of the engine room.

The apparatus just enumerated practically filled the station, and yet by the removal of the two horizontal engines, jack-shaft and arc machines, four 750-kw direct-connected, alternating-current units have been installed without undue crowding. The gallery on which the arc machines formerly stood has been strengthened, and constant current transformers for the Astoria arc lamps and the step-up transformers supplying the transmission line to Flushing and Jamaica have been installed upon it. This gallery has been extended along one side of the room for the installation of the main switchboard. The remodelled plant and the switchboard are interesting examples

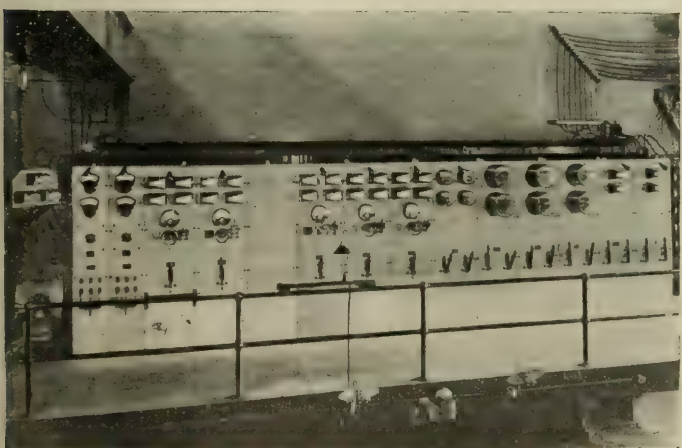


FIG. 1.—ASTORIA, L. I., SWITCHBOARD.

of the economy of space with modern electrical apparatus. The switchboards show the evolution of practice from a simple marble board having all the switching apparatus and bus-bars mounted upon it, with all of the live parts exposed, to the much neater and more substantial construction of oil switches and operating levers with all live parts protected. On this board there is no more danger at the rear of the panels, and among the wires and switches, than at the front of the panels themselves; and the operator is relieved from the constant feeling that he must risk his life every time he enters the passage way behind the high-tension switchboard.

This switchboard is particularly interesting owing to the numerous kinds of service which it handles. The power is generated two-phase at 2,200 volts, and is used for incandescent lighting and power purposes at this pressure for local distribution in Astoria. The Astoria arc lights are supplied by means of constant current transformers wound for 2,200 volts primary. Power is also transmitted from the station at 6,600 volts, three-phase, to sub-stations in Jamaica and Flushing, where it is used for incandescent lighting and power on 2,200-volt, two-phase circuits, and for arc lighting with constant current transformers whose primaries are wound for 6,600 volts.

The Astoria switchboards are made up of a generating board, a local lighting and power distribution board, an arc lighting board, a low tension transformer board, and a high-tension transformer and transmission board. Duplicate bus-bars are provided throughout the entire system, and where they are not heavily insulated they are placed above the panels, well out of reach, and are protected from falling objects by strips of hard wood, one inch in thickness and grooved to fit down over the copper bars.

The main switchboard consists of one motor-driven and two engine-driven exciter panels, one 300-kw, one 500-kw and four 750-kw generator panels, one station load panel, one step-up transformer load panel, one arc load panel, one local incandescent and power

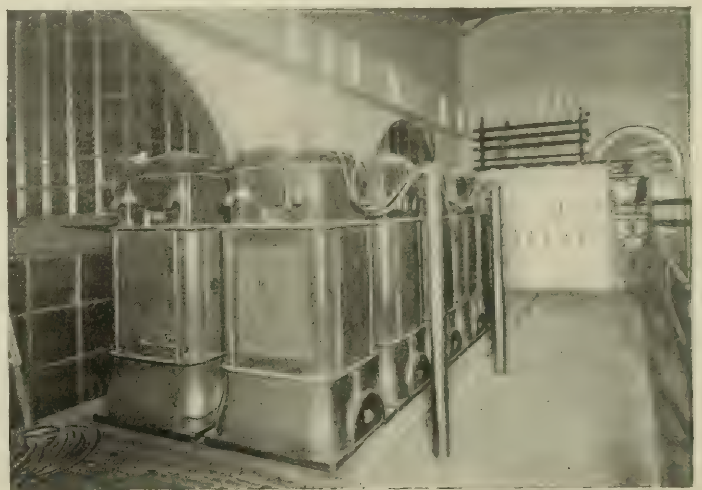


FIG. 2.—TRANSFORMER GALLERY.

load panel and two local 2,200-volt feeder panels controlling four circuits.

The arc switchboard consists of two 8-circuit panels, so arranged that the primaries of the transformers may be thrown on either set of busses, and safety devices are provided so that it is impossible for the operator to parallel the main bus-bars at this point by a wrong connection of the transformers. Only one ammeter is mounted on each panel, and it is so arranged that it may be inserted into any of the eight circuits for current adjustment.

A rather unusual but simple device is a pilot lamp in each arc circuit. This consists of a series incandescent lamp mounted on a wall bracket above the board and in plain view, so that the switchboard attendant may know at once whether the circuit is in operation. The arc transformers which are of 75 and 100-light capacity are all wound for two circuits,although they are not necessarily operated in that manner. Where two circuits are fed from one transformer, means are provided for grounding and disconnecting one of the circuits while the other is still in operation. This is necessary in order to relieve it of pressure and static charge while being repaired, and is accomplished by putting two single pole switches in each circuit, so that it may be entirely cut off from the transformer. It is then grounded by closing a suitable ground switch.

The switchboard which controls the primaries of the step-up transformers is located on the transformer gallery between the main board and the transformers. This location makes the wiring as simple as possible. The board consists of two panels, each controlling four 200-kw air-blast transformers, connected in units of two, and by which the two-phase power is transformed to three-phase at the higher pressure. The high tension side of the transformers is controlled by two panels having the operating levers for the 6,600-volt switches mounted upon them. Panels for the two transmission lines join the high-tension transformer panels, and each has mounted upon it two operating handles to control three-pole, single-throw, oil switches.

In order to warn the attendants against paralleling the bus-bars at any point excepting on the main board, a system of pilot lamps

is used. The high-tension transformer panels have colored lights directly above each switch, indicating the proper switch to be operated as soon as the low-tension switches on the transformer have been closed. Small pilot lamp transformers are connected to each transmission line in the main and sub-stations, and as soon as the line is made alive from either end it is indicated by a lamp on the line panel and fed from these pilot transformers.

The 2,200-volt switches are of the two-pole, double-throw oil type, and are mounted on the wall back of the boards. Two switches, mounted one above the other, are operated by one handle so that the combination is equivalent to a four-pole, double-throw switch. The 6,600-volt switches are mounted in brick compartments. All operating levers pass underneath the floor and up the back of the panels to the handles.

Each generator panel has mounted upon it two single-phase wattmeters, two ammeters, one hot-wire voltmeter, for synchronizing, one synchronizing lamp and plug, one 8-point voltmeter receptacle and plug, one field switch and one operating handle for the oil switches.

The entire output of the station is recorded by four single-phase integrating wattmeters, mounted on the station load panel. Two of these wattmeters are mounted in each pair of the two-phase busbars. The power to the local Astoria lighting, the arc lighting and the transmission lines are separately measured on the load panels by polyphase integrating wattmeters. The low tension transformer boards contain ammeters which show the distribution of the load on the transformers. The transformer fuses are mounted on marble slabs fastened to the rear of the panels.

The blowing apparatus for the air blast transformers is installed in duplicate and is placed on the engine room floor directly underneath the transformers. The switches and controlling devices for the blower motors are near the transformers and are operated from the switchboard gallery. The switchboards which have been described above and which are shown in the accompanying illustrations were manufactured by the General Electric Company. Mr. J. N. Bissell is the 2d vice-president and general manager of the New York and Queens Electric Light and Power Company, and the engineers who have designed and carried out the work are Messrs. J. G. White & Co., of New York City.

Comment on Existing French Conditions.

American enterprise in France is attaining considerable proportions, according to the statements made by Charles A. Conant, treasurer of the Morton Trust Company, who has returned from Paris: "Financial conditions in France," he said, "are typical of the conditions which have existed there for many years. There is an immense amount of capital seeking investment, resulting from the thriftiness and conservatism of the French people. They have lost some money in Russian industrial securities, and some in South African mines, in which they invested from $400,000,000 to $600,000,000. They will probably go back into mining investments to some extent, now that the war in South Africa is over, but those who lost are disposed to look for something different.

"France has not been swept along to any great extent on the current of economic expansion of the last few years. Few industries have been consolidated, comparatively few improvements have been made in railway equipment, and the general extension of tramways has resulted somewhat disastrously to their promoters. The fact that French manufactures are so largely those in which high artistic skill and hand labor are required has made less important the failure of the large financiers to inaugurate the economies in production and transportation which have been so important a factor of industrial development in the United States.

"Americans are interested with some French capitalists in the control of several of the Paris tramways. They are also bidding for control of the gas franchise of Paris upon much more favorable terms than were offered by the old French company. Paris has, as yet, only one subway, but the excavations are being made for several others. These subways are owned by the government, but leased to the operating companies. It is not unlikely that Americans will be bidders for the operation of some of them when they are completed.

"A few of the more educated French people are fearful that the Americans will get control of everything in France, and are fighting the gas franchise upon the ground that we ought not to be given such an entering wedge, but the more far-sighted among them are eager to get the benefit of American methods of organization, with a view to the industrial development of their country."

The Nodon Rectifier.

By P. Letheule.

The Nodon rectifier for alternating currents is based upon a well known principle, discovered in 1857 by Buff when experimenting with aluminum in an electrolyte, who observed the great apparent resistance opposed to the passing of a current from an aluminum terminal used as an anode. When used as a cathode, however, nothing different from the usual resistance was observed. Numerous attempts have been made to take advantage of this dissymmetry for the restification of alternating currents. Aluminum-carbon couples have been used for this purpose, but their practicability has not been demonstrated.

The new Nodon rectifier consists essentially of an iron cylinder, in the axis of which is fixed, by means of a rubber bushing, an aluminum rod containing 5 per cent. of zinc, the whole being submerged in a saturated neutral solution of ammonium phosphate. When an alternating e. m. f. is applied and gradually increased from 15 to 110 volts, a coating of aluminum phosphate is formed over the surface of the rod and acts as a perfect insulation up to 130 volts. This coating is formed inside of a few seconds, when an automatic device connects the terminals of the receiving system to the terminals of the alternating feeding system through the Nodon elements. Each terminal of the alternating-current system is connected to contrary poles of two elements, the free poles of the same sign being all connected together. A unidirectional current then flows from the aluminum toward the iron. The rectification of current is complete, no change of sign taking place even if the receiving circuit has no self-induction.

The efficiency of the Nodon rectifier as determined from wattmeter reading reaches 75 to 80 per cent.; it seems to be independent of frequencies ranging from 42 to 84 cycles. Both e. m. f. and intensity are reduced about 10 per cent. in the transformation. The electrolyte does not show any alterations. By regulating the current density to between 5 and 10 amperes per square decimeter by means of a glass tube partly surrounding and covering the aluminum rod, the temperature can be kept about 55 per cent. C. in a rectifier of 4 hp. The e. m. f. utilized can be as low as 50 volts.

Thermo-Electricity.

Two patents were issued July 15, 1902, to Chas. B. Thwing, one of which was on a thermo-electric element and the other on a thermo-electric generator. The positive of the thermo-electric element consists of iron or of an alloy in which iron predominates. For the negative element an alloy of nickel and copper is employed, having the proportions by weight of 1,746 parts nickel to 1,264 parts of copper, corresponding to the chemical composition $Ni_3 Cu_2$. The element may be cast one upon the other, or joined by brazing or other hard soldering. An alloy of copper and antimony in the proportions of 9 of copper to 1 of antimony, which has a melting point slightly below that of copper, may be employed for the solder, or copper alone may be used therefor. The thermo-electric generator consists of an aggregation of the above couples. The joints of the heater are compact and brought near to one another and close to the flame, a comparatively large portion of the elements being in the path of cooling currents of air passing up through the generator between the outer side of the casing and the chimney.

Electric Locomotives for Baltimore.

The mayor of Baltimore has approved the ordinance by the city council requiring the Baltimore & Ohio Railroad to substitute electric locomotives entirely, in hauling freight trains through the tunnel under the city, in order to get rid of the smoke and cinders now given off from the tunnel openings. It is stated that the railroad will comply with the ordinance just as soon as the locomotives can be built and delivered.

Hertzian Waves and Wireless Telegraphy.

By A. Frederick Collins.

WITH the progress of wireless telegraphy in its physical and commercial aspects there has followed, coincidently, an array of ideas advanced to account for the many phenomena which seemingly set at defiance the laws governing electromagnetic manifestations of the luminiferous ether.

These ideas are usually originated with a view to explaining away the supposed mystery surrounding two remarkable facts which have arisen since the practical application of Hertz's experiments with electric waves, namely: (1) the necessity of earthing the terminals of one arm of the oscillator system of the transmitter and of the resonator system of the receiver for long-distance wireless transmission, and (2), that the curvature of the earth is assumed to be a barrier to the transmission of the free electric waves between the radiator emitting them and receiving wire where the elevation of the latter is exceeded by that of the intervening earth.

When Hertz concluded his classical experiments, showing by purely optical methods that the long electric waves he discovered and the shorter ones of light obeyed the same laws, his work was accepted with admiration by physicists of the calibre of Lord Kelvin, Helmholtz, Poincaré and a host of others, all of whom hailed with delight the fulfillment of Maxwell's prophecy, itself based upon the experimental work of Faraday.

But when Marconi, trained in the school of Righi—who was himself a champion of the Hertzian discoveries—found that by grounding one of the terminals of the oscillator and likewise one of the resonator, and at the same time extending the opposite terminals vertically in the air, the effective distance over which the wave propagation could be transmitted was greatly increased, the experiments of Hertz were apparently so modified that at once suppositions innumerable were originated and put forth to account for the seeming changed conditions. By a few, the electric wave theory was entirely discredited; by others elaborate and cumbersome schemes, involving earthed currents and sliding waves, were put on record, but by the many the theory of free electric waves emitted by the antenna prevailed, and by these it was likewise generally accepted that the earth acted simply as a capacity and not as a medium of wave propagation. The experiment which led to this belief is described below, and the pseudo-reasoning that the earth and sea are opaque to free Hertzian waves was due to the imperfectly understood nature of the phenomenon involved.

However, it was not until wireless messages had been transmitted over such distances as to absolutely preclude the rectilinear propagation direct of free electric waves between the oscillating and receiving antennæ without the curvature of the earth offering any perceptible obstacle that the search for a theory to fulfill these conditions and requirements became popular; the following paragraphs will serve to illustrate with what diligence it was, and is at the present time, carried on.

A.—Very early in the history of the spark-gap and coherer system of wireless telegraphy the supposition was advanced that there were four varieties of alternating electric currents, *i. e.*, low-frequency, low-potential; low-frequency, high-potential; high-frequency, high-potential, and a fourth state or degree of current that is as much higher in the scale of frequency and potential as the Tesla oscillating currents are higher than the commercial alternating; it was also supposed that this "vibratory" current was the energy radiated by the wireless emitter, and that the earth or sea and air acted as conductors. This supposition accounted for the use of the antennæ and the earthed arms of the oscillator and resonator systems.

B.—Here, as in the cases above cited, Hertz's deductions and all the known laws governing the action of electric waves were set aside. This supposition shows how all the phenomena occuring in long-distance wireless telegraphy may be readily explainable if the mode of transmission be considered a form of electrostatic displacement of the charged upper strata of air. In the issue of the Electrical World and Engineer of July 12, this supposition is ressurrected by Prof. J. W. Gore, but it is not very ably defended by him, probably for the reason that there is little or no experimental or theoretical evidence upon which to base a "legitimate inference."

C.—The observed fact that a coherer will not act when buried in the earth is taken as sufficient proof that the earth is not a suitable medium for the propagation of electric waves; therefore, as cited above, it is to-day largely believed that the free vertical arm of the oscillator only radiates available waves. On the theory of wave interference it can be shown that this is erroneous, and that waves are emitted from the earthed terminal as well as the antenna, and that both are necessary to effect cohesion of metal filings at a distance.

D.—A supposition has been advanced by an English physicist that in the case where the curvature of the earth cuts off "the direct visual line" between the transmitting and receiving antennæ, the waves, being propagated in a straight line, were transmitted through that portion of the sea above the line joining the antennæ perpendicularly, since the sea or other body of water fulfilled the requirements of a transparent medium for the propagation of free electromagnetic waves.

E.—Another authority has advanced the very ingenious hypothesis that since water and the upper strata of air acted as reflecting surfaces the free waves emanating from the sender on reaching the upper strata of air was reflected and, striking the surface of the water, was again reflected to the air, the process continuing indefinitely, or until finally the zig-zag line of wave propagation would reach the receiving wire.

F.—Another solution has been offered by Mr. E. P. Thompson, in the Electrical World and Engineer of June 124, in which he contends that transmission of energy between wireless instruments within visual range is accomplished by free Hertzian waves, and that when the distance becomes so great that the curvature of the earth exceeds the height of the antennæ, the earth or water acts as a conductor for the high-frequency, high-potential oscillations, and thus establishes the connection between the sending and receiving instruments.

G.—Dr Lee De Forest elucidates the hypothesis of sliding waves over conducting surfaces, in the Electrical World and Engineer of July 5, and holds to the opinion that the sea acts as a conductor for the propagations of these sliding waves. Incidentally Mr. De Forest takes Mr. Thompson to task for the latter's "confusion of ideas" and laments the "loose terminology" employed by "writers partially informed." Mr. Kintner in the Electrical World and Engineer of July 12, seriously objects to the theory of "rectilinear wave propagation," and, after considering the three available propositions concludes that the sliding wave idea has most in its favor.

These are only a minority of the ideas, suppositions and hypothesis offered to account for the propagation of energy which will bend around corners, follow the curvature of the earth, necessitate earthed terminals and antennæ and contribute some other properties which the adherents of the above exhibits cannot see their way clear to solve on the theory of rectilinear propagation of free electric and luminous waves.

In the article above referred to, Mr. De Forest begins by correctly defining "Hertzian waves," and stating the term to mean, "free electromagnetic waves in the ether," which is taken from Hertz's paper on "Electric Radiation[1]"; this paper describes all the electro-optical effects produced by Hertz, nearly all of which are in one way or another serving as vital features of Hertzian wave wireless telegraphy. Mr. De Forest's second definition of Hertzian waves, which is likewise correct, is summed up in the statement that they are "transverse electrical displacements or detached vibrations traveling over a conducting surface," and this is taken from Hertz's paper, "On the Propagation of Electric waves by Means of Wires[1]"; on these experiments are based the hypothesis of sliding waves, but Mr. De Forest wavers when he claims the latter has been most appropriately styled "Hertzian waves," for, on the contrary, "Hertzian waves" are universally understood by expert and laymen alike to mean "free electromagnetic waves," as set forth in Hertz's paper on "Electric Radiation," above referred to, and which have all the characteristics common to and following the laws of light waves.

"Oscillating currents" would be a much more appropriate name for electric waves traversing wire and "Hertzian" or "electric waves"

[1] Electric Waves, by Hertz. Translated by D. E. Jones.

should designate the energy radiated from oscillating currents in the form of undulatory disturbances in free ether. It would seem to the "partially informed" that Mr. De Forest is a little mixed in his terminology when he states that "pulsations at the rate of a million per second" cannot be classed with "alternating or oscillatory currents."

While oscillating currents are alternating, alternating currents, on the other hand, are not termed oscillating. By alternating currents the writer has labored under the impression that the term designated the process of producing a low-frequency current by moving bobbins of wire to and from magnets[1]. and that oscillating currents were currents of high-frequency and high potential produced by the sudden discharge through a small resistance of two charged surfaces having a large difference of potential, as a Leyden jar or the oscillator system of an induction coil; when the periodicity of the surging charge exceeded the oscillatory to the extent of producing visible waves, the term "vibratory" is employed. An oscillating current having a periodicity of 1,000,000 or 100,000,000 is certainly oscillatory.

Again, the conclusions of Mr. Thompson are not so widely divergent—though not so elegantly expressed—from those of Mr. De Forest that the latter should consider for a moment the inconsequential misinterpretation or misuse of the terms accepted by the "wholly informed." Although Mr. Thompson's ideas of long-distance wireless telegraphy and my own differ very materially, his were clearly enough expressed, and his drawing showed at a glance exactly what his article intended to convey, namely, that where elevations intercept the visual range from one antenna to another the energy is transmitted by "electric oscillations," or as Mr. De Forest would rather have it expressed, by "Hertzian waves."

By assuming salt water to be a perfect conductor of electricity—which it is not—and, therefore, "completely opaque" to electromagnetic waves, Mr. De Forest is able to account for the necessity of grounding the one terminal of the oscillator and resonator as well as eliminating the supposed interference of the curvature of the earth. But salt water conducts only by electrolytic action, and instead of being opaque to electromagnetic waves it is a fairly good medium for their propagation. However, the hypothesis advanced by the foremost technicians in wireless telegraphy does not call for the transmission of free Hertzian waves through the water or waves which slide over its surface, but Hertzian waves produced by electric oscillations and emitted in the form of etheric radiations just as the vibrating charge of an atom sends out waves which travel in straight lines in the transcendental matter called ether, through and by which they are propagated, but when the ether becomes identified with gross matter the waves may be made to diverge from the normal line of propagation even to the extent of describing a complete circle, as in the familiar optical experiments wherein a number of prisms are arranged in a position, likewise describing a circle.

The idea that the earth and sea are opaque to Hertzian wave radiation apparently found its origin in an experiment first made by M. Guarini, who ascertained that a coherer when buried in the earth with the proper receiving appliances was unaffected after the emission of the waves above the surface. This also, possibly, gave rise to, or accentuated the belief in the hypothesis of sliding waves, which if my memory serves me aright Prof. Fessenden first advanced.

In order to test the validity of the statement that earth and water are opaque to Hertzian radiation I placed a symmetrical oscillator system, *i. e.*, without earthing one arm, and a similar receiving system in basements on opposite sides of the Schuylkill River (Philadelphia), the transmitting and receiving instruments set below the surface of the river and the oscillator and resonator systems were placed in horizontal positions and parallel with each other. The instruments were encased in zinc boxes with openings on one side only, so that the emitted radiation would be propagated through the basement walls and the river. There was no difficulty in obtaining calculations across the river, although the distance was short and a four-inch spark coil was employed. That the waves passed through the intervening earth and water is as certain as their passage through free air.

In combating the pseudo-hypothesis of sliding waves it will not be necessary to evolve here the theory of electric wave interference wherein one set of waves is propagated through the earth or water and its component set of waves through the air, but it will suffice the purpose of this paper to hold only to the theory of rectilinear wave propagation through the air, which is only a part of the electromagnetic process involving the true Hertzian waves or radiation, as employed in wireless telegraphy.

The part that seems to puzzle the novice who attempts to apply the Hertzian radiation theory to the practice of wireless telegraphy lies chiefly in the use of the earth plates at the transmitting and receiving ends.

Over short distances, just as Mr. Thompson said, the coherer effect is due to free Hertzian waves, but contrary to his idea, it is not the lack of a direct visual line between the co-operating instruments which prevents long-distance transmission of the waves, but in the great difference in electrical resonance or "tuning" of the electric wave circuits of the oscillator and resonator which forms the vital part of the apparatus.

When the emitted waves are powerful and the instruments are quite close together, this divergence of resonance is not such an important factor in causing and effecting results, but as the distance is increased the necessity for exact tuning becomes more and more a matter of vital importance, and, practically, absolute resonance of the oscillator and resonator circuits can be obtained by one method only, and that is by the expedient of grounding one arm of the systems.

The reason for this is simplicity itself; capacity and inductance are the leading co-efficients in the tuning of electric circuits, as Lodge has shown in his experiments with the syntonic jars; by virtue of the unknown value of the resistance of the spark-gap of the oscillator during the disruptive discharge and the difficulty of obtaining exactly the same degree of resistivity of the coherer after tapping, it is exceedingly hard to obtain resonance in commercial systems without resorting to the method of loading a large and like capacity on the oscillator and resonator, but when such a capacity—as the earth offers—is attached by means of an earth plate to one arm of the oscillator and one arm of the resonator is likewise earthed, whatever their distance may be apart they will fulfill the law of resonance, and the systems will be in tune or syntonized. Under these conditions it is clear that any receiver within the sphere of action which may have one arm of its resonator grounded will respond to the transmitter, assuming that it is in adjustment and that its opposite arm extends into the air the proper distance, and any amount of inductance or capacity, or both, which may be added above ground in the form of coils and Leyden jars will avail the designer of such a wireless telegraph system but little since these additions are as a molecule in a litre of water.

This is the greatest technical difficulty Mr. Marconi, Dr. Slaby and all others who are working with earthed terminals have had and will have to contend with in their efforts to produce individual syntonized systems. Sir Oliver Lodge operated effectively a multiple tuned or syntonized set of instruments over comparatively short distances by doing away with the earthed connections. Prof. Braun has, in my opinion, approached the goal of individual syntonic wireless telegraphy more closely than any other inventor; this he has done by eliminating the untoward results of exaggerated capacity which the earth produces and by combining the good qualities of the closed circuit oscillator with those of the open circuit oscillator, as described in my recent article in the ELECTRICAL WORLD AND ENGINEER of June 14.

Loading one end of the oscillator and that of the resonator with so gigantic a capacity as the earth, leaves little opportunity to vary the emitted wave length, and any calculation for oscillator and resonator systems is at once grossly in error the moment the terminals are earthed.

That the curvature of the earth should be assumed to be a complete barrier to the rectilinear propagation of free Hertzian waves by the adherents of other dogmas is surprising, for the simplest law of optics explains easily and naturally how electric waves traveling in straight lines may be made to act around a corner or the arc of a circle equal to the quadrant of the earth's circumference; nor is it needful to work this law overtime as in the hypothesis giving a continuous zig-zag reflection from the upper strata of air to the surface of the sea, and *vice versa*, to account for the phenomena of rectilinear propagation of electric waves.

The reflection of the sun's rays before rising and after setting offers an exactly similar proposition in producing twilight and dawn. By reflection and diffusion of free Hertzian waves all the phenomena of long-distance wireless telegraphy by rectilinear propagation is at once made clear. A searchlight directed against the sky at night gives a visual reproduction of identically the same

effect which takes place when the oscillator system is substituted for the vibrating system of the arc-lamp and the coherer for the human eye.

In conclusion, it is safe to say that the rectilinear propagation of free electric waves will be accepted as the true solution for the responsive action of a wireless receiver to that of a distant transmitter for whatever time the theory of light based on undulations of the luminiferous ether prevails, or as long as the electromagnetic theory of light endures, and to the finality of belief in the theory that Hertz's free electric waves are of the same origin as light waves.

Wireless telegraphy is getting out of its swaddling clothes rapidly, and as it grows new phenomena will be constantly observed, but in the future whatever may arise of a seemingly anomalous nature, it would be well to test the applicability of known optical laws before resorting to explanations founded on mere fancy or to build hypothesis on phenomena of which the principles are far less known and more deeply merged in the darkness of obscurity than the electro-optical laws which Hertz has shown to govern free electric as well as light waves.

New Telephone Patents.

The issue of the Patent Office for July 22 has two patents relating to telephony, one granted to Mr. Mason Grover, of Bidwell, Ohio, covering a device for preventing humming of telephone wires, commonly called a damper; the other to Mr. William Kaisling, of Chicago, assignor to the Kellogg Switchboard and Supply Company, covering a supervisory relay.

Mr. Grover's improved damper, as shown in the drawings, consists of a tapered body, of the form of the corks used by runners when competing for records, which is split to admit of placing the wire in the central groove or bore. A peripheral groove allows of binding the damper on the wire, the tie-wire being attached to the

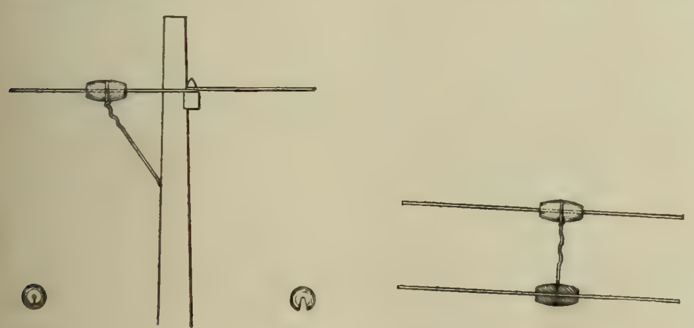


FIG. I.—GROVER DAMPER.

damper on a neighboring wire, or to the pole or fixture. Mr. Bidwell preferably uses rubber for his damper, but points out that any suitable "dampering" material may be used and any proportions may be observed without departing from the spirit of the invention.

Mr. Kaisling's relay invention has for its object to provide a compact and efficient relay, and more particularly to provide means for mounting the armature of the relay. The accompanying fiugres give a longitudinal sectional view; a view partly in section; an end view with the cap f in section, and the armature c removed and the supporting strip, c^3 partly removed; a detail view of the back contact d^2 and its mounting; a detail view of the armature and its mounting, and a view showing the manner of securing the armature to the suspending spring. The relay is surrounded by a shell, a, in which the core a^1 is mounted, a^1 having a threaded shank a^2 passing through the shell and secured by nut a^3. The winding b is held between insulating end pieces C^1 C^2, and the ends of b are connected to the conductors b^3 b^4.

The armature, c, is circular; at its center is a tapped hole to receive a screw, c^1, secured by nut c^2, the end of c^1 carrying a platinum contact-point, c^5, which is one of the contacts of the relay. Armature c is suspended opposite the end of a^1 by means of spring-strip, c^3, which is preferably of copper. The upper end of c^3 is screwed to shell a by screw c^4, and the lower end is secured to the armature c by being bent at right angles and inserted in a slot near the periphery of c; the circumference of c, after the bent end of c^3 has been inserted in the slot, is prick-punched to make the joint secure. The strip c^3 acts as a spring to maintain the armature normally a short distance from the end of the core. When the armature is attracted the metallic circuit is completed from the shell-terminal e^3, through shell and spring c^3 to the armature contact c^5, thence to back contact d^2 and by wire e^2 to terminal e.

The advantage claimed for the means of suspending the armature is that the weight of the armature is balanced and, therefore, the only strain to be exerted by the magnet is against the spring copper-strip c^3. The mounting of the back contact is as follows, and is

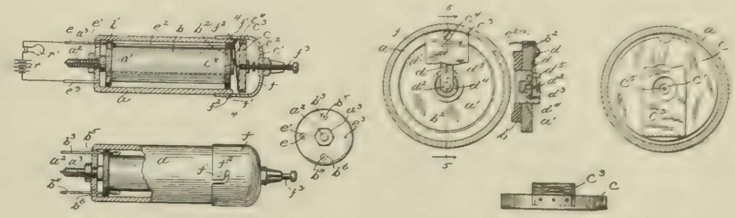


FIG. 2.—KAISLING SUPERVISORY RELAY.

clearly illustrated in the small sectional figure. Upon the front insulating-plate C^2 a spring-strip, d, is secured by screw d^1. The lower end of d carries a platinum contact, d^2, adapted to make contact with c^5 on c when c is attracted. The contact d^2 carries a shank, d^3 extending back into an opening in the insulating-block, d^4, inserted in a bore in the end of the core a^1. The face of the insulating-block, d^4, rests at a distance from the end of the core, so that the contact d^2 rests wholly within the end of the core. A slot, d^5, is provided in the core to allow the passage of the strip d. The strip c^3, supporting the armature, has a central opening to permit the contact c^5 to engage the contact d^2. The circuit controlled by the relay is clearly indicated, one wire, e^3, being connected to the shell and the other, e, being connected by wire e^2 to the back contact-strip d. As shown, the cap f carries an adjusting screw, f^3, by which the distance of the armature from the magnet may be regulated. Mr. Kaisling has produced a compact and neatly-designed relay.

Meeting of New York State Independent Telephonists.

At Rochester, N. Y., on July 25, about 100 representatives of independent telephone companies operating in the State of New York convened for the purpose of forming a State association. Owing to rivalry springing up over the question of two long-distance connections, a split occurred in the convention, and after many animated scenes the adherents of one of the long-distance interests bolted after the friends of the other had secured the temporary organization. Eighty-five per cent. of the delegates then went into convention at the Powers Hotel. Among others, the following companies were represented. Rochester Telephone Company, Home Telephone Company of Albany, Niagara Falls, Tonawanda, Lockport, Medina, Batavia, Warsaw, Troy, Schenectady, Elmira, Binghamton, Newburg, Catskill, and Rome, N. Y.; Kingston Standard Telephone Company.

The following officers were elected: President, G. R. Fuller, Rochester; first vice-president, Homer Hendrickson, Albany; second vice-president, Boyd McDowell, Elmira; secretary and treasurer, C. O. Harris, Rochester; advisory board, S. B. Lawson, Niagara Falls; J. S. G. Edwards, Johnstown, N. Y.; J. S Bradley, Jr., Utica; Edward Davis, Troy; F. N. Potter, Jr., Syracuse; C. D. Vernoy, Cortland, N. Y.; W. D. Bernard, Saratoga; E. L. Barber, Rome. A constitution and by-laws were then adopted, and the organization made permanent, after which the convention adjourned sine die.

The bolters' convention also elected officers as follows, after which they adjourned to meet in Buffalo to perfect organization: President, Martin Carey, of the Frontier Telephone Company, Buffalo; secretary, Charles H. Blood, of the Ithaca Telephone Company of Utica.

The differences are of minor importance, and negotiations are already under way looking toward a union of the two organizations into one and an adjustment of all differences arising in the convention.

International Tramways Union Congress in London.

The twelfth annual congress of the Union Internationale Permanente de Tramways was held last month in London, at the Agricultural Hall, under the presidency of M. Leon Janssen, the able managing director of the Brussels Tramways Company, and extended over four days, ending July 4. The proceedings were conducted in French, occasionally in English or German, and an interpreter made a memory brief of each speech in English for the benefit of those not understanding the other languages. A great deal of excellent work was done, of which note is made below; and there was, in addition, an exhibition of street railways apparatus.

The opening address was made by M. Janssen, who indicated the useful work attempted and done by the body, and noted the fact that not only had various governments sent representatives, but that some of their members had been honored by special recognition. The chair was then taken by Sir C. R. Wilson, who welcomed the congress to England, regretting that they would find that country far behind others in traction work. The union accepted an invitation from the mayor of Islington to lunch, and attended a conversazione of the Institution of Electrical Engineers at the Natural History Museum. Several plants were also visited, and the congress closed on Friday, with a banquet at the Royal Hotel.

An interesting paper was read by Dr. M. G. Rasch, instructor of the Polytechnic School at Aix-la-Chapelle, on "A Proposed Basis for Estimating Powers of Motors." He referred to the regulations which had been issued by the German Association of Electrical Engineers regarding the testing of generators and motors, and commended them to the consideration of the congress. He urged the carrying out of tests extending over a longer period than one hour—the time stipulated by many companies—and the fixing of the normal full load of the motor at such a figure that it will bear, say, a 25 per cent. overload for 30 minutes without injury. The question of temperature rise was next considered, it being pointed out that the limit of permissible temperature rise depended largely upon the character of the insulation employed. Thus, under the German regulations, the figures were, for cotton insulations, 50° C.; for paper, 60° C., and for mica or similar materials 80° C. above a surrounding atmosphere having a temperature not exceeding 35° C. (say 95° F.). For stationary coils a further margin of 10° C. is usually allowable, and, for tests carried out in a test room, the above limits, it was stated, may be increased by 20° C.

Dr. Rasch agreed with those who insisted that high efficiency was not the primary consideration in the design of a traction motor, and pointed out the considerations as to weight and temperature rise, which were also of great importance. He concluded by suggesting that, taking the method of rating a motor proposed by the German Association of Electrical Engineers, the following particulars should be asked for in tenders for half, full, and 50 per cent. overload: (*a*) Current in amperes; (*b*) torque in kilogrammetres; (*c*) speed per minute; (*d*) efficiency. Mr. Macloskie, whose work had been referred to, agreed with the suggestion that the basis for rating motors proposed by the German Association was a good one. M. Pedriali, of Brussels, was in favor of officially adopting the proposals of the German Association of Electrical Engineers as standard, but Dr. Rasch observed that as they stand they are not suitable for traction work, and it would be for the congress, if it adopted them, to suggest several modifications. Herr Max von Leber, of Vienna, thought that local conditions were so different that it would be very difficult to arrange any set of tests which would be suitable for all conditions. Messrs. Scotter, F. W. Egger and others spoke on the subject, but nothing definite was done, the question going over until 1903.

Mr. Chas. Thonet, engineer and manager of the General Contract Company, of Liege, Belgium, read a paper on central stations. It was divided into two portions: the first dealt with the present tendencies of power station design on the Continent, the second with the cost at which electrical energy was produced in a number of important tramway stations. He gave various details, for instance, boilers with fire-boxes suitable for burning petroleum are coming into extensive use in Russia and Roumania; on the Continent stokers work on an average eleven hours per day, and the use of superheaters is becoming general, though few companies will give any details as to the actual economy they effect. Cooling towers are extensively employed, and considerable attention is paid in many quarters to the purification of the feed water before admission to the boilers, but mechanical stokers appear to meet with little favor. In large generating units the engines are generally cross-compound, with the generator between the cylinders; in Berlin and Paris triple-expansion sets are in use, and some useful steam consumption tests figures are given. Mr. Thonet referred also to the working of several producer gas stations with which he is connected, and concludes this part of the paper with a number of details regarding dynamos and accumulators. The second portion gives the results of working of a number of stations using steam and producer gas, and stated that the coal consumption per hp-hour for even the smallest station equipped with gas engines is far from being as high as that in steam plants. He gave power cost data from a number of roads.

Mr. R. H. Scotter, of Warrington, read an interesting and comprehensive paper upon "Legislation in all Countries Relative to Tramways and Light Railways." He urged the collection and collation of résumés of the different laws in actual operation, and described English practice and procedure both under the Tramsways Act of 1870 and the Light Railways Act of 1896. The evils resulting from the limited tenure, the right of veto of local authorities, and also of frontagers, were brought out and compared with the practice in other countries, notably Belgium, where, owing to more enlightened regulations, a system of light railways or chemins de fer vicinaux has proved a great commercial and social success. In this plan the interests of the government, the local authorities and the public are as far as possible harmonized, with the result that schemes are matured along lines which ensure not merely local, but national, prosperity. He commended the British practice of holding local inquiries as worthy of imitation. The rest of the paper dealt with the length of time taken in various countries to obtain concessions, the duration of concessions, gauge, width of roadways, the question of ultimate ownership, and the suggestion of various points for the consideration of future congresses.

M. M. A. Trautweiler, chief engineer of the Strasburg Tramway Company, read a paper on "Car Barns and Their Location," summarizing some seventeen replies to inquiries. The answers were of such a varying character that it was impossible to base any very specific recommendations upon them. Some companies favor a number of car sheds so distributed over the various routes that the number of non-profitable car-miles run was a minimum. Some went as far as to suggest a small shed at or near each terminus, so that the traffic on that particular line would be adjusted to meet varying requirements. Speaking generally, seven of the seventeen companies, and among these are those owning the greater number of cars, advocate concentration; the remaining ten favor distribution among several sheds. He held that in many cases the additional maintenance expenses incurred by dividing the cars between a number of sheds have not been sufficiently appreciated, and that too much importance has been laid upon the cost of running idle cars to and from the main depot. M. Trautweiler thought that so long as not more than 100 to 150 cars are required for any system, one shed is best, but that for large undertakings several car sheds, each having accommodation for the above number of cars, will prove most economical. This conclusion is in general accordance with American practice, where a small number of large car sheds is the rule. For ease of comparison, he instanced a system having about 27 kilometers of track, 70 motor cars, and as many trailers; where the car house, if a single one were used, would have to be one and one-half kilometers from the center of the city. Such a road would find one car barn more desirable than several.

M. Ziffer, of Vienna, president of the board of directors of the local railways of Bukowina, read a paper on "Systems of Traction," dealing, in an exhaustive manner, with the various types of conduit and surface contact systems of electric tramways proposed or adopted. For each 100 kilometers of track electrically equipped, of which returns have been received, 82 employ the overhead trolley, 7 a conduit system of one type or another, and 11 are worked with cars carrying accumulators. Dealing first with conduit systems of working, M. Ziffer gave

a history of early efforts, and described in detail the conduit lines at Brussels, Paris, Buda-Pesth, and Vienna, with the costs of construction and operation. The second portion of the paper presented information regarding surface contact systems of traction. The Schuckert system, on a short line at Münich, the Claret-Vuilleumier at Lyons, the system of the Thomson-Houston Company, of Paris, installed at Monaco and Monte Carlo, the Diatto system at Tours and Paris, and the Lorain system recently placed in use at Wolverhampton were all referred to. He concluded by pointing out the real need for a reliable surface contact system, and considered that at present all systems in use are of a more or less experimental character.

M. Poetz, of Hamburg, Germany, read a paper on "Tramway Brakes." It discussed hand, air, electric and friction brakes, and described tests on the power of different brakes, their power being expressed in terms of the distance in which a given car could be brought to rest from a given speed. He expressed himself in favor of electric rather than air brakes in all cases where the number of trailers does not exceed one or two. In the discussion M. Thonet spoke in support of the author's tests and results. He gave the following results of tests made under his direction, at a speed of 20 kilometers per mile. The figures give the distance in metres run before stopping.

For one car	14.0	for air brake.
For one car	12.5	for General Electric brake.
For one car	11.6	for Thomson-Houston brake.
For one car and one trailer	18.1	for air brake.
For one car and one trailer	15.6	for General Electric brake.
For one car and one trailer	11.7	for Thomson-Houston brake.
For one car and two trailers	20.7	for air brake.
For one car and two trailers	19.4	for General Electric brake.
For one car and two trailers	14.7	for Thomson-Houston brake.

Herr Koehler disapproved of the magnetic brake, which he had tried in Berlin. He regarded the air brake as more reliable. Herr von Leiber, speaking on behalf of the Austrian government supported the author's claims as regards electric brakes. In Vienna they had decided to adopt electric brakes.

M. S. Peiser, of Berlin, read a paper on "Heating of Cars," as practiced in Germany, including a stove for burning briquettes. He spoke of electric heating as expensive, but believed the subject of sufficient importance to warrant further inquiry into it by the union.

Mr. P. V. McMahon, chief engineer of the City and South London Railway, read a most interesting paper on "Underground Tube Railways." He made a comparison between the existing electric tube railways in London, and discussed the relative advantages of deep and shallow level tunnels, arguing in favor of the latter. At the opening of the City and South London Railway it was looked upon by Continental and American engineers as a fine piece of engineering. But it went on quietly carrying seven million passengers a year without any notice from the general public and the press until the Central London Railway was opened, and then it was rediscovered. It paid a dividend from the start. Separate locomotives have many advantages over the system in which the motors are fixed to each car. They tried a motor car train several years ago on the City and South London line. It gave greater seating capacity for the same weight, and the coal consumed per passenger carried was slightly less, but unnecessary time was lost at terminal stations, due to the driver and assistant having to change positions from one end of the train to the other. More spare carriages are required, and sidings have to be larger. If one compares the continuous-current system on the City and South London with the Central London three-phase system it is seen that less has to be spent in copper. In the Waterloo and City Railway the generating station is at Waterloo, operated on the two-wire direct system at 500 volts. There are no elevators, and motor car trains are used. For heavy traffic four-coach trains are run. The front and rear carriages have two motors on the leading and trailing bogies; they carry 46 passengers each, while the two intermediate carry each 56 passengers, making a total seating capacity of 204 passengers. The normal rating of motors is 42 b-hp—that is, 70 to 100 amperes at 500 volts. These are run for three and a half to four hours in the morning. The total weight of train is about 100 tons, and the time taken between stations is five minutes, the average speed being 18 miles per hour. For light loads single motor cars are run, weighing 26 tons, and make the journey in four minutes, speed 22.5 miles on the average. They ascend the 1 in 60 gradient at 30 miles an hour. The coal consumption is 5 pounds per kw-hour. The number of passengers in the half year is two and one-half millions. On the Central London Railway current is generated at 5,000 volts, and reduced to 550 at the line. Each train consists of seven carriages on eight-wheeled bogies, weight unloaded 98 tons, and the seating capacity 336. Locomotives are used, but motor cars are being made. Each locomotive is 117-hp. The maximum current at full-load is 1,200 amperes for each locomotive, and its weight is 44 tons. The passengers carried for half year are 20,802,650. Mr. McMahon's road is operated on the 5-wire system, continuous current, whose efficiency he compared favorably with that of the alternating current method. The locomotives have two gearless motors, weighing 13.65 tons; or a fully loaded train 49.8. He presented several curves, and some data as to high acceleration.

Storage battery traction came up in one of the discussions and fared rather badly. Herr Köhl described the battery system in Hanover as absolutely ruinous, and said that both in Hanover and at Hagen accumulators had been given up. M. Thonet, of Liege, said that, although the horse tramways at Dunkirk had been worked for nineteen years and paid a good dividend, when accumulator traction was adopted the concern soon became a losing one. The batteries only lasted five months, there were numerous stoppages, and, as a result, traffic was disorganized. Several other speakers condemned the battery system, including Messrs. Koehler, Bonevin, Lavalard and Von Leber, and a resolution was passed condemning the use of storage batteries in street railway work.

Tributes to the Memory of Mr. Mackay.

Special meetings of the officers and directors of the Postal Telegraph Cable Company and the Commercial Cable Company, for the purpose of taking suitable action upon the death of John W. Mackay, president and director of both companies, were held in New York City on July 25. The Commercial Cable meeting was presided over by Mr. A. B. Chandler. The Postal Telegraph Cable meeting was presided over by William H. Baker, vice-president and general manager of the Postal Telegraph Company. Resolutions were passed relative to the death of Mr. Mackay, and brief speeches were made by several present, many of whom had been intimately associated with Mr. Mackay both in business and socially.

A part of the resolutions passed by the Commercial Cable Company was as follows: "In making this record this board desires to record also its high appreciation of the surpassing merit of Mr. Mackay as a man, a citizen, and a friend, as well as in his capacity of chief officer of this company. We recognize that the existence of this company is due to his foresight, his courage, his ability, and his generosity. We believe that no other man would or could have created a telegraph system of such wide extent and such merit under the great oceans and throughout our vast continent in the midst of such difficulties and discouragements as have surrounded those enterprises almost from their inception. We feel the loss of his command, his counsel, and his friendly and encouraging presence as a personal affliction to each one of us, and we know that this feeling exists among all officers and employees throughout the service."

The directors of the Commercial Cable Company are: Edward William Hawley, James Gordon Bennett, Cardner G. Howland, Col. William Jay, George G. Ward, Sir W. C. Van Horne, Edward C. Platt, W. Seward Webb, Lord Strathcona, Charles R. Hosmer, Thomas Skinner, Clarence H. Mackay, Albert B. Chandler, Dumont Clarke.

In the course of the resolutions of similar effect adopted by the Postal Telegraph Company, the following graphic passage occurs, in regard to its late president:

"He was honest, his name being a synonym for honesty. He was just, wronging no man. He was generous, ever aiding the needy. He was far-seeing, judging correctly men and affairs.

He was humble, seeking no place above his fellows. He was ambitious, striving not to gain honors, but to do good. He was courageous, knowing no fear. He was patient, waiting with confidence for the fruition of his labors. He was strong, bearing adversity with fortitude and prosperity without pride. He was righteous, fearing God and loving his fellow-men. Fortunate in unlocking, by persistent endeavor, the treasure house of Nature, he used his vast wealth wisely. Great in simplicity, earnestness of purpose and fidelity to principles of right, he compelled the admiration and won the love of those who knew him."

The officers and directors of the Postal Telegraph Cable Company are: William H. Baker, Edgar C. Bradley, George G. Ward, C. H. Mackay, A. B. Chandler, Edward C. Platt, George Clapperton, Sir W. C. Van Horn, Charles R. Hosmer, James W. Ellsworth.

A cable dispatch from London announces that the Pope has granted Mrs. John W. Mackay special permission to hold private services over the body of her husband. A memorial service for Mr. Mackay will be held in the Church of St. Peter and St. Edward, Buckingham Gate, during the present week. Quantities of floral tributes are daily received at the Mackay home. Among these was a five-foot column of asters, with a broken cable of steel-colored flowers, with the words "Atlantic and Pacific" at the base. The Postal Telegraph Company sent a handsome cross. Among the many who have called at the Mackay house, or who have sent messages of condolence are Charlemagne Tower, United States Ambassador to Russia, and Mrs. Tower, Lord Strathcona, and Mount Royal, Canadian High Commissioner in London, and Lady Strathcona, James Gordon Bennett, Baroness de Reuter, Nikola Tesla, George Gould, Dr. Seward Webb, of New York; Princess Louise, United States Ambassador Choate.

In an anecdotal contribution to the New York *Times*, Mr. H. Allaway, who has met all of the financial celebrities of his time, says: "In Mr. Mackay's career nothing was ever attempted with enthusiasm beyond that which he had in his ambition to establish the Pacific cable. Over seventy years old, he still could foresee and plan and hustle. Why not put his capital into some less extraordinary enterprise? Why the part of the Pacific cable pioneer? Easily answered, such conumdrums, he said: 'I don't want to bother with railroads, and be bothered by them. But I am obliged to invest the capital. So I've decided to put the money into something where they can't be holding me up forever on rights of way and town taxes—put the money where they'll have to swim to get it.' There be land-lubber financiers who can appreciate this Mackay philosophy."

Mr. Chandos Fulton, in the same journal, says: "When asked to select his office in the Postal Telegraph Building, Mr. Mackay, as soon as he had entered the room on the southern corner, decided on that, giving directions that his desk should be placed as he indicated, affording a view over the City Hall Square down into Frankfort street. 'From this window,' he said, 'I can see the site of the house in which I lived as a child before I dreamed of going to the Coast, or ever amounting to anything.'"

Reported Change From Steam to Electricity of Ohio Railroad.

A report that the Appleyard syndicate has secured the lease of the Cincinnati, Lebanon & Northern Railway, a steam road operated by the Pennsylvania Company, has been both confirmed and denied in financial and traction circles. The Appleyard syndicate has been seeking an entrance to Cincinnati from Lebanon to complete the line now practically complete from Columbus to Lebanon. The steam road is in fine condition, and the electrical equipment could be installed so that the through line could be in operation this year. The acquisition would afford fine terminal facilities in Cincinnati, and make the syndicate independent of the Cincinnati Traction Company. In steam road circles the reported lease is discredited, as it is claimed the Pennsylvania some time ago placed a price of $8,000,000 on the property, which is figured to be almost prohibitive for traction purposes. The Appleyard syndicate has opened offices in Cincinnati, and it is stated that Cincinnati and Boston banks are about to arrange for a consolidation of all the Appleyard interests between Columbus, Dayton and Cincinnati.

Recent Progress in Electrochemistry.

By Clinton Paul Townsend.

BAKING CARBON ELECTRODES.

Mr. Charles M. Hall, of Niagara Falls, describes the following disposition of apparatus for baking carbon electrodes, particularly such as are intended for the electrolytic decomposition of fused baths, as in the production of aluminum. The carbons are arranged horizontally or vertically, and in one or several rows, around the carbon core and within the masonry walls of a furnace, the carbons being insulated not only from the core, but from one another by means of a refractory and non-conducting powder such as bauxite, purified alumina, magnesia, etc. Upon the passage of a suitable current through the core, the carbons are brought to a temperature of 3,000 or 4,000 degrees Fahrenheit, the interposed insulation guaranteeing against the diversion of notable quantities of current through the carbons themselves. Data are given as follows: A core four or five feet in length and twelve by thirty inches in cross sectional area requires to have developed therein 400 to 500-hp by an alternating current of 35 to 50 volts.

The conducting core is preferably of granular charcoal or coke, but the inventor suggests also the employment, as a heating resistance, of a fused electrolyte, in which case the baking of the carbons becomes an additional feature of the exceedingly interesting method of purifying bauxite by the reduction of its impurities heretofore fully described. De Laval has employed the heat developed in a fused electrolyte for producing a useful effect, as in the superheating of metals or even the smelting of ores, but the method here described is unique in its utilization of both the electrolytic and thermic effects of the current.

The disposition of parts calls to mind the recently described method of Acheson for graphitizing carbons by arranging them in piles, separated by powdered carbon, between the circuit terminals. As a matter of fact, however, the relation of the fusing point of any available insulator to the temperature required for graphitic transformation would probably render any application of the method to the latter purpose impracticable; the actual analogy is rather with certain early methods for the carbonizing and baking of lamp filaments and arc carbons.

MERCURY CATHODE CELL.

James Mactear, of London, patents a new cell belonging to this highly developed type. The essential features are the provision of an anode bell, the lower edges of which rest in grooves upon a plate which in turn rests upon the bottom of an external chamber containing water; this plate is further provided with a central well, and with radial grooves in its lower face, which afford passages for the circulation of mercury, means therefor being provided in the form of a rotary propeller within the well. In operation the inner cell is filled as usual with a solution of brine, and the mercury is flooded outwardly, passing beneath the anodes and through the groove which operates as a seal between compartments, then to return by its own gravity through the radial grooves to the well. There is little probability, however, that any construction of this type will displace the rocking cell of Castner.

IRIDESCENT COATING FOR COPPER ARTICLES.

A patent to Duncan Sinclair, of Coalbrookdale, England, deals with a method of forming brilliant and variegated surface colorations upon metals, through the agency of electrolytic deposits. This method, which is most simply operated by connecting the article to be coated as the anode in an alkaline solution of litharge, and carefully regulating the current, depends upon the deposition of exceedingly thin films of lead peroxide; such films give most brilliant interference effects resembling the changing tints in a soap bubble, and being, in fact, attributable to the same optical phenomena. Articles so colored have found much favor, especially in France, since the early days of galvanoplastics. Mr. Sinclair's improvement consists in adding to the alkaline lead solution a small amount of a salt of copper, concerning the effect of which the specification is silent. The claims, however, state that copper enters into the anodic deposit, and the record of the case shows it to be the inventor's belief that this metal, like lead, may separate at the anode—a statement which will scarcely command the assent of electrochemists. On the other hand, it is well known that in the electrolytic separation of cobalt from nickel the presence of copper in the solution is of great assistance in controlling the current and securing a slow and even deposition of the peroxid. Without doubt this is the function performed by the copper salt in the present case.

Tests of Cotton Mill Electrical Equipment.

Some interesting tests of economy in the use of electric power in otton mills have recently been made at Columbia, South Carolina, n what is known as the Olympia Mill. This plant, which has only reently been completed, has been operated but a comparatively short eriod, and is somewhat notable for the reason that its machinery is ot only driven by electric power applied directly, but that it contains

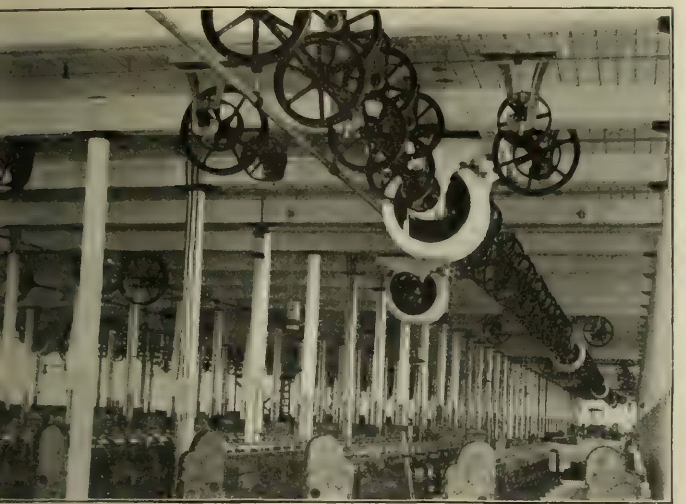


FIG. 1.—OLYMPIA MILL SHAFTING.

he largest number of spindles under one roof of any similar mill n the United States. In designing this mill, the engineers, Messrs. V. B. Smith Whaley & Co., of Columbia, were given *carte blanche* o install any system of power which they deemed most effective, nd at the same time economical. After calculating upon the extent f the equipment and the probable service required, as well as the ocation of the plant, it was decided to install a series of motors n both the spinning and weaving departments, in place of rope or elt-driven machinery. The complete equipment of the mill is 04,000 spindles and 2,400 Draper looms, in addition to apparatus for naking print cloth. At present about 85,000 spindles, 1,550 looms nd supplementary machinery are being utilized, and with this equipment the tests were made. The electrical plant is General Electric hroughout.

The spinning motors, as they are termed, are of 150 hp each and 575 to 580 volts; the three-phase, 40-cycle system being employed with a drop between the motor and switchboard of 1 ½ per cent. Each spinning motor serves 38 frames, or a total capacity of 10,032 spindles. The driving motors in the weave rooms are of 150 hp, for serving the complement of looms in operation. As will be noted in the accompanying illustration, the motors are su-pended to the ceiling in the various departments in such a manner that belting and ropes are entirely avoided, while it is calculated that the waste of power is reduced to a minimum by the insulation and connections between the motors and other machinery.

The tests, which were made under the supervision of Mr. J. K. W. Davenport, electrical engineer of the Whaley Company, have been tabulated and give the following results:

With one section of 38 frames, the power in kilowatts required was 140, each kilowatt corresponding on an average to 81.8 spindles. Operating a series of 28 frames, 107 kilowatts are required, an average of 83.4 spindles per kilowatt. With 18 frames, 76 kilowatts are required, an average of 82.2 spindles, while with 8 frames, 44 kilowatts are required, an average of 75.7 spindles per kilowatt. The tests showed that one horse-power thus applied would furnish sufficient power for 68 spindles. The result of loom operation showed that with 638, 154 kilowatts are required, equal to 5.1 loom per kilowat, or 3.8 to one horse-power. To operate 549 looms, 136 kilowatts were required, equal to 5.3 looms per kilowatt, or 3.9 per horse-power. In all tests of the looms, ranging from the larger number, 638, to 45, proportionate results were obtained, in the case of the smallest series 46 kilowatts being required, or an average of 5.6 looms per kilowatt and 4.2 looms per horse-power.

From these tests the average is 68 spindles, or 5 looms per horse-power, while the mechanical and electrical losses or waste in conducting the current from the switchboard to the spinning frames is estimated at 12 per cent., and to the looms at 20 per cent.—an average loss of power of the equipment of 14 per cent. Compared with modern rope-driven machinery, the engineers estimate this to be from 11 to 17 per cent. less than where the former system is installed, while it is 25 per cent. less than in the case of power transmission by belting.

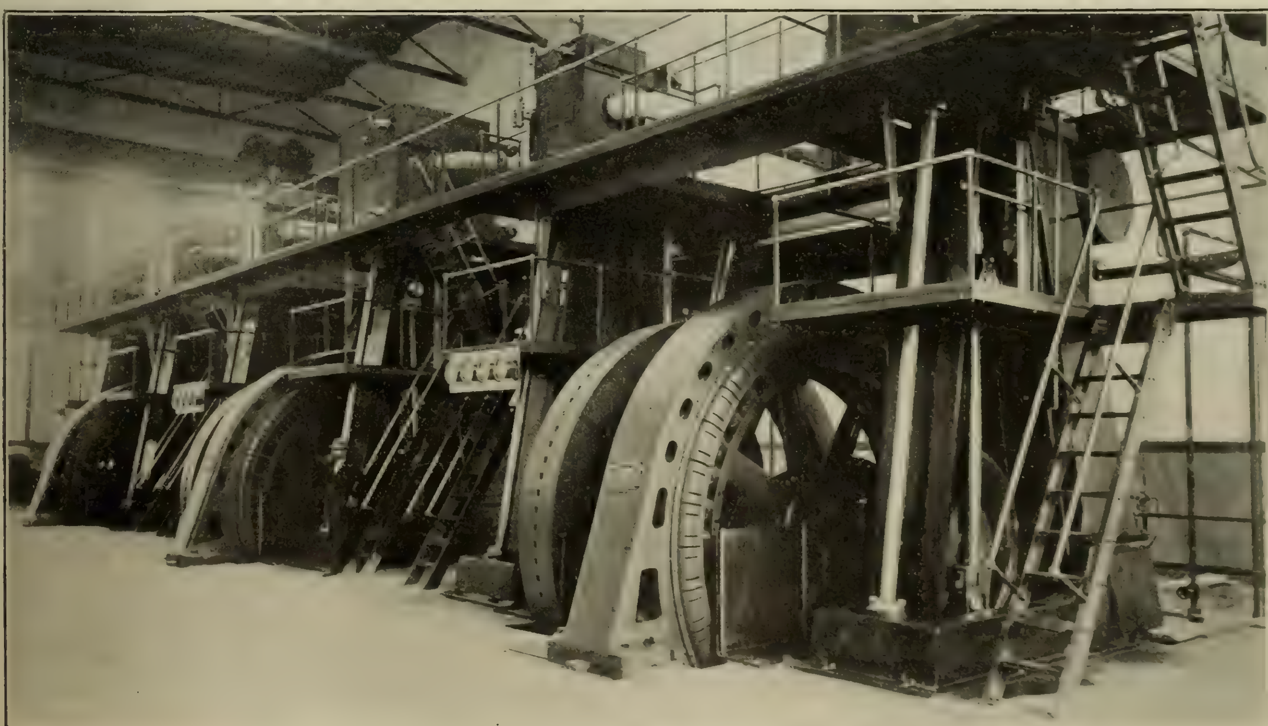


FIG. 2.—OLYMPIA POWER PLANT.

These calculations bear out statements made by other electrical engineers who have studied the application of power, especially in Southern cotton mills. Mr. H. H. Vreeland, president of the Metropolitan Street Railway Company, who has made several visits to the South and investigated the various systems of power, some time ago made the prediction that the larger mills, if electrically equipped could be operated at a saving of fully 25 per cent. compared with steam or water power transmitted by shafting and belting.

Distribution of American Exports.

A series of tables, compiled by the U. S. Treasury Bureau of Statistics, show that during the year 1901 52 per cent. of the manufactures exported went to Europe, 23 per cent. to North America, 6.6 per cent. to South America, 8.2 per cent. to Asia, 7 per cent. to Oceania, and a little less than 3 per cent. to Africa. The total value of manufactures exported to Europe was $215,000,000, to North America, other than the United States, $96,000,000; to South America, $27,000,000; to Asia, $33,700,000; to Oceania, $29,000,000, and to Africa, $10,500,000. Of the total exports of manufactures to Europe, amounting to $213,000,000, the largest item was iron and steel manufactures, to the value of $43,812,323, the next item in order of magnitude being copper manufactures, $41,454,074; scientific instruments, $3,840,763; cars and carriages, $3,718,381; india rubber manufactures, $2,187,453. To North America the largest item in the exports of manufactures was iron and steel, $43,518,293; cars and carriages, $3,577,765. To South America, iron and steel exports were $8,754,800. To Asia, oils, refined or manufactured, formed the largest item, $12,443,128, the next largest items being iron and steel manufactures, $8,992,967. To Oceania, the principal manufactures exported were iron and steel manufactures, $8,871,602. To Africa, iron and steel manufactures formed the largest item, $2,368,635, and cars and carriages, $543,674. Of the $117,319,320 worth of iron and steel manufactures exported, $43,812,323 went to Europe, $43,518,993 to North America, $8,992,967 to Asia, $8,871,602 to Oceania, $8,754,800 to South America, and $2,368,635 to Africa.

Water Power in Arizona.

Arizona, the dryest state in the Union, strange as it may seem, has several large and very important water power projects under construction. Lack of rain in the southwest serves as a great hindrance to development of water storage and developments in water power. In the Salt River Valley the towns of Phœnix, Tempe and Mesa are lighted with electricity, generated by small falls in the valley's canal systems. Sixty miles southeast of Prescott, on Fossil Creek, work has begun on a scheme that is destined to develop 2,000 horse-power, to be used mainly in the mines of central Yavapai County. A great power project is in incubation, based upon the damming of Bill Williams Fork, in extreme western Arizona. The new dam that is to store flood waters for the use of the Salt River Valley is to be built largely with the aid of water power, and a few miles above the reservoir it will supply power for a 3,000-hp transmission line to Globe and other central Arizona mining camps. This plant is being built by C. M. Clark.

The Grand Canyon of Arizona affords the greatest field for electricity generated by water power. Below the new Santa Fé Hotel, on the canyon brink, are Indian Garden Springs, which, in ordinary seasons, have a flow of nearly 100 miners' inches, that can be thrown over a cliff 3,000 feet high. In Cataract Canyon, the stream of flow usually approximating 10,000 miners' inches, makes three great leaps of 70, 144 and 250 feet, respectively, without reference to several thousand feet of drops from the Indian villages to the Colorado's channel.

Many plans have been mooted for developing the marvelous power of the Colorado, a stream which rises as much as 100 feet in flood time within the canyon. Floats equipped with great paddle wheels have been suggested, but it is probable that the river will some day be harnessed by means of tunnels that will "pick up" the fall of the stream. One such tunnel, at a point near Bass's Trail, and not over half a mile in length, driven through black granite, would cut off 12 miles of river channel, averaging not less than 12 feet of fall to the mile.

Dr. A. J. Chandler, of Mesa, Arizona, is engineering the latest Grand Canyon power plant. Dr. Chandler is the manager of the southwestern interests of Bowen & Ferry, the Detroit capitalists, and has made a success of a power generating plant near Mesa. He has found an ideal location for power generating works on the Kanal, Wash., not far from its union with the inner canyon of the Color. do about 70 miles north of Williams. It is stated that even 5,000 feet of fall can be found in a distance a little over a mile. The water supply is said to be ample and of remarkable regularity of flow. The only question seems to be that involving the carriage of the necessary heavy machinery down into the canyon and across the river, unless it be hauled southward from some Utah railroad point and lowered over the precipitous cliffs.

CURRENT NEWS AND NOTES.

CHICAGO DRAINAGE CANAL POWER.—The sanitary district board have ordered Chief Engineer Randolph to resume immediately the work of developing water power caused by the flow of the water in the sanitary district channel from the Chicago drainage canal at a point below Joliet. He is ordered to construct a dam and other works necessary to secure full control of the water power created at Hickory Creek.

ANOTHER TELEGRAPH TYPEWRITER.—A telegraphic dispatch from Utica, N. Y., of July 25, says: "About five years ago Charles E. Yetman, a Western railroad telegraph operator, conceived the idea of an attachment by which, while simply manipulating the keyboard of a typewriter as in ordinary typewriting, a message, mechanically correct, could be sent over telegraph wires. Mr. Yetman has become connected with the Remington Typewriter Company at Ilion, and it has decided to manufacture the invention, which he has just perfected. The machine will consist of a typewriter and telegraph instrument combined. The latter will be so arranged that by striking a key on a keyboard the Morse letters are made plain and accurate. Short wires connect the machine with the telegraph wire. The new machine has been tested on long and short lines, and operators pronounce it perfect. The Associated Press, it is alleged, will equip all of its offices with the Yetman machine, and arrangements have been made by the company's chief operator for a large number of machines.

MARCONI AND HIS CRITICS.—The jingo warfare in England against Marconi does not appear to relent. Mr. Henniker Heaton in a letter to the London *Times* recently ventured to defend the young inventor from the reproach of not being of English birth, saying, "I do not care if Mr. Marconi were found to be a full-blooded Huron or Liberian. The fact remains he has devoted his youth to working for England." He also remarked that Prof. Lodge's wireless telegram sent 200 yards compares poorly with Marconi's sent 2,000 miles. A friend of the knightly claimant replies through the same columns, asking, "Which of the two was the first to send a wireless telegram? Was it Lodge in 1894, or Marconi in 1896?" It would thus appear that the claim of Lodge to the coherer has been retired, and that he now rests on the futile laboratory experiment of 1894 as entitling him to the honors and emoluments of the art created by Marconi. A statement has also been circulated by Prof. Lodge's friends that Marconi had falsified as to the apparatus which he used in Newfoundland, the assertion being made that he employed a receiver invented by Solari. When the attention of Marquis Solari was called to this, he authorized the New York *World* to make the following statement: "*Saturday Review* was not correct; Newfoundland reception of signals from Cornwall was obtained independent of the use of the Solari coherer." What appears to be another incident of the warfare was the subject of sensational cable despatches to the New York papers of last Sunday. It was stated that Signor Marconi had applied for leave to amend an application for a patent so as to change it into an application for a patent communicated to him from abroad by Marquis Luigi Solari. Some of the London despatches interpreted this as an admission by Marconi that his entire system was invented by another. In the absence of details, it can only be surmised what amendment Marconi asked leave to introduce in the patent application. It appears, however, that there has been a heated controversy in Italy concerning the invention of a certain form of coherer. By some the invention of this coherer was attributed to one Castelli, a corporal in the Italian Navy, and by other to Marquis Solari, an officer in the same navy. In the concluding portion of Marconi's paper before the Royal Institution, as printed in our issue of July 12, there is reference to this dispute. Mr. Marconi said that the coherer was brought to him by Lieut. Solari, but that recently the invention was claimed by a signalman in the Italian Navy. He, therefore, wrote the Italian Minister of Marine, asking him to make an authoritative statement on the subject, and the following was the reply received: "The coherer has been with good reason baptized with the name of 'Italian Navy Coherer,' as it must be considered the fruit of the work of the various individuals in the Royal Navy and not that of one." In consequence of this authoritative statement, Mr. Marconi in his paper refers to the instrument as the "Italian Navy Coherer." It is possible that the controversy above-referred to may have some bearing on the amendment which Mr. Marconi asked to have made in his patent specifications.

LONDON'S WIRES.—Some people think of London as a city f underground wires. It is stated that there are 10,000 miles of verhead telegraph wires there. The number of telegraph messages eceived in London last year was over 6,000,000.

THE THUNDER STORM.—In the letter by Mr. A. G. Dell, entitled "The Thunder Storm," printed in our issue of July 12, two rrors appear in proof-reading. In the sentence, "The storms are enerally absent when the wind is from between the north and south n the Eastern states," the word "states" should have been "parts." n the sentence, "It is evident to my mind that heat, an initial charge, nd a stratum of some kind are necessary for their production," the vord "stratum" should have been "rotation."

A "CAR AHEAD" ORDINANCE.—Mayor Low, of Greater Jew York, has approved a second ordinance to stop the practice f compelling passengers to take the "car ahead" at certain times nd points. A former resolution was held illegal, as it was not tated where the destination signs were to be placed. The ordinance rovides that all cars shall have in plain view a sign denoting the estination, and that it shall be a misdemeanor to fail to run to such estination or to compel a passenger to take the "car ahead."

TELEGRAPHY IN ALASKA.—The government telegraph wire rom Dawson to Ashcroft, making connection through the Canadian Pacific and other lines to the outside world, has been down most of he time since the latter part of May. The trouble has been chiefly rom spring freshets taking down trees and banks and allowing the vires to fall. In many places storms have blown trees over the vires. The government will put a land cable over the most difficult nountains when snow begins to fall. It is desired to delay until that ime so that rodents will not gnaw the insulation. In the cold weather ast winter the wire was kept up well and worked most of the time fter the fall trouble. The difficulties in the autumn were mostly outh of Atlin, but at the present time are along the Yukon proper s well as to the southward in the wilderness of 1,800 miles to Ashroft.

TELEPHONE EXCHANGE ON STILTS.—The exchange of the Youngstown (Ohio) Telephone Company, which has been on stilts or many months, while the building below was being rebuilt, has been owered and now rests on the new block. The entire work of raising he top of the building, rebuilding the portion below and finally lowring the exchange portion into place, was effected without in any vay interfering with the every-day operation of the exchange. The ask of lowering the building was effected by huge screws. A trestle vork of timbers resting on the steel beams of the second floor was uilt around the office, and into the top of this trestle were placed ong bolts which were fastened into timbers extending under the office. The bolts were screwed up tight and held the office in place while the oncrete floor was being laid to receive the exchange. When this vas completed the work of lowering the suspended building was ffected by simply unscrewing the large bolts.

HELPING A FELLOW-WORKER.—A rather good, or bad, tory has recently been told, says *Cassier's Magazine* for August, llustrating the arrogance, ignorance or whatever it may be called of he executives of some of the trade unions in dealing with their nembers. It appears that while a workman was engaged in guiding a cable into a conduit in a building that was being wired, his ngers were caught between the cable and the walls of the conduit. The men at the far end of the conduit, unaware of their comrade's light continued to pull upon the cable, seeing which an apprentice ad ran to his assistance and pulled back on the cable. A delegate f the union who had witnessed the affair and had expressed sympathy for the sufferer, reported him for violation of the rules of he order, and the latter was called to executive headquarters to explain his conduct. Notwithstanding that his fingers bore evidence o the extent of the accident he had undergone, he was fined "for llowing an apprentice to do helper's work, to wit, assisting a ourneyman drawing wire into conduits."

SWEARING BY TELEPHONE.—At St. Louis, Mo., last week, Dr. Gettys, the physician, who was arrested for swearing through telephone at a "central" operator, was given a spectacular trial in he police court, and at the conclusion fined $5 and costs by Judge Sidener. In giving his verdict, the court decided three unique points f law: First, Judge Sidener decided that profanity has no sufficient provocation. Profanity, he declared, is always aggressive, never protective, and is, therefore, never excusable by the plea of self-defense. The working principles of the law, it was further declared, have not been materially changed or invalidated by modern inventions; that crimes or offenses committed at long distance, such as the hurling of oaths at a person in another jurisdiction by means of the telephone, are amenable to the laws in the jurisdiction in which the offense is consummated. Dr. Gettys, in court, admitted the offense charged. "Did you swear over the telephone?" he was asked. "Yes, sir, I did. I cussed the system, not the employes." The court held that Dr. Gettys, on his own testimony, was guilty of using abusive language, and inflicted the fine of $5.

PROVIDENCE AND WORCESTER TROLLEY.—Another trolley, parallel to existing steam service, is being planned between Providence and Worcester by the Providence & Worcester Street Railway. The route will as nearly as possible form an air-line, making its length 40 miles; the only existing tracks that it will use will be those of the Union Railway, of Providence, and the Worcester Consolidated in securing an entrance into Providence and Worcester. The necessary franchises and locations in the towns traversed have been secured, and the remaining preliminary work is the securing of charters from the next Massachusetts and Rhode Island legislatures. The former charter is expected to be secured without difficulty, but in getting the latter the active opposition of the New York, New Haven & Hartford is already felt, in similar manner to the experience of the New York & Portchester line. The electric road will compete with the Worcester division of the New Haven under conditions disadvantageous to the latter. The distance on the latter is 50 miles, on account of a deflection to Woonsocket, against 40 miles on the trolley road; the running time of 1 hour and 45 minutes will be but 15 minutes faster, and the fare is $1.20, against 5 or little more cents for the electric line.

AUTOMATIC TELEPHONES IN FRANCE.—A special cable dispatch from Paris, of July 28, says: "After exhaustive tests the French government has adopted the automatic telephone invention of a Russian engineer. The apparatus does away with "Central" girls. The subscriber turns five disks, each numbered from 0 to 9, to form the number wanted, whereupon the correspondent is called automatically. If he is absent a sign soon appears saying: "Rang one minute; no answer," while the caller's number is registered at the other end, so that he may be called after the person sought returns. When the number desired is already "busy," a special buzz is immediately heard. In order not to dismiss all the telephone girls together, which might disturb the labor market, the new system will be introduced gradually. Three towns of moderate size are being equipped now—Limoges, Nimes and Dijon. A strange light is thrown on French methods by the fact that the apparatus would have been adopted two years ago if the police side of the government, which has always found the telephone exceedingly useful, had not insisted that secret conversations should be audible to a third party when desired."

NEW YORK STREET SIGNS.—President Cantor, of the borough of Manhattan, has been able to advertise for bids for the erection of street signs in New York, after a delay of considerable time. The Board of Estimate, after a discussion lasting several months, appropriated money for the signs. Then the president had to make the specifications, which were sent to the office of the corporation counsel. There they were either mislaid or lost, as they could not be found, and a new advertisement had to be drawn up. The bids will be opened on Wednesday, August 6, at 11 A. M., in the president's office. There are three contracts advertised. They are: (1) For furnishing and erecting and maintaining for three years 6,000 dark-blue enamelled metal street signs with clear-cut conspicuous white letters; (2) for furnishing, erecting and maintaining (without lighting) for three years on existing lamp-posts, fire-alarm posts, electric light poles, 1,200 sign boxes of two patterns, one for electric light and the other for gaslight, and (3) for furnishing, erecting and maintaining (without lighting) for three years, on existing poles and posts, 2,000 street sign boxes with a reflector attachment, the sign to have a reflector, deflector and radiator attachment. The specifications say explicitly that the signs become the property of the city, and the prices must include maintenance for three years. The sureties required are $2,000, $6,000 and $10,000, respectively.

TRACTION IN LONDON.—A cable dispatch received last week from London says: The bills affecting the Morgan and Yerkes underground railroads in London have been passed to a second reading by the House of Commons. The House of Commons has passed the bill authorizing J. P. Morgan's London United Electric Railways. Mr. Yerkes opposed the bill.

WIRELESS IN THE NAVY.—The U. S. Navy Department having decided to equip the fighting ships of the American Navy with a wireless system of telegraphy. Within a few days a board, consisting probably of five members, will be appointed to investigate the whole subject, to decide upon the system to be installed and to work out plans for the education and training of men to operate it aboard the ships.

MARCONI TOWERS AT CAPE BRETON.—The towers at Table Head, Cape Breton, were formally taken over from the building contractors on July 16th by the Marconi Wireless Telegraph Company. Everything in the matter of erection is now completed, and the wire work connections between the tower caps and the operating room are being installed by the electricians. The receiving apparatus is already in operation, and when the wire connections are made the station will be ready for the transmission of messages. Table Head, as its name imports, is a small barren promontory rising abruptly from the sea to a height of about 70 feet. The site has been illustrated in these pages.

N. E. L. A.—Miss H. Billings, assistant secretary of the National Electric Light Association, reports the following new members added in the past two weeks: Electric Light & Power Company, Adrian, Mich.; Corsicana Gas & Electric Company, Corsicana, Tex.; Shiawassee Light & Power Company, Corunna, Mich.; Fond du Lac Street Railway & Light Company, Fond du Lac, Wis.; Franklin Electric Company, Franklin, Pa.; Southwest Missouri Light Company, Joplin, Mo.; The Kokomo Railway & Light Company, Kokomo, Ind.; Bailey Light & Water Company, Madisonville, Ky.; W. A. Nolt, Oconto, Wis.; Ottumwa Traction & Light Company, Ottumwa, Ia.; The Telluride Power Company, Provo, Utah; Andrew F. Hall, Southbridge, Mass. A pithy extract is also being distributed from a letter of Mr. Chas. E. Scott, treasurer of the Bristol, Pa., Electric Light & Power Company, giving his experience as to the benefits accruing to small companies from membership in such a body.

DISPUTE OVER NIAGARA POWER.—The Ontario government has heard a lengthy argument regarding the dispute that has arisen between the Ontario Power Company and the Canadian Power Company in regard to the use of the waters of Niagara for power development. The Canadian Company is installing a very large plant, and the Ontario Company wishes to enlarge its first proposal by getting 25,000-hp additional from an intake at Dufferin Islands. This is 3,000 feet from the Canadian Power Company's intake, but its engineers say they are not in a position to state whether or not the Ontario Power Company's intake will injure the flow towards their own until they see detailed plans. They accordingly asked the government to require the production of plans by the Ontario Power Company of the proposed intake at Dufferin Islands. The Ontario Power Company was represented by B. R. Paine, J. J. Albright, General Hayes and General Bissell, of Buffalo, and Z. A. Lash, of Toronto; the Canadian Power Company by William B. Rankino and the company's counsel, Mr. W. Nesbit. The government reserved its decision.

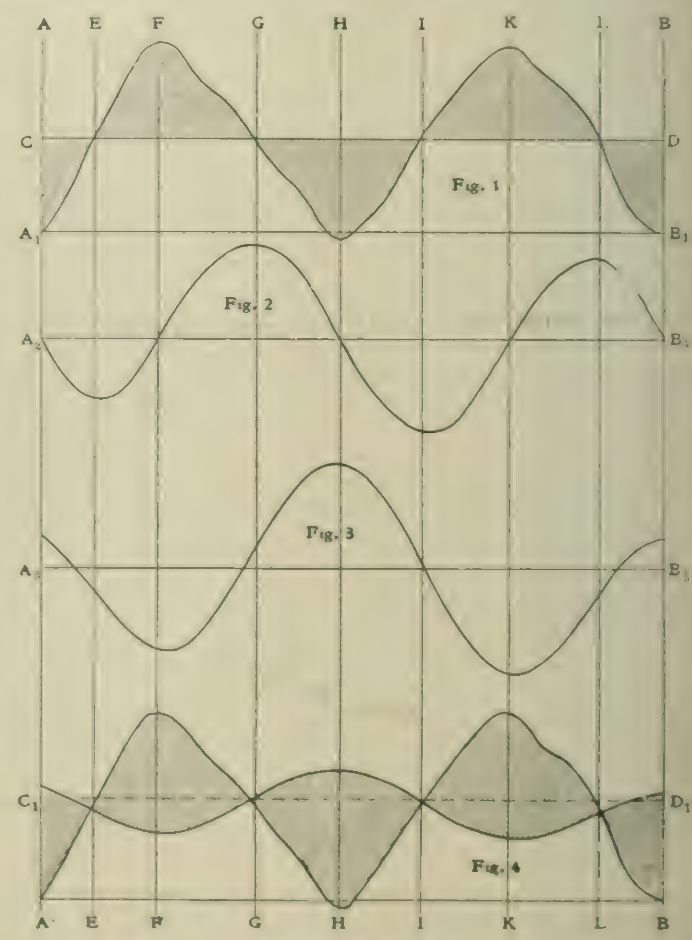
WIRELESS TELEGRAPHY AT SANDY HOOK.—Rear Admiral Rodgers and the naval board of which he is chairman, have selected a site for a government wireless telegraph station, on the Navesink Highlands, overlooking Sandy Hook. The tower is to be placed near the north beacon of the famous Twin Lights and close to the Postal Telegraph Observatory. This is the first land station selected by the Navy Department for sending wireless messages of an official character. The new tower will be of wood and entirely independent of the American Wireless Company's new tower, which is being built a short distance from the light-house. It is understood to be the intention of the Navy Department to have direct communication with the Brooklyn Navy Yard, as well as with vessels far out at sea, and if the experiment is successful wireless telegraph stations will be built for the government in several places on the East and West coast. The new station will contain all the latest improvements of Marconi.

Letters to the Editors

Paralleling of Alternators.

To the Editors of Electrical World and Engineer:

Sirs.—I read with great interest in your issue of March 31st, the abstract of Mr. H. E. Longwell's paper, "Paralleling of Alternators." In some respects I have quite the same opinion as Mr. Longwell, and a paper referring to "Paralleling of Alternators, Especially if Driven by Large Gas Engines," which I read before the Hanoverian Electrotechnical Society on January 23d, of this year, contains some paragraphs and figures which are nearly the same as those of Mr. Longwell.



LONGWELL DIAGRAM

I will add that it is impossible that Mr. Longwell had knowledge of my paper, for it was published in three parts, not earlier than the month of May, the 15th, 22d and 29th (*Elektrotechnische Zeitschrift*). But I am happy that Mr. Longwell comes to the same result as an electrical engineer handicapped by a "formidable array of mathematics, Greek letters and scientific terms."

I concede to Mr. Longwell that it is quite possible to understand without mathematics that the synchronizing force increases the angular variation in an engine. I showed the same with figures similar to those of Mr. Longwell, both with theoretical sinoidal diagrams of crank forces and with practical diagrams of steam and gas engines. But if one uses only these diagrams, the calculation of the total amount by which the synchronizing force increases the displacement is indeed, to use Mr. Longwell's words, "a tedious and somewhat involved process." But with a little "array of mathematics," and with a polar diagram of oscillating and damping, I was able to show that the total increase of the degree of irregularity, also the increase of the oscillating velocity and variation, and the resulting increase of the synchronizing force is:

$$\frac{1}{1-q}$$

where q is the proportion between the first synchronizing force and the oscillating force of the original crank-force diagram. If, in Mr. Longwell's Fig. 4, the curve, *C, D,* of the first synchronizing force is in a proportion

$$\frac{1}{10}, \frac{1}{5}, \frac{1}{3}, \frac{1}{2} \ldots .$$

to the original oscillating force of the curve, *A, B,* the total increase of irregularity, etc., is

$$\frac{10}{9}, \frac{5}{4}, \frac{3}{2}, \frac{2}{1} \ldots .$$

Therefore, I concede to Mr. Longwell that one must not ask the same angular displacement for alternators with different short-circuit currents. But one must also not ask the same variation from engines with different crank-force diagrams. A double steam engine must not have so great a variation as is allowed for a single steam engine, and the latter must not have the same as a two-cycle gas engine. A variation of 3 or 4 electrical degrees, which does not matter in a gas-driven alternator with a very great oscillating force in the crank-force diagram, and with a heavy flywheel, may give enormous trouble in an alternator driven by a twin steam engine with very low oscillating forces in the original diagram and with a light flywheel.

I cannot give here more particulars of my theory, but an English translation of my paper will soon be published in a London journal.

G. ROSENBERG.

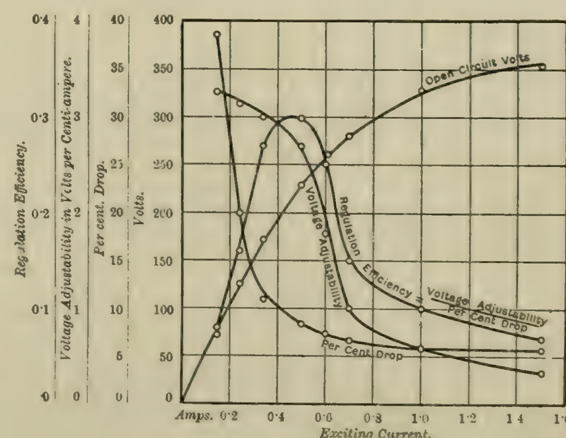
HANOVER, GERMANY.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Standardization of Machines.—In 1901, a special committee of the Association of German Electrical Engineers presented a report on the standardization of electric machines, with a proposed set of rules, as was duly noticed in the Digest. This set of rules was then adopted for one year on trial. The same committee has now presented a recent report, in which they propose some modifications of the former rules and also some new suggestions. They are reprinted in full, together with an explanatory article of Dettmar. Under definitions, it is proposed that by the simple term tension (spannung) of the three-phase currents should be meant the effective voltage between two of the three main conductors, while by the star tension or star voltage is to be meant the voltage between one wire and the neutral point. The transformer ratio is to mean the ratio of the tensions at no load. Frequency is to mean the number of complete periods per second. The old rules concerning the measurements of the rise of temperature have been modified in details; it is now required to determine it by measuring the increase of resistance in the following cases: in the field coils of direct and alternating-current machines, in the armature coils of single and polyphase alternators with stationary armature, also in the stationary part of induction motors. The temperature rise is determined with the thermometer in the armature of direct-current machines and converters, in the armature of alternators and synchronous motors with stationary field, in the revolving parts of induction motors, and in all coils of transformers. If nothing else is said, inductive voltage variation refers to a power factor of 0.8. As an appendix to the rules, a set of suggestions is given. The frequency should be 25 or 50. For the speed of single or polyphase alternators the following values are suggested: 75, 83, 94, 107, 125, 150, 166, 188, 214, 250, 300, 375, 500, 600, 750, 1,000, 1,500, 3,000; they correspond to numbers of poles between 2 and 80. For the voltage of direct-current system is suggested 110 for the motor, 115 for the generators; 220, 230, 440, 470, 500, 550; for the voltage of single and polyphase systems 110, 115, 220, 230, 500, 525, 1,000, 1,050, 2,000, 2,100, 3,000, 3,150, 5,000, 5,250. If one and the same direct-current generator has to give a higher voltage at constant speed, this can be accomplished by increasing the excitation, if the power is not increased; generally the increase of voltage, thus accomplished, should not be more than 30 per cent. of the normal voltage; a greater increase of voltage is to be obtained by increasing the speed. If one and the same direct-current dynamo has to give a lower voltage at constant speed, this can be accomplished by decreasing the excitation, as long as the power is diminished in the same ratio as the voltage; generally, the decrease of voltage thus accomplished should not be more than 20 per cent. of the normal voltage; a further decrease of the voltage is to be obtained by decreasing the speed. If one and the same direct-current generator has to give at times a lower, and at times a higher e. m. f. than the normal e. m. f., this can be accomplished by changing the excitation as long as, at the higher voltage, the power is not increased, and that at the lower voltage the current is not increased, and that the difference between maximum and minimum voltage is not more than 45 per cent. of the latter. Further variations of the voltage are to be accomplished by variations of the speed.—*Eelk. Zeit.*, June 5.—At the annual meeting of the Association of German Electrical Engineers the report of the committee and the set of rules were accepted for one year on trial. Next year the committee will report again, and if the rules have proved satisfactory in practice, they will be definitely adopted.—*Elek. Zeit.*, June 26.

Normal Saturation of Alternator Fields.—BEATTIE.—An article on the definition of the "normal saturation" of an alternator field. An alternator is considered good if it has a small percentage voltage drop and high voltage adjustability, but bad if it has a large percentage drop and low voltage adjustability; the voltage adjustability meaning the capability of varying the terminal pressure by altering the exciting current. It is, therefore, reasonable to take the ratio of the voltage adjustability to the percentage voltage drop as a measure of the "regulation efficiency" of the machine. In general, this regulation efficiency is low at low degrees of saturation as well as at high, and for some intermediate saturation will have a maximum value. He suggests the adoption of that degree of saturation which makes the regulation efficiency a maximum, as a useful working definition of normal saturation. He gives the result of a test of a small alternator for experimental purposes. They are given in the adjoining diagram. The curves show how the regulation efficiency reaches a maximum with an exciting current of



SATURATION OF ALTERNATOR FIELDS.

0.45 ampere, which is, therefore, the current required to produce normal saturation. The corresponding normal voltage and normal voltage drop are 210 volts and 9.2 per cent., respectively. The regulation efficiency as thus defined does not form, of course, a strict basis for the comparison of the regulating qualities of different machines, but it is a very convenient way of expressing the degree

of saturation in a given machine. Thus from the curves one may say that with an exciting current of 1 ampere the machine is oversaturated to such a degree that the regulation efficiency is reduced to one-third of its maximum. He says it would be interesting to know exactly the degree of oversaturation at which modern alternators are generally worked.—Lond. *Elec.*, July 11.

REFERENCES.

Armature Reaction and Voltage Drop in Dynamo Electric Machines.—PICOU.—An illustrated paper read before the International Society of Electricians, in Paris. For the predetermination of the voltage drop in alternators, Behn-Eschenburg, Rothbert, Blondel and Potier have developed different methods. The present author co-ordinates these different methods, by connecting them more intimately with the theory of magnetic circuits; he thus obtains a generalization which permits the application to direct or alternating-current machines as well as to transformers. The paper is long and highly theoretical and cannot well be abstracted here.—*Bull. Soc. Int. des Elec.*, June.

Compound Alternators.—BOUCHEROT.—His very long illustrated paper in full, on his system of compounding alternators, read recently before the International Society of Electricians, in Paris. An abstract of the paper was noticed recently in the Digest.—*Bull. Soc. Int. des Elec.*, June.

Elimination of Harmonics in Alternators.—GUILBERT.—A mathematical article. For eliminating the higher harmonics in the e. m. f. waves of alternators, methods have been suggested repeatedly which are analogous to those applied in direct-current dynamos in order that the distribution of the tension between two brushes of opposite sign may become more sinusoidal. The mathematical theory of two methods of this kind and of their application in alternators is given.—*L'Eclairage Elec.*, June 14.

Tramway Motors.—See the abstract of a paper of Rausch under International Tramway Union Congress, under Traction.

POWER.

Electrical Power in Manufacturing Plant.—A long and well illustrated description of the electrical equipment of the Nordbery Manufacturing Company's plant at Milwaukee. The main products are mining and other heavy machinery. The plant is electrically driven throughout, and, with the exception of those in the tool room, all tools are fitted with individual motors. Direct current is used, and to get a wide variation of speed, the multiple voltage system is used, combined with field control. The ratio between the highest and the lowest speeds is 7.5 to 1. The full voltage is 250. By means of a compensator or equalizer the total voltage is divided into three steps. This machine consists of two machines mounted on one base, and with the same shaft, one having two armature windings and two commutators, the other one armature winding and one commutator. Four wires are used for distribution.—*Am. Mach.*, July 3.

REFERENCES.

Transmission Plant.—McCONNON.—An illustrated description of the power plant of the Missouri River Power Company, at Canyon Ferry, Montana, and its 50,000-volt transmission line.—*Jour. of Elec.*, June.

Water Power Plants.—EASTWOOD.—A paper read before the Pacific Coast Electric Transmission Association, on "The Hydraulic End of Power Transmissions."—*Jour. of Elec.*, June.

TRACTION.

REFERENCE.

Tramway Exposition.—The first part of a well illustrated description of the exhibits at the second International Tramways and Light Railways Exhibition in London, comprising tramcars, generators, motors, conduits, multiple-unit systems, switchboards, brakes, rail joints, etc., of British companies.—Lond. *Elec.*, July 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Regulating the Current of a Gas Engine Driven Dynamo.—LAURIOL.—A paper read before the International Society of Electricians, in Paris. In a French central station one gas engine drives two direct-current dynamos by belts, one of the Henrion type with series excitation, the other of the Gramme type with separate excitation. Each dynamo supplies a circuit of arc lamps in series. The current supplied from the Gramme dynamo shows fluctuations in the light of the lamps, synchronous with the cycle of the motor; in the other arc circuit there are no fluctuations of the light. The difference is believed to be due to the fact that the Henrion dynamo has a much greater moment of inertia than the Gramme dynamo; the former, therefore, will not follow exactly the speed variations of the gas engine. To suppress the variations in the Gramme dynamo circuit, Girard has successfully applied the following remedy after a series of experiments. By means of a rheostat, inserted in the circuit of excitation and operated by the distributing-shaft of the engine, the resistance of the exciting circuit and, therefore, also the field produced are periodically varied.—*Bull. Soc. Int. des Elec.*, June.

REFERENCE.

Automatic Switches for Pumping Installations.—An illustrated article on switches for automatically starting pumps when the water in a reservoir has fallen below a certain level, and interrupting the circuit when the reservoir is filled.—*Elek Anz.*, July 3, 6.

WIRES, WIRING AND CONDUITS.

REFERENCES.

Armored Cables.—ROCHAS.—The first part of a mathematical discussion of the geometrical problems involved in the theory of the armoring of submarine cables with iron wires.—*L'Eclairge Elec.*, June 7.

Laying a Cable in Earth.—An illustrated description of a plough for laying an electric cable in earth to a depth of 70 to 80 cm. below the surface. It will be used for laying a telegraph cable in Africa, and was built by a French telegraph and telephone company.—*L'Ind. Elec.*, May 10.

ELECTRO-PHYSICS AND MAGNETISM.

Zeeman Effect.—RIECKE.—A paper in which he attempts to harmonize the values for the ratio of the electric charge to the mass of an electron, obtained from the Zeeman effect, with that obtained from cathode rays, more closely than has hitherto been possible. The fact that some spectrum lines are divided into triplets and others into more complicated structures shows that the above ratio cannot be the same for every mode of vibration. By means of simple dynamical reasoning he deduces a formula for the difference in the frequencies of the two extreme components of a triplet. Zeeman applied this formula to the cadmium triplet and found the above ratio divided by the 15th power of 10 to be 743 electrostatic units per gram. Similar values may be obtained from the mercury lines. In the mercury spectrum, the first line of the second subordinate series is divided into nine components showing an equal interval of frequencies. Any pair of them gives the above value for the ratio. It differs from that obtained from cathode rays, which is 559. But the author points out that the isolated mercury lines, which form true triplets, give the value 558.5. He concludes that the same is the case for all true triplets, and that the cadmium triplet is not a triplet at all, but consists of six lines close together.—*Phys. Zeit.*, June 15; abstracted in Lond. *Elec.*, June 27.

Electron Hypothesis and Theory of Magnetism.—VOIGT.—A paper in which he analyzes the possibility of obtaining from the theory of electrons an explanation of paramagnetic and diamagnetic phenomena. It is assumed that the "translation velocities" of the electrons are small in comparison with the "velocity of radiation"; and on this assumption some important conclusions are arrived at. "It is assumed in the first place, in accordance with the analogy of the unresisted molecular currents of the older magnetic theories, that the electronic motions are undamped, and it is then found that changes in the velocities of the electrons in consequence of the formation of magnetic fields will not give rise to magnetic phenomena." The effects of damping, which play so important a part in the optical phenomena of dispersion, are then considered, and the author shows that "if the electronic motions of a body in a constant magnetic field are subject to damping, while at the same time the energy dissipated is supplied by means of any completely irregular series of impacts, as, for example, with other electrons, or with ponderable molecules, so that the mean value of the energy tends to a fixed limits, the body will exhibit paramagnetic or diamagnetic properties according to whether the mean energy of the electrons after the impacts, is mainly potential or mainly kinetic."

inally, it is shown that the presence in a magnetic field of rotating odies carrying electric charges, can only give rise to diamagnetic henomena when they experience no resistance. Charged bodies, on e other hand, rotating against resistance and having their energy ss made up by irregular impacts, may give rise to either paraagnetic or diamagnetic phenomena.—*Ges. Wiss. Goettingen, Nachr. fath. Phys. Kl.*, 3, p. 169, 1901; abstracted in *Science Abstracts*, une.

Phenomena with Three Variable Quantities.—Hospitalier.—A ote presented to the International Society of Electricians, in Paris. n a great number of electric phenomena there are three variable uantities. The graphical method for studying them has generally een by means of a series of curves, each of which curves gives ne variable quantity as a function of the second, the third being onstant, while for the different curves the third or constant quanty has different values. For more complicated cases this method is ot to be recommended. He recommends, instead, representing one ariable quantity as a function of the two others by a surface in pace, produced by means of bent iron wires. He suggests using is method for the study of various alternating current problems, or instance the variation of the excitation of a constant voltage lternator as a function of the current and of the phase difference beveen current and e. m. f., etc.—*Bull. Soc. Int. des Elec.*, May.

REFERENCE.

Conductivity.—Mewes.—A very long article on resistivity and onductivity of metals, alloys and electrolytic solutions. He first iscusses the two theories developed by Liebenow and by himself, n the conductivity of different materials at the same temperature. he second part of the article deals with the change of the electric onductivity with the temperature. The article is highly theoretical nd cannot well be abstracted.—*Elektrochem. Zeit.*, May, June, ıly.

Electro-Chemistry and Batteries.

Calcium Carbide.—Gin.—An article on the reactions in the forıation of calcium carbide. It is known that the gases developed different parts of calcium carbide furnaces contain both free xygen and free calcium. The amount of free oxygen increases ith the current density; it is formed at the places of highest temerature. The calcium vapors come from places of lower temperıure. The development of oxygen causes the burning of the elecodes immediately below the surface of the molten bath. The fine ıst which is deposited on the furnace consists nearly entirely of lcium. To explain this, he calls attention to the experiments of erthelot, which prove that carbonous oxide is dissociated at high mperatures, also to the fact that in the industrial manufacture of rbide it is not the formula of Bullier which is used for the chargg mixture, but there is a surplus of calcium oxide; and finally e calls attention to the fact that the contents of the furnace is a ries of layers in which the temperature rapidly decreases from the side to the outside. In these layers different chemical equilibria e formed, the reaction being the more endothermic, the higher e temperature. When in the hottest places the temperature is high that the carbonous oxide is entirely dissociated, the formaon of calcium carbide consists of a simple substitution of the xygen in calcium oxide by carbon, with the development of free xygen. Calcium vapors are developed at the boundary surface of lcium oxide and calcium carbide; two formulas are given by the ıthor.—*Zeit. f. Electrochemie*, June 19.

Electrolytically Produced Compound of Sulphur and Copper.—ieder.—An article in which he describes the following phenomenon. he end of a copper bar was surrounded with a non-conducting lphur cylinder, and then placed as cathode in a copper-plating ıth, so that part of the copper bar above the sulphur is also imersed in the solution. After 20 hours, it was found that the copper r had been somewhat eaten away at the point where it was in ntact with the sulphur, while the sulphur cylinder near this point d increased, its surface having become blue-black. This is due a compound of copper and sulphur, which is a good conductor d is decomposed in dilute sulphuric acid, hyrosulphuric acid being rmed. He believes that this compound acts like an electrolyte, that the formation of this compound progresses gradually into the ternal parts of the sulphur. If the sulphur is mixed with other itable materials, for instance zinc dust or sulphide of copper, etc., en when brought as cathode into a copper bath, the formation of e blue-black begins at once over the whole surface of the sulphur ock. He used this copper sulphur compound as one electrode in a cell, while the other electrode is of zinc, and the electrolyte is ammonium chloride mixed with zinc chloride. At the zinc electrode zinc goes into the solution and forms zinc chloride, while at the other electrode hydrosulphuric acid is formed, which reacts upon zinc chloride in the solution, zinc sulphide being formed.—*Zeit. f. Elektrochemie*, June 5.

Faraday's Law.—Bose.—An abstract of a paper on the range of validity of Faraday's law. To test the accuracy of the law, no salt should be used, the cation of which is capable of existing with two different valencies, as a possible disturbing factor then enters, for instance that due to the reaction of one bivalent ion with one atom giving two monovalent ions. The deviations found in the electrolysis of silver salts (0.0001 of the total weight of silver deposited) are due to secondary reactions, an important one of which is attributed to oxygen occluded by the platinum electrode. Faraday's law may be regarded as an absolutely exact law of nature. The current which passes through an electrolyte is entirely conducted by the transportation of material, and there is no evidence of "metallic conduction." He considers Faraday's law as comparable with Dalton's law of multiple proportions as far as exactness is concerned, and views it as an extension of Dalton's atomic laws.—Lond. *Elec. Eng.*, June 13.

Electrolytic Formation of Peroxide of Lead from Metallic Lead.—Peters.—Continuations of his very long serial, the first parts of which were abstracted in the Digest, Jan. 25. As in the former abstract, the numbers in parentheses after each electrolyte give the grams of peroxide which he obtained for 100 amp.-hours, with a current of 0.6 ampere and a surface of 144 sq. cm. (Theoretically, 100 amp.-hours could form 222 grams of lead peroxide.) The following electrolytes are discussed: 30 gr. bichromate of potassium and 12 cc. concentrated sulphuric acid to 1 liter water (1.1575 gram peroxide of lead); 20 gr. chromic alum and 12 cc. concentrated sulphuric acid to 1 liter water (1.c070 gr.); 150 gr. sulphate of sodium, free of water, sp. gr. 1.12, to 1 liter water (0.6927 gr.); 150 gr. of ammonium sulphate, sp. gr. 1.070 to 1 liter water (0.7284 gr.); 150 gr. of crystallized magnesium sulphate to 1 liter water (0.1147 gr.); 600 gr. of crystallized magnesium sulphate to 1 liter water (0.1181 gr.); 900 cc. 15 per cent. solution of magnesium sulphate mixed with a solution of 30 gr. ammonium sulphate and 20 gr. crystallized hydroxide in 100 cc. water (34.9311 gr.); 30 gr. crystallized magnesium sulphate and 20 gr. sodium sulphate, free from water, to 1 liter water, sp. gr. of solution 1.026 (3.5432 gr). The serial is to be continued.—*Centralbl. f. Accum.*, April 1, May 1, June 1.

Tests of French Storage Batteries.—An account of a long series of tests of French storage batteries for use in the French Navy; 21 batteries, made by 13 different firms, were tested; 11 had pasted plates throughout, 9 had positive Plante plates and negative pasted plates; 1 had both plates of Plante formation. All the batteries were connected in series and were discharged or charged together. A discharge was stopped when the e. m. f. of any cell had dropped to 1.65 volts; every cell which dropped to 1.65 volts in less than half an hour was removed from competition. At the end of 251 discharges five batteries were still in competition, four of which had pasted plates throughout, while the fifth had positive Plante plates and negative pasted plates.—*Centralbl. f. Accum.*, June 15.

REFERENCES.

Tin From Tinned Iron Scrap.—Mennicke.—A very long article on the electrolytic recovery of tin from tin scrap in sodium hydroxide solution. The tin scrap is used as anode and pure tin is deposited on the cathode, while the iron of the scrap with other impurities remains in the anode sludge. He gives the formulas of the reactions and discusses at great length practical questions concerning the process.—*Zeit. f. Elektrochemie*, May 22, June 5, 12.

Electro-Analysis.—Hanaman.—An illustrated description of an apparatus for electro-analytic purposes. The different devices and accessories, necessary for this purpose, are combined in one apparatus.—*Zeit. f .Elektrochemie*, June 19.

Resistance Furnace.—Gin.—An article in which he gives some formulas for approximately determining the temperature and efficiency of an electric resistance furnace.—*Elektrochem. Zeit.*, May.

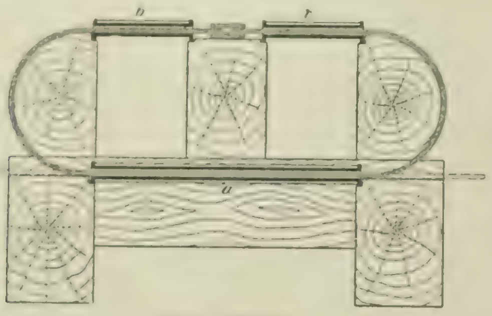
Calcium Carbide.—Muensterberg.—An article on the present conditions of the calcium carbide and acetylene industry. He believes that acetylene is the light of the future in small cities and in isolated buildings.—*Rev. Gen. des Sc.*, June 15.

Theory of Electrolysis.—[illegible].—The first part of a mathematical article on Maxwell's electromagnetic theory and its application to the phenomena of electrolysis.—*Elektrochem. Zeit.*, June

Dusseldorf Exposition.—An article on storage batteries exhibited by three German manufacturers.—*Centralbl. f. Accum.*, May 15, July 1.

Units, Measurements and Instruments.

Iron Testing.—Richter.—An illustrated description of a new method of testing iron, which has proved satisfactory in the works of Siemens & Halske, of Vienna. Iron sheets are tested as a whole in the form in which they come from the mill. In this way an average value is obtained of the quality of the iron at different parts of the sheets. The apparatus consists of three magnet coils, *a b c*, which are held in position by means of a wooden frame, as shown.



IRON TESTING.

The sheets to be tested are passed through the coil *a*, then bent upwards at both ends and the ends pushed through the coils *b* and *c*. The only air-gap in the iron circuit is where the ends touch. To get a good average value, at least four sheets are tested at the same time, which are insulated from one another by means of tissue paper. Only the ends of the internal sheet touch each other, while the ends of the other and outer sheets are slightly separated from one another, as shown in the figure. At this point two small sets of small iron sheets are clamped above and below the terminals of the large sheets; they are pressed together against the ends of the large sheets to close the magnetic circuit. The preparations for the tests require 15 minutes and no great accuracy is necessary in putting the sheets into the apparatus, in order to remain within the allowed limit of error of 3 per cent. Nothing is said about the way the measurements are made.—*Elek. Zeit.*, June 5

German Reichsanstalt.—A long abstract of the official report of the work of the German Reichsanstalt in 1901. The platinum resistances which have so far been used for measuring low temperatures have now also been calibrated at higher temperatures up to 500° C. For two sorts of platinum the following formulas were found:

$$W = W_0 (1 + 0.003923\, t - 0.000\,00485\, t^2)$$

and

$$W = W_0 (1 + 0.003966\, t - 0.000000582\, t^2).$$

They are correct within − 100° and + 500° C., with an accuracy of ± 0.15 per cent. At lower temperatures there are greater discrepancies, which are above 2 per cent. at the temperature of liquid air. The different sets of standard resistances have again been compared, and have been found to be very constant. The Deprez-d'Arsonval type of galvanometer has been found well suited for exact resistance measurements and for ballistic measurements. Many measurements have been made with standard cells, and the cadmium (Weston) cell has been found to be reliable, in spite of the claims of Cohen to the contrary. Extended researches have been made on the behavior of mercurous sulphates; 378 instruments, 7 motors and transformers, and 24 materials have been tested. Arrangements have now been made by the Reichsanstalt officials to test the behavior of electric meters of different makers at the place where they are installed; these meters are first carefully tested in the laboratory and then 20 to 30 of each type are installed at various consumers and are accessible only to Reichsanstalt officials. The equipment of the alternating and three-phase current laboratory has been completed, so that potentials of 3 × 5,000 volts and currents up to 3 × 1,000 amperes are available. For testing watt and current meters, a double three-phase machine has been installed, the revolving magnets of a 5-kw and a 1.5-kw, three-phase machine are mounted on the same axle; the armature of the 5-kw machine is fixed, as usually, while that of the 1.5-kw machine can be displaced against that of the larger one by an angle up to about 100 degrees. The larger machines gives the current for the main current coils of the current and watt meters, the smaller one for the voltage coils. In this way the phase difference between e. m. f. and main current can be varied at will by displacing the armature of the smaller machine. Moreover, a switch is provided which enables one to change the three conductors of the smaller machine so that phase differences of 60 degrees can be instantaneously obtained; 228 resistances, 125 Clark standard cells, 39 Weston standard cells, 87 primary batteries and 6 storage batteries were tested. In the magnetic laboratory, three instruments were examined and 57 materials tested. Extended researches were made concerning the determination of hysteresis and eddy current losses; 518 Le Chatelier thermo-cells, 5 thermo-cells of platinum and platinum-nickel and 7 thermo-cells for the use at low temperatures were tested.—*Elek. Zeit.*, June 5, 12

REFERENCES.

Analyzing Alternating Waves.—Loppe.—A mathematical paper on a method of decomposing an alternating wave into a sum of sine waves.—*L'Eclairage Elec.*, June 28.

Compass.—Meldau.—A mathematical article on the deviation of the compass needle on board of iron ships.—*Phys. Zeit.*, June 1.

Röntgen-Ray Apparatus.—Rollins.—A continuation of his illustrated article. He describes the apparatus for supporting a photographic plate and makes some remarks on the capacity and potential in coils used for exciting Röntgen-ray tubes.—*Elec. Rev.*, June 21.

Telegraphy, Telephony and Signals.

REFERENCES.

Telegraphy and Telephony.—Kohlfürst.—A brief summary of the progress made in 1901 in installations of submarine telegraphy, wireless telegraphy and long-distance telephony.—*Zeit. f. Elek.*, June 1.

The Coherer in Submarine Telegraphy.—Guarini.—The first part of an article, in which he discusses chiefly with reference to his own patents, the use of the methods of tuned wireless telegraphy to the realization of multi-communication in submarine telegraphy.—Lond. *Elec. Rev.*, June 27.

Multiple Telegraphy.—Anizan.—A continuation of his well-illustrated article on the Mercadier system of multiplex telegraphy.—*Jour. Teleg.*, June 25.

Theory of Wireless Telegraphy.—Kareis.—An illustrated article on "the field of force in wireless telegraphy." He discusses the views advanced by Taylor and Lecher that the earth's surface, or still better the surface of the water, acts like a wire, the Hertzian waves following it with oscillations perpendicular to this surface.—*Zeit. f. Elek.*, June 22.

Electric Clocks.—Richard.—An article giving brief illustrated descriptions of new electric clocks of seven different inventors.—*L'Eclairage Elec.*, June 21.

Statistical.—Articles on telegraphy and telephony in Austria in 1900, and on telegraphy in Italy in 1898-99.—*Jour. Tel.*, June 25.

Miscellaneous.

REFERENCES.

Dusseldorf Exposition.—Seyferth.—A long illustrated description of the exposition, the systems of power generation and distribution, and the electrical exhibits.—*L'Eclairage Elec.*, June 14, 28.

Goetze.—A long and very well illustrated description of the exhibits referring to the use of electricity and power gas in mining and metallurgy.—*Glueckauf*, June 28.

Loppe.—An article on the electric power generation and distribution, and on the electrical exhibits.—*L'Ind. Elec.*, June 25.

Statistics of German Patents.—A long abstract of an official report of the German patent office.—*Elek. Anz.*, June 8, 12, 15, 19.

New Books.

DIE FUNKENTELEGRAPHIE. By A. Slaby. Berlin: Leonhard Simion. 119 pages, 32 illustrations.

A number of important papers by Dr. A. Slaby, of the Technical High School, of Berlin, and inventor of the wireless telegraph system which bears his name, has been compiled in book form, and makes an interesting addition to the literature of the art.

The title of the volume is "Spark-Telegraphy," the name favored by the doctor as the most appropriate for the designation of the spark-gap and coherer system in use to-day. The work consists of four principle papers read before various societies, together with two inserted pamphlets relating to the graphic and mathematical elucidation of the Slaby theory of wireless telegraphy.

The first paper is entitled "Spark-Telegraphy," from whence the book derives its name. It is a history and resumé of the state of the art to 1897. It includes the rectilinear wave theory from the free end of the oscillator, the process of cohesion under the action of electric waves, and a plate on which is reproduced the tapes from a Marconi and a Slaby receiver, and showing the rapidity of the latter.

"The Application of Spark-Telegraphy to the Marine Service" is the second paper, and was read before the Technical Shipbuilding Association, Dec., 1897. Dr. Slaby recites the requirements of the merchant-marine as well as of the navy, and considers the nature of the antennæ, and from theoretical considerations he evolved a special form of equipment especially adapted to the trying conditions involved in armored vessels.

In his third paper Dr. Slaby reviews the various theories advanced to account for the transmission of energy in wireless telegraphy, but naturally devotes the principle part of the paper to a discussion of the wave system he evolved, which has been described in these columns in an article by Mr. A. F. Collins, which appeared in the issue of Nov. 9, 1901. This paper was read before the conference of the General Electric Company, on Dec. 1, 1900.

"The Latest Improvements in the Art of Spark-Telegraphy" is the title of the last paper of Dr. Slaby, which was read before the general assembly of the German Engineering Association, at Kiel, June, 1901. The subject matter of this paper deals largely with the author's improvements in the practical application of his wave theory. The papers in book form make a convenient reference of Dr. Slaby's work, which is invaluable to the technician who would have at his finger ends the complete writings of each master.

THE ARITHMETIC OF ELECTRICAL MEASUREMENTS. By W. R. P. Hobbs, R. N. Revised to date by Dr. Richard Wormell, M. A. Ninth Edition. London: Thomas Murby. New York: D. Van Nostrand Company. 112 pages, illustrated. Price, 50 cents.

The main thing of interest about this volume is the fact that it has managed to run through nine editions. Less than a dozen pages are devoted to specific statements, and in them are simply set forth the rules for calculating the resistance of parallel circuits, the strength of current with batteries grouped in various ways and how cells may be most advantageously combined to work on a given circuit. Each one of these is followed by a few examples and the entire remainder of the book by problems to be worked out by the reader, the answer of each being given.

PHYSICAL DETERMINATIONS. Laboratory Instruction for the Determination of Physical Quantities. By W. R. Kelsey, B. Sc., A. I. E. E. London: Edward Arnold. 316 pages, illustrated. Price, 4 shillings and sixpence.

This is one of the large family of text-books intended for student's use as a laboratory manual and guide. In reviewing works of this character it is always interesting to note the particular trend of the various authors' fancy, some of them making a specialty of one branch of physics and some of others. In the present case electricity and magnetism seem to be the hobby; a full one hundred pages are devoted to it, light coming next with about fifty, heat with about the same, and sound last of all, with less than twenty.

It is to be regretted that there are so few illustrations. In a great many instances it is necessary to wade through a page or two of description of apparatus which could be understood at a glance if a line drawing had been provided, and even then the reader is left with a far less clear conception of details. There are a few cases in which the description is absolutely unintelligible, and while this may not be of very great importance where the volume is used as a text book in a laboratory where the actual apparatus is at hand, it certainly greatly diminishes the value of the book as a work of reference.

Viewing it in the light of a text-book pure and simple, the omission of important preliminary instructions, such as the necessity of systematic working and tabulation of results and the liberal use of curves is open to unfavorable criticism. To indicate the habit of systematically recording the results of observations in a clear and concise manner is one of the most important functions of the instructor and his right-hand assistant—the text-book, and failure to lay emphasis on such fundamental requirement is a conspicuous fault.

Another point which we would criticize unfavorably is the entire omission of definitions of units. As a beginner frequently requires to refer to such data, they should be readily accessible. Under the electrical section no space is devoted to the derivation of standards, and in a book on physical determinations this would certainly seem to be a proper starting point.

In the hands of an instructor ready to point out and supply omissions, the book will, however, undoubtedly be of much value, as the tests are arranged in a logical and systematic manner and go to the heart of the questions with great directness. The book will also be found convenient by those who are already conversant with the general subjects treated, but whose knowledge has become rusty through lack of use and requires a quick polishing up when a problem in measurement is presented for prompt solution.

L'ANNÊE ELECTRIQUE, Electrotherapique et Radiographique, 1901. By Dr. Foveau de Courmelles. Paris: Ch. Beranger. 404 pages. Price, 3.50 francs.

This annual review is mainly devoted to the progress of electrotherapy and radiography with Röntgen rays. About one-third of the book is occupied with these subjects. The remainder deals with brief accounts of progress made during 1901 in electrical science, electrochemistry, electric lighting, heating, telegraphy, telephony, wireless telegraphy, electric traction, electricity in warfare, and diverse applications. The book is well prepared and valuable as a reference in the therapeutic and radiographic departments. It necessarily gives only a cursory view of the progress made in the other fields of electric application. Considering, however, the breadth of the whole series of subjects, the representation made is excellent, and the best that we have seen in the French language. In fact it would be difficult to find a book in any language that attempts so earnestly to display the progress that has been made during any year in the electric arts and sciences. Electric transmission of power and dynamo-electric machinery have received the briefest consideration. The book is most suitable for electrotherapeutists who also take an interest in electric applications generally.

BOOKS RECEIVED.

NATURLEHRE. By Dr. Alois Lanner. Wein: Jos. Roth'schen Verlagsbuchhandlung. 377 pages, 377 illustrations.

DIE TELEGRAPHIE OHNE DRAHT. By Adolf Prasch. Wien: A. Hartleben. 272 pages, 202 illustrations. Price, 5 marks.

ELEMENTARE VOLESUNGEN UEBER TELEGRAPHIE UND TELEPHONIE. By Dr. Richard Heilbrun. Berlin: Georg Siemens. 64 pages, 44 illustrations. Price, 1.60 marks.

ANLASSER UND REGLER FUR ELEKTRISCHE MOTORMEN UND GENERATOREN. By Rudolf Krause. Berlin: Julius Springer. 92 pages, 97 illustrations. Price, 4 marks.

HANDBOOK OF ELECTRICAL MACHINERY AND APPARATUS. By Geo. L. Anderson, A. M. New York: D. Van Nostrand Company. 161 pages, 214 illustrations. Price, $3.00.

DIAGRAMS OF MEAN VELOCITY OF UNIFORM MOTION OF WATER IN OPEN CHANNELS. By Irving P. Church. New York: John Wiley & Sons. 11 Diagrams. Price, $1.50.

THE MUNICIPAL YEAR BOOK, 1902. With Summaries and Editorial Discussion. Edited by M. N. Baker, Ph. B. New York: The Engineering News Publishing Company. 310 pages. Price, $3.00.

THE ELECTRICAL CATECHISM. 533 Plain Answers to 533 Practical Questions About Electrical Apparatus. Compiled from the Regular Issues of *Power*. New York: Hill Publishing Company. 210 pages, 246 illustrations. Price, $2.00.

Power Development in Southern California.

The fact that the Edison Electric Company, of Los Angeles, has placed bonds during the last few days in New York to the amount of $10,000,000, of which $3,000,000 is to be immediately available, indicates the process by which the supply of electric energy will be provided for the roads yet to be built in Southern California. John B. Miller, treasurer of the Edison Company, has just returned to Los Angeles from New York, where he placed the bonds on the basis of all the money being available during the next five years, as required. With the funds thus made available, the company proposes to increase its capacity to 25,000 horse-power. The enlargement includes the building of a steam plant and of the plant for utilizing the power of Kern River. Work on the water power plant is well in hand, and ground has been broken on a four-acre tract in Los Angeles for the steam plant.

Mr. Miller has made the following statement of the plans of the company: "The $10,000,000 of the Edison Electric Company's bonds were taken by a banking syndicate consisting of N. W. Harris & Co., of Chicago; E. H. Rollins & Sons, of Boston, and Perry Coffin & Burr, of Boston. The company's plans include not only the building of a new steam plant and the enlargement of its present water-power plant, but also the extension and improvement of the system in every direction.

"The detail thus far decided upon for the enlargement of the latter plant are as follows. There will be 840 feet effective head, diverting dam, a canal consisting mainly of tunnels in solid rock, with water capacity of not less than 300 cubic feet per second; hydraulic and electric machinery in a fire-proof power house, with a standard rated capacity for delivering 20,000 hp to the transmission lines; two pole lines, and at least two transmission circuits, having at least three wires each, and having a total capacity for delivering at Los Angeles 16,000 hp at 10 per cent., line loss, and 9 per cent, .power factor, at 40,000 volts(although without doubt the voltage to be used will be 60,000 or 65,000); and a receiving installation for 18,000 hp at Los Angeles, with all accessories, such as switchboard, transformers and lightning arresters.

"As to the new steam plant, it is our intention to design a modern one, for supplying current to our entire system, to work in conjunction and in parallel with our several water-power plants. We shall incorporate in this plant the highest degree of engineering practice, with its consequent economy of operation. The plant is to have an ultimate capacity of 5,000 kw, divided into four or five units of 1,250 or 1,000-kw capacity each. Two thousand kw will be installed as soon as deliveries can be had. The generators are to be connected direct to compound-condensing engines, or possibly to steam turbines, using superheated steam. The boilers will be of the high-pressure, water tube type, with a total capacity of about 8,000 hp, divided into units of 500 hp each.

"In connection with the boilers, will be installed economizers and superheaters. We probably shall use a self-sustaining steel stack, brick lined. We shall use surface condensers, which, in addition to the economy added to the engines, will increase the economy and life of the boilers by insuring a good feed of water and absence of scale-forming properties. We shall, of course, design the plant to use oil as fuel.

The whole mechanical and electrical equipment will be designed with a view to simplicity of operation, low cost of maintenance, and symmetry of arrangement. It will be laid out in such a way that complete, simple and easy provisions will obtain for future extensions and increase of capacity. A large overhead traveling crane will be installed in the engine room to facilitate prompt handling of apparatus, especially in case of emergency or the making of repairs."

Mr. Miller added that at present the company's Los Angeles plant has a capacity of 8,000 hp, and there is being completed a 3,000 hp plant at Redlands. With the building and equipping of the new steam plant, which will require seven months, the Edison company will have at its disposal 20,000 hp by water-power generation, and 6,000 hp by steam generation as a reserve. "There is a market," said Mr. Miller, "for all the electricity we can generate. In addition to street railway consumption, there is demand for fully 12,000 hp of electrical energy along our line, taking in Santa Ana, Los Angeles and Redlands."

Wireless Telegraphy from Hawaii to San Francisco.

It is reported that Mr. John D. Spreckels, who is so very largely interested in Hawaiian industries, contemplates establishing a wireless telegraph system between the islands and San Francisco. This project, however, is dependent upon the success of the system being installed between Los Angeles and Catalina Island, 40 miles off the coast.

System for Calling Carriages by Electricity.

One of the greatest drawbacks and nuisances of city life after dark is the trouble caused in getting carriages to the door of a theatre, opera house, reception, etc., after the affair is over. Various schemes have been tried, but until quite recently, at least so far as New York is concerned, one's carriage is brought out of chaos by means of stentorian shouting. The clamor and confusion are immense; foot passengers are seriously incommoded by the absence of system, while people living in adjacent streets and nearby houses have life made a burden each night for an hour or two just when they would be asleep.

Fig. 1.—Carriage Ticket.

It would appear that the electrical carriage call system here illustrated is a most ingenious and laudable effort to contend with the difficulties of the problem, while reports of its use go to show that the apparatus is a decided success. This system, which is the invention of Messrs. Mortimer Norden and Lucien S. Crandall, is being introduced by the Electric Carriage Call Company, of 1402 Broadway, New York, and operates in the manner which will now be described.

The system depends broadly upon the use of a perforated ticket, which tears in two, and of which the perforated end is retained by the carriage occupant, while the driver gets the other end, numbered. This card is shown in Fig. 1. When the performance is over, and the carriage is needed, the perforated end is given up by its holder and is inserted in a box or switch, which immediately flashes the number required on a large lamp sign over the street, to be seen by the driver. The cards are made of heavy manila, like postal card stock, and as the tear-off coupon is numbered the same as the

perforated section, the perforations correspond to the number just as the holes in a pianola roll enable corresponding bars of

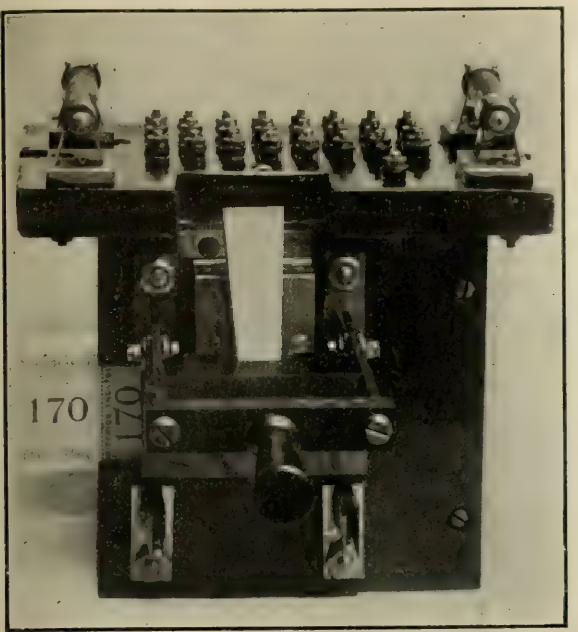


FIG. 2.—TICKET SWITCH.

music to be played, it is not possible to call up the wrong carriage.

Fig. 2 shows the switch into which the card is inserted when given up by the person holding it. This switch is of standard form, fitted with special plate and pin contacts, enabling the proper circuit connections to be made through the holes in the card to the lamps in the street sign. The plate containing the spring pins is first forced down to the proper contacts by throwing the switch, as indicated in the cut. When the switch is released, it opens the circuit arcing only at the clip contacts and not at the contact pins, thereby preventing any oxidation of the pin contacts. The side where the card is inseerted is slotted so that the card cannot slip or drop out, but can also only be inserted in the proper way.

From the lower contact terminals the circuit wires are run to a small slate distributing board on top of the switch, and thence by cable to the sign board. The mains first connect to the fuses of the enclosed type, and thence to the lower coils.

Fig. 3 is a detail of the "number," showing the tube in which each lamp is placed, preventing the light from radiating in any but the desired direction and also avoiding exposure to the weather. The "number" is made in the sizes from 14 inches high and 12 inches wide to 5 feet high and 4 feet wide. It can be read as easily in the day as at night, and is shown built up into a panel complete in Fig. 4, which is of galvanized iron, wired to meet the requirements of the underwriters.

One of the first installations of the system was at the Criterion Theatre, Forty-fourth street and Broadway, New York City; and another is at the Herald Square Theatre, of the type shown in Fig. 4. The management of the latter place state that carriages can be called ten minutes quicker than before, and that it is even possible with one switch and sign to call up 10 to 15 carriages per minute. Since the installation at the Herald Square and Criterion

FIG. 3.—ARRANGEMENT OF LAMPS.

Theatres the company have closed contracts with the Metropolitan Opera House for three, one in Buffalo, two in Kansas City, two in San Francisco, three in Boston, three in Philadelphia, and are now negotiating with numerous electrical firms for State rights. They do not sell the machine outright, but rent at low monthly rates.

The device can be used for private gatherings, such as balls, parties, and other social functions, as they are entirely portable and can be installed in a few minutes. The current required for a single-sided sign is about 4 amperes, and the cost of operating one night will not exceed 15 or 20 cents. The size lamps used are 4 c. p. Any number of sign boards can be operated from the one switch.

The company have one machine in operation in London for the coronation, and are installing one in Paris. The system can also be used to call members of the stock exchange, or waiters in large restaurants, notifying them when their order is ready in the kitchen, so that they are on duty at tables continually until wanted in the kitchen. Three of these are now being installed at the Terrace Garden, New York, for that purpose.

FIG. 4.—CALLING BOARD.

Constant Alternating Current Transformer Panels.

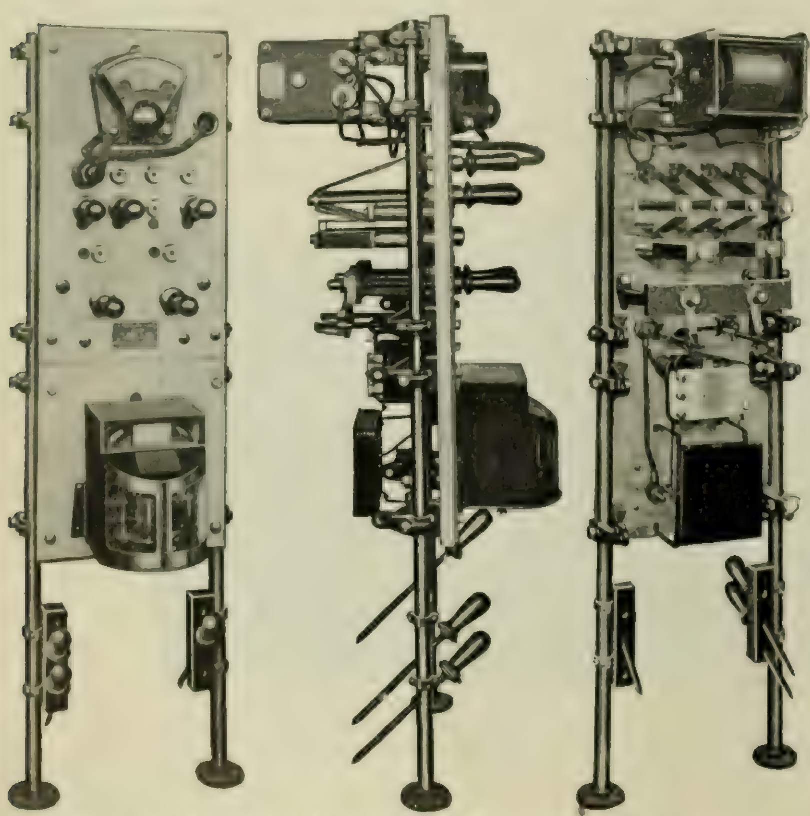
The General Electric Company has designed a line of panels for use in connection with the Thomson alternating constant-current series arc-lighting system, which system employs, as will be recalled, a special type of transformer which, by means of movable coils, maintains constant the current supplying a series arc circuit. The panels are designed for installation immediately beside the transformer controlled, and, therefore do not form part of the usual station switchboard.

The panel, which is shown in the accompanying illustration, consists of a single piece of blue Vermont marble, 28 inches in height and 16 or 20 inches wide. This panel is supported 36 inches from the floor, and a standard sub-base of similar width and 16 inches in height, equipped with a recording wattmeter for the measurement of

the total input of energy to the transformer, can also be attached. The panel is equipped with the following devices:

Ammeter; current transformer (on all panels for 35 lamps and above, but not on smaller panels); ammeter connection plug with necessary cable (on all panels for 50 lamps and above, but not on smaller panels); ammeter plug receptacles (one for each side of each circuit controlled by the panel, for 50 lamps and above, but not on smaller panels); open circuiting plugs and receptacles (two for each circuit controlled); short-circuiting plugs and receptacles (one for each circuit controlled); two primary switch plugs and receptacles; two plug racks for the reception of all idle plugs; two primary fuses.

The General Electric standard form of primary plug switch and the standard form of tubular expulsion fuse have been combined in a single element for more convenient application to constant transformer panels. The plug switch will open the circuit to which it is applied, under any condition of load. The fuse used is of such a capacity as to rupture only under emergency conditions equivalent to a short circuit in the transformer. The only difference existing between the standard panels for 1,100 and 2,200 volts is in the capacity of the fuse. The short-circuiting plugs and receptacles consist of a simple plug switch, one for each secondary circuit, and are used to short-circuit the lamp circuit in starting up the transformer, provided the transformer is started from the switchboard. These plugs are used also on a double-circuit transformer, in case one circuit only is to be operated. One plug and receptacle is provided for



FIGS. 1, 2 AND 3.—CONSTANT-CURRENT TRANSFORMER PANEL, WITH WATTMETER ATTACHMENT.

opening each side of each circuit. In connection with the short-circuiting plug, these plugs serve to disconnect any circuit from the transformer. Work may be easily and safely done upon a circuit so disconnected without shutting down the transformer. These plugs and receptacles are furnished with all constant-current transformer panels.

The General Electric standard form of arc circuit ammeter is used on these panels, the scale being so marked as to render the ammeter interchangeable for 6.6 and 7.5 ampere circuits. A single ammeter is used for each panel. This ammeter is connected through a double-conductor cable with a two-part plug, which, when inserted in any one of the ammeter connection receptacles, throws the ammeter in series with the outgoing or incoming leads of either circuit. The purpose of providing a receptacle for both the outgoing and incoming sides of each circuit is to facilitate testing for grounds. Any leakage or flow of current to ground will show a difference of reading when the ammeter is plugged into different sides of the circuits. The use of the ammeter connection plug provides for the measurement of the current of either circuit with only one ammeter. Ammeter transformers are provided for panels controlling more than 25 lights. A plug rack provides a permanent receptacle for all plugs not in use.

Desk Telephones.

It begins to be a question whether as many telephones are not now to be found on desks as are applied to the wall; for no modern city desk seems complete without its means of communication with the outside world. This may serve to explain the rapid improvement made in desk telephones, as exemplified

FIG. 1.—CAST-BASE DESK TELEPHONE.

FIG. 2.—COMPOSITION BASE DESK TELEPHONE.

in the two sets here shown in Figs. 1 and 2, apparatus produced by the Russell-Tomlinson Electric Company, of Danbury, Conn. Fig. 1 shows a set with a heavy cast base, ornamented, in which all the connections are made, so that there are no outside connection contacts. It is finished in full nickel. Fig. 2 illustrates a similar form, made up with composition metal base, highly finished and heavily nickel-plated.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The past week was an active one on the stock exchanges, and there were some remarkable advances. The market was, however, no less dangerous than it was buoyant, for it was difficult to see where manipulations ended, and equally hard to see the reason for some fluctuations. Possibly the strength of the railroad situation, the better aspect of the crops, and the steady activity in the industrial world were enough to explain all, but no one in Wall Street doubts that the hand of the expert was at work. In the electrical and traction group prices were a bit off, except Westinghouse Electric, the preferred of which rose from 213 to 218, and the common from 208 to 210. On sales of 75,800 shares, Brooklyn Rapid Transit went off from 72⅜ to 69¼; Metropolitan Street Railway, on 20,400, from 152½ to 150, and Manhattan Elevated from 136¼ to 134¾; General Electric also was off on 5,000 shares from 190½ to 187½. Western Union, also, after a boom slid back to 86¼, showing a net decline of 2⅛. The "outside market" was generally inactive, and no changes of any note occurred during the week. Below are given the latest prices for July 29 and approximate dates, furnishing latest quotations:

NEW YORK.

	July 22.	July 29.		July 22.	July 29.
American Tel. & Cable.	—	—	Hudson River Tel......	—	—
American Tel. & Tel..	—	164	Metropolitan St. Ry...	150¾	149⅜
American Dist. Tel....	—	—	N. E. Elec. Veh. Trns..	[illegible]	—
Brooklyn Rapid Transit.	71¼	68¼	N. Y. & N. J. Tel....	[illegible]	—
Commercial Cable	—	—	N. Y. E. V. T. Co....	—	—
Electric Boat	30	30	Tel. & Tel. Co. Am....	—	—
Electric Boat pfd......	50	50	Western Union Tel....	88½	86⅛
Electric Lead Reduc'n..	3	—	West. E. & M. Co......	205	—
Electric Vehicle	6	7	West. E. M. Co. pfd..	213	210½
Electric Vehicle pfd....	14	—			
General Electric	188½	184½			

BOSTON.

	July 22.	July 29.		July 22.	July 29.
American Tel. & Tel..	—	164	Mexican Telephone	2⅜	—
Cumberland Telephone .	—	125	New Eng. Telephone....	142½	144
Edison Elec. Illum....	—	280	Westinghouse Elec. ...	—	—
Erie Telephone	—	—	Westinghouse Elec. pfd	—	—
Western Tel. & Tel....	29	—			
Western Tel. & Tel. pfd.	102½	—			

PHILADELPHIA.

	July 22.	July 29.		July 22.	July 29.
American Railways ...	46½	47	Phila. Traction	99⅞	99⅞
Elec. Storage Battery	93	92	Phila. Electric..........	5⅜	5 9/16
Elec. Storage Bat'y pfd.	—	—	Pa. Elec. Vehicle......	—	—
Elec. Co. of America..	8¾	8⅞	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	July 22.	July 29.		July 22.	July 29.
Central Union Tel.....	—	—	National Carbon pfd.....	101	107½
Chicago Edison	180	177	Northwest Elev. com...	35⅜	37
Chicago City Ry.......	210	220	Union Traction	16⅝	15¼
Chicago Tel. Co........	—	127¼	Union Traction pfd....	—	—
National Carbon	29	—			

* Asked.

PRICE OF GENERAL ELECTRIC.—When the stock rights on General Electric were announced, there was speculation as to the probable price of the stock ex-rights. Some very well informed people, says the *Wall Street Journal*, thought the stock would not sell higher than 160. Insiders believed that it might reach 180. All have been surprised by the result of the company's business thus far this year. Sales for the four months ended May 31, amounted to $10,175,379. The cost of manufacturing and selling was $7,891,707 leaving a profit of $2,283,672. Profits on sales of securities of other companies, royalties, interest and dividends, with some miscellaneous profits brought in $510,254 against which the company paid $10,099 interest on debentures, and $499,906 in dividends, leaving the net profit for four months $2,283,921, or almost 5½ per cent. on the present volume of stock, $42,031,600. This is at the rate of over 21 per cent. per annum, and while, prehaps, it is unreasonable to believe that so large profits can be maintained, it is fair to assume that profits will be fully double the present dividend requirements. Furthermore the company has a surplus of $17,571,061 from which to draw.

INVESTMENT IN JAPAN.—New Yorkers, who are represented in Japan by A. Tsion, formerly of the Japanese Imperial University, have purchased control of the gas companies of Osaka and Tokio, which are earning large profits. Both companies needed large funds for extension. The Tokio company has a paid-up capital of 4,200,000 yen in shares of 50 yen each, which are selling at above 70 yen. The arrangement made with the New York capitalists is to double the number of shares, the Americans buying the increased stock at 80 yen per share. A sum representing the premium on shares is set aside for reserve, and the balance will be devoted to extensions. An arrangement recently made with Osaka is of a similar nature. The preliminary arrangements are said to have been made in New York by Baron Shibusawa.

DIVIDENDS.—Twin City Rapid Transit has declared the regular quarterly dividend of 1¼ per cent. on the common stock, payable August 15. The Allis-Chalmers Company has declared fifth consecutive quarterly dividends of 1¾ per cent. on its preferred and common, out of net earnings, payable August 1. The American Light and Traction Company has declared a quarterly dividend of 1½ per cent. on the preferred stock, payable August 1. The New England Telephone and Telegraph Company has declared a dividend of $1.50 per share, payable August 15. The Westinghouse Electric and Manufacturing Company has declared a dividend of 1¾ per cent. on its assenting stock, payable August 15.

BOSTON ELEVATED.—A special meeting of the stockholders of the Boston Elevated Railway was held last week, to authorize an increase in the capital stock from $10,000,000 to $15,000,000. Boston Elevated people explain the proposed issue of $5,000,000 new stock by the following statement: "The cost of erection of the Elevated structure, both road and terminals, has far exceeded the estimates of our engineers. The cost of our rolling stock also exceeded original estimates, and the new stock issue is to pay the indebtedness thus incurred and also for the purpose of meeting land and other damages. No part of this new issue will be used for extension, such as extending the road to Cambridge."

GERMAN ELECTRICAL SECURITIES.—A cable dispatch from Berlin, of July 27, says: The annual balance sheet of the Schuckert Electrical Company, of Nuremberg, published last evening, shows a loss of 15,200,000 marks, against net earnings of 6,250,000 marks for the preceding year, which amount was carried forward to the new account, and is now lost. The report of the Continental Company for electrical undertakings, which concern the Schuckerts are financing, shows a loss of 1,198,372 marks, and the Schuckerts had to write off 9,000,000 marks to cover the depreciation of the securities they held.

CLEVELAND TELEPHONE BONDS.—Holders of the 5 per cent. bonds of the United States Telephone Company have signed an agreement not to sell these bonds for less than 90 before July 1, 1903. According to this agreement, H. A. Everett, J. R. Nutt and others are appointed a sales committee with power to negotiate for the sale of these bonds for 90 or better. The Federal Telephone Company owns between $600,000 and $700,000 of these bonds, and if they could be sold the Federal situation would be greatly relieved. The earnings of the United States Company are making rapid gains.

PERUVIAN TROLLEYS.—The Lima Street Railway Company has incorporated under the laws of New Jersey, with a capital stock of $5,000,000, divided into $1,000,000 preferred stock bearing 7 per cent. cumulative dividends, and $4,000,000 of common stock. The charter sets forth that the company will operate street railways in Lima. Callao, Miraffiores, Barranco, Charilles, and other cities in Peru. The incorporators are Charles A Neville, Henry W. Carter, and Charles Bath, presumably New Yorkers.

SPRAGUE GENERAL ELECTRIC DEAL.—The terms offered by the General Electric Company to holders of Sprague Electric Company securities, having been accepted by holders of 74 per cent. of the capital stock and 88 per cent of the bonds, President Markle, of the Sprague Company, declares that the sale of the company to the General Electric Company has become operative. The General Electric Company has deposited the cash necessary to carry out the contract with the United States Mortgage and Trust Company, New York.

MICHIGAN TELEPHONE CO. BONDS.—A large majority of the consolidated mortgage 5 per cent. bonds of the Michigan Telephone Company having been deposited with the Old Colony Trust Company of Boston, as depository under the bondholders' agreement, dated June 28, the time for the deposit of bonds has been extended until August 5, after which no deposits will be received, except upon such terms as the committee may prescribe.

CONNECTICUT CONSOLIDATION.—The United Gas Improvement Company, of Philadelphia, is reported to be negotiating for the Hartford, Conn., Street Railway Company, the Hartford Electric Light Company and the Fair Haven and Westville Street Railway at New Haven, Conn.

Commercial Intelligence.

THE WEEK IN TRADE.—Commercial and industrial reports for the midsummer climax of vacation and dulness are remarkably good. Crop statements are excellent, especially from the southwest and northwest, and all the railroads are well employed in the agricultural regions, with only a little off-setting complaint as to the check imposed on pleasure travel by the continued cold and wet weather. An active distribution of merchandise is going on, and railway earnings thus far as reported for July are 2.5 per cent. in excess of 1901 and 20 per cent. better than in 1900. The short supply of fuel is a check on the iron and steel trade, and there is a keen inquiry for pig iron, steel rails and structural steel. *Bradstreet's* reports 178 failures in the United States during the week, against 174 for the previous week, and 199, 183, 170 and 189 for the corresponding weeks of 1901 to 1898. The Middle States had 55; New England, 28; Southern, 26; Western, 38; Northwestern, 17; Pacific, 10, and Territories, 4. Canada had 16, against 17 for the preceding week. About 91 per cent. of the total number of concerns failing had capital of $5,000 or less, and 7 per cent. had from $5,000 to $20,000 capital.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials from the port of New York for the week ended July 9: Antwerp—3 pkgs. machinery, $257; 7 pkgs. material, $2,264. Argentine Republic—82 pkgs. material, $1,547; 5 pkgs. machinery, $466. British East Indies—170 pkgs. material, $6,163; 5 pkgs. machinery, $562. British West Indies—26 pkgs. material, $655; 22 pkgs. machinery, $1,500. Bremen—14 pkgs. material, $170; 2 pkgs. machinery, $87. Brazil—13 pkgs. material, $7'9; 86 pkgs. machinery, $5,825. Barcelona—6 pkgs. machinery, $439; 7 pkgs. material, $212. Berlin—38 pkgs. material, $646. Brussels—4 pkgs. material, $200. British Guiana—9 pkgs. material, $440. British Possession in Africa—2 pkgs. material, $260; 120 pkgs. material, $6,899. British Australia—22 pkgs. material, $960. Cuba—60 pkgs. material, $1,355. Central America—36 pkgs. material, $424. Chili—32 pkgs. material, $12. Dutch Guiana—1 pkg. material, $12. Dutch West Indies—5 pkgs. material, $26. Frankfort—3 pkgs. material, $113. Genoa—2 pkgs. machinery, $75. Glasgow—3 pkgs. material, $413; 5 pkgs. machinery, $1,743. Grenoble—3 pkgs. material, $455. Havre—17 pkgs. machinery, $444; 21 pkgs. material, $906. Hamburg—5 pkgs. machinery, $632; 68 pkgs. material, $4,204. Liverpool—32 pkgs. material, $1,288. Leeds—12 pkgs, material, $141. London—207 pkgs. machinery, $5,649; 133 pkgs. material, $6,148. Moscow—7 pkgs. machinery, $320. Mexico—27 pkgs. material, $599; 1 pkg. machinery, 129. Manchester—17 pkgs. machinery, $9,680; 3 pkgs. material, $390. Odessa—5 pkgs. material, $130. Peru—51 pkgs. machinery, $1,978. Rotterdam—2 pkgs. machinery, $485; 1 pkg. material, $50. St. Petersburg—2 pkgs. material, $200. Southampton—23 pkgs. material, $1,519. U. S. Columbia—22 pkgs. material, $996. Venezuela—171 pkgs. material, $1,475. The following are the exports of electrical materials and machinery from the port of New York for the week ended July 26: Argentine Republic—42 pkgs. material, $1,364. Antwerp—18 pkgs. machinery, $833. Azores—4 pkgs. material, $188. Berlin—20 pkgs. material, $500. British West Indies—19 pkgs. material, $488; 25 pkgs. machinery, $800; British East Indies—7 pkgs. material, $303; 1 pkg. machinery, $10. British Possessions in Africa—15 pkgs. machinery, $1,649; 123 pkgs. material $5,714. Brazil—84 pkgs. material, $4,813; 48 pkgs. machinery, $2,095. British Australia—23 pkgs. machinery, $1,792; 148 pkgs. material, $11,814. Christiana—2 pkgs. machinery, $483. Cuba—8 pkgs. machinery, $121; 32 pkgs. material, $900. Copenhagen—8 pkgs. machinery, $332; 3 pkgs. material, $93. China—7 pkgs. machinery, $199. Chili—7 pkgs. material, $142. Central America—19 pkgs. material, $367. Ecuador—3 pkgs. material, $25. Genoa—4 pkgs. material, $200. Glasgow—4 pkgs. material, $405; 49 pkgs. machinery, $1,417. Helsingfors—1 pkg. material, $10. Hong Kong—5 pkgs. machinery, $200. Hamburg—1 pkg. machinery, $65. Havre—41 pkgs. machinery, $1,184; 24 pkgs. material, $1,100. Japan—73 pkgs. material, $6,799. London—196 pkgs. material, $10,717; 16 pkgs. machinery, $591. Leeds—2 pkgs. machinery, $122. Lisbon—12 pkgs. material, $402. Liverpool—74 pkgs. machinery, $8,279; 38 pkgs. material, $1,403. Mexico—12 pkgs. material, $121; 14 pkgs. machinery, 077. Manchester—6 pkgs. machinery, $1,350. Nova Scotia—15 pkgs. material, $108. New Castle—3 pkgs. material, $417. Naples—1 pkg. material, $50. Portsmouth—1 pkg. material, $76. St. Petersburg—3 pkgs. machinery, $100. Sheffield—3 pkgs. machinery, $1,876. Stockholm—1 pkg. machinery, $104. U. S. Colombia—42 pkgs. material, $374. Venezuela—18 pkgs. material, $737.

THE PELTON WATER WHEEL CO., of San Francisco and New York, reports an unusually large number of orders lately, both foreign and domestic. Among those received by the San Francisco branch might be mentioned: Three units, aggregating 3,200 hp, for the Bay Counties Power Company; two units for driving generators, for the Yosemite Valley (National Park) plant; 2,000 hp plant for Clark Electric Company, Ophir, Utah; wheels for operating plant of the Pacific Portland Cement Co., of Spokane, Wash.; one 500 hp wheel for the Lewiston Water & Power Co., of Lewiston, Ida.; one 800 hp wheel for the United Light & Power Co., Georgetown, Colo. Also complete plants for Hilo Electric Light & Power Co., Hilo, H. T.; Cia. de Transmission Electrica de Potencia; Oroville Gas & Electric Co., Ouray Electric Light & Power Co., Ouray, Colo.; Bagnall & Hilles, Japan; Cariboo Gold Fields, Barkerville, B. C.; Ardjasarie Electric Power & Transmission Co., Batavia, Java; Sullivan Group Mining Co., Marysville, B. C.; and wheels for operating the entire mine and milling machinery of the Eagle Shawmut Mining Co., Chinese, Cal. Among the most recent foreign orders received from their New Yok office might be mentioned: A 2,000 hp water-wheel plant and three miles (1,500 tons) of large diameter steel pipe, for a large cement factory near Barcelona, Spain; a 250 hp unit and 2,000 feet of 24-inch steel pipe for the San Juan Cotton Mills, of Puebla, Mexico; two 250 hp wheels for driving electrical apparatus in France; a 200 hp unit for the same purpose at Bologna, Italy; besides several smaller plants to be used on sugar plantations in the West Indies.

LARGE SAN FRANCISCO CONTRACTS.—The United Railroads of San Francisco has closed an important contract with the General Electric Company for further equipment. The second plant now ordered will consist of two 1,250-kw General Electric 3-phase generators, direct connected to one Union Iron Works 4,000-hp triple expansion engine. There will be two 800-kw rotary transformers, with switchboards and auxiliary apparatus. It will be a 25-cycle plant. Delivery should be made in about seven months. The first unit, which was ordered some months ago, will probably be installed and in operation late in the present year. All of this apparatus will be placed in the new power station now in course of construction, on Jefferson street near the Bay shore. The building will have space enough for the installation of a 16,000-hp plant, the largest on the Coast. The first and second contracts cover about half of the total capacity of the plant. The second boiler contract has been let through Chas. C. Moore & Co., of San Francisco. It calls for 8 Babcock & Wilcox water-tube boilers, having a capacity of 550-hp each. All of the pressure parts are of forged steel for 200 pounds pressure. Green's fuel economizers are included. There will be two steel-plate, induced draft fans, each having sufficient capacity for half of the 16,000 hp. These fans will be held in reserve in case it should ever become necessary to burn coal. C. C. Moore & Co. will install the boiler plant and the oil burning system. The National Supply Company's apparatus will be used.

MINE VENTILATION CONTRACT.—Among the recent contracts awarded to the Buffalo Forge Company, of Buffalo, N. Y., is one of particular interest, that of the Continental Coal Company of Glouster, Ohio, who have ordered three 250-inch fans installed at their mines for the purpose of ventilating and exhausting fumes, smoke and dangerous mine gases. The fans are 250 inches, housing of ¾ type, and of the special width of 72 inches. The sides are built of extra heavy steel plate and are thoroughly braced with angle iron of ample size, effectually preventing all vibration. The blast wheels of these fans are of the usual centrifugal type. The radial blades or vanes with backwardly curved tips are supported by two spiders of wrought iron tees springing from cast-iron hubs, and are further stiffened by the conical side plates. The fan shaft is supported independent of the housings by two standard Buffalo self-aligning, chain oiling outboard bearings mounted on masonry pedestals. This plant is similar in many respects to that of the Modoc Coal Mining Company, located at the same place, and recently installed by this company.

TUNNEL BID ACCEPTED.—A short time ago the Rapid Transit Commission of New York opened bids for the construction of a tunnel from near the City Hall, New York, to the Battery and under the East River to Brooklyn, constituting an extension of the subway now being built in Manhattan. The Rapid Transit Construction Company, headed by August Belmont and John B. McDonald, presented two propositions. The first offered to build the tunnel for $2,000,000, or with all terminals for $3,000,000. The second bid proposed to construct the tunnel for $4,000,000, and, if this bid should be accepted, they offer to construct for the nominal sum of $100,000 a subway under Broadway from Union Square to Forty-second Street. The Rapid Transit Company, of Brooklyn, bid $8,000,000. The Belmont bid has now been accepted. The Rapid Transit Construction Company now have the contract for the present subway work, and the new work will form an extension to that system. This company will control the present subway for 50 years and the extension for 3[illegible] years.

WIRELESS TELEGRAPH CONTRACTS.—The De Forest Wireless Telegraph Company announces that it has received a contract from the War Department, at Washington, for installations for four complete wireless telegraph stations. The contract calls for kerosene or gasoline motors for generating current of one horse-power capacity. The date of delivery is specified as August 15, in time for the army and navy manœuvres. The Postal-Telegraph Cable Company has arranged with the Marconi Wireless Telegraph Company, of America, for the exchange at Sagaponack, L. I., of messages to and from vessels equipped with the Marconi wireless apparatus, so that it is now possible for passengers to telegraph friends on shore either farewell messages or notice of arrival. The arrival of steamers may also be reported from Sagaponack several hours in advance of their being sighted at Fire Island or Sandy Hook.

TELEPHONE SYSTEM FOR VINCENNES, IND.—The Kellogg Switchboard and Supply Company has recently closed a contract with the Northern Construction Company, of Bryan, Ohio, for a common battery multiple switchboard for Vincennes, Ind., having 1,500 lines ultimate capacity, and a framework large enough for 3,000 lines. The present equipment will contain 640 lines. The switchboard will consist of two 6-panel, 3 position sections. The exposed cabinet work, including the cable turning section and movable end panels, will be of selected mahogany of a dead finish. Included in this contract are 600 standard common battery wall telephones, quarter sawed oak woodwork and concealed line binding posts; also all necessary power apparatus, main and intermediate distributing frames, relay racks and sneak current arrester equipment.

FOUR THOUSAND TWO HUNDRED HP. EQUIPMENT FOR MEXICO.—The Mexican Gas & Electric Light Company, a British capitalized concern, has let contracts for the construction and equipment of a new 4,200 hp power station, which is to be built in the city of Mexico. Milliken Brothers have been allotted the contract for the requisite structural material. The Mexican General Electric Company, which represents the General Electric Company in Mexico, has secured the contract for three 800 kw generators and one of 400 kw. The engines are to be furnished by McIntosh, Seymour & Co. There will be three cross-compound condensing engines of 1,200 hp each and one machine having a capacity of 600 hp. These engines are to be direct connected to the generators.

THE STANDARD POLE AND TIE COMPANY, of 44 Broad Street, New York, have just completed the delivery of their second large order from the Central New York Telephone and Telegraph Company, of Utica, New York. The poles which have been supplied are the Southern white cedar or juniper poles, of which the Standard Pole and Tie Company make a specialty. They began to introduce this pole in the northern market about two years ago, and now they report that the orders are coming in as fast as they can handle them. The main reasons for the extreme popularity of the juniper pole are its freedom from butt rot and its symmetry and straightness. The poles ordered by the Central New York Telephone and Telegraph Company were for use at Utica, Syracuse and vicinity.

SHANGHAI LIGHTING PLANT TO BE ENLARGED.—The electrical light plant which furnishes power for lighting the foreign settlement at Shanghai, and is operated by the municipal council of that Chinese city, is about to be considerably enlarged. The contracts will be let through Fearon, Daniel & Company, of China, whose New York offices are at 90-96 Wall street. This firm is at present making some fair-sized purchases for supplies, etc., for the plant. The General Electric Company has secured a contract for arc lamps. An order calling for some $5,000 worth of fans for office and private-house use were shipped lately to Shanghai, through Fearon, Daniel & Company, by the Federal Electric Company.

LEWISTON, IDA., ENLARGED PLANT.—The board of trustees of Lewiston, Ida., have decided to enlarge the electric light plant. The cost of the betterment now going on will aggregate some $16,000. This includes a new 500 hp Pelton wheel, a larger penstock to take water from the high flume of the Vineland Company, enlargement of the flume, new street arc lamps for Lewiston throughout, new transformers, and extensions of the company's lines. The proposed enlargement in the capacity of the plant includes a new generator, more transformers, etc., which would cost about $15,000. It is thought the company will secure the contract to furnish power to the city water works.

BIDS WANTED FOR PLANT.—Bids will be opened August 8 by Clarence M. Addison, city clerk, Columbus, O., for labor and material for the municipal lighting plant. Specifications have been prepared by Superintendent Oakley, of the electric light department, for the following: Three cross-compound (vertical or horizontal) engines of 500-hp each at 150 r. p. m.; three 400-kw steam turbines and generators; two condensers (jet or surface type); four horizontal water-tube boilers, 300-hp each, with straight tubes; one 176 x 9 self-supporting steel stack; fuel economizers; three 500-kw, two-phase, 60-cycle alternating-current generators for direct connection to engines, and fifteen hundred 7.5-ampere series, alternating, enclosed arc lamps.

POWER PLANT IN UTAH.—Construction work upon the big power plant in Beaver canyon (Utah), planned by the Majestic Co., has commenced. Bids are invited upon the construction of the lower dams, Nos. 1, 2 and 3, and upon various portions of the works. The approximate cost of these three dams will be $50,000, and they will develop 2,000 hp. Power will be delivered to the mines in the surrounding country. The company has located two additional power sites. The Cactus mine, in Copper Gulch, 50 miles away, has contracted for 500 hp upon completion of plant.

ANOTHER MEXICAN TRACTION PROJECT.—Negotiations are, according to private Mexican advices, all but completed for the electrical conversion of the existing mule line in Guadalajara, a flourishing city located on the east coast of the Southern Republic. The present system is 25 miles in length. J. M. Bermejillo, of the financial house of Bermejillo & Co., Guadalajara, holds the controlling interest in the concern. The equipment necessary for changing the road from animal to electric traction will be purchased in the United States.

AMERICAN UNION ELECTRIC COMPANY will, it is said, soon place its stock on the New York market. It has been recently organized with an authorized capital of $7,000,000, all common, of which $5,000,000 has been issued, it is said, to take over the Falcon Electric Manufacturing Company, the Electric Motor Specialty Company, the Fountain Electric Company, Union Railway Power and Electric Company, Morris Electric Company, and the Refrigerating Machine Company. The present net earnings are reported to equal 2 per cent. on the $5,000,000 outstanding.

MORE CARS FOR DURBAN, NATAL.—The British electrical engineering and contracting firm of Macartney, McElroy & Co., Havemeyer Building, has secured a further contract for cars to be shipped to South Africa, for use on an extension of the Durban municipal electric traction system. The present contract calls for 10 complete cars. Eight cars manufactured by the J. G. Brill Company, and equipped with General Electric motors, were shipped recently to the same South African road by the British concern.

PLANT FOR BURLINGTON, IA.—The People's Gas and Electric Company, successors to the Burlington Railway and Light Company, has placed the entire rebuilding of its system and power station in the hands of Royal H. Holbrook, as advisory engineer. A new engine of about 400 hp, some water-tube boilers, a condenser, about four miles of new track and a large portion of the old rebuilt and bonded, an extension of the car barns and many other improvements are contemplated. Ten new cars have been purchased from the St. Louis Car Company for September delivery.

SEARCHLIGHTS FOR THE AMAZON.—Owing to the many collisions which have recently taken place on the River Amazon, the Brazilian government has issued an order requiring all vessels plying on that water way to be equipped with search light apparatus. It is stated that between Manaos and Iquitos, a distance of 3,600 miles, fully 500 steamers are engaged in the carrying trade. Bytton Brothers, coffee exchange, New York, have received several inquiries for searchlight equipment varying from 2-kw to 7-kw sets.

BALL ENGINE ORDERS.—W. H. Wagner Sons, Freeport, Ill., are installing an electric plant, consisting of a Crocker-Wheeler generator, direct connected to an engine built by the Ball Engine Co., Erie, Pa. The United Railways & Electric Co., Baltimore., Md., are installing a 350-hp tandem compound engine, built by the Ball Engine Co.

PLANT FOR PRINCETON UNIVERSITY.—Contracts are now being let for the erection and equipment of a plant for the furnishing of light and general power at Princeton University. The contract for the boilers, which calls for four Cahall horizontal water-tube units of 300 hp each, has been secured by Thayer & Company, incorporated.

MINING PLANT ORDERED.—An order has been placed with the General Electric agent at Salt Lake, Utah., by the De La Mar Mining Co., for $30,000 worth of electrical machinery for its power plant to be built about eight miles below Calientes, Nev.

General News.

THE TELEPHONE.

OAKLAND, CALIF.—The Independent Telephone Company, which recently secured a franchise in [illegible], has made applications for franchises in Alameda and Berkley.

PASADENA, CALIF.—The Sunset Telephone Company is circulating a petition in Pasadena, Calif., against the establishing of a second telephone company in that place. The majority of the business men have signed the paper.

PASADENA, CALIF.—The Home Telephone Company is attempting to obtain a franchise in Pasadena, Calif. A petition has been circulated among the business men asking the City Council to refuse to grant a franchise to an outside company. The Pacific States Telephone Company has a system in operation and M. F. Metcalf has applied for a telephone franchise.

CANTON, ILL.—The Canton Home Telephone Company has been formed; capital, $75,000; incorporators: F. G. Bills, G. F. Miner, O. S. Baileys.

CHICAGO, ILL.—The Stephenson County Telephone Company, capital, $150,000; will operate telephone and telegraph systems. Incorporators: Fred C. Bills, George E. Miner, O. S. Baylies.

INDIANAPOLIS, IND.—The Summit Rural Telephone Company, of Henry County, has been incorporated; capital stock, $10,000.

MOUNT SUMMIT, IND.—The Mount Summit Rural Telephone has been incorporated with a capital stock of $10,000. The company will build an exchange and operate a telephone system throughout the rural districts.

VINCENNES, IND.—The Palmyra Independent Telephone Company, of Knox County, filed articles of incorporation July 17. The capital stock is placed at $14,000, but will be increased. Directors: Rob't B. Patterson, John G. Dreiman, Edward E. Shaw, J. W. Alton, V. S. Manning, L. S. Root and C. W. Wilson.

ORLEANS, IND.—The Lyria and Orleans Telephone Company, of Orange County, has been incorporated. Capital stock, $5,000. Directors: Aaron Pickens, Jas. L. Noblitt, Henry McCoy, J. R. Gifford, A. L. Gallion and Jno. M. Frost. This company will establish an exchange at Orleans, construct and operate telephone lines throughout Orange County.

BRAZIL, IND.—The new Citizens' Telephone Company are daily receiving material for the construction of their exchange and expect to have it in operation inside of ninety days. This company are composed of local capital and they will install an exclusive single party line. The switchboard has a capacity of three thousand telephones, 500 of which will be put in at once. R. H. Cokefair, an expert telephone man of Indianapolis, is superintending the putting in of the exchange.

BEDFORD, IND.—The citizens of this place are aroused and indignant over the announcement by the New Independent Telephone Company, which has secured a franchise, that the rate will be $30 a year instead of $1.25 a month, as was promised when the franchise was asked. The Central Union Telephone Company has an exchange, and the only reason a franchise was granted to a second company was to secure lower rates. The citizens declare there is collusion between the two companies and are looking about for some effective remedy.

JEFFERSONVILLE, IND.—The telephone girls, twenty-five in number, have recently given the Cumberland Telephone Company five days in which to arrange for better comfort, lest they will strike. The girls operating the local exchange are not allowed to use fans and the company will not put in electric fans. The night operators want screens put in the windows and doors to keep out the immense and numerous Ohio river mosquitos and bugs. The local manager says his superiors have prevented him furnishing these necessary conveniences.

MELROSE, IDA.—The long distance telephone line owned by J. W. Burton and W. E. Schruebly, of Melrose, and C. W. Green, of Lenore, Ida., is completed into Lewiston, Ida. This gives communication to all the reservation towns.

FONDA, IA.—The Northern Telephone Company, of Fonda, is to build a new line out of Fort Dodge, running north to Humboldt, thence west to Gilmore City, Pocahontas and Storm Lake.

MITCHELLVILLE, IA., will have a new and independent telephone system. It will be completed and ready for use by September 1. Plans are well under way for this new enterprise. A company has been formed with $10,000 capital and will be incorporated with the following officers: President, J. E. [illegible]; secretary, E. R. Patterson; treasurer, S. T. [illegible].

PERRY, IA.—The city council has ordered that the Hawkeye Telephone Company reduce its telephone rates to $[illegible] per year for residences and $[illegible] per year for business houses. This is on a report showing rates in other cities. The franchise provides that the rates shall not exceed the average in any two cities of the State of the same size and having approximately the same number of telephones.

WELLINGTON, KAS.—The city council has granted a franchise for a rural telephone system to place wires and poles in the city. The system is backed by John T. Stewart, George T. Pitts, G. T. Hackney and T. F. Randolph. Work on the new plant will begin at once and the main office is to be in Wellington.

BEDFORD, KY.—The Cumberland Telephone Company is putting in a new exchange and running its lines throughout the county.

OWENSBORO, KY.—The Cumberland Telephone & Telegraph Company has brought suit against the Rough River Telephone Company to restrain it from stringing its wires in certain places, charging that its own service is thereby interfered with.

DETROIT, MICH.—The Detroit Co-operative Telephone Company is pushing its construction work and subscriptions are coming in fast. Mr. C. M. Burton, the president, says that the cables will be there by Sept. 1; that they ought to have between 500 and 600 telephones working by the latter part of October.

DETROIT, MICH.—At a meeting of the board of directors of the Citizens' Telephone Company the twentieth consecutive quarterly dividend of two per cent. was declared, the checks for which will aggregate $16,000. During the year ending July 1, 935 subscribers have been added, and in all departments the company is in a most flourishing condition.

FERGUS FALLS, MINN.—The Fergus Falls Telephone Company is about to install an exchange in the village of Parkers Prairie. The company has completed a long distance line to the village.

ST. LOUIS, MO.—The movement against free telephones in St. Louis started by the druggists is being taken up by other business men who keep free telephones for their patrons.

BEATRICE, NEB.—A twenty-year franchise to operate a telephone line in Beatrice has been granted by the city council to the R. V. Montague Investment Company of Kansas City.

YORK, NEB.—The Independent Telephone Company has just built a line through New York Township and a large number of farmers have subscribed for telephones. The Independent company now has connections with Waco, Benedict, Bradshaw and Arborville, and in a short time will have instruments in every township in York County.

ALBANY, N. Y.—The Davis Telephone Company of Kortright, Delaware County, has been incorporated. Capital, $10,000, and directors: Ferris E. Davis, James K. Penfield, Andrew J. Nicoll, of Delhi, and others.

JAMESTOWN, N. Y.—The Home Telephone Company has elected officers as follows: Jules Voutrout, president; P. H. Hoyt, vice-president; C. B. Selby, secretary M. M. Skiff, treasurer. The above with G. B. DeVoe, C. W. DeVoe and Edgar Putnam are directors. The company will inaugurate service about August 1 with 1,200 subscribers. The company is owned largely by people from Warren, Ohio.

BUFFALO, N. Y.—The Rural District Telephone Company is busily engaged in the erection of poles and the stringing of wires throughout Orleans County. The company was organized for the purpose of benefiting the farmers in the rural communities. The service that the company will offer to its subscribers is unlimited. The rate for the first year for residences will be $20 and for business places $26. For the second and subsequent years the rates will be $6 for residences and $9 for business places. In case the subscribers buy the telephones the rates are $10 a year for residences and $12 a year for business places.

CALEDONIA, OHIO.—The Marion County Telephone Company has secured a franchise for an exchange in this town.

COLUMBUS, OHIO.—The East Telephone Company, of Jefferson County, has been incorporated with $6,000 capital.

EAST SPRINGFIELD, OHIO.—The East Springfield Telephone Company has been incorporated with $6,000 capital stock to build a local exchange.

JOHNSTOWN, OHIO.—The new independent exchanges at Johnstown and Croton are about completed. They will be connected with Newark and Utica.

URBANA, OHIO.—The Urbana Telephone Company increased its capital stock from $5,000 to $10,000. C. H. Marvin is the president and J. C. Powers, secretary.

NEWARK, OHIO.—The Newark Home Telephone Company has placed a contract with W. H. Crumb & Company, of Chicago, for the complete reconstruction of the Newark exchange. It will be altered to the central energy system.

URBANA, OHIO.—The Urbana Telephone Company has increased its capital stock from $50,000 to $100,000. One half of the new issue has been subscribed [illegible] the old stockholders. The company has made many improvements of late.

COLUMBUS, OHIO.—The officials of the Columbus Citizens' Telephone Company have practically decided to install a new automatic switchboard. The company has been planning extensive improvements to take care of re[illegible] and it now seems quite probable that the entire system will be rebuilt and made automatic. The company has about 5,000 subscribers.

CLEVELAND, OHIO.—The bankers' committee in charge of Everett-Moore affairs continue to dispose of the subsidiary properties of the Federal Telephone Company and it seems probable that in the near future only a very few exchanges will be left in the hands of the Cleveland people. The Portsmouth Telephone Company, of Portsmouth, was sold a few days ago to Judge J. M. Thomas and others. The property will be improved at once. The Willoughby Telephone Company, of Willoughby, has been sold to Fred Stearns and others who have been identified with the company. The price is said to have been $[illegible]. The Stark County Telephone Company, formed for the purpose of developing the exchanges at Canton, Alliance and adjoining towns, has been closed and the securities have been distributed through the Savings & Trust Company. The company had an authorized capital of $[illegible], but only one half of this had been issued. Negotiations for the purchase of the People's Telephone Company, of Detroit, are still on.

CLEVELAND, OHIO.—[illegible], representing the Cuyahoga Telephone Company, appeared before the board of control and made an appeal for a change in the franchise of the company to enable it to charge higher rates for service. It is claimed the company has [illegible] subscribers and is losing money because of its growth. The company wants to increase the rates for business service from $[illegible] to $[illegible] per year. The board of control is considering the matter and will investigate the company's books before making a recommendation. It is believed, however, that the city council will be unable to take any action in the matter because of the injunction granted by Judge Caldwell against the city council, restraining that body from granting any company or persons any franchise or special privilege for the use of the city's streets. The intention of the council to favor the Cuyahoga company was one of the measures against which injunction was asked. It is claimed that no action can now be taken until a decision is rendered by the supreme court.

WESTERLY, R. I.—The Westerly Automatic Telephone Company has been formed under a special act of the legislature and has organized with the following board of directors, composed of prominent local professional and business men: John Champlin, M. D.; Albert B. Crafts, George C. Bartrum, William S. Slocum, Robert A. Sherman, George L. Stillman, Thomas J. Bannon and James A. Welch. The company has adopted the Strowger automatic telephone system and has ordered 100 telephones and switchboard with an ultimate capacity of 1,000. The first carload of material has arrived and the work of installing the plant is now actively under way. Joseph B. Baker, of Boston, for many years connected with the experimental department of the American Bell Telephone Company is consulting engineer and Mr. O. S. Bowen, formally with the New Bedford and Fall River Automatic Telephone Companies, is Superintendent of Construction. It is hoped to open the exchange for service by September 1st. It is proposed to extend the service to Watch Hill, Stonington, Noyses Beach and other surrounding towns in the Spring.

SUMTER, S. C.—The Bell Telephone Company is making a strong effort to secure a franchise in Sumter. The franchise is opposed by the local company which holds a ten-year franchise.

COLUMBIA, S. C.—The South Carolina Long Distance Telephone Company has added to its connections the towns of Hartsville, Darlington and Society Hill. During the next few months the company will devote its attention to rebuilding its lines in the Pee Dee section, changing them into metallic circuit lines.

PECAN GAP, TEX.—The North Texas Telephone Company of Pecan Gap, Delta, County, Tex., has been incorporated by W. A. Cockrell, W. R. James and J. H. Gordon, with a capital of $5,000.

GALVESTON, TEX.—Assistant General Manager G W. Foster, of the Southwestern Telephone & Telegraph Company, has been in Galveston, Tex., inspecting the local exchange and arranging for the laying of the new cables in underground conduits. He states work will be completed by September.

THE ROCKY MT. BELL TELEPHONE COMPANY is erecting new poles, to be occupied by the company and the electric light company at Lehi, Utah.

OGDEN, UTAH.—The Rocky Mountain Bell Telephone Company has asked the city of Ogden, Utah, for an extension of its telephone franchise for fifty years. The present franchise has eight more years to run. It is understood that no trouble will be encountered by the company in getting the extension.

SEATTLE, WASH.—The Independent Telephone Company, of Seattle, Wash., has been granted an extension of 60 days to complete its system.

OAKESDALE, WASH.—The Granite Hill Telephone Company of Oakesdale, Wash., has completed its line from Thornton to Oakesdale. Over $400 has been raised by public subscription for an exchange in Oakesdale.

HARTFORD, WIS.—The Wisconsin Telephone Company is extending its lines from Hartford to Mayville, serving the towns of Rubicon, Woodland, and Iron Ridge with a metallic circuit.

PLATTEVILLE, WIS.—The consolidated farmers' telephone company have secured forty-two subscribers to their telephone system in this city and have purchased a 100-drop switchboard of the Elston Telephone and Electric Manufacturing Company, of Muscoda, which will soon be installed.

Electric Light and Power.

SONORA, CALIF.—The Main River Ditch Company has revived its electric power project. It is claimed that 35,000 hp can be generated at the mouth of the ditch. Power lines to Stockton, San Jose and Oakland, Colo., are projected. The engineering work is in charge of Wm. Hammond Hall, and M. H. Walsh, of Sonora, is interested. The water of the Stanislaus River is to be used—head 2,200 feet.

SISKIYOU, CALIF.—The Siskiyou Electric Power Company is reported to have commenced work on its projected electric power transmission system in Siskiyou County, Calif. E. H. Steel is manager of the company, which proposes to take water from Fall Creek where it flows into the Klamathon River. It is said that 2500 hp can be developed. Light and power will be supplied to the mines near the plant and a pole line will be built to Yreka.

THE CALIFORNIA POWER COMPANY is now in a position to complete its projected electric transmission system from the Kern River Canyon to Los Angeles. Bonds in the sum of $3,000,000 have been placed in Chicago and the financiers are ready to take the remainder of the $10,000,000 bond issue, which was authorized, when needed. The right of way across the Forest Reserve in Southern California has been granted and there is no reason for further delay in the construction of the plant.

ALAMEDA, CALIF.—The Suburban Electric Light & Power Company which distributes the current of the Standard Electric Company's transmission system, has offered to supply the city of Alameda, Calif., with current at a rate lower than the cost of production by the municipal electric lighting plant. The City Cleek has been instructed to advertise for bids for electric current delivered at the switchboard in the municipal plant. Superintendent Wiese, of the municipal electric system, is in favor of the change. Fuel now costs $700 a month at the city plant and $370 per month could also be saved in salaries.

SAN FRANCISCO, CALIF.—The United Gas & Electric Company, which was organized as a distributing agent for the current from the Standard Electric Company's electric transmission system, is rebuilding the Pacific Power Company's underground conduit system in San Francisco. A controlling interest in the latter company is held by the United Company. The Standard Electric Company's current now reaches the substation at the intersection of Kansas Street and Division Avenue, but it will not be put into commercial use until the distributing system is placed in proper condition. Rates are being cut for electric lighting current in the competitive districts and there is no definite prospect of a consolidation of lighting interests in the city.

CRIPPLE CREEK, COLO.—The Golden Wedge mine of Cripple Creek, Colo., is installing an electric hoist, pumps, etc.

DENVER, COLO.—The Denver Gas & Electric Company has not purchased the Lacombe Electric Company, as has been reported.

CRIPPLE CREEK, COLO.—The Emma Mining Company, of Cripple Creek, Colo., will install an electric light and power plant at their mine.

DENVER, COLO., may have a site for a dam on Tarryull Creek, in Park County, provided it buys and gives the owner, F. F. Nixon, the privilege of using the water to generate power. Mr. Nixon has laid his plans before Mayor Wright of that city.

LEADVILLE, COLO.—It is reported that eastern capital will at once start building a power plant in Leadville, Colo. The plant will be located at Malta, having a capacity of 5,000 horse power, and this power the new company has agreed to sell to the mines at $136 per hp per annum. The mines are now paying about $240 per hp per annum, using coal as fuel.

DENVER, COLO.—O. S. Adams has been appointed receiver of the Grand Junction (Colo.) Electric and Manufacturing Company by United States Judge Hallett, on application of the Morton Trust Company of New York, which claims that the electric company is indebted to it to the amount of $50,000, having defaulted interest on its bonds for two years.

BRIDGEPORT, CONN., Mr. G. C. Batcheller, corset manufacturer, is putting in a new electric light plant. McClave, Hamilton & Co., of New York are the contractors.

KEY WEST, FLA.—On July 26, William Curry and Son's ice and electric plant was blown up. Two firemen were killed and six men were wounded. The plant is a complete wreck. No cause for the accident is given. The explosion caused great excitement in the city.

WEISER, IDA.—The town of Weiser, Ida., will spend $3,500 on a small electric light plant.

BOISE, IDA.—The Payette River Power Company has secured a franchise to build its pole line through the city of Boise, Ida.

LEWISTON, IDA.—A proposition has been presented to the city council of Lewiston, Ida., by the electric light company to furnish the city with water; the electric company will put in a large electric pumping plant if proposition is excepted.

ALBION, IDA.—The committee appointed to report on the proposed municipal electric light plant at Albion, Ida., reports that the plant could not be built under the present conditions less than $6,000, which is considered too much for the resources of the town. The matter has been dropped.

NEW CASTLE, IND.—The Newcastle Electric Light, Power & Heat Company recently organized, hopes to erect and equip a plant before winter.

ST. FRANCISVILLE, LA.—An election will be held on an issue of $10,000 bonds for water and electric lights.

NEW ORLEANS, LA.—The Sewerage and Water Board, F. S. Shields, secretary, will receive bids until Aug. 12 at 12 M. for furnishing and erecting all machinery, dynamos, etc., for a central pumping and generating station.

LIVERMORE FALLS, ME.—The Livermore Falls Light & Power Company, Edwin Riley, president, has an authorized capital of $100,000, and offers free use of land on railway lines to those who will erect establishments. The company employs the Edison system, and has 15 miles of circuit.

NEWBURYPORT, MASS.—The Newburyport Gas & Electric Company, Newburyport, Mass., will erect a new electric plant to cost about $50,000. D. D. Tilton is general manager, and C. S. Spaulding, superintendent.

GREAT BARRINGTON, MASS.—The Great Barrington Electric Light Company is to enlarge its plant and has leased from P. A. Russell the water power and woolen mill of the woolen company. The mill will be fitted up with machinery with which to supply power. The plant will be run in connection with the station at Housatonic. The company has recently had many applications for power which it has been unable to furnish. The Stanley instrument Company propose to run their plant by electricity. Mr. P. A. Russell will manage the company.

ZEELAND, MICH.—A. Lahnis, secretary of the local Board of Public Works, has plans and specifications for a 1500-light electric plant and water works and bids are asked for equipment.

YAZOO CITY, MISS., will issue $200,000 bonds for the construction of water works, sewage and electric light plants.

EAST ST. LOUIS, Mo.—E. W. Clark & Co., of Philadelphia, have purchased the Citizens' Electric Light & Power Company plant in East St. Louis for $600,000.

SALEM, N. J.—The Salem Electric Company is to build a new power plant, including one 80-kw 60-cycle and one 65-kw 60-cycle Stanley light machine; one 125-hp 4-valve and one 90-hp single valve Russell engine. The current will be delivered to Pittsburgh transformers, and Helios-Upton arc lamps.

IVY, N. C.—The big electric power plant at Ivy will be enlarged, as the available water power has proved greater than expected.

MORGANTON, N. C.—M. B. Wilkerson, of Asheville, and Philadelphia associates, are endeavoring to interest a New York syndicate in developing falls on Linville river, where 20,000 hp is available. It is proposed to distribute this power along the line of the Southern railway. The river has a fall of about 2,000 feet in eight miles embraced in the holdings of Mr. Wilkerson and associates.

BRIDGETON, N. J.—The Bridgeton & Harrison Electric Company has a capital of $50,000 and operates ten miles of circuit, using Westinghouse apparatus. About 1,500 16-cp lights are operated. The company was formed in 1895.

CHATEAUGAY, N. Y.—The Chasm Power Company, which was formed June 27, has a capital of $20,000 and capacity for furnishing 2,500 lights. The company is now constructing the dam.

FISHKILL LANDING, N. Y.—The Citizens' Railroad, Light & Power Company, of Fishkill Landing, N. Y., has received consent from the State Railroad Commission to increase its capital stock from $100,000 to $175,000 and to issue $100,000 bonds.

[illegible] terested in the new Ontario Power Company of Niagara Falls, Ont., the concern organized to develop electric power on the Canadian side of the river, has confirmed the report that an American company had been formed to take care of business on this side of the river. The name of the American company is the Ontario Power Transmission Company, and its directors are John J. Albright, Edmund Hayes and George S. Field, of Buffalo, and J. S. Simmons and S. P. Franchot, of Niagara Falls. Mr. Albright is president, Mr. Hayes, vice-president, and Raymond K. Albright, treasurer. The two corporations are practically identical, the same men being interested in both.

CONNEAUT, OHIO.—The P. & C. Dock Company will erect an electric light and power plant.

MILLERSBURG, OHIO.—Citizens of this place are negotiating for the erection of an electric lighting and hot water heating plant.

COLUMBUS, OHIO.—The Columbus Edison Electric Light Company has purchased a site opposite its present plant and will erect an addition.

NEW BREMEN, OHIO.—A proposition to issue bonds for a municipal water works and electric lighting plant has carried at a popular election.

COLUMBUS, OHIO.—J. A. Erner & Company, of Cleveland, have secured the contract for installing an electric lighting plant in the State institution for the blind.

COLUMBUS, OHIO.—The City Clerk has been ordered to advertise bids for the building and equipping of the municipal lighting plant after plans prepared [illegible].

MANSFIELD, OHIO.—The county commissioners have directed the county auditor to issue $10,000 in bonds to equip a power house with which to illuminate the county buildings.

WYOMING, OHIO.—The Cincinnati Gas & Electric Company is negotiating for the purchase of the plant and business of the electric light company at Wyoming. The company holds franchises and contracts in Wyoming and Lockland.

COLUMBUS, OHIO.—The Columbus Lighting & Heating Company has been incorporated with $10,000 capital stock by J. W. Barber, J. D. Karns, Wm. T. Mills, J. S. Barber and F. E. Hoover. The company proposes to furnish electric light and hot water heating.

CLEVELAND, OHIO.—B. P. Foster, who has applied for a city franchise to furnish electricity for "fuel, heating and power purposes," admits that the chief aim of his company is to furnish light throughout the city. It is probable that the city will call for bids before granting the company a franchise.

HAMILTON, ONT.—The Hamilton Electric Light & Cataract Power Company has arranged to have a steam plant manufactured for the company and installed at the Victoria Avenue substation in the city. This new plant will be put in next year. It will have a capacity of 3,500 hp, and is calculated to insure a continuity of service even under the most unfavorable circumstances.

BAKER CITY, ORE.—A. B. Frame, representing eastern capital, is in Baker City, Ore., looking over the ground for the erection of the new proposed light and power plant to be established on Eagle Creek. The plant will cost $300,000.

YORK, PA.—The York County Traction Company has completed the erection of a power station at Red Lion. Several electricians from Philadelpia have just completed the wiring of the building.

PETROS, TENN.—The new electric power house of the State coal mines at Petros has been completed and is being equipped. This is said to be one of the best equipped plants in East Tennessee.

YORK, PA.—The charter of the City Arc Light and Power Company has been received. The company is capitalized at $1,000, and the directors are L. M. Hartman, J. P. Julius, R. H. Shindel, Granville Hartman, Jr., J. Herbert Thomas and William T. Gerber.

JOHNSTOWN, PA. [illegible] H. H. Weaver, Charles R. Glock, M. L. Woolf and C. S. Price are named as the incorporators of the Citizens' Light, Heat and Power Company, which will apply for a State charter Aug. 8. When a State charter has been granted, [illegible] The plans for a light, heat and power plant have already been completed, and everything is ready for the company to go ahead as soon as the requisite papers have been secured.

SHERBROOKE, QUE. [illegible] the concern at $78 per share. The capital stock of the electric company is [illegible] brooke Street Railway and the People's Telephone Company. It is stated that [illegible] cerns will be also merged. There is a considerable amount of feeling excited [illegible] Council recently purchased a water power for the purpose of supplying light to the city.

NASHVILLE, TENN. [illegible]

GILMER, TEX. [illegible] capital stock, $4,000. The incorporators are J. F. Croley, T. C. Mitchell and [illegible]

BEAUMONT, TEX. [illegible] formed; capital stock, $10,000. The incorporators are H. R. Becker, W. A. [illegible]

BEAVER, UTAH.—Construction work upon the big power plant in Beaver Canyon [illegible] pushed to completion with all possible speed. The current will be conducted to the mines of the company beyond Milford [illegible] Milford for lighting and power purposes. Owing to the scarcity of fuel and water, the use of electricity will effect a great saving in the cost of operating the mines and reduction works. It is the intention to convey the current as far as Copper Gulch, a distance of fifty miles, and furnish 500 hp to the Cactus, Mr. Newhouse having entered into a contract to take this amount of power [illegible] concentrator.

RICHFIELD, UTAH.—W. A. Miles has located his power house to supply Richfield and Elsinore, Utah, with light and power, on the Sevier River, about five miles from Richfield. A fall of 231 will be had and about 340 horse-power will be developed.

TOOELE COUNTY, UTAH.—The Clark Electric Light & Power Company of Tooele County, Utah, is erecting a pole line to carry power to the big Honerine Tunnel at Stockton.

PARK CITY, UTAH.—The electric light company at Park City, Utah, is placing meters through the city, as the flat rate will be abandoned.

DAYTON, WASH.—Mr. Mellmunn, proprietor of the Dayton-Pendleton (Wash.) electric road, located a site for a power house about sixteen miles from Dayton. This plant will also supply power to Pomeroy, twenty-seven miles away.

MANNINGTON, W. VA.—The Mannington Electric Light Company has completed plans for a new plant which will be erected in the near future.

SARATOGA, WYO.—The new light plant at Saratoga, Wyo., which has just started operation, has in place a 80-hp boiler, 125-hp Ball engine direct-connected to a 1200-light generator. Space has been provided for an additional boiler and three generators if desired.

THE ELECTRIC RAILWAY.

SAN JOSE, CALIF.—[illegible] Calif., announcing the sale of the electric street railway franchise applied for by L. A. Sage. It calls for a single track electric road from San Jose to Saratoga and Los Gatos.

THE CALIFORNIA PACIFIC RAILWAY, which will build and operate the Los Angeles Tranction branch from Los Angeles to San Pedro, has commenced work on the foundations of the new power house on Pico Street. It will be 150x150 feet and the equipment thoroughly modern.

LOS ANGELES, CALIF.—The Los Angeles Pacific Railway Company of Los Angeles, Calif., will electrify the steam motor line extending from the terminus of the Temple Street line to Hollywood through the oil district. The road will continue to transport oil and other freight, and a passenger service will be added.

SANTA ROSA, CALIF.—An application for a franchise for an electric street railway in Santa Rosa, Calif., was recently presented at a city council meeting by S. N. Griffith. The route of the proposed road covers the principal streets in the city and suburbs. The City Council has declared the Central Street horse-car line a nuisance, thus opening the way for an electric line.

MACON, GA.—The three street car systems of Macon have been merged and the new management will take charge on August 1. A combination was formed between the owners of the Macon and Indian Springs Line, the Savannah Trust Company, J. P. Williams' Sons, of Richmond, Va., and Middeldorf & Co., of Baltimore, who paid over $300,000 for the other lines. Thomas J. Carling, of Macon, will be president of the new organization.

NEW PALESTINE, IND.—The city council has granted a franchise to Charles L. Henry for the Indianapolis & Cincinnati Traction Line—a new enterprise being promoted by Mr. Henry.

WINCHESTER, IND.—A new interurban company was incorporated on the 17th of July, to be known as the Winchester & Muncie Interurban Company to build a line from Union City to Muncie. James E. Lowes is president. The power house will be located at Winchester, a site having been donated.

LOGANSPORT, IND.—The Cass County Commissioners have granted a franchise to the Logansport, Rochester & Northern Traction Company to extend its lines through Spencer Park over a public highway. This is a great victory for the McCullough interest and a severe blow to the local street railway company, [illegible]

RICHMOND, IND.—The contract has been let for the construction of the Hamilton, Eator & Richmond traction line, the project promoted by G. M. Hodges, of Dayton. It went to Falk Brothers, of Milwaukee, who were the [illegible] trolley line, furnish cars and erect fifteen stations.

RICHMOND, IND. [illegible] the contract for the construction of the Hamilton, Eaton & Richmond Traction [illegible] year.

MARION, IND. [illegible] Marion Transit Company and ordered it to tear up all its tracks in the streets [illegible] street without permission and in the night time and connecting its tracks with [illegible] revoked by the council.

ANDERSON, IND.—At a meeting of the stockholders of the Union Traction Company on the 17th inst. it was voted to lease the Indianapolis and Northern lines. They also passed a resolution of consolidation by which all the branch lines will be under the control of the Union Traction Company. The final step in merging all these lines was taken the next day when the Indianapolis-Northern filed with the recorder of Indianapolis a $5,000,000 mortgage on its property to the Colonial Trust Company of New York with the Union Traction

company as guarantee, to secure an issue of $5,000,000 of bonds. The work of completing all these branch lines will now be pushed and when completed will be the greatest interurban system in the world, it is claimed.

LOUISVILLE, KY.—About $50,000 has been subscribed by local capitalists towards a proposed electric line between New Albany, West Baden and French Lick Springs. W. H. Newbury, of the Baden-Lick Sulphur Springs Company, is interested. He states that when $250,000 is subscribed work will begin.

CONCORD, MASS.—The Railroad Commissioners of Massachusetts have approved an issue of bonds to the amount of $165,000 by the Concord, Maynard & Hudson Street Railway, to refund floating indebtedness incurred in building and equipping the road.

OWOSSO, MICH.—The Owosso & Corunna Electric Company which operates a line between the towns mentioned in the title, is to be reorganized and the line will be extended to Durand, twelve miles.

OLIVETTE, MO.—M. B. Greensfelder has filed a petition in St. Louis for the privilege of building an electric or horse power street railway about three miles long. Olivette is a suburb of St. Louis.

ST. LOUIS, MO.—The St. Louis Terminal Depot Company has been organized to bridge the Mississippi and perform other important work. Among other things the company asks for franchises for right of way over about ten miles of city streets and the privilege of operating by either steam or electricity. J. C. Van Blarcom and others are the corporators.

ATLANTIC CITY, N. J.—Note is made of the incorporation in New Jersey of the Atlantic City and Suburban Traction Company with a capital of $500,000, to build a line from Atlantic City to Pleasantville, N. J.

PRINCETON, N. J.—The Johnson Trolley Company has completed its line through Witherspoon Street, in Princeton, to within 100 yards of the campus. After much opposition the company secured a franchise last spring and the line is already in working order.

NEW BRUNSWICK, N. J.—The Trenton and New Brunswick Railroad Company, which is building a line between Milltown, near New Brunswick and Trenton, is securing options on land on the northern side of the Raritan River and then the company intends to extend its line to Elizabeth. The road is to extend from Milltown to the Raritan River and cross by means of a trestle bridge at a point known as Martin's Dock, about two miles below New Brunswick. The road will then continue to Elizabeth, passing south of Metuchen, Rahway, and Linden.

GLOVERSVILLE, N. Y.—A project for an electric line from Cornwall to Toronto is being rapidly pushed by American and Canadian promoters, who have a capital of $8,000,000.

NEWBURG, N. Y.—The Intervale Traction Company, to operate a 28-mile electric railroad from Newburg to Goshen, has been incorporated with $300,000 capital. Directors: Hiram B. Odell, Graham Witchie, Newburg; Charles D. Hobbs, Louis W. Slotensbury, New York.

MOUNT VERNON, N. Y.—The local Board of Aldermen has granted permission to the Port Chester Railroad Company to build its railroad through the city. There were no restrictions as to fares or any other point, except that the railroad is to be built and operated under the restrictions of the State Railroad Commissioners. When the meeting was called to order there were about 500 citizens present, who urged the board to grant the railroad company permission to build its road.

FRANKFORT, N. Y.—Horace E. Andrews, president of the Cleveland Electric Railway and J. J. Stanley, general manager of the company, have been in New York preparing for a development of their New York properties. Two years ago the syndicate obtained a control of the Utica Belt Line Company and built lines to Frankfort, Rome, Utica and Clinton. Negotiations are now on to purchase the Rome City Railway at present using compressed air cars. The syndicate is building a line from Frankfort to Little Falls and another from Clinton to Oneida, giving its trunk line from the latter city to Little Falls 50 miles. The line will be double track throughout and will parallel the New York Central Railway. Freight service will be instituted to compete with the steam road.

BRILLIANT, OHIO.—The Ohio Valley Traction Company is planning to erect a car barn and power station at Brilliant and work will start in the near future.

LIMA, OHIO.—The city council has granted a franchise to the Lima, Delphos, VanWert & Ft. Wayne Traction Company over a route established some time ago.

CINCINNATI, OHIO.—The Cincinnati, Milford & Goshen Railway has been given a franchise to build a spur line into the grounds of the Cincinnati Camp Meeting Association.

SPRINGFIELD, OHIO.—The Springfield, Piqua & Sidney Traction Company has applied for a franchise on Bechtel Avenue, with a view to securing entrance for its new suburban line.

EATON, OHIO.—The Hamilton, Eaton & Richmond Traction Company has secured a 25-year franchise from the county commissioners. The road must be completed by July 4, 1903.

SEBRING, OHIO.—The Stark Electric Railway has been granted a perpetual franchise to operate through the streets of Sebring. The power house near that place is nearly completed.

FINDLAY, OHIO.—The Toledo, Bowling Green & Southern Traction Company is building a new power station near Cygnet. When completed the facilities of the road will be greatly improved.

DAYTON, OHIO.—A new company of Dayton capitalists have obtained an option on the old Reading turnpike between Cincinnati and Lebanon and propose to build an electric road following the route.

SPRINGFIELD, OHIO.—Harry Frey, Jr., promoter of the Springfield-Hillsboro lines, announces that he has succeeded in disposing of the bonds for the new road and states that construction work will start within six weeks.

TOLEDO, OHIO.—The Toledo Railways & Light Company has [illegible] a tract of about thirty acres of land on the W. & L. E. Ry. and [illegible] to erect large car barns, repair shop and storage house for [illegible] and city cars.

CINCINNATI, OHIO.—The Cincinnati & Eastern Railway Company has received a large shipment of red cedar poles from Idaho for use on the new line between Cincinnati and New Richmond. Work on the line is progressing rapidly.

CINCINNATI, OHIO.—It is announced that the Columbus & Cincinnati Traction Company has secured all required right of way for a 119-mile line between the two cities and that negotiations are being made with eastern contractors to build the road.

HAMILTON, OHIO.—J. C. Hooven, president of the Cincinnati, Hamilton & Indiana Traction Company has made application to the county commissioners for a franchise from Hamilton to College Corner and Oxford. All required consents have been obtained.

MARIETTA, OHIO.—The Parkersburg, Marietta & Interurban Railway Company recently organized under West Virginia charter with $440,000 capital stock, has been authorized to do business in Ohio. The road is now in operation from Parkersburg to Marietta.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company has secured much of the right of way for an extension from Middlefield to Sharon, Pa., by way of Bloomfield, Greene, Gustavus, Kinsman and Orangeville, about 38 miles. Courtland citizens are endeavoring to have a spur line touch their town.

YOUNGSTOWN, OHIO.—Park & Hamilton, who organized the Youngstown & Southeastern Railway to build a line to Struthers, have withdrawn in favor of the Pennslyvania & Mahoning Valley Railway, which proposed to build over the same route, and Park & Hamilton have taken the contract for building the line.

NEW RICHMOND, OHIO.—The Cincinnati & Eastern Traction Company, which is building to New Richmond, will have river connection with Augusta, Ky., arrangements having been completed for a large passenger steamer to ply between the towns. This will enable the company to compete with the C. & O. (steam) for business on the Kentucky side.

COLUMBUS, OHIO.—The Greenville & Union City Traction Company has been incorporated with $10,000 capital stock by Dr. J. E. Lowe, J. E. Feight, W. B. Gebhart, R. H. Deweese and C. M. Anderson. The road will be an extension of the Dayton & Northern, which is owned by the same people. Contracts for the construction work have been placed.

TOLEDO, OHIO.—Charles P. Griffin, G. G. Metzger and W. T. King and others who are interested in several Ohio traction roads, have organized a company to build the Bloomington, Peoria & Pekin Railway. Right of way has been secured between Bloomington and Pekin, Ill., and work will start as soon as the balance has been secured, which will be in the near future.

NORWALK, OHIO.—The Lake Shore Electric Railway Company has obtained a franchise for a new line in Norwalk, affording a better entrance for the Norwalk-Sandusky division of the road. The company has received permission to relay its tracks in town with 70-pound T rails instead of the girder rails now in use. A special nosed brick is to be used inside of the track adjacent to the rails.

COLUMBUS, OHIO.—The merger of the Columbus, Buckeye Lake & Newark Traction Company, the Newark City Street Car Company and the Newark & Granville Traction Company has been effected under the title of the first mentioned company. Officers have been elected as follows: P. L. Saltonstall, Boston, president; Chauncy Eldredge, Boston, secretary-treasurer. The above, with J. R. Harrigan, M. J. Loftus and C. A. Alderman, of Newark, are directors.

CLEVELAND, OHIO.—R. L. Andrews, of the Eastern Ohio Traction Company, and Barney Mahler, of the Lake Shore Electric Railway, have been appointed a committee by the Cleveland interurban roads to negotiate with the officials of the city companies with a view to the speedy construction of the union freight station already started on Bolivar Street. The plan is to induce the city companies to build and operate the freight station. The freight business of all the Cleveland roads is being held up because of inadequate terminal facilities.

KINGSTON, ONT.—Folger Bros., of Kingston, Ont., who have the controlling interest in the street railway company of that city, are now arranging to utilize the water privileges at Kingston Mills for creating power for car service and for supplying the public. This proposition is contingent upon the city acquiring the present electric plant, the price for which was fixed by arbitration, but is now in the courts for readvisement on the appeal of the electric company.

WINDSOR, ONT.—An American civil engineer is inspecting the topography of the country between Windsor and St. Thomas, Ont., for a syndicate which, it is said, means to build an electric railway between the two cities. It is proposed to have the line parallel the system of the Michigan Central and the Lake Erie and Detroit River Railway, through a rich and populous district, the residents of which have now to haul their produce a long way to the railway stations. Just who is behind the movement for the new road is not disclosed.

HULL, QUE.—The Hull Electric Railway, which runs through the city of Hull from a terminus at Ottawa to Aylmer, Que., is now owned and operated by the Canadian Pacific Railway Company. The Gatineau & Pontiac Railway systems, which were amalgamated with the Hull electric line, were acquired some time ago by the Canadian Pacific, the present deal being part of that purchase. The price paid for the electric system is placed at $700,000.

HAWKINS, TENN.—The County Court of Hawkins, Tenn., has voted to issue bonds to the amount of $100,000 in aid of an electric railway.

NASHVILLE, TENN.—The court of chancery appeals has delivered a decision invalidating the consolidation proposed by the constituent lines of the Nashville railway. The city held that the consolidation was effected in 1900 without its consent. The consolidated properties are bonded at $6,500,000.

BEAUMONT, TEX.—The Beaumont Street Railway Company will shortly open its line for traffic. The power house is completed and track laying is being pushed. Lack of cars has held up the company for nearly a month.

DALLAS, TEX.—A. K. Banta, representing the United Electric Securities Company of Boston, and head of the new Metropolitan Street Railway Company of Dallas, announces that he and associates have purchased the Rapid Transit Electric Street Railway of Dallas. The only competition now against the new concern is the Dallas Consolidated with about 35 miles of trackage.

NORFOLK, VA.—A four-million-dollar first mortgage has been recorded in Norfolk for the consolidation of the Norfolk, Newport News and Portsmouth electric railway systems. Also a first income mortgage of two million dollars has been recorded to the Richmond Trust and Safe Deposit Company.

CLARKESBURG, W. VA.—Hon. J. A. Howard, promoter of the Fairmount & Clarksburg Electric Railway, states that the line between Fairmount and Clarkesburg will be built this year.

OBITUARY.

MISS ELISE NEUMANN.—A special cable dispatch from Berlin of July 24 says: Elise Neumann, the first woman who received the degree of doctor of philosophy of Berlin University, was found dead in bed yesterday in her laboratory here. She had been engaged in experiments in electric chemistry and it is supposed that she accidentally poisoned herself. She was a sister of the African explorer, Oscar Neumann.

PERSONAL.

MR. HENRY FOURNIER, the famous French automobilist, promises to return to the United States in September with a new car of great speed.

MR. GEORGE F. McCULLOCH, president of the Union Traction Company, and Mrs. McCulloch, will sail for Europe the first of August, to be gone two months.

MR. T. W. HOPKINS, local manager of the Citizens' Telephone Company, at Galveston, Tex., has resigned his position. His successor has not been appointed.

MR. S. BERGMANN, the electrical manufacturer, who after a successful career in this country, has been equally successful in Germany, is about to visit this country again.

MR. GEORGE WESTINGHOUSE was a guest at a dinner given in honor of Mr J. Pierpont Morgan by Mr. A. W. Maconochie, M. P., at the British House of Commons on July 24. Premier Balfour was also one of the party.

MR. R. E. GAUNT has been appointed general manager of the Lexington, Ky., Railway Company, succeeding E. C. Hathaway, who has been made general manager of the Norfolk, Portsmouth and Newport News Company at Norfolk.

MR. G. F. BROCKMAN, for the past three years superintendent and chief engineer of the Cold Spring, N. Y., Light, Heat & Power Company, has resigned that position and has become superintendent of the Newton, N. J., Gas & Electric Company.

MR. A. E. TOWER, a wealthy metal merchant at Poughkeepsie, whose wife killed herself and a 15-year-old son some months ago, has become engaged to Miss Mary Bogardus, a telephone operator in the Hudson River Telephone Company's exchange at that city.

MR. JOSEPH WETZLER, president of the Electrical Engineer Institute of Correspondence Instruction, of New York, has been suffering from a severe attack of rheumatism and laid up at his Far Rockaway cottage, but a host of friends are glad to learn of his recovery.

MR. H. C. LANG has resigned his position of secretary of the Springfield & Xenia (Ohio) Traction Company and Will Christy has been elected to fill the vacancy. Mr. Lang continues as secretary of the Southern Ohio Traction Company and the Western Ohio Railway.

MR. F. D. ROUNDS, some years ago general superintendent of the Metropolitan Street Railway Company of New York, and well known in street railway and electrical circles, is reported to have committed suicide at Hoboken, N. J., where he was found dead with a bullet wound in his head.

MR. R. S. MASSON, who is one of the incorporators of the Arizona Power Construction Company and consulting engineer for the Huntington-Mellman electrical enterprises in Southern California, returned recently to Los Angeles. He had been inspecting an electric power site in Arizona.

MR. HENRY D. ESTABROOK, a member of the law firm of Lowden, Estabrook & Davis, of Chicago, on Sept. 1, will take charge of the law department of the Western Union Telegraph Company as general attorney for that corporation, succeeding George H. Fearons. His headquarters will be in New York.

MR. C. T. MALCOLMSON, superintendent of power and transmission exhibits in the department of machinery of the St. Louis Exposition, has been on a trip to the East with a view to arranging for apparatus for a temporary or, rather, preliminary plant, which is already very much in demand to meet the calls for power.

MR. EDWARD P. BURCH, as engineer of a municipal electric light plant to be built at Grand Rapids, Minn., has issued a very complete set of specifications for the plant, which are published in pamphlet form. The completeness of the specifications may be assessed from the fact that they occupy forty large octavo pages.

MR. WILLIAM STANLEY contributes an interesting chapter of personal and general electrical history in an affidavit recently made by him in pending litigation between the Westinghouse and Stanley companies. It is a striking review of alternating current development during the last two decades and abounds in dates, references, etc.

MR. J. R. CURTISS has been appointed superintendent of construction on the extension of the Canton-Akron Railway, Ohio, from Navarre to New Philadelphia. Work on the line is progressing rapidly. Mr. Curtiss was formerly at the head of the Curtiss Construction Company, of Cleveland, and has been identified with the building of a number of Ohio roads.

MR. WILLIAM M. RANK has been appointed assistant general manager of the North Shore Railroad Company, California. President John Martin has been acting as general manager since the death of Jerome A. Fillmore. Mr. Rank was formerly connected with street railways in Oakland. The North Shore Company is preparing to build a standard gauge electric road between Sausalito, Mill Valley and San Rafael.

MR. ADOLPHO ASCHOFF, a well-known Brazilian engineer and electrician, has just arrived from Rio Janeiro, and will spend a little time in this country before going on to Europe. He was here last in 1893-4 when attached to the Brazilian Commission at the Chicago World's Fair. Just at present he is carrying out some street railway enterprises and will secure apparatus while in this country, where he has a great many friends and acquaintances.

ROEBLING-ESTABROOK.—At Trenton, N. J., on July 25, the engagement was announced of Miss Blanche Estabrook, of Chicago, daughter of Henry Estabrook, general solicitor of the Western Union Telegraph Company, and a niece of Col. Robert C. Clowry, president of the same company, to Karl G. Roebling, son of Ferdinand W. Roebling and a director of the John A. Roebling Sons' Company. He was graduated from Princeton in the class of 1894.

MR. CHARLES J. SEIBERT, formerly of the Sprague Company, and now electrical engineer for Abraham & Company of Manaos, Brazil, which concern is represented in New York by Bytton Brothers, of 66 Beaver Street, has sailed for Brazil after a visit of several weeks duration in the United States. Mr. Seibert expects to close some half dozen further contracts for small lighting plants somewhat similar to that which has been ordered by the village of Labria, already noted.

MR. A. H. BROOKS, chief of the party which under the U. S. Geological Survey is exploring and investigating in Alaska, has called attention to the extensive water powers existing in the southwestern portion of Alaska. This is the narrow portion of the country, extending southward along the Pacific coast, upon which Juneau, Sitka and Skagway are located. Low grade ores in large bodies are found and can be worked to advantage by making use of excellent water powers, which abound in the region. In the Ketchikan mining district the water powers are available for the entire year.

MR. H. H. PEARSON, JR., president of the New Orleans Railways Company has given out the following list of its officials and staff: Mr. Chas. H. Ledlie, first vice-president; Mr. Jos. H. DeGrange, second vice-president; Capt. John G. Woods, general manager railway department; Mr. Bankson Taylor, general manager gas department; Mr. Alexander Black, chief engineer and electrical department; Mr. E. B. McKinney, superintendent power houses; Mr. H. A. Ferrandou, auditor of the City & Orleans Railroad Companies; Mr. E. J. Morris, master mechanic; Mr. John R. McGivney, purchasing agent.

PROF. A. G. BELL has been very busy lately over his aeroplane. A telegram from Sydney, C. B., of July 28, says: Prof. Alexander Graham Bell has nearly completed his flying machine, which he expects to test very shortly. The machine is being built under his personal direction and is radically different from Santos-Dumont's machine. Every effort has been made to keep secret not only the details of the construction, but the fact that such a machine is being built. Nevertheless, it is reported to be 20 feet long and to be composed of twenty-five distinct parts. It is celled internally with canvas and in places with linen stretched on piano wires. Five miles of this wire were used in the construction. The principle of the kite will be utilized to a considerable extent.

ATTENDANTS AT CONTRACTORS' MEETING.—Up to the present time we have not received the list of those in attendance at the recent annual convention of electrical contractors in Philadelphia, although it was promised officially at the time. Through the courtesy of Mr. Alexander Henderson, who managed the special train from New York to Philadelphia, we are able to give below the names of his party: H. C. Adams, Peru Electric Manufacturing Company, New York, N. Y.; G. A. Annable, Cutter Electric & Manufacturing Company, New York, N. Y.; Thomas H. Bibber, J. L. Kirkland, H. B. Kirkland, Thos. G. Grier and R. R. Corey, American Circular Loom Company; Arthur Bosley, Electric Material Company, Baltimore, Md.; C. A. [illegible], Marine Engine and Machine Company, New York, N. Y.; John H. Dale, Dale Manufacturing Company, New York, N. Y.; Avery P. Eckert, Safety Insulated Wire & Cable Company, New York, N. Y.; A. C. [illegible], City Electrician, Atlantic City, N. J.; E. W. Goldschmidt; F. M. Hawkins and W. B. Hall, Pass & Seymour; C. I. Hills; Robt. T. Lozier, Bullock Electric Manufacturing Company; H. G. Issertel and Alex. Henderson, Sprague Electric Company; W. C. Ballda, B. & C. Electric Construction Company, Utica, N. Y.; J. W. McDewell, Manhattan Electric Supply Company, New York, N. Y.; H. E. Monk, Ostrander & Company, New York, N. Y.; J. M. Wakeman, T. C. Martin and George W. Elliott, ELECTRICAL WORLD AND ENGINEER; Mortimer Norden, Norden Bittner Electric Company, New York, N. Y.; G. A. Nisbet, G. I. Company, New York, N. Y.; J. B. Olson, Habirshaw Wires, New York, N. Y.; A. A. Pope, Luther Stieringer and Arthur Williams, New York Edison Company; J. Jones Jr., J. Jones & Son, New York, N. Y.; Robt. McKean Thomas, Thomas & Betts, New York, N. Y.; W. J. Watson, American Electrical Works, New York, N. Y.; C. L. Eidlitz, Pres. National Electric Contractors' Association, New York, N. Y.; Harry Alexander, New York, N. Y.; Fred Blackall, Blackall & Baldwin, New York, N. Y.; A. J. Martin, Commercial Construction Company, New York, N. Y.; S. Davis, Conduit Wiring Company, New York, N. Y.; Mr. Haviland, Edwards & Company, New York, N. Y.; J. C. Hatzel, Hatzel & Buehler, New York, N. Y.; Geo. W. Russel, Russel & Company, New York, N. Y.; J. R. Strong, Tucker Electric Construction Company, New York, N. Y.; J. D. Van Wagoner, Van Wagoner & Linn, New York, N. Y.; E. S. Keefer, Western Electric Company, New York, N. Y.; J. C. Stearns, Buffalo, N. Y.; W. H. [illegible], Johnson & Morton, Utica, N. Y.; F. L. Frost,

Albany, N. Y.; James Hilton, Rodgers & Hilton, Syracuse, N. Y.; J. H. McCarthy, McCarthy Brothers & Ford, Buffalo, N. Y.; H. L. Sackett, Buffalo, N. Y.; Mr. Wilhelm, Wilhelm Telephone Manufacturing Company, Buffalo, N. Y.; H. D. Pierce, Water Valley, N. Y.; F. W. Newman, Albany District Telephone Company; E. G. Bernard, Troy, N. Y.; Messrs. Schmidt, Horton, Whipple, Jennings, Peacock, Crowley, Hall and Kingston, all of Rochester, N. Y.; E. E. Newbury, St. Louis, Mo.; Frank J. Miner, Seidler-Miner Electric Company, Detroit, Mich.; Mr. Sutter; Mr. Andrews; Frank Stout, I. P. Frink & Company, New York, N. Y.; Mr. Luckhurst; J. F. Burns, Schenectady, N. Y.; C. E. Corrigan, Osburn Conduit Company, New York, N. Y.; H. C. Roberts, H. C. Roberts Electrical Supply Company, Philadelphia, Pa.; Messrs. Dolbier and Coster, Walker & Kepler; Thos. H. Townsend, Vallee Brothers Electric Company; Mr. Keller, Keller, Pike & Company, Philadelphia, Pa.; Mr. Boyd, Baltimore, Md.; Mr. Gray, Minneapolis, Minn.; Judge McCleary, Detroit, Mich.

NEW INDUSTRIAL COMPANIES.

THE RAILWAY AND ELECTRIC SUPPLY COMPANY has been formed; capital, $50,000. Directors: H. M. Shaw, East Orange; E. E. Shaw, G. C. Moon, New York.

THE EASTERN INSULATION COMPANY, formed at Newark, N. J., will manufacture wire insulation; capital stock $100,000; incorporators, Robert W. Taylor, Rudolph Brummeshop, Louis P. St. Clair.

AUTOMATIC CALLS.—The Wilson Automatic Bell Call and Fire Alarm Company has been incorporated at Buffalo; capital, $100,000. Directors: Edward J. Bowen, L. E. Haynes and F. S. Parker, Buffalo.

THE LAGONDA MANUFACTURING COMPANY, of Springfield, Ohio, has been incorporated by H. C. Wineland, J. W. Gunn, C. Pence, and Baldwin McGrew to manufacture boiler cleaners, tools, supplies and steam specialties. Capital stock $10,000.

THE POMEROY MOTOR VEHICLE COMPANY, of Brooklyn, has been chartered by the Secretary of State. The capital stock is $120,000. The directors of the company for the first year are as follows: Bernard H. Pomeroy, James L. Lazelle and Charles D. Winfield, of Brooklyn.

THE GENERAL ENGINEERING & CONSTRUCTION COMPANY recently organized at Akron, Ohio, with R. T. Nailer, president, C. J. Brunner, vice-president, and J. E. Leighton, secretary-treasurer, will do electrical construction work and manufacture electric tram cars and outfits for industrial equipments.

CLARK WIRELESS TELEGRAPH CO.—Articles of incorporation of the Thos. E. Clark Wireless Telegraph-Telephone Company have been filed at Lansing, Mich. The capital stock is $250,000, of which $150,000 is paid in and the shareholders are Thomas E. Clark, $50,000; John Hubbard, $25,000; Thomas F. Ahern, $25,000 Thomas E. Clark, trustee, $75,000; John Hubbard, trustee, $25,000; Thomas F. Ahern, trustee, $50,000. The company has bought out all Clark's patents, and the instruments and equipments worked under Clark's patents in Detroit by the American Engineering Co. and these have been turned over. This new organization will be a parent concern, doing business after the plan adopted by the Bell Telephone Company in forming subsidiary companies to control certain districts.

LEGAL.

STORAGE BATTERY SUIT DECIDED.—On July 23, 1902, Judge Kohlsaat, at Chicago, dissolved the restraining order granted against the Porter Battery Company of Chicago under suit brought by the Electric Storage Battery Company of Philadelphia. Injunction against the manufacture of the Porter storage battery was denied.

CAR FENDER ORDINANCES.—As to car fenders, a judge has decided that the city council has no right by legislative outhority, either expressed or implied to pass an ordinance requiring a street railway company to place fenders on all its cars. The street railway company refused to obey the ordinance and suit was brought to enforce it.

IMPORTATION OF STORAGE BATTERIES.—Judge Thomas, in the U. S. Circuit Court, New York, has granted a temporary injunction restraining the International Power Company and the Manhattan Transit Company from importing, manufacturing, selling or using any storage batteries made under the Brush patent of 1886, claimed to be owned by the Electric Storage battery Co., and especially the "so-called Fulmen batteries." The defendants are required to show cause on August 6 why the injunction should not be made permanent. The order of the court was served upon Geo. W. Hoadley, treasurer of the International Power Company, and F. W. Curtis, secretary of the Manhattan Transit Company.

Trade Notes.

THE STANDARD ELECTRIC COMPANY, of Erie, Pa., has been incorporated under the laws of Pennsylvania, and has changed its name to that of the Federal Electric Company.

NOME, ALASKA.—The John M. Klein Electrical Works recently shipped fifty telephones to Nome for a new telephone system that will be established there. This house has a great demand for telephones all over the coast for independent companies and private lines.

INDICATING ENCLOSED FUSES.—[illegible] of [illegible]

CLEVELAND, OHIO.—[illegible] awarded the contract for the largest of three mammoth cranes to be installed [illegible] a 70-ft. span with 60 tons capacity, and will be electrically driven.

THE GREGORY ELECTRIC COMPANY, [illegible] publishes a list of installations which it has supplied with electrical apparatus. The 2,000 or more names in this list make the pamphlet a useful reference list to central stations and isolated plants. Every State in the Union appears to be represented, and also several foreign countries.

ELECTRICITY IN CEMENT WORKS.—An interesting article appeared in these pages on July 19, of the use of electricity at the American Alsen Cement Company's Works, West Camps, N. J. We learn that all of the electrical machinery, with the exception of the balancing transformer, was furnished by the Crocker-Wheeler Co., of Ampere, N. J.

STUART-HOWLAND COMPANY, 279-287 Devonshire Street, Boston, report great activity in business. They now have 12 salesmen on the road calling upon the electrical trade throughout the greater part of the United States and Canada. Their foreign trade is also increasing and is quite a factor in their business. They have recently acquired several exclusive Eastern agencies, including that of the Acme time switch.

WARREN, OHIO.—The Sterling Electric Company has elected old directors as follows: W. A. Smith, C. G. Denison, G. C. Webster, Wm. Coale, Washington Hyde, Charles Devoe and G. B. Devoe. Officers: W. A. Smith, president; C. G. Denison, vice-president; G. C. Webster, secretary, and Wm. Coale, treasurer. It was decided to increase the capital stock from $50,000 to $1,000,000. Work on an addition to the plant has been started.

COLUMBUS, OHIO.—John G. Webb and H. A. Fisher, of the Columbus, Delaware & Marion Railway, visited the factory of the Kuhlman Car Company, Cleveland, a few days ago to inspect the new cars being built for the company. They are among the finest cars ever built, being 57 ft. over all, with smoking compartments and all modern improvements. They will be equipped with four 75-hp G. E. motors and with the type N. multiple unit controllers.

WOTTON ELECTRIC & MANUFACTURING COMPANY, of Atlanta, Ga., have recently installed an up-to-date cabinet shop, and are prepared to fill orders promptly for annunciators, etc., in regard to which they have just issued a neat little bulletin, which is now about ready, and which brings out very prominently the features most vital in the manufacture of this important class of apparatus. The condenser is always worth consideration, and copies of another bulletin on it should be also secured.

THE GREEN FUEL ECONOMIZER COMPANY, Mattawan, N. Y., have recently issued a handsome catalogue in octavo size, of about 100 pages, devoted to the Green economizer. A large number of plants are illustrated in which the economizer has been installed, while prospective and diagrammatic details are given of the construction of this well-known apparatus. These are accompanied by numerous testimonials from users. There is also a large amount of technical data, with tables, etc., relative to chimneys and fuel, boiler temperatures, etc. The pamphlet is not only interesting, but valuable, and of the kind that an engineer usually keeps around on his desk.

HARRISBURG ENGINES.—The Harrisburg Foundry & Machine Works, Harrisburg, Pa., has gotten out in unique form a list of Harrisburg engines in use all over the world. The usual book-form of such lists is departed from; in this case the list is given on one slip of paper 22 ft., 10 in. long by 4¾ in. wide, and folded in zig-zag fashion so as to make a pad about 3 in. by 4¾ in. when it is closed up. The list is arranged by States and foreign countries, alphabetically, the names of the concerns operating Harrisburg engines and their location, together with the horse power of the engines being given. The total horse power represented is given as nearly one-half million.

THE GEO. WORTHINGTION COMPANY, 95-103 St. Clair St., Cleveland, Ohio, a well-known and large hardware concern, have issued a very handsome catalogue in paper cover, devoted almost entirely to electrical apparatus and supplies, and known as their electrical catalogue. There are no fewer than 150 pages, all of which are profusely illustrated, while details are given of the apparatus, with prices. The book includes annunciators, electric gas lighters, push-buttons, switches, lamps, cable clips, pulley blocks, conduit, magnetos, electric motors, fuses and fuse blocks, insulated wire and cables, small generators, insulating materials, etc. Several hundred cuts are shown.

ECONOMICAL ELECTRIC LAMP COMPANY, 123 Liberty Street, New York City, have just issued a very neat and interesting little pamphlet entitled, "A Tale of a Turndown," devoted to their ingenious lamp for giving two degrees of light. The lamp screws into an ordinary socket, and when current is on, the amount of light can be changed without touching the bulb. There are two strings with lettered tags; one says "Dim" and the other says "Bright," and each when pulled gives a corresponding illumination. Lamps of several candle powers and voltages are furnished and prices are quoted on large or small quantities. A price list, pamphlet, etc., will be sent on application.

BUYING AN AUTOMOBILE.—A good plan for the beginner at automobiling is to buy a second-hand machine, says *Country Life in America*. There may be good reasons against this; the previous owner may have abused his car, or a new car may have more improvements or conveniences; still, price is an object to many, and good second-hand cars may be had from the manufacturers who have used them for demonstration or similar purposes. A little paint and overhauling will often change a well-worn automobile into a desirable bargain for the prospective automobilist. Again, some owner may desire a larger or more powerful car, in which case he is willing to dispose of his present machine at a reasonable price, and in first-class condition.

PACKARD LAMPS.—The success of the Packard lamp in the last year has been most pronounced, especially among the street railway companies. The

[illegible] increase in the lamps in actual use of about 8 per cent. This success in the street railway line has followed closely upon their success in the manufacture of lamps for commercial service, and is due largely to the policy of the company in sticking to standard lamps and avoiding novelties and freaks. The Electric Appliance Company are selling agents, Chicago.

WALRATH GAS ENGINES.—[illegible] become so great that the company has been compelled to enlarge its plant at Marinette several times, and, having reached the limit of its capacity again, they have decided to erect an entirely new plant at Warren, Pa., which is now in course of construction, and which it is expected to be in full operation by the beginning of the year. It is the intention of the company to devleop the engine in large sizes for use on producer gas, and with this end in view has erected at its factory a complete Taylor producer for thoroughly testing their machines. It may be recalled that this engine received the highest award at the Pan-American Exposition. The Eastern agents, the MacKay Engineering Company, also reports the sale of two engines, 125 and 150-hp, for belted service, to the town of Middleboro, Mass., as well as one 20 and one 30-hp engine for Boston parties, in addition to some smaller machines.

THE WORLD'S WORK for August gives a large portion of its pages to the seasonable subject of the whole people at play. A series of strikingly interesting stories and experiences, descriptions of recreation country, articles on striking development of the continental-wide business of vacation-making, all filled with the spirit of the American summer, are written by Walter H. Page, Julian Ralph, Lindsay Denison, Charles F. Holder, E. T. W. Chambers, Arthur Goodrich, W. G. Cuniff and Ray Stevens. And the hundred illustrations which accompany this special feature of the number help the text to bring the reader [illegible] the Great North Woods, the varied New England resorts by Wisconsin Lakes, over the Rockies, by the shores of Santa Catalina. Be[illegible] and Among the World Workers there are such additional features as Frederick Palmer's fine article about West Point after a Century, illustrated by Frances Benjamin Johnston—a companion article [illegible] Naval Academy article in the July number [illegible] How Labor is Organized, by Ray Stannard Baker. Russell Doubleday, who wrote A Gunner Aboard the Yankee, tells of the [illegible] New York and Chicago—a striking chapter [illegible] P. Austin, Chief of the Bureau of Statistics at Washington, discusses the future of the American commercial invasion.

THE EXIDE BATTERY, manufactured by The Electric Storage Battery Company, of Philadelphia, combines, it is claimed, the three necessary features of a commercially successful automobile battery—high capacity, long life and freedom from structural weakness. A phenomenally high mileage capacity does [illegible] successful battery, as the increase in [illegible] maintenance cost far outweighs the advantages thus gained. The Exide battery is the result of a most careful series of tests made by The Electric Storage Battery Company in the operation of vehicles by the New York Transportation Company, which after a year or more of continuous service with seventy-five sets of the Exide decided that these batteries provided a sufficient mileage capacity for all classes of service, together with a cost of operation, including maintenance, which is reasonable. Runs of over sixty miles have been frequently made and a conservative estimate of the life of these cells is placed at [illegible] An interesting statement is made by an engineer who has had under his personal observation hundreds of electrical vehicles in daily service to the effect that the Exide Battery is "better adapted to its work than are other portions of the equipment and in point of maintenance cost, is a smaller [illegible] in the total expense than are, for instance, the rubber tires on the vehicle it runs."

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 22, 1902.

[Conducted by Wm. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

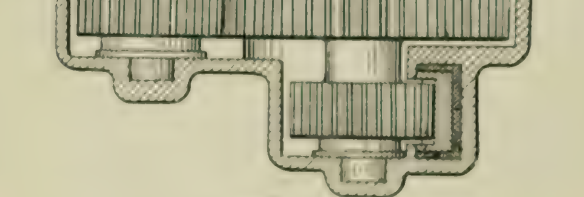
705,016. TRAIN CONTROL SYSTEM; C. E. Barry, Schenectady, N. Y. App. filed Dec. 16, 1898.

705,028. CAR BRAKE; A. Mroluska, Detroit, Mich. App. filed May 12, 1902. A frame under the platform of the car contains gearing interposed between the brake staff and the brake rigging.

705,049. CAR TRUCK; [illegible] App. filed Nov. 18, 1901. Details.

705,056. TONGUE SWITCH; G. M. Ervin, Johnstown, Pa. App. filed Nov. 12, 1901. [illegible] the adjacent main-rail are formed by a separate wear-plate of extra hard metal, which can be removed and replaced.

705,057. RAILWAY TRACK STRUCTURE; G. M. Erving, Johnstown, Pa. App. filed [illegible] the [illegible] can be easily removed and replaced.



705,028. Car Brake.

705,0[illegible]. DEVICE FOR PREVENTING HUMMING OF TELEPHONE WIRES; [illegible] App. filed Sept. 6, 1901. (See page 175.)

705,0[illegible]. CAR SEAT; H. S. Hale, Philadelphia, Pa. App. filed April [illegible] side edges, one being flat and the other bulging.

705,0[illegible]. MANUFACTURE OF CARBON ELECTRODES; C. M. Hall, Niagara Falls, N. Y. App. filed Oct. [illegible]

705,0[illegible]. SURFACE CONTACT ELECTRIC RAILWAY; E. M. Hewlett, Schenectady, N. Y. App. filed Oct. [illegible]

705,083. ELECTRIC RAILWAY; F. W. Hild and S. B. Stewart, Jr., Schenectady, N. Y. App. filed Nov. [illegible]

705,09[illegible]. SUPERVISORY RELAY; W. [illegible], Chicago, Ill. App. filed Feb. 4, 1901. (See page 175.)

705,131. RAILWAY TRACK STRUCTURE; [illegible] App. filed Nov. 10, 1901. The wear-plate is provided with lugs extending outward and engaging with portions of the structure and being secured thereto by means of keys or wedges.

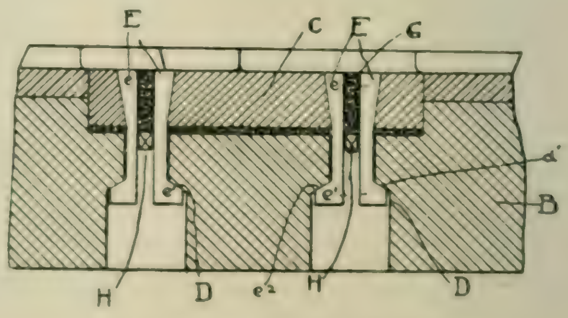
705,136. ELECTROMAGNETIC SWITCH FOR SURFACE CONTACT ELECTRIC RAILWAY SYSTEMS; W. B. Potter, Schenectady, N. Y. App. filed Oct. 11, 1897.

705,137. ELECTRIC SWITCH; W. B. Potter, Schenectady, N. Y. App. filed [illegible] Renewed April 23, 1902.

705,138. BLOW-OUT MAGNET; W. B. Potter, Schenectady, N. Y. App. filed Feb. [illegible] Renewed April 23, 1902.

705,150. STREET CAR FENDER; H. J. Schuldt, St. Paul, Minn. App. filed Nov. 25, 1901. A pair of toggle levers for supporting the fender are combined with a trip and resetting device controlled by a plunger which the motorman can operate with his foot.

705,164. RAILWAY SWITCH; A. G. Turcotte, Holyoke, Mass. App. filed Jan. 27, 1902. A projection from the car co-operates with certain mechanism in the roadbed for throwing the switch.



705,057. Railway Track Structure.

705,[illegible]. PUSH POLE; [illegible] App. filed May [illegible] site ends of the pole.

705,[illegible]. ADJUSTABLE BRAKE HEAD; [illegible] App. filed [illegible] point of adjustment.

705,[illegible]. TRUCK BOLSTER; H. R. Keithley, Buffalo, N. Y. App. filed [illegible] superposed at the ends of the bolster.

705,[illegible]. IRIDESCENT COATING OF COPPER, BRONZE, OR LIKE SURFACES; [illegible] App. filed Dec. 31, 1901.

705,466. STREET CAR FENDER; O. Spillern-Spitzer, Brunnersdorf, Kaaden, Austria-Hungary. App. filed [illegible] end, which can be let down when desired by the motorman.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

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CONTENTS.

GREAT TRACTION DEVELOPMENTS.

The public of Greater New York is at present more impressed with the fact that preparations are being made to provide it with the new rapid transit facilities that it needs than with the not less striking fact that all the work in question depends upon electricity. We print elsewhere a summary of Mayor Low's admirable locution on the subject of the transportation problems of Manhattan Island, and it is curious to note even there how the speaker harks back constantly to what electricity is going to do, without being conscious apparently that but for electricity, the problems would be approached, and would have to be solved, in very different fashion. The same is true of the Chicago aldermen who have been in New York lately, investigating subways and systems, and have evidently gone home impressed deeply with the idea that their great city must have an equal share in the benefits that, apparently, electricity alone can confer on modern centers of dense population.

Electricity is indeed the keynote, and every electrical engineer is stimulated at once by the magnificent opportunities of new work thus presented, as well as by the confident manner in which the leading and most progressive communities of the Old World and the New lay these burdens and responsibilities upon his shoulders. With these pending changes accomplished, the age of steam, cable, air and horse will have definitely closed in urban transportation, and electricity alone will reign exclusively and supreme. And while this means much to the electrical engineer, it means not less to the art and industry; for even with the existing outlook it is impossible to conceive how the plant and apparatus required can be furnished without large additions to manufacturing facilities already inadequate to meet the demand.

So far as New York is concerned, it is well enough; but there is involved a great gain to the traveling public at large. Not only is the Pennsylvania Railroad committed to the adoption of electricity, but the New York Central has reached the point where it breaks away from an ancient regime and adopts the newer motive power, with all that is implied in so serious and momentous an improvement. It would indeed have been an intolerable anachronism for the filthy old Park Avenue tunnel to continue operated by steam while other trans-continental accesses and all the local subway routes were being traversed by means of electricity; and it is interesting to note that having once determined to adopt electricity terminally, the New York Central avows itself ready to utilize the same agency for its large suburban business. In fact, that change was again consequent and inevitable; but it is better to have it come as part of a systematic and scientific programme than as a slow and piecemeal revolution keeping things in confusion over a long series of years. That the change again may involve, through the use of common electrical methods, a close alliance between New York Central and the Manhattan Elevated system, is by no means improbable; is, indeed, strictly logical.

GERMAN ELECTRICAL STANDARDIZATION.

Following in the wake of the American Institute of Electrical Engineers, the Association of German Electrical Engineers appointed a standardization committee last year to draw up a set of rules relating to the testing and classification of electric machinery. The committee presented its first report in 1901. This year an extended and more complete report has been accepted, which bids fair to be officially adopted in Germany in the near future. It is interesting

to notice the resemblances and differences between the reports of the German and American standardization committees. They follow the same general lines, commencing with definitions and ending with a table of voltages; but the differentiations are of the greater interest.

Among the German definitions is that of "starvoltage," as distinguished from the simple "voltage" of a three-phase system, and is the voltage between any terminal and the neutral point. This term would be very acceptable in our own general use. A seemingly useful German classification of machinery with respect to service is that of

(1) Intermittent service, to which one hour's full load test is applied.

(2) Short-period service, to which a specified period of load test is applied.

(3) Continuous service, to which ten hours of load test is applied. In the American rules there are only two classes: that of continuous service tested for a sufficient period to attain a close approach to final temperature, and that of discontinuous service, tested under specified conditions. The necessity for the third class does not appear to have presented itself in American practice. The methods of measuring the temperature elevation of machines follow the same lines in both reports, but are somewhat more detailed in the German schedule. The new American rules are somewhat more precise, however, in the application of the temperature coefficient of resistivity in copper.

It is curious to observe that the German rules specify that mechanical power should be measured in horse-power. This seems to be deplorable, although on commercial grounds it may be temporarily condoned. It is to be hoped that in all countries the kilowatt will displace the horse-power as the unit of power. There is no necessity, beyond that of commercial conservatism, for retaining that crude and meaningless unit of activity, the "horse-power." Two frequencies also are recommended in the German report for alternating-current circuits; namely 25 and 50 cycles per second. This is an improvement over the American rules, which still recommend three, namely, 25, 60 and 120 cycles per second.

It is interesting to observe that the high-pressure testing voltages are similar in the two schedules, the American rules being somewhat more stringent. Above 20 kilovolts of normal working pressure, both call for a testing voltage of 50 per cent. extra. It is to be hoped and expected that every civilized country will elaborate a set of standardization rules for itself; and that, following upon the confusion which would thereafter be likely to ensue, an international convention may ultimately be called, at which a single set of rules may be selected for universal use all the world over. This achievement will, however, probably take time to effect.

Long Distance Transmission by Continuous Currents.

It is so seldom that we hear about the transmission of power by direct currents, that a novelty of this sort is refreshing. At one time it was fairly common to find direct-current series motors of small capacity operated from constant-current series-arc circuits. Now it is comparatively rare to find a constant-current motor. The transmission plant from St. Maurice, on the Rhone, to Lausanne, Switzerland, a distance of about 35 miles, employs the constant-current system at a total pressure of 23 kilovolts. At the generating station there are five 1,000-hp turbines, each turbine driving a pair of D. C. generators of 150 amperes and 2,300 volts maximum. All the ten D. C. generators are connected in series to produce a total maximum of 23,000 volts. The disadvantages of a system of this sort are the high electric pressure brought to bear upon the insulation of each generator in the series, the danger of flashing at commutators, and the reduced plant efficiency of the copper in the transmission lines; since in the three-phase system of the same voltage betwen wires the copper could be reduced 25 per cent. The advantage of the system is its great simplicity. There is no necessity for a switchboard. The power transmission plant virtually becomes a series arc-light plant of relatively large current, and with a relatively large number of series generators.

Under special conditions, and with careful installation, there seems to be no reason why such a plant should not be more convenient and economical than a three-phase plant of the same capacity. This only shows that it is not safe to conclude that one particular system cannot serve a certain purpose; merely because it is the almost universal custom to adopt another system for that purpose. It is likewise proverbial that there are always alternative methods for exterminating an ordinary specimen of the feline race.

In connection with the same system, a Thury direct-current dynamo is stated to have been built for 25 kw at one ampere and 25 kilovolts. This seems to be by far the highest direct-current voltage obtained from a single commutator. We are familiar with series-arc dynamos, which develop a terminal e. m. f. of ten or even twelve kilovolts; but this pressure has been looked upon as the limiting value. In the Lausanne generator the average e. m. f. between commutator segments is about 500 volts, and means are described for applying an air-blast to the brush contacts on the commutator, on the principle of the blower in the Thomson-Houston arc dynamo.

Although this is a great achievement in its way, and a direct-current dynamo of 25 kilovolts would be a useful machine in various applications, it seems doubtful whether the commutators of such machines could be trusted to operate continuously for months and years without breaking down in insulation. A single failure of the blower, for a few moments, might cause a disastrous arc to be established around the commutator. It is true that high-pressure D. C. arc generators operate satisfactorily; but their current delivery is limited to ten amperes. The commutation difficulties and dangers tend to increase with the current delivered by the machine. The Lausanne transmission plant is certainly unique, and its operation will be followed with interest. It is important to ascertain under what conditions and limitations a high-pressure, direct-current plant is superior to a high-pressure alternating-current plant. If commutator difficulties were eliminated, there can be no doubt that the range of direct-current systems would be greatly increased.

High-Tension Switching.

As we have had occasion to remark in our columns several times previously, the tendency of practice around high voltage transmission plants, and especially those in the far west where the most experience has been had with handling extremely high voltages, has been toward doing as little switching as possible on the high-tension lines. It has come to be rather generally accepted among transmission engineers on the Pacific Coast that switching, as far as possible, had better be done on the low-tension side of step-up transformers, leaving the high-tension switches to be opened only in case of absolute necessity. To those who have been educated to this idea, the new practice being introduced in several very recent plants of doing all switching on the high-tension side of step-up transformers, is little short of startling at first thought. In these recent plants, each generator is considered as a unit with its bank of trans-

formers, the generator being connected directly to the low-tension coils of the step-up transformers. That such an arrangement simplifies immensely the work of switching around a high-tension transmission plant and also equally simplifies the switchboards and electrical connections, cannot be denied. Where the switching is done on the low-tension sides of the step-up transformers, there must be switches not only for the low-tension circuits between the generators and transformers, but also for the high-tension circuits, because it is necessary to disconnect transformers from the high-tension bus-bars. The successful operation of a plant doing all its switching on the high-tension side of 26,000-volt transformers would have been out of the question three years ago because of the lack of high-tension switches capable of surely breaking circuits of 14,000 volts and over.

The usefulness of the oil switch for breaking high-tension circuits has been greatly increased in the last few years, however, and it is maintained by those who should know that the handling of a 26,000-volt circuit with oil switches is as certain as handling the 6,600 and 11,000-volt circuits on which the oil switch has been in use for some time. As a large manufacturing company is not likely to install and guarantee apparatus calling for a large expenditure of money and involving the reliability of immense power houses without experimental data demonstrating the correctness of faith in the oil switch for breaking high potentials, there is no good reason to fear the outcome of this new practice. Some questions do, however, arise as to the static strains on high-tension lines suddenly opened in this manner. This is a question which has been thoroughly analyzed and discussed during the past year in papers by Messrs. Steinmetz and Baum; and danger from this source is, perhaps, feared more generally than before on this account. Whether or not this will prove serious in this connection will manifestly depend on whether the transformers used are built to stand much in excess of the normal working potential. As most of the transformers used on high-tension transmission lines are built to stand this excess potential there will probably be little trouble until voltages are reached which approach the limit of possible transformer insulation.

A STUDY OF ELECTRIC PUMPING.

Mr. Bowie's paper on electric pumping for irrigation, in this issue, throws much light on a subject over which rule of thumb has consistently reigned for an indefinite period. The perspiring dweller in the East in particular has very vague notions as to what irrigation really means in the evaporated West. The only mental picture which it calls before his consciousness is that of the optimistic suburbanite officiating with a garden hose over the gravel patch for which he still entertains lingering hopes. The conception of a barren, dust-blown country suddenly converted into a garden spot of boundless fertility by a careful wetting-down is a new one to him. Hitherto irrigation in the West has been the result of elaborate ditch systems involving great engineering works and very large investments of a sometimes precarious character. The material results have been magnificent, but the benefits of the system have been somewhat limited by the single question of cost. Obviously, it does not pay to occupy lands where irrigation is very expensive, until more favored localities are pretty thoroughly settled, and the irrigation works always have to keep in advance of settlement, for the self-evident reason that farmers will not settle in an unirrigated desert. Hence there is at the start a speculative element about irrigation works which has led to some conspicuous successes and to some pathetic disasters.

Irrigation from wells is quite another matter. It is a case for the enterprise of the individual. A group of wells can be put down on comparatively short notice, and ordinarily without great expense; at least one would not attempt to make a large investment of this kind unless the end justified the means. With reasonably cheap electric power, water can be raised from wells quite cheaply and rendered available for irrigation. But it must not be for a moment supposed that such is the whole of the story. Lifting the water is the smallest part of the problem. In theory, it requires only about 3,000,000 pounds of water to flood an acre a foot deep, and from a well 50 feet deep or so, the power required thus to flood the dry earth by steady pumping 24 hours per day amounts to very little. Ten horse-power would probably take care of a good many acres in the ordinary course of irrigation. But the very land which most needs irrigation needs it because it does not hold the moisture but lets it drain through to the lower strata. Hence, when the land is nicely arranged for irrigation the water sinks through the soil about as fast as it can be pumped—it is like trying to fill a bottomless pitcher—and if the water has to flow far from the pumps it flows downward instead of outward. The actual size of the motor pumps is determined not by the total water required to properly wet the surface, but by the rate of flow which is necessary to distribute the water at all. Mr. Bowie's advice regarding cemented ditches is excellent. These might well be supplemented by small wooden distributing flumes, carrying thus within the limits of a single ranch the general methods of the big ditch companies. When the water supply is good enough to insure freely-flowing wells without going to a prohibitive depth, the pumping scheme would seem to be an excellent one. But wells are notoriously uncertain things to locate. We recall one instance of a determined individual in California, who plugged down 1,400 feet after water, and then gave up in disgust. And even after one well is successfully located, as Mr. Bowie points out, the sinking of a few more may exhaust that particular vein of water. If one could chart the subterranean rivers and lakes, rills and morasses, it would be a curious map indeed that would result.

All in all, the pumping plan for practical irrigation is rather of a local than of general applicability, and points strongly toward intensive farming, a line of agricultural operations comparatively little practiced in this country. But still it has a good field for usefulness, and the power transmission companies find in these irrigation pumps a useful and profitable load. The fixed investment of a transmission plant requires a good load factor to insure economical running, and a pump load which can be cut off at the peak is peculiarly useful in building up a good load factor. From an engineering standpoint the practice is interesting as requiring for its economical administration a very reliable class of motor-driven pumps and accessories And as has already been discovered, it is no light thing to make machinery of this kind run twenty-four hours a day without attention. Machinery laid out for ordinary work breaks down here, and extraordinary precautions have to be taken to insure continuity of operation. Even the question of heating takes on a new aspect under the fierce Western sun. In particular, where natural ventilation of transformers is depended upon it makes a very material difference whether the initial temperature of the air is 80 degrees or 110 degrees, and data on the performance of apparatus under these high external temperatures are scarce. Hence, there is every occasion for extreme watchfulness in the pumping installations, and it would be well if those who build the apparatus would study the engineering side of the problem carefully on the ground, and with a keen eye to future developments. There is a vast deal of irrigation to be done, and it may be that a skillful combination of natural and artificial supply would materially reduce the costs. Above all, the methods of water distribution need close watching and shrewd improvement, for the crude methods of the past will not do when the water has to be pumped.

Mayor Low on Electric Traction Around Manhattan Island.

In the course of a carefully prepared paper or written interview, Mayor Low, of Greater New York, discussed, last week, the many electric railway problems and projects now awaiting settlement, the two main points treated being interborough communication between Manhattan Island and Long Island, and communication with Manhattan from the north. As to Brooklyn Bridge, he advocates rebuilding the suspended structure, and says:

"When the Brooklyn Bridge was designed, it was intended, from the railroad point of view, to be a bridge with shuttle trains passing to and fro upon it. In the process of time, it has become a railroad thoroughfare—wholly so as to trolley cars, partly so as to the bridge railroad proper. One need not be a prophet to be able to foresee that its destiny is to become, from this point of view, wholly a thoroughfare. Two conclusions follow from this situation: First, that the suspended structure of the Brooklyn Bridge should be rebuilt as soon as possible, to adapt it to the largest possible use as a railroad thoroughfare; second, that all the other East River bridges must be treated as railroad thoroughfares—that is to say, they must not only arrive; they must lead somewhere. These conclusions may be briefly amplified. There are certainly very few, if any, railroad bridges in the country, 20 years old, that have not been rebuilt, at least once, in that interval, and, in some instances, twice, to adapt them to the demands of modern use. The towers of the Brooklyn Bridge and the cables and anchorages of it are equal to any demands that may be made upon them, but the suspended structure cannot do any more than it is doing now. Were this suspended structure to be rebuilt to comply with modern conditions, six-car trains could be run instead of four-car trains; in other words, the train capacity of the bridge could be increased 50 per cent. I believe this work can go forward without interfering with the use of the bridge. It ought to be planned for at once, and put under contract as early as possible. The estimated cost is $2,000,000. With this work completed, we should have a modern railroad bridge instead of one 20 years old."

Referring, incidentally, to the moving sidewalk idea, he says: "I think it is true that a moving platform would carry double the number of people of the present bridge railroad, but it would be reverting to the old idea of the bridge as a thing complete in itself, instead of as a railroad thoroughfare. Neither do I think it good judgment, if it can be avoided, to abandon, even temporarily, a single fare between the boroughs. I am quite confident that the moving platform should not be resorted to, except in case of necessity or except in response to a popular demand. The part of wisdom, I am sure, is to go ahead with the plans for permanent relief as soon as possible."

Coming to the northern problem, Mayor Low remarks: "The key of this situation, so far as it is an unsolved problem, is the New York Central and Hudson River Railroad. It is a fortunate thing that no legislation affecting the Grand Central Depot was had last winter, for legislation hurriedly prepared and passed under pressure of a feeling of panic can seldom be sufficiently matured to deal wisely with such a problem. When the Legislature was in session, the New York Central Company was under the impression that it could not undertake to change the motive power of its through traffic from steam to electricity for many years to come. It advocated, then, plans for a change of power for its suburban traffic, which called for a loop under Madison Avenue and various other streets.

"Since the adjournment of the Legislature, I have kept in close touch with this question, and I am now authorized by the president of the New York Central Railroad to say that his road is ready to enter into a stipulation with the city, if the city will approve the changes which they now wish to make at the Grand Central Depot, to substitute electricity for steam, not only for their suburban but also for their through traffic; and that they will sign a contract for erection of power houses adequate for both of these purposes, immediately after the approval by the city of their terminal plans.

"Nor is this all that has been gained by a more careful study of the problem. In response to my suggestion that there ought to be some point or points in the Borough of The Bronx at which passengers could change from their suburban and through trains to the subway and to the various elevated roads running south, the company has given me its assurance that the city can command its most earnest and energetic co-operation in developing such a center, or centers, as may be deemed best, north of the Harlem River.

"This matter will be brought before the proper boards for action in September. The city has ample power, under the charter, to do a large part of what is asked. If more power is necessary to complete the work, that can be had next winter by enlarging the powers of the city, instead of the railroad. This will avoid the difficulty of passing a general law to deal with a very special situation. The railroad company must, of course, get legislative authority to change its motive power from steam to electricity, but there is no doubt that this authority can be had for the asking. A law should also be passed, which was overlooked last winter, compelling the New York, New Haven and Hartford to make the same change, so far as it continues to use the Grand Central Depot."

With regard to the mayor's remarks, Vice-President Brown, of the New York Central, states that the company has demonstrated that electric motors can be made of sufficient power to draw the trains of the suburban service, and that the project for a loop under the Grand Central Station will be proceeded with. The total cost of the projected loop and new lines will reach $10,000,000.

Another Electric Traction Tunnel for New York.

Frederick B. Esler, president of the New York and Brooklyn Railroad Company, states that the plan of the new tube tunnel from New York to Brooklyn, in imitation of the two-penny tunnel of London, and which was first spoken of in 1896, is about to be begun. J. H. Hoadley, of the International Power Company, and G. S. Drummond, of the Manhattan Transit and British Traction Company, are on their way from London to New York, with a view, as Mr. Esler states, of beginning promptly the physical work of construction. His explanation of the development of the scheme and its present status is as follows:

We have the franchise permission from the Railroad Commission to proceed with the work, and, in fact, are in a position to go ahead with the work without any legal barrier. The plan of building the tunnel is being underwritten by a syndicate, of which Lord Kintgore is the chairman. The other members of this syndicate are Earl Grey, Sir Charles Rivers Wilson, and Washington Hume. The men who propose to build the tuunel are G. S. Drummond and J. H. Hoadley. Our franchise gives us permission to build a tunnel from Park Row to the dock line of Brooklyn. Efforts were made to get the franchise ratified by the Municipal Assembly, to which Brooklyn objected. Nevertheless, as the city has been extended, including Brooklyn, our franchise was also extended.

The tunnel will have a double track, and will be entirely fire-proof. James Stewart, of the Westinghouse Electric Company, has been spoken of for carrying the work through to completion, but he is not yet fully decided upon. There will be three entrances and three exits, so far as we know now, on each side of the river. We will connect with no road whatever, but will merely transport passengers under the river. So far as we know now, the fare is to be three cents, but that may be altered. The fact that the recently arrange' for tunnel will cross under the river at pretty nearly the same spot at which we hope to cross will make no difference to us. We cannot yet tell what the exact cost of the road will be. About $6,000,000 is ready for use. It is to be finished by July 16, 1904. We are now buying property at both sides of the river for entrances and exits. The tunnel will be almost precisely like the two-penny road of England. The deepest point of the tunnel will be 98 feet under the water level.

Traction in New York and Chicago.

Note was made in our pages last week of the visit to New York of a special committee of the Chicago City Council, appointed to investigate subways, traction development, etc. One or two opinions cited by the Chicago newspapers would indicate that that city may soon be launched on a career of traction development as extensive as that now proceeding on and around Manhattan Island.

"Surface street railways here," said Alderman Foreman, "should be operated as they are in New York, as one system, and the same company should operate cars in a subway, which under all circumstances must be owned by the city.

"New York and Boston do not seem to hold to the theory that in order to be prosperous a city must be dirty. New York is experiencing a degree of prosperity without example in this or any other country, and in spite of prosperity has clean streets and pure air."

Missouri River Power Company's 50,000-Volt Transmission Plant.

By A. W. Clapp.

As noted in the Electrical World and Engineer of March 15, the Canon Ferry, Montana, generating station of the Missouri River Power Company early in the year began the supply of current at 50,000 volts for transmission to Butte, 70 miles distant. Since that time the plant has been supplying current continuously to Butte, being thus the first plant in the world to operate normally at such a voltage. The Canon Ferry plant, which was completed in 1899, was described in the issue of July 13, 1901, of this journal, and some of its constructional features were the subject of an article in the issue of June 7, 1902. Since the earlier articles a number of improvements have been added, of which it is the object of this article to give some account, as well as of the new Butte sub-station.

As stated in the previous description, the power house at Canon Ferry is a rock-faced granite building 225 x 50 feet inside and 28 feet in the clear below the roof trusses, with a steel and concrete arch gallery along the west side 17 feet 6 inches wide and 13 feet 6 inches clear below the roof trusses. This gallery also extends across the north end of the power house, affording ample room for offices, etc. All of the space between the edge of this gallery and the east or river side of the house is covered by a 15-ton crane, furnished, as was all the steel work, by the American Bridge Company.

Penstocks beneath the gallery enclose the pairs of turbines, which are direct-connected to the generators, both being carried on I-beams across tail races 15 feet wide by 12 feet deep, formed by granite walls 5 feet thick, spaced on 20 feet centers. On the west side of the main power house a steel and corrugated iron addition 156 feet long, occupying the space between the power house and the canal wall, and having its floor just above the penstocks and on a level with the gallery floor, affords room for the six 950-kw transformers mentioned later.

The original installation consisted of four two-phase, 750-kw, 550-volt generators, direct-connected to pairs of Dayton Globe Iron Works turbines, three of these being controlled by Replogle governors, and the fourth by a Lombard governor. There were two 90-kw, 125-volt exciters direct-connected to separate turbines. From a white marble switchboard with four sets of busses the current was carried from four transformer panels over sixteen 1,000,000-cm., lead-covered cables to a separate transformer house, where there were eight 325-kw transformers, oil-insulated and self-cooled, in four sets connected to transform from 550 volts, two-phase, to 11,000 volts, three-phase. At this pressure the current passed through a plug-board Westinghouse lightning arrester, and into four feed lines of No. 4 solid copper which led to another plug board of similar construction at East Helena, and from there to the company's various services in and around that city.

The changes and additions recently made include the moving of these transformers and plug boards on the main gallery of the power house and the arresters into the addition; the purchase of four more transformers of the same capacity, and the changing over from the old switchboard to an entirely new one. The four generators were also changed from two-phase to three-phase by the addition of brass fish-plates to stiffen the laminations at each end of the armature, and the substitution of new ventilated type, three-phase collector rings for the original two-phase rings. The new apparatus installed consisted of six three-phase, 750-kw, 550-volt Westinghouse generators, direct-connected to pairs of 45-in. turbines, furnished by S. Morgan Smith Company, York, Pa.; one 225-kw, 150-165-volt exciter connected to another turbine; seven Lombard governors and another exciter of 150-kw capacity driven by a 150-hp, 550-volt induction motor. There were also installed six 950-kw, 550-50,000-volt transformers, together with 12 static interrupters, six lightning arresters, fused circuit-breakers, etc., at Canon Ferry, and a duplicate equipment in the Butte sub-station. These 12 transformers can all be connected with 550-volt or 2,200-volt to 25,000-volt or 50,000-volt, and are supplied with extra strips for adjustment to meet running conditions.

Fig. 1.—General View of Canon Ferry Power Plant.

The main switchboard at Canon Ferry is 47 feet 4 inches by 9 feet 9 7-16 inches high, of blue Vermont marble, finished in polished copper and black enamel, and is located centrally on the gallery. At the left of the board are six 325-kw, 550-11,000-volt transformers, in two groups. At the right is an exciter board of four panels with two pairs of busses adjacent to six more transformers like those on the left; and lastly, a four-panel plug-board to control the 11,000-volt output of these 12 transformers and distribute it as desired to the four feeder lines before mentioned. From either end of the main switchboard the arrangement is as follows:

1. Five generator panels, each carrying one field ammeter, one alternating-current ammeter and one long scale polyphase watt-

meter, two circuit-breakers, nine 1,200-ampere U-blade switches, synchronizing lamp of 5 cp and synchronizing plug.

2. Two feed panels, each controlling three of the 325-kw transformers and equipped with three ammeters connected to three 5-ampere series converters directly in the circuit of each transformer, three circuit-breakers and nine 2,000-ampere U-blade switches.

3. One feed panel similar to the last two, but equipped for 3,000

FIG. 2.—TRANSFORMER HOUSE.

amperes per leg, and controlling three of the 950-kw, 550-50,000-volt transformers. The eighth panel from either end is a junction panel equipped with 4,000-ampere, U-blade switches, for joining the halves of the sets of busses, and on its upper section carrying six polyphase indicating wattmeters, one connected to each feeder circuit.

The nine separate bus-bars are built of ⅛-in. x 3-in. rolled copper; there are a number of strips on each bus, increasing gradually from six at the outer ends of the board to 30 strips opposite the fifth generator panels. Small marble panels in front of the main board, on the I-beam carrying the crane rail, furnish a mounting for field switches and voltmeter plugs, and six polyphase integrating wattmeters connected to the feeder circuit. Directly below the field switches are the corresponding rheostat pedestals connecting to base-plates, and hung below the gallery floor. The rheostat, which is of the cast-grid type, is also mounted below the gallery floor.

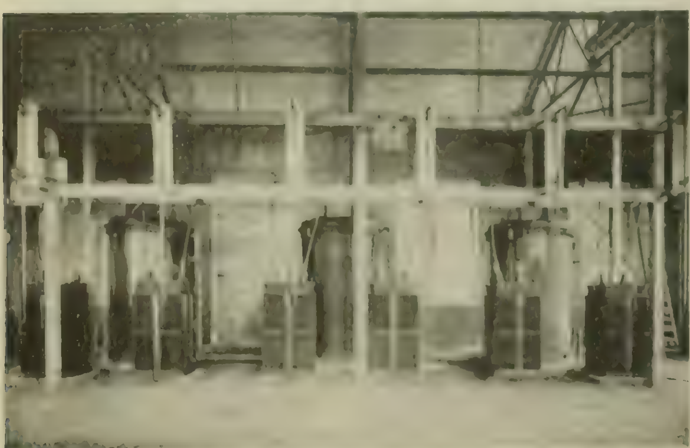


FIG. 3.—TRANSFORMERS.

There are four voltmeters swinging at each end of the board, three for each half set of the three bus-bars, and one throwing-in voltmeter for the five generators on each half. The alternating-current indicating instruments are all long scale, and of exceedingly wide range. All switches are of the latest unit-blade type of very ample capacity, while the current density in busses and cables is nowhere allowed to exceed 500 amperes per square inch. All circuit-breakers are non-automatic, of the air break brush type, of ample capacity, and easy operation.

During the period of change from the old two-phase to the new three-phase switchboard, the two systems were run in parallel on the 11,000-volt side for several days with perfect satisfaction.

From each of the four small feed panels six 1,000,000-cm., lead-covered cables are led through an open cableway level with the top of the switchboard directly to the 325-kw transformers, the circuit-breakers on the board being connected each in one leg at the transformers, as are also the ammeters.

From the high-tension side of the transformers, No. 4⁹/₂₂ rubber-covered units lead straight to a cross-arm on the roof trusses, thence distributing to the proper wire of 12 busses, which are supported on the roof trusses, and leading down to the 11,000-plug-board at the extreme right. During the various changes necessitated during construction these busses were found very convenient for facilitating the removal of transformers, changing from two-phase to three-phase, etc. From the plug-board current passes through lightning arresters in the addition to the power house, and thence straight up through the nearly flat roof of the addition. The insulation consists here simply of rubber-covered wire drawn through 2-in. x 36-in. glass tubes which are supported by split wooden bushings; the tubes are surmounted by 12-in. conical galvanized taps tapped to a water-tight joint next to the wire. The wooden bushings are flashed to the roof to form a water-tight joint, and are lag-bolted to the roof.

FIG. 4.—THREE PETTICOATED INSULATOR.

The 550-volt leads are brought out through the roof in an entirely similar manner through glass tubes 2 inches x 40 inches, with light cone of heavy waterproof canvas and dry wooden frame, with a base diameter of 18 inches, used for a protection from moisture.

From each of the two large feed panels eighteen 1,000,000-cm. cables lead through convenient doorways, pass along the wall of the addition, and thence span a distance of about 5 feet to the low-tension terminals of the 950-kw transformer sets. One leg of each transformer can be opened by the circuit-breakers on the main board, the other leg by knife switches, located in the doorways mentioned above.

The high-tension leads of the transformers pass first through static interrupters, then through fused circuit-breakers on one leg and a plain knife switch on the other leg, thence connecting to three bus wires of heavy rubber-covered wire overhead. The outer end of each of these busses connects through fused circuit-breakers through the roof to one of the two three-wire lines to Butte. The inner ends may be tied together by similar fused breakers. Thus either transformer set may feed either line, or both may be fed in parallel or separately. Also, any transformer may be entirely cut out by opening both high-tension and low-tension leads, without interrupting the service.

The static interrupters are comparatively novel. Their theory and commercial form were fully described by Mr. Thomas in a recent paper before the American Institute of Electrical Engineers. They consist essentially of a choke coil in series with the trans-

former lead, and a condenser connected on the transformer side of the choke coil to ground, the whole immersed in oil. The ground current from this condenser has been put to a novel use by the electrician of this company. The Weston alternating-current voltmeter is used as an ammeter connected in the ground circuit of the condenser to determine the condition of the transformers and attached line relative to ground; the induction being fully that of the dynamic current, many bothersome features of the ordinary static inductor are avoided. There are, of course, sources of error, but these do not prove troublesome.

The main transformers are water-cooled, but the coils being about 6 feet above the level of the water in the forebay, it was necessary to have recourse either to pump circulation or to some form of siphon. Main intake pipes in duplicate, supplied with proper strainers, were brought in through the canal wall below low water level. The transformer coils were bridged between there and other pipes leading 30 feet down to the tail races. These intake and discharge pipes were connected by a valve which allows water to flow directly through the discharge pipe vents, thus starting a vacuum. This valve is then closed, and water is immediately siphoned through the transformers. A common vacuum gauge shows the condition as to vacuum, while in the discharge pipe of each transformer a small brass pipe 12 inches long and ⅜ inch small and 1½ inches large diameter has a single mercury U-tube connected between the central small diameter and the upper end of the pipe, affording an accurate indication of the amount of water circulating through the transformer.

Each of the six cables of the two feeder lines to Butte are protected by lightning arresters at Canon Ferry and Butte. These cables are of seven strands of copper aggregating 106,500 cm. each, mounted on special glass insulators designed by H. M. Gerry, Jr., chief engineer and manager of the company, and made by the Hemingray Glass Company, Covington, Ky. The insulator proper is three-petticoated glass 5⅛ inches high and 9 inches diameter, the pin extending as near as possible to the wire groove below the insulator; extending up inside the inner petticoat is a tapered glass sleeve 5½ inches diameter at its lower end, clearing the cross-arm by 1¼ inches, and supported on a 1¼-inch shoulder on the pin. The pins are all seasoned oak, still further dried and impregnated by boiling in hot paraffin, so that the pins themselves stand 100,000 volts on test. The pins are 12 inches long above the butts, 1½ inches at top of thread, which is of standard pitch. The maximum diameter is 2½ inches, tapering on a 60-degree angle at the top of this butt, whose diameter is 2 inches for the pin which fits the cross-arm, and 2⅛ inches for the pin which fits the pole tops. These latter butts are 8 inches long, the former 5½ inches, and a special reamer insures a close fit of the 60-degree taper at the top of the pole and on the cross-arm. The distance between the line cables is 18 inches. The pole lines are 40 feet apart, and the right of way is entirely cleared of trees, etc. The poles are of Idaho cedar, 8-in. tops, and in length from 35 to 90 feet, all poles above 75 feet being spliced.

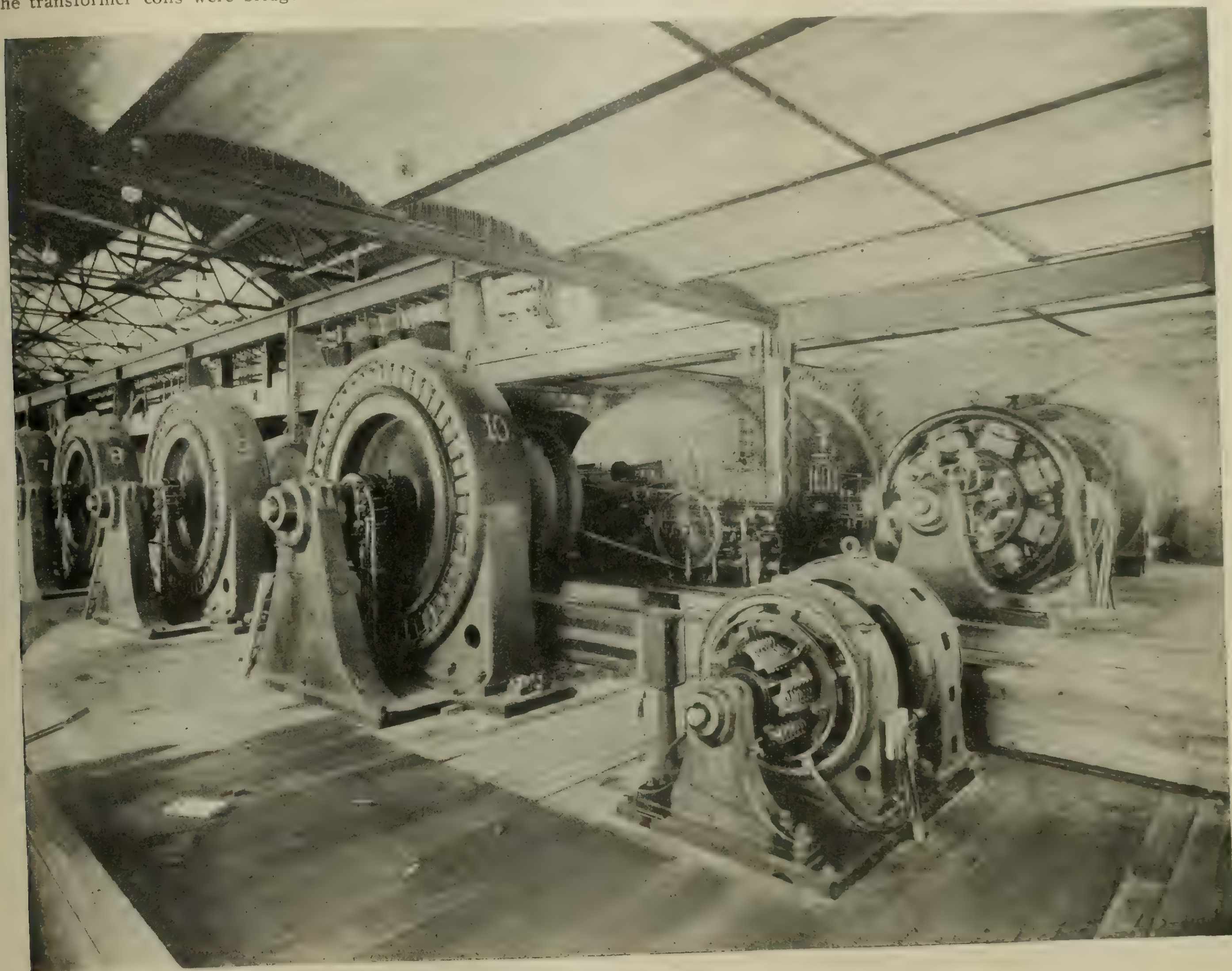


FIG. 5.—VIEW OF INTERIOR OF POWER HOUSE.

The Butte sub-station is a steel and corrugated iron building, 60 ft. x 80 ft. x 20 ft. studs, the feeder lines entering at one end through glass tubes 2 in. x 48 in. passing through a wooden panel and protected from the weather by a shed roof overhanging about 5 feet.

Low equivalent arresters, fused line breakers, paralleling breakers and breakers on each leg of the six 950-kw transformers, together with the static interrupters, are practically a duplicate of the equipment at Canon Ferry. The arresters, line and tie breakers are at the end of the building; the transformers are along each side of the central court, toward which all breakers open. The main switchboard here consists of two 40 in. x 9 ft. 9 in. panels with three circuit-breakers, three ammeters and six knife switches, each connecting the low-tension (2,200 volts) of the transformers to either or both of the two bus sets. As at the generating station, the switch-

board circuit-breakers open one leg of each transformer circuit, while a knife switch mounted on each transformer case opens the other leg. These transformer cases are very substantially built of heavy boiler steel, with cast-iron and walnut covers bolted on, and hold about 16 barrels of transformer oil each. A pair of synchronizing lamps and a swinging voltmeter are provided. Integral with these two panels on either side are panels 20 inches wide, on which are mounted the sets of feeder instruments, three ammeters and one polyphase indicating wattmeter. These feeder circuits feed out through three-pole, double-throw General Electric oil switches to bare stranded cables of 600,000-cm. section, leading to the company's various loads in Butte.

There are at the present time three of these feeders, and the switchboard instruments are provided with an unusually ample range so as to read starting motor currents and even short-circuited currents. All feeder wattmeters take their series currents from three to five-ampere, series-connected coils directly in each transformer circuit, the three currents being combined into two circuits of 8.6 amperes each at full normal speed, through the two coils of the wattmeter. The shunt circuits are fed from auto-converters at Canon Ferry, and shunt transformers at Butte. These meters have a long and uniform scale, and are intended to be very accurate under all conditions. The wattmeters at the Canon Ferry generating plant are also of the polyphase type, but are connected according to the more common scheme of two wattmeters on three-phase circuits.

As before stated, all station electrical apparatus is of the Westinghouse make, except a few oil circuit-breaking switches at Butte. Nearly all consuming apparatus at Butte, however, is General Electric. This apparatus, aside from incandescent lighting to the mines, consists entirely of induction motors ranging from one to 800-hp capacity, there being at the present time only one of the latter size driving an air compressor at the Anaconda mine at constant full load. Most of the motors from 50 to 300-hp capacity are equipped with rope drive. Some of the smaller motors are direct-connected to 500-volt generators, furnishing direct current for cranes, mine trolleys, etc. Power is supplied for a great variety of purposes at the great copper mines and to the smelters and various reduction works at Butte.

Telephonic Growth in Arizona.

The Tombstone (Ariz.) Telephone Company has completed its local system and now has its construction force putting up poles and stringing the wires from that place to Bisbee. It is expected to make a connection with the local system there not later than the middle of August.

The Tombstone company, after reaching Bisbee, will begin the construction of a line north to a connection with the Gila Valley Telephone Company at Solomonville. This connecting line will touch at Pearce, Black Diamond, Cochise, Willcox and Fort Grant. The Globe Telephone Company has now about completed a connection at Fort Thomas with Alexander Bros.' line which will connect with the Gila Valley line. When these connections are made from Tombstone and Globe, every important point in Graham, Gila and Cochise counties will be connected by telephone.

The Globe company will reach Globe, Black Warrior, Rice station, San Carlos and Fort Thomas. The Gila Valley company now reaches Fort Thomas, Matthewsville, Pima, Safferd, Thatcher, Solomonville, Guthrie, Clifton and Morenci. The Tombstone company will reach Solomonville, Fort Grant, Bonita, Willcox, Cochise, Pearce, Black Diamond and perhaps other camps in the Dragoons, Tombstone and Bisbee. From Bisbee south, the Bisbee Improvement Company already has connection at Naco with the Cananea line and at Douglas with the line owned by the Douglas Improvement Company.

These are local systems owned by home people. It is also known that a telephone line is to be built from Douglas to El Paso during the next six months. This line will connect with the Rocky Mountain Bell Company at Deming and with the Southwest Bell Company at El Paso. The Sunset company have sought a connection with the Gila Valley Telephone Company and also with the local system in Bisbee. The Sunset will, of course, connect either at Globe or Tombstone. If it connects at Tombstone, Benson would be brought within the "hello!" circle. The Sunset expects to complete the connection of their Arizona lines with the Los Angeles soon.

By the first of the new year the probability is that Solomonville can speak with every city in the southwest and as far as Chicago and Los Angeles through a telephone. Southern Arizona is fast getting out of the wilderness.

Electric Pumping for Irrigation.

By Aug. J. Bowie, Jr.

THE subject of electric pumping for the purpose of irrigation is one of growing interest in the West. In many parts of the country the rainfall is so small that irrigation is almost wholly relied on for the cultivation of the land. This irrigation has in the past depended largely upon diverting water from the rivers and streams that flow through the land, and distributing the same, by canals and ditches, over the ground to be cultivated. In the West, until comparatively recently, little use had been made of the water other than that which nature had thus provided, above the surface of the ground. These rivers and streams furnish a variable supply of water—at times, when they are high, giving far more water than can be used, and when they are low, falling far short of the desired supply. Extensive plans have been made, chiefly in an embryonic state, for constructing large impounding reservoirs, with the idea of regulating the flow of water, so as to make it more uniform, and to turn to profitable use as much of it as might be possible. Should these results be accomplished, great ultimate benefits will of course accrue from them. Floods will be largely prevented—the water from which they had previously been fed being stored for use at times when the flow of the rivers is small, or even when it disappears altogether.

Underlying the surface of the earth are strata of various materials. Some of these are saturated with water, holding within themselves a volume of water of fully one-third of their entire bulk.

To those who have never studied this subject, the extent of these subterranean reservoirs of water will appear prodigious. Imagine that fully one-third of the volume of the earth, even for a depth of one hundred feet, is composed of water; that this water supply is constantly being replenished from many sources, and it will at once be apparent what an almost inexhaustible reservoir the earth becomes.

This is especially true where this water is pumped for the purposes of irrigation, as by far the greatest part so used returns whence it came, the amount of water which is turned to useful work, in nourishing vegetation or which is lost in evaporation, being only a comparatively small proportion. This is notably the case in sandy soils where the amount of water which filters through the surface is very great. For instance, it is nothing unusual in such soils to use for a single irrigation enough water to cover the entire land to be irrigated two feet deep. This, of course, is a great waste of water, and could and should be much cut down by proportioning properly the size of the checks to the head which is to be used in irrigation.

Perhaps the method of irrigation most commonly used, is to divide the land into checks, throwing up embankments of earth all around them. These checks are laid out on contour lines, the fall in each check, or the difference of elevation, between the top and bottom contour lines varying with the fall in the ground. They are fed from ditches, and water is turned into them until all parts of the land in that check are submerged. Then the enbankment on the lower side is cut, thus letting the water drain down into the next check, and turning as much of it to good use as is possible without allowing it to filter through the soil. The object is simply to wet the entire surface of the ground. However, in the time which it takes the check to fill, much of the water has of necessity filtered through the soil and gone to waste. The use of a large head of water cuts down this loss very materially. Large heads of water require skillful handling in the matter of irrigation. Small checks interfere with agricultural operations, are more costly to make, and require more attention in irrigation. It is a matter of no small importance to proportion somewhere nearly properly the size of the check to the head of water available. The character of the ground should, of course, be taken into account in all such calculations.

Water-bearing strata extend often for many hundred feet below the surface of the earth. The water pressure in different strata—that is when these strata are separated by other strata practically impervious to the flow of water—will often be different; the water standing at different levels in the well, in such cases, as the well-casing goes down. When the water level of a stratum of water-bearing sand or gravel is higher than the surface of the ground, the well becomes a flowing well, or artesian well as is commonly said.

The word artesian is often misapplied to wells which do not flow. Artesian wells will discharge a quantity of water of such magnitude that the loss of head by friction in the pipe and in the strata leading to the pipe is equal to the height above the outlet to which the water would normally rise in the casing at no discharge. The flow of

water from an artesian well is no way different from the flow of water from a pumped well, both following the same laws. The water-strata which supply artesian flow get their pressure usually from some distant sources at higher elevations. These strata are not at all replenished by the water which the wells discharge; such water when used for irrigation going into the strata much higher up. As the water which supplies these artesian wells gets its pressure from so far away, and as the strata may be limited in extent, sinking several of these wells, even though they may be miles apart, may in time interfere seriously with the flow from each other. For the reasons given above, these will be far more subject to mutual interference than in the case when the strata are near the surface, where the water for irrigation is constantly replenishing them.

The flow of water through porous media, according to numerous experiments made, is directly proportional to the head causing such flow. The writer performed such experiments on one pumping station which had been in operation for some time, which agreed very closely with this theory. They showed that the flow of water from wells was directly proportional to the distance which the ground water was lowered. It is probable that this is true in most cases, though, owing to the peculiar conformation of the ground, this will not always be so.

In many localities in California the level of the surface of the ground water is from five to thirty feet below the surface of the ground, and it is not necessary to sink wells further than to a depth of eighty to one hundred feet before getting an ample supply of water-bearing strata from which to draw for pumping.

There are two different cases under which pumping plants may be installed. The first case being where the installation is intended to supplement the water supply from the rivers in event of any shortage or failure of the same, and the second case being where the supply from the wells is relied wholly upon to irrigate the land.

In considering the first case, whether the system can be reckoned as a financial success is largely a matter of chance. It is all a gamble. In fact, it bears a close resemblance to spending money for fire insurance policies. If no fire occurs, the money so spent is of no benefit. So it is with these plants—if there is plenty of water in the rivers the plants will, of course, be financially a failure. They are depreciating all the time whether they are worked or not. If the plants are worked for only a month in the year, they may save a crop by so doing. The water they pump will, of course, cost very high, as the fixed expenses will be especially large. It is almost impossible to estimate the value of such a plant, even at the end of the year, and it resolves itself into simply a matter of insurance.

As a general proposition, the water pumped from pumping plants will furnish a much smaller head than that which is used for irrigation from the rivers. Ditches for carrying river water will be so large that the small amount of water pumped will suffer great losses from seepage while flowing through them. Also, the checks will be so large that most of the water will be wasted in flooding them.

One way out of part of this difficulty is to construct a reservoir of moderate capacity near the pump station, and to pump the water into it. The ground should be thoroughly puddled to reduce the seepage as much as possible. Should the reservoir be too large, the loss by seepage and evaporation may fully equal the water pumped into it.

This shows some of the difficulties of endeavoring to supply large ditches and checks from pumping stations, and shows some of the radical errors which can be made in not proportioning properly the amount of water to be delivered to the work to be done. Much attention is often paid to getting a few per cent higher efficiency from motors and pumps; while far too little attention is paid to the subsequent use of the water pumped.

Where pumping water is so comparatively expensive, it will surely pay to devote much attention to its proper distribution. It often will pay to put in additional small ditches rather than to try to run water in ditches out of proportion. For instance, the writer recalls one case where two pumps discharged into a twenty-foot ditch, a half-mile long, a flow of about seven cubic feet a second, and were just able to hold the water up about three feet deep, with no discharge. The ditch ran through a very sandy country, consequently the seepage was very large.

In the second case to be considered where pumps are to be depended on for irrigation, the problems to be solved are of a more definite nature. Ditches, checks and pumps should be proportioned for a proper flow of water.

Where the land allows it is often a good plan to have two or more stations so located that they can be used either separately or the combined flow can be used in irrigating the land. It is, of course, important to have the distance which the water has to flow in the ditches as short as possible, and the pump stations should be located with that in view. It may often pay to have the ditches lined with cement, to minimize the loss by seepage; as considerable expense may be justified in this connection. Usually one well will be insufficient to supply the demands of a station for irrigation, in which event additional wells are put down. These, of course, interfere with each other to a certain extent.

The level of the ground water varies with the seasons, with the rainfall and with the amount of irrigation; a succession of dry years lowering it decidedly, and wet years correspondingly bringing it up. It is advisable to get some idea of the extent of this variation before starting in to install pumping plants. Continued pumping from stations will in general lower the level of the ground water at these stations, though after the pumping plant has been shut down, the water will rise in the ground continuously for some time.

Having ascertained the condition under which the water is to be delivered, the amount desired and the level of the ground water, then the next step is to determine on the system of pumping which is to be employed.

Pumps for this purpose may be classified under three different heads. 1. Deep-well pumps. 2. Those not for deep wells, where the pumps are placed where all parts are readily accessible. 3. The air lift.

Where the water is within a reasonable distance from the surface, it will usually pay to use the second class, especially where a large quantity of water is desired, although it may be necessary to sink a pit to get the pumps nearer the water level so as to increase the available flow from the wells.

Deep-well pumps as a class are not advisable for handling large quantities of water. They are necessarily limited by the size of the wells, and the fact of having their working parts far from the surface is also a disadvantage.

Their field is especially adapted to handling limited quantities of water, where the distance from the ground to the surface of the water is fairly great. A very fair efficiency can, under these circumstances, be attained.

The long lengths of connecting rods in lift pumps necessitate slow speed for suitable operation. The jar of starting the column of water on the up-stroke is intensified by any lost motion in these connecting rods, and as a result the machinery must be very rigid and must run slowly.

The air lift may be advantageously used in many places, where several wells located near a central source of power are to be pumped. This possesses the advantage of extreme simplicity, and of having all parts which it is essential to handle conveniently located. It has the disadvantage of comparatively low efficiency, and of the attention which it is necessary to give the air compressor.

As a general proposition, where irrigation by pumps is carried on on an extensive scale, it will be done by the second class of pumps. This case being of most interest, will be the only one which will be further discussed.

The system of pumping which it is advisable to install depends largely on the form of power available. In case comparatively cheap fuel is available, as is at present the case in many parts of California, it might pay to install a central air station with engines and compressors, and to pump the wells by the use of air lifts; that is, provided it was not too far from this station to the wells. However, electric lines are at present in operation and being constructed over many parts of California. Cheap power is at many places available for the operation of motors, furnishing a simple and reliable means of obtaining energy. It was mainly with an idea of expounding the use of electric power in pumping that this article was written. It has been necessary to digress from this subject, however, to show the proper application of results of this pumping in order to present a clear view of what was to be accomplished, and what obstacles are in the way.

The pumps most commonly used would be either direct-acting power pumps or centrifugal pumps. The former will give better efficiency in general; but it is necessary to reduce the high speed of the motor by double reduction belting or gearing in order to obtain suitable speed for the pumps. This is in itself an objectionable feature, in addition to the power loss which it entails. Also,

there are many wearing parts and bearings about these pumps, all of which require attention and oiling.

With centrifugal pumps, on the other hand, the wearing parts and bearings are reduced to a minimum, and consequently the attention they require is very small. There is little to get out of order about them, and while in general they may not be quite as efficient, still they are far preferable for the general purposes for which irrigation pumps are used. Having decided to install centrifugal pumps, the next question is as to the method of connection of the same to the motor.

In general, as will be explained later, it is advisable to put the pump down as low as possible in the ground. The motor, on the other hand, must be where it will be out of danger of becoming wet. Pump pits may be flooded or the ground water may rise very high. While the pump is in operation there will be in general no danger of the pit being filled; but when the pump is shut down the water may rise above the pulley of the same. Under these conditions, if the pump is belted to the motor, this will necessitate bailing out the pit before the motor can be started, and if the belt had not been taken off, it may be ruined.

No end of trouble has been caused by belted plants installed in dry seasons, having the ground water rise above the pump pulleys. In some instances it has been necessary to pump the pits for hours with other pumps, before lowering the water sufficiently to put on the pump belt, and even then should the pump stop even for a short time, the pit will immediately fill up with water.

Direct-connected units in large sizes are generally preferable to belting. Where the wells are of ample capacity, horizontal units will be preferable, these being located near enough to the surface to avoid all danger of the water rising up to them. Horizontal units are simpler than vertical units, and on this account should be used where they are possible.

Where, however, it is a question of obtaining all the water possible from the wells, which is usually the case in irrigation problems, the pumps should be set as low down as possible. One reason for this is to be able to pump the wells as far down as possible without exceeding the suction limit, and hence obtain more water from them. Another reason which is important is that all well water contains more or less entrained air. This air expands very much in the suction pipe with increased vacuum, and may cut down very materially the discharge from the pumps. Should the pump exhaust the water too far in the wells, this air is liable to make it loose its priming and in consequence the pump will stop pumping.

Where the pump is placed very low down where it may be under water, vertical units must be used if they are to be direct-connected. The pump could, of course, be belted to the motor by a quarter turn belt, but direct connection is preferable. A simple vertical frame of angle iron can be used for the motor and pump. This frame can be steadied by bolts, connecting it to the timbers in the pit. It is not always necessary to have the motor above the surface of the ground, and in this event these frames can be very much shortened, to their advantage.

It makes no difference whether or not the pumps are submerged by the rising ground water. The only difficulty is in event of its being necessary to take out a pump or to make repairs on it in place. In this event it may be necessary to pump out the pit by an auxiliary pump.

It is well to have such an auxiliary pump on hand. A very convenient method is to have a direct-connected pump and motor mounted on a wagon with electrical cables, and rubber suction hose. In event of being unable to afford such auxiliary apparatus, it will be well not to try to put the pumps down too deep, so as to be inaccessible from rise of the ground water.

Direct-connected vertical units as commonly installed figure on supporting the weight of the rotor and of the runner almost entirely by the up thrust of the runner. Of course, the ideal method of running is where there is no weight to be supported by the bearings, all thrust being taken up by the difference of pressures on the two sides of the runner. With this object in view the suction side of the pump is usually on top.

Great difficulty is often experienced from the unbalancing of pumps, creating very large end thrusts and damaging the bearings. A centrifugal pump runner has a natural tendency to unbalance itself, and the further it goes to one side, provided there is end play, the stronger will it pull in the direction in which it goes. The extent and the possibility of this pull can be imagined, when supposing the runner to be twenty inches in diameter, a difference of pressure of one pound per square inch between the two sides will produce three hundred pounds difference of end thrust.

The proper balancing of pumps is a very important item in their successful operation. Ignorance in this respect may lead to very bad results, enormous end thrusts being brought into play. Proper adjustment of the runner is of prime importance. Difference of discharge as the ground water is gradually lowered in the wells will cause a variation in the end thrust, and while the pump may balance while the ground water is at a certain level, still, when it has been lowered a few feet, it will be out of balance.

Of course small differences of end thrust are easily taken care of in the bearings, but the usual form of bearings used in the West for that purpose is insufficient for taking any great end thrust. Some of them are incapable of taking even the weights of the rotors and runners wthout overheating.

Some automatic balances have been put on pumps of this nature which have been entirely ineffective. The writer got up a form of automatic balance for pumps which worked very successfully and kept the runner off either end bearing. One-half inch end play was allowed in the bearings, the runner working up and down only about one-sixteenth of an inch, running clear of either bearing when the balance was in operation.

Vertical bearings for the motors and the oiling devices for the same require considerable thought to give satisfactory results. They are more complicated, decidedly, than horizontal bearings. The lower motor bearing is often made almost inaccessible, so that it is impossible to tell what is going on, and one has to put his faith in providence till the bearing burns out. Of course this should not be allowed.

In connection with this subject are suggested the conditions under which these motors have to operate. Where there are many pump stations operated by the same company, scattered over considerable territory, it becomes a matter of importance to reduce as far as possible the expenses of operation.

It is cheaper, far, to have an occasional bearing burnt out than to keep men in constant attendance at each station. Two visits a day of twenty-four hours to each station has been found to be sufficiently satisfactory in the operation of such stations.

In a sandy country, sand storms will force considerable dirt and grit into the buildings, especially where they are not substantially put up. This is liable to find its way into the bearings and to cause trouble, particularly where there is no one in attendance. The bearings on this account should be made as dust-proof as possible.

For the vertical bearings of the motor, the oil is usually kept in circulation by being thrown up by centrifugal force from an oil-cup on the shaft into the top of the bearings. Where this is done, it is well to provide a filter for the oil before returning it to the bearing.

Many bad forms of oiling devices for vertical motors are made. A fine spray is formed where the stationary tube goes into the rotating oil-cup, which in short order throws all the oil out of the cup and all over the motor. By suitable design this can be prevented without difficulty.

Proper ventilation of the buildings having motors and transformers is a thing which should not be overlooked. Places where irrigation pumping stations are located are usually places where the temperature goes up very high in the summer time, temperatures as high as one hundred and twenty degrees in the shade not being uncommon. This is, of course, a higher temperature than is usually figured or for electrical apparatus, and in consequence it is well not to overload the same. High temperature will, of course, cause rapid deterioration of the insulation. Some means of cooling the air in the motor and transformer rooms is desirable.

A very important item in the expense of operating stations in the country is that of team hire. It cuts a very large figure in the costs of repairs of apparatus where the same has to be hauled any distance. So it usually is a good plan to do as much of the repair work as possible in place. By watching carefully, so as to minimize the hauling, considerable money can be saved.

Where there are no attendants constantly at a station, automatic cut-outs should be provided, so that should the power go off or the pump lose its priming, the motor will be automatically switched out. These cut-outs should be governed by the flow of the water, and should not be electrically controlled or governed by the stopping of the pump. One reason for this is that should the pump lose its priming, these other devices will not cut out the motor. Another

reason is that these devices are the simplest, the cheapest and the most reliable.

Where the vertical thrust bearings are on the motor, many motors rely on the water relieving the bearing of part of the weight of the rotor; and when the rotor and the runner are running with no water in the shell, these bearings will get excessively hot. So with this type of bearing it is essential that the motor be cut out when the pump stops pumping.

Some manufacturers use marine type bearing on the pumps, these bearings taking all the end thrust of the pump, as well as the weight of the rotor. It is, of course, advantageous to balance somewhere nearly the end thrust of the pump so as to avoid as much friction and wear as possible.

The simplest form of cut-out for the motors is a float cut-out Where the water discharges over a weir, the head of the weir as well as the friction head in the discharge pipe can be made use of in operating these cut-outs.

Another plan which the writer has used, where the water was delivered through pipes at a distance from the station, was to put a vane in the pipe itself, with bearings on each side. A rod came through one bearing and a stuffing box. This rod was weighted by a weight on a bell-crank lever, tending to keep the vane closed. The vane was so bent that when wide open it conformed closely to part of the perimeter of the pipe, thus reducing to a minimum the friction in the pipe. The bell-crank lever communicated through other levers to tripping the device for opening the switches. All such devices should be as compact and as direct-acting as possible.

In regard to the proper selection of a location for a pump station, the location is usually selected with reference to convenience in pumping the water and distributing it.

There is no more uncertain matter than the manner in which a well is going to turn out. One well may be sunk within fifty feet of another, and while the first may give a splendid flow, the second, even if sunk to just the same depth, may furnish almost no water at all. When the depth of the well is moderate, say fifty to one hundred feet, it is usually a good plan to sink a small test well first, to determine the nature of the soil. If this well shows a sufficient amount of good water, sand or gravel, then a well of the size desired should be put down. However, it is by no means safe to go on indications alone, and this well should be tested by pumping it. This can be easily done by the use of a centrifugal pump driven by a portable engine.

Having found a well to give sufficient flow, any desired number of wells may be put down. but it should be borne in mind that the flow obtainable will not increase as fast as in proportion to the number of wells put down, as, of course, the wells will interfere with each other.

The simplest form in which to put down the wells is in a straight line. This involves least amount of construction and pipe. The best form, perhaps, is in the shape of a cross, the wells going out in four directions from the pump. This will give greatest distances between wells, hence interfering less with each other.

Of course the greater the discharge from the wells, the further down will the water be pulled in them, and the greater will be the lift. In addition to this, greater continued discharge will cause still further lowering of the ground water, necessitating additional lift, and hence additional power. Call A the distance from ground to ground-water, B the distance ground-water is pulled down, Q the corresponding discharge, and P the power required for that discharge, then

$$P_1 = KQ\ (A + B).$$

If it is desired to double this discharge, and this can be done without exceeding the suction limit, then

$$P_2 = 2KQ\ (A + 2B).$$

If $A = O$, additional discharge is obtained only by increasing the power as the square of the desired discharge. As A is not in general zero, this power will not increase as fast as in proportion to the square of the discharge, but will increase decidedly faster than the first power.

Bearing this in view, it would seem to be better policy to put in more wells to pump from (provided these be not too expensive) rather than to put the pump too far down, and to try to exhaust the wells too deep. The cost of power and the cost of the wells should all be taken into account in those calculations.

An important item from the practical standpoint is to have the suction pipe as short and as simple as possible. A very small leak in the suction, which may not be of sufficient size to make the pump lose its priming, will still cut down the discharge decidedly. Where the entrained air is considerable, means should be taken to cut it off.

If perforations in the well are above the level of the water in the same, the water pouring down through these perforations will drag air down with it. If this is of any extent, simple means may be provided to prevent the splash caused by the dropping water.

In general, it must be remembered that exact conditions cannot be figured on, that the head will vary in some instances to a considerable extent, and that the efficiency of the pumps will not be what we should like to have it. It is inadvisable in any extended system to have several makes and sizes of pumps, and it is well if possible to have them all alike. The same thing applies to the motors. Too many different kinds of pumps and motors make a needless amount of work. It may often be well to sacrifice efficiency to simplicity.

Too many mistakes are made in plants by the assumption that they will always run under the maximum efficiency, delivering the rated amounts of power or water, or whatever it is.

If it be an irrigation plant, the water is assumed to be distributed over the land, with no appreciable loss. Interest on the investment and depreciation are not taken into account. When the actual cost of irrigation is figured, it is found to be far different from the original figures, which included only the cost of power and operating expenses, the theoretical highest efficiency, continued running of the plants and the distribution of the water with no appreciable loss. It is similar to figuring the output of an alternating station, at 100 per cent. power factor and 100 per cent. load factor, no accidents being allowed to occur. Of course, these would be ideal conditions of operation, but would almost never be attained.

Before leaving this subject, it will be well to point out a very important phase of the problem, namely, the advantages to be derived by electric companies from a load of irrigation pumps.

Such a load by proper manipulation can be made to fill in many of the inequalities of the load curves of these stations, and the power so furnished, in the case of water-power plants, can be supplied at no additional cost. It is power which would otherwise go to waste. By arranging with the consumers to have the motors cut out during the peak load, this power could be furnished at a price sufficiently reasonable to make it quite an object to the latter, and all the money so obtained is pure gain.

Where pumps must be run nearly continuously all year, hardly any sort of load can be considered more advantageous, for many reasons. For example, no serious loss or damage, outside of the sale of power, will be occasioned by temporary shut-downs for short periods. Moreover, the load is not fluctuating, but is very steady. A pumping load will help very much to steady the voltage, not only for the reason just given, but also because any drop in speed of the generator will correspondingly relieve the pump motors of a load which varies as a power of the velocity between the second and the third. Thus, for small variations in speed, the percentage change in the power consumed in pumping will vary from two to three times as fast as the percentage change in speed. This of itself tends very much to steady the speed and likewise the voltage. Another good point of such a load is that the motors are approximately fully loaded, and consequently the power factor is fairly high.

While a certain extent of pump load is very desirable for filling up the load curve, and while irrigation pumps which run practically all the year are also desirable, pumps which would exceed the limit of inequalities in the load curve and which would run only a few months in the year, would be decidedly undesirable, provided that further market could be had for the power.

Taking all these things into consideration, perhaps the fairest charge for pumps is on a flat rate by the year. Two kinds of rates could be furnished—one for those who would be willing to cut out during the peak, and the other for continuous operation.

The writer has endeavored to point out some of the principal points in the installation and operation of irrigation pumping plants, with particular attention to electrically-driven centrifugal pumps, and to show wherein the difficulties lay, and why expected results have not been attained.

The efficiency of the mechanical and electrical part of the plant is given in general a great deal of attention, but the losses which may occur in the distribution of the water are often disregarded. These are really of prime importance, and when an irrigation plant is laid out, particular care should be taken to proportion somewhere nearly the money to be invested to the proper place to make the saving.

The Economic Design and Management of Telephone Exchanges—XIII.

By Arthur V. Abbott, C. E.

KNOWING the number of trunk lines, the only missing factor necessary to determine the trunk lineage is the length of the trunks. It is impossible to predict the exact length and location of trunk lines in any exchange, until the specific territory shall be examined, districted, and the telephonic centers located. But it is feasible to ascertain for any group, another quantity that is proportional to the trunk lineage needed with offices of varying areas, and which may be substituted for the true trunk lineage, passing under the same name, till such time as the telephone centers *are finally* located and the precise trunk lineage can be ascertained, and which will serve as a guide to determine the relative relations of sub-station lineage and trunk lineage when the territory is split up into varying numbers of offices.

It will be remembered that the average length of the sub-station lines is determined by dividing the sum of all the sub-stations mileage in any district by the total number of sub-stations, and that a series of curves was given showing the probable relation between the length of sub-station lines, and the number of subscribers tributary to offices of various sizes, in large and small cities. Now if any office is to deliver messages to sub-stations that lie outside its boundaries the average distance that such messages travel will evidently be the sum of the distances, measured along streets, from the office to all sub-stations outside of the boundaries, divided by the number of stations. The larger the territory embraced by the office under consideration the greater will be the distance from its telephonic center to sub-stations lying outside its boundary and the smaller will be the number of these foreign sub-stations. Hence the average distance, that messages must thus travel, will increase with the size of the offices. This quantity is called the *average trunking distance*. The average sub-station mileage was ascertained by plotting the stations on a map and scaling from the various telephonic centers to which they were tributary. In the same manner the average trunking distance may be ascertained, by scaling on the map from the various telephonic centers to all stations outside the boundaries of the office. It is easy to see that while the average trunking distance is not the same as the trunk lineage, or rectangular distance between telephonic centers, it is proportional thereto. Now if the trunkage for subscribers, obtained by dividing the office trunkage by the number of sub-stations, be multiplied by the average trunking distance a quantity that represents the trunk lineage per subscriber is obtained. If this calculation be made for several offices of various size, it is easy to plot a curve of the results and compare the subscribers trunk lineage in offices of various sizes, and determine which gives the best results.

In Figs. 28, 29, 30, 31 and 32 all of the preceding quantities have been calculated and plotted for five typical cases, namely, Fig. 28, contains the data applicable to offices located in the center of a large city, say, of 500,000 inhabitants; Fig. 29 the same curves for an office located in the outskirts of the same city. Figs. 30 and 31 apply to offices located respectively in the center and outskirts of a medium-sized city of about 200,000 population, while Fig. 23 is for the center of a small city or large town of, say, 75,000 to 100,000 people. All five of the illustrations are plotted to the same scale, and arranged in the same manner, so that comparison is easy. There are nine curves on each sheet, as follows:

Curve No. 1—Number of originating messages.

Curve No. 2—Theoretical Percentage of messages trunked $= \dfrac{S - S'}{S}$

Curve No. 3—Actual percentage of messages trunked $= \dfrac{q\,(S - S')}{S}$

Curve No. 4—Out Trunk Traffic = Curve 1 × Curve 3.

Curve No. 5—Out Trunk Traffic per station $= \dfrac{\text{Curve 4}}{S}$.

Curve No. 6—Office Trunkage $= \dfrac{\text{Curve 4}}{Q}$ + reserve trunks and call circuits.

Curve No. 7—Sub-station Trunkage $\dfrac{\text{Curve 6}}{S}$

Curve No. 8—Trunkage Distance, ascertained from map measurement.

Curve No. 9—Sub-station Trunk lineage = Curve 7 × Curve 8.

On the bottom of each sheet the axis of X is the independent variable and gives the size or number of stations in the office under consideration. The vertical scale on the right hand indicates the number of messages, and is used with Curves 1 and 4, thus in Fig. 28 relating to the center of a large city, the total number of stations in the whole exchange is taken at $S = 40.000$, the average originating messages T and $T' = 20$, Q is assumed to be 150, and to vary, say, from .65 to .85, depending on the size of the office. Then in an office of, say, 4000 stations the number of originating calls would be found by following a vertical line from 4000 on the lower horizontal scale till it intersects Curve 1, and then a horizontal to the right finding 80.000 on the scale of "Number of Messages." Similarly the out trunk-traffic for the office is obtained in the same manner by following a vertical from 4000 to the intersection with Curve 4, thence a horizontal to the message scale finding 52,000. On the left hand of each sheet there are two scales of equal parts, the outer one reading from 0 to 500 and the inner from 0 to 20. The inner scale applies to Curves 2, 3, 5, and 8. Thus on Fig. 28 if it be desired to ascertain the theoretical percentage of messages trunked from an office of 2000 stations follow a vertical from 2000 on the lower scale till Curve 2 is intersected, thence a horizontal to the inner scale on the left hand reading 95 per cent. The actual per cent of trunking is found on the same scale by stopping at Curve 3, and reading 87 per cent, while the out trunk traffic per station is found by continuing till Curve 5 is intersected and then reading 15.4 messages on the same inner left hand scale. Curve 8 exhibits the data pertaining to the average trunking distance, as determined by map measurements. Taking the various areas needed to include 1000, 2000 and 3000 stations, etc., scale measurements were made to all sub-stations beyond these boundaries, and the sum of the distances (via streets) thus obtained divided by the number of stations, this fixing the average trunking distance. In an office of 3000 stations the average trunking distance would be found by following a vertical from 3000 to the intersection with Curve 8 and thence a horizontal to the inner left hand scale finding 1.4 miles. The outer left hand scale is devoted to Curves 6, 7 and 9. For Curve 6 (the total trunkage) this scale reads directly in whole numbers; thus, to ascertain the total trunkage (including call circuits) that is needed from an office of 2000 stations follow a vertical line from 2000 on the lower scale to the intersection with Curve 6, thence a horizontal to the outer left hand scale finding 300. For Curves 7 and 9 a decimal point must be prefixed to all the numbers of this scale. Thus the sub-station trunkage and sub-station trunk lineage for an office of 3000 stations is found by following a vertical from 3000 to Curves 7 and 9, and thence horizontals to the outer left hand scale to be respectively .1225 of a trunk line, per station, and, .2025 miles per station. The curves of Fig. 29 are plotted on the assumption that the office is in the outskirts of the same city, and therefore works *into* an exchange of 40,000 station with an average originating message rate of 20. The originating message rate for the office is set at 10; the values of Q, q and other factors are the same as for Fig 28, while the average trunking distance is compiled from map measurements. Figs. 30 and 31 deal with a medium-sized city. Fig. 30 predicating the exchange in the center, and Fig. 31 on the outside. The entire exchange is taken at 20.000 stations, the average originating message rate for the whole at 16, with office rates of 16 for Fig. 30 and 8 for Fig. 31. The value of Q is taken from 100 to 150 for Fig. 30 and from 80 to 130 for Fig. 31, while q is allowed to vary from 65 per cent to 85 per cent. In Fig. 32 the whole exchange is estimated at 10,000, the originating message rate at 10, Q from 80 to 130 and q from 65 to 85 per cent. As in Fig. 28 the average trunking distance is in all cases ascertained from map measurements.

The preceding data convey general average information appertaining to outgoing trunk business, but it must not be forgotten that the curves apply to trunking in one direction only, and that the quantities must be doubled, on the average, if both incoming and outgoing business is to be cared for. Further, the curve quantities are *linear* measurements, or *circuit* mileage, and must again be doubled if wire mileage is desired. To accurately and completely design an interlacing Reverse Call Circuit Trunking System, and to determine that point at which the increasing trunk mileage overbalances the decreasing sub-station mileage requires that the territory to be served be districted into a number of different offices, the telephonic centers located with some considerable care, and the trunk line routes set-

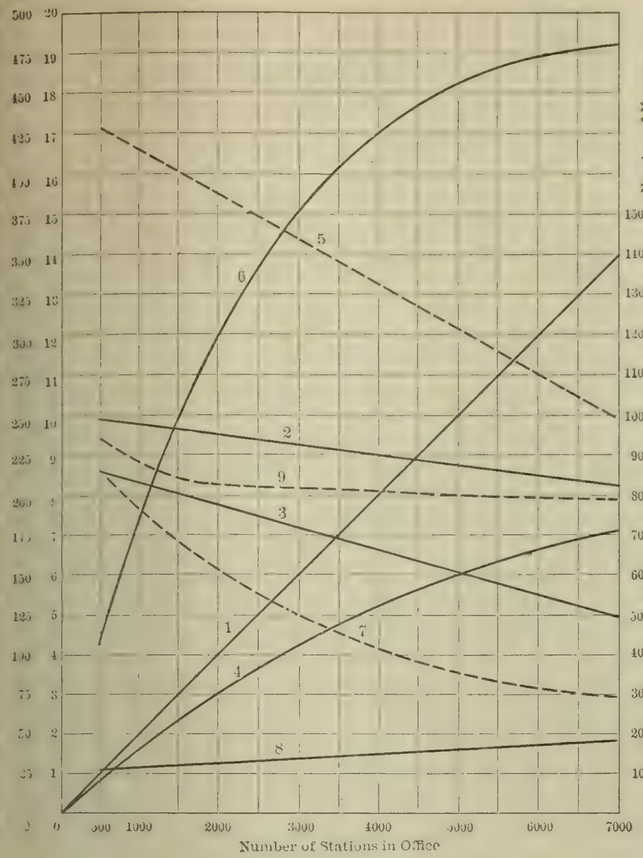


FIG. 28.—CENTER OF LARGE CITY.

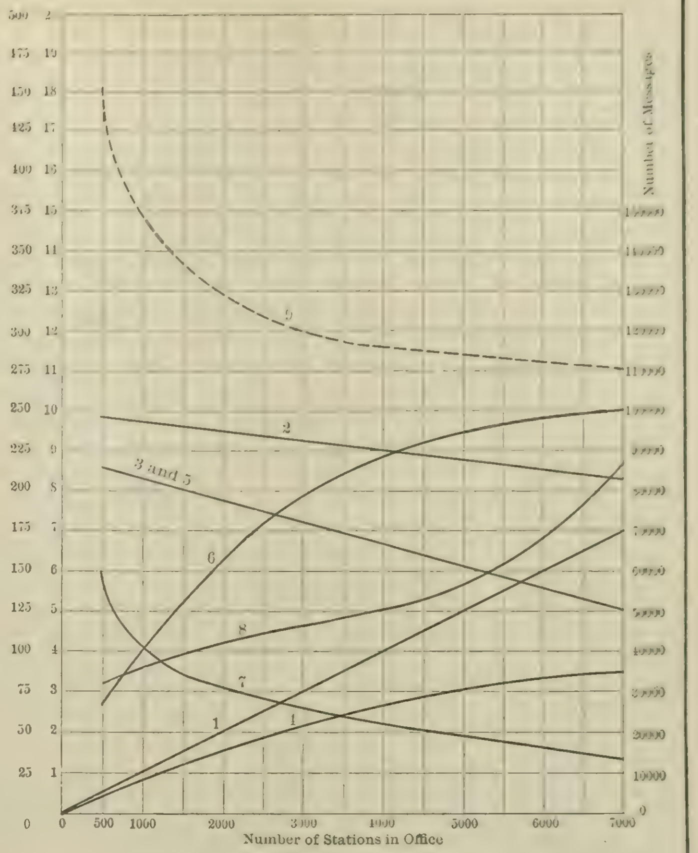


FIG. 29.—OUTSKIRTS OF LARGE CITY.

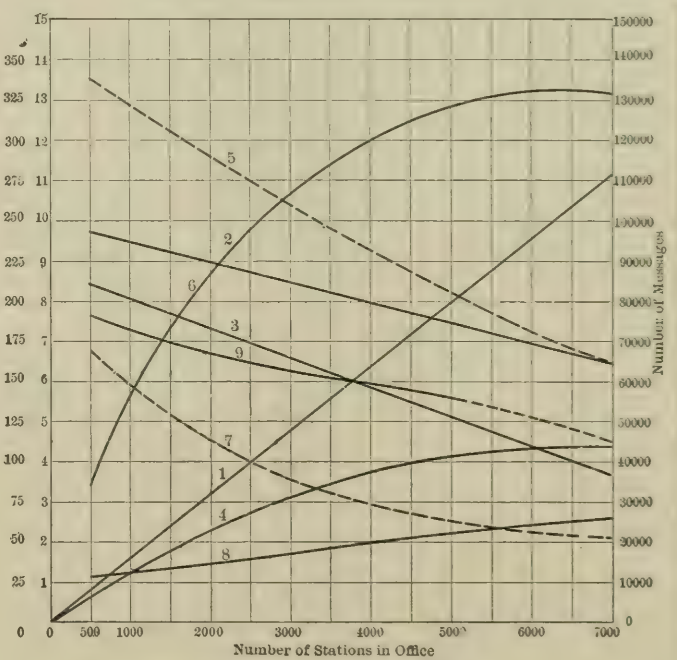


FIG. 30.—CENTER OF MEDIUM CITY.

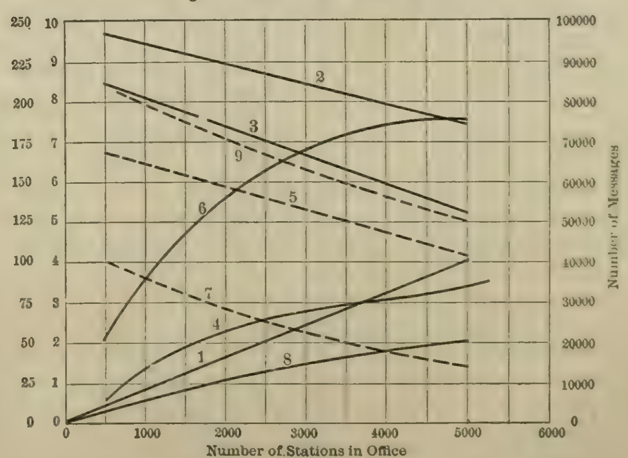


FIG. 31.—OUTSKIRTS OF MEDIUM CITY.

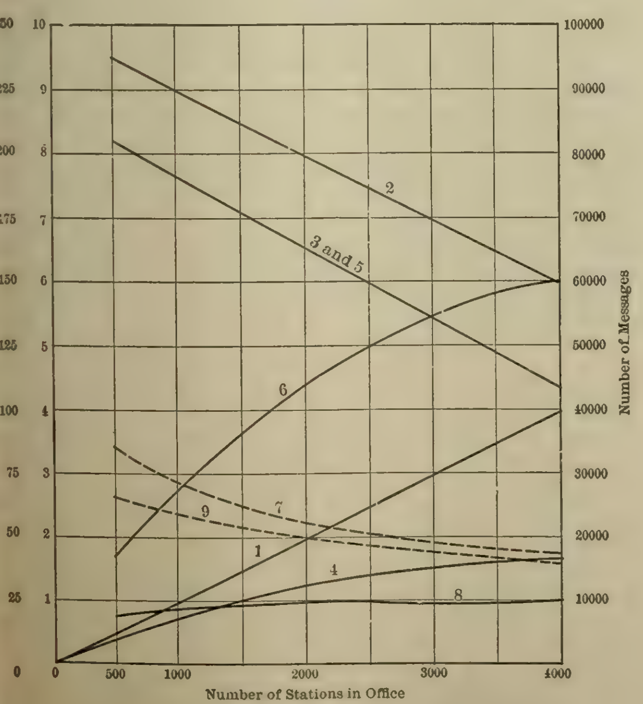


FIG. 32.—SMALL CITY.

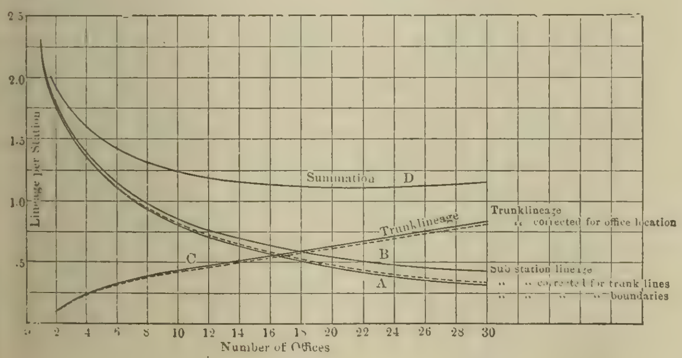


FIG. 33.—LINEAGE PER STATION.

CURVES FOR DETERMINING AVERAGE TRUNK LINEAGE

tled and measured with a fair degree of accuracy, and then the sub-station and trunk mileage plotted for each of the different number of offices. In Fig. 27 a curve was given showing for an imaginary though typical large exchange, the rate of variation of the average sub-station lineage with the variation in the number of offices into which the territory was divided. If the total trunk lineage be divided by the sum of all the sub-stations the exact sub-station trunk lineage is obtained, and if this is done for each of the different number of offices into which the territory is sub-divided, data for plotting a curve that shows the rate of variation of trunk lineage with a change in the number of offices is obtained. In Fig. 33 curve *C* is plotted showing the change in trunk lineage per sub-station for the same conditions that were used in plotting the curves for sub-station lineage in Fig. 27, which are here repeated. Now by plotting a curve whose ordinates are the sum of the sub-station lineage plus the sub-station trunk lineage, while the abcissæ are the different number of offices into which the territory is divided the total variation of wire mileage with a change in the number of offices is obtained, and by inspection it is easy to discover the least ordinate to this curve and to determine that number of offices which will require the minimum wire plant. In the illustration about seventeen offices show the least ordinate, amounting to 1.2 miles, made up of .60 miles for the sub-station line and .60 miles for the trunk line mileage. Incidentally it is obvious from the discussion of this subject that the curve for sub-station mileage and trunk line mileage per sub-station will intersect at the point of maximum economy in wire mileage, and that this point, like many other similar problems, is reached when the sub-station mileage and trunk mileage per sub-station are equal.

The trunk lines form a series of wires extending from every office in each group to all other offices, and evidently there will be trunk lines extending in all directions rectangularly to each adjacent office. In all but very exceptional cases the number of lines on the different sides of each office will be unequal. Thus offices located on the outskirts of a group will have lines on three sides only, and frequently only on one side. Offices between the circumference and the center will have more lines extending towards the center and less towards the outskirts. So the addition of the trunk lines increases the number if wires radiating from each telephonic center. It has previously been shown that the telephonic center is so located as to place an equal number of sub-stations on each side of each co-ordinate axis drawn through it. This is equivalent to saying that there are an equal number of wires entering from the office on all four sides. The addition of the trunk lines will usually cause an unbalance in the number of wires on one or more sides. If now the office be moved in the direction of the preponderance of the number of trunk lines it is evident that all the lines both of the sub-stations and of the trunks will be shortened in the direction that the office moves and lengthened in the other. By the principles previously enunciated the number of sub-station lines are equal on each side of the office, and until some sub-stations are crossed this equality is uneffected by moving the office. When trunk lines are added therefore the office ***should move*** in the direction of the preponderance of trunk lines till such a point is reached (by crossing sub-stations) as to cause an equal number of lines to enter on both sides of each co-ordinate axis. So after the number of trunk lines have been calculated and the routes between the various offices selected, inspection will determine whether the location of the various telephonic centers will be sensibly affected. This is easily done on the map of the territory, the various offices being slightly shifted until an equal number of wires enter each, on each side of each co-ordinate axis. By this shifting the sub-station mileage is somewhat increased, while the trunk mileage is decreased but the sum of the two is the true minimum. In the center of large towns or cities this displacement is almost inappreciable, but on the outskirts it may become a source of considerable error unless taken into consideration. Any change in the office location will, of course, react on the curve for sub-station mileage, which must be correspondingly corrected as shown by the dotted line near the curve *A* (Fig. 33.)

All these corrections are shown by the dotted lines in close proximity to the curves *B* and *C*, while the summation curve *D* is plotted for the corrected values. It will be noticed that this curve is quite flat near its least ordinate, there being only a difference of .025 of a mile per station between fourteen, eighteen or twenty-two offices. So that quite a liberal latitude may be exercised in the selection of the desired number of offices without seriously changing the total required wire mileage.

The complete analysis of the relations of office location and the relation of the number of offices to the wire plant has now been exhibited, and the methods of ascertaining the change in wire mileage with any variation either in location or number of offices in any exchange. To determine relative economy it is now necessary to investigate the methods of construction and determine the cost of wire plant.

British Street Railways.

At the recent meeting of the Association of Municipal Tramway Managers, of Great Britain, it was brought out that the municipalities in Great Britain now own and operate about 1,200 miles of tramway track, and have invested over $15,-000,000 in these undertakings. In a paper read before the meeting, Mr. Bellamy, of Liverpool, discussed the question of half-penny fares, and statistics which he gave showed that these would not, as a rule, be desirable. He pointed out the importance of securing from the British Board of Trade the privilege to increase the speed, which is now limited to 6, 8 or 10 miles an hour under different conditions. He believes that the double-deck cars used in Great Britain are desirable for the conditions in that country, and that a careful system of checking the receipt of fares by conductors is very important. Another paper, read by Mr. Fell, of Sheffield, dealt with "Power Stations." He believes that the installation of very large generating units at the start is undesirable, and that the station should be so arranged that two-thirds of the plant installed will carry the maximum load. He then discussed some of the possible economies in power-station operation, such as automatic stokers and oil separators, and in conclusion gives some statistics as to the cost per kw-hour and "per passenger carried" of his power station.

Some notes on American tramway systems were presented by J. B. Hamilton, of Leeds, in which were given some observations made during a trip of about 20 days through some of the principal cities in the United States. Referring to rail joints, it was stated that the cast-welded joint is giving very good satisfaction. Electrically-welded joints are being used in Buffalo, in which city there are over 3,000 joints of this kind. The number of joints broken since the contractors removed their welding plant has been about 1 per cent. The electrical return has been very much improved, and the Buffalo company is very well pleased with its electrically-welded rails. Repairs of car equipment are nearly all done at one point on a system; about one man to every seven cars is the rule. Labor-saving appliances are the rule, and repair work is nearly all done on the piece-work system. Very little or no laying-off time is allowed at the end of the lines. The men are usually paid by the hour. The maximum speed between stops in cities is not greater in most American cities than in Great Britain, but a higher average speed is attained, due to quick acceleration.

Electrical Utilization in St. Louis.

Much space is given to statistics on overhead and underground wires and cables in the annual report of the Supervisor of City Lighting, submitted to the Board of Public Improvements of St. Louis, Mo. Last year 38,889 miles of cable and 22,519 duct feet were laid by all companies. The report states that there are 361.896 miles of trolley wire and about 300 miles of high-tension wires of the electric light and power companies. There are 985.913 miles of pole lines, exclusive of trolley lines and 62,512 poles in streets and alleys, including trolley poles. There are 18,370 trolley poles. The telephone, telegraph, light and power companies have 44,142 poles, many of which carry high tension wires. From April 5, 1897, to April 1, 1902 the following progress was made in burying wires and cables: Trench feet, 1,162,916; duct feet, 3,864,024; feet laterals, 256,334; miles of cables, 388,157.

The accident list shows that six deaths were caused by contact with live wires; sixteen persons were shocked by the same cause; one death was caused by falling from a pole, and six persons were injured in this way.

The electric railways occupy 200.886 miles of street; 361.896 miles of track are operated; there are 361.896 miles of trolley wire and 19,107 poles. The Transit Company utilizes 190.548 miles of street, operates 325.821 miles of track, has 325.821 miles of trolley wire and 17,865 poles. The Suburban utilizes 19.338 miles of street, operates 36.075 miles of track, and has 36.075 miles of trolley wire.

The cost of street lighting in 1901-1902 was $498,729.92, as compared to $416,080.95 in 1900-1901, and the cost of lighting public buildings $66,285.62, as compared with $95,799.49.

Combined Railway and Central Station Plant for Wilmington, N. C.

A power installation of more than ordinary novelty is in process of installation at Wilmington, N. C. The Consolidated Railways, Light and Power Company is at present operating a small lighting and street railway service in this city, and has acquired the properties of a suburban road of approximately 12 miles in length, running from Wilmington to an attractive summer resort, Wrightsville Beach, on the Atlantic Coast.

This road is now operated entirely by steam, and it is the purpose of the company to change the motive power to electricity and operate both urban and interurban systems from a single power house located in Wilmington. The power for present uses is generated in two separate power houses, which were originally operated by the two companies forming the consolidation, representing gas, electric lighting and street railway interests, respectively. These plants will be abandoned and a new power house constructed, which will furnish power for city and suburban railway, incandescent and arc lighting. A substation has been built about 1.5 miles from the beach terminal and nine miles from the city, in which will be located apparatus for converting the 10,000-volt alternating current used on the transmission lines, to 550-volt direct current for furnishing motive power to the suburban cars. The accompanying illustration gives a diagram of the system.

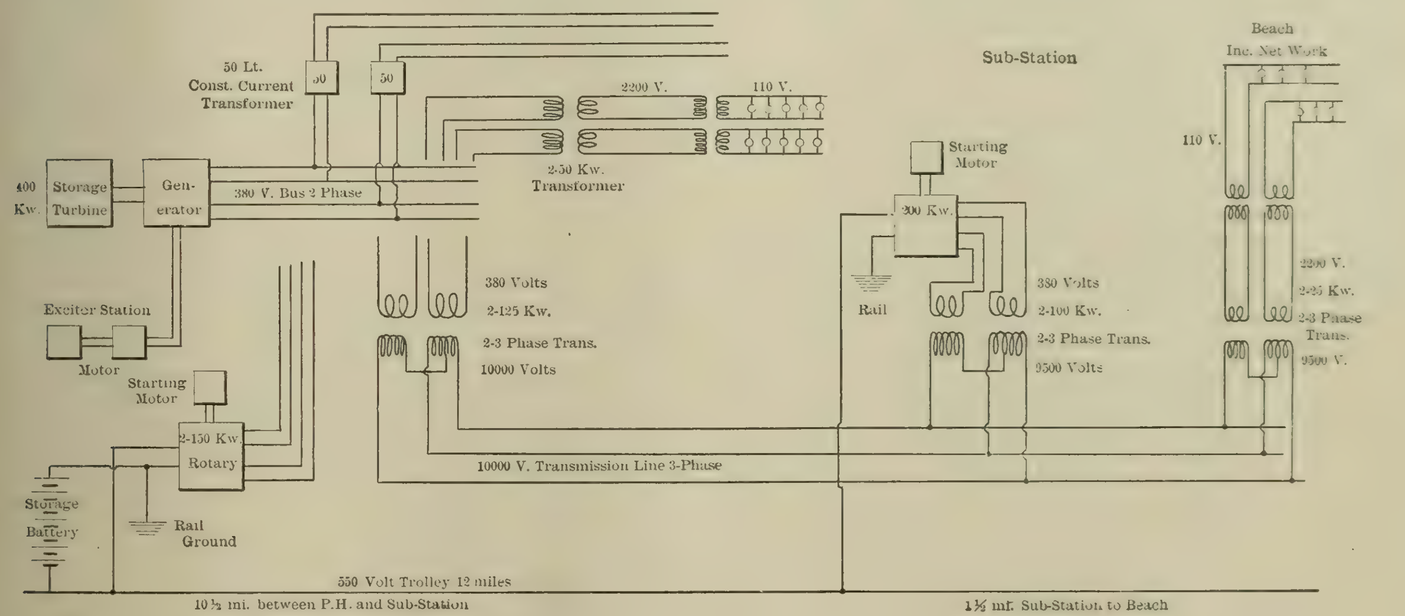


DIAGRAM OF THE WILMINGTON COMBINED RAILWAY AND CENTRAL STATION SYSTEM.

The item of greatest interest outside of the somewhat novel combination of railway and lighting service contemplated by the company, is the installation of a 400-kw Westinghouse steam turbo-generator as the main power unit, which will ordinarily furnish the entire motive power of the proposed plant. The turbine equipment will be supplemented by a reserve of reciprocating engines for the purpose of furnishing power during emergencies or on very light loads. The turbine will be of the multiple-expansion, parallel-flow type, the present standard type of the Westinghouse Company, and will operate at 150 lbs. steam pressure on 26-inch vacuum with no superheat. The approximate dimensions will be 4½ x 19 feet, and the combined weight 25,000 lbs. The turbine will be provided with a by-pass valve connecting high-pressure and low-pressure steam chests, by means of which an overload of 50 per cent. may be carried continuously. Steam will be furnished by two 250-hp B. & W. boilers, arranged for hand firing. The condensing outfit will be of the most approved and efficient type and capable of sustaining continuously 28-inch vacuum.

The generator will be of the two-pole, rotating field type, direct connected by means of a flexible coupling to the turbine, and will generate two-phase alternating current at 380 volts. Part of this current will be stepped-up by two-phase, three-phase transformers to 10,000 volts, three-phase currents for the transmission system, a second part converted into 550 volts direct current for the local railway system by two rotary converters located at the power house, and the remainder utilized for the local lighting system, comprising two 50-light constant-current arc circuits and a 2,200-volt incandescent distributing network. The generator will be excited by a small direct-current machine, direct connected to an induction motor operating directly on bus-bars.

Arrangements will be also made for exciting the alternator field directly from a storage battery in case of accident to the regular exciting unit. This storage battery will be located in the power house at Wilmington, and is designed to serve the two-fold purpose of a floating battery and power reserve for emergencies. Its output will be controlled by a differential booster set.

The rotary converters to be installed in the power house will be provided with induction starting motors and also with extended shafts for belting to the engine reserve if necessary. They will then operate as double-current generators, furnishing alternating current to the transmission line and lighting systems, and direct current to the local trolley system, being assisted in this respect by two Edison bipolar machines now in use. These converters will be of 150 and 200-kw capacity, respectively.

The sub-station will contain one rotary converter set with oil-cooled transformers and switchboard. This station will also contain two two-phase, three-phase lighting transformers stepping down to 2,200 volts, for supplying a lighting feeder extending along the right of way to the Beach. The lightning protection of the entire system involves the use of choke coils and the low equivalent arrester system.

The rolling stock of the suburban line will be of the double-truck interurban type, 41 feet in length, equipped with two motors and controllers. The cars will make a scheduled speed of approximately 15 miles per hour. The new city cars will be equipped with Westinghouse motors.

Wrightsville Beach is one of the most attractive resorts on the southern coast, and the elimination of the steam service will greatly enhance the value of both the railway systems and terminal properties.

The consulting engineers for the Consolidated Company are Mr. H. R. Randolph and Prof. W. L. Robb. All the electrical apparatus will be furnished by the Westinghouse Electric Manufacturing Company.

To Transmit Messages to Ships at Sea.

The Marconi Company of America announces that it has established direct connections all over the United States with its shore stations, and is prepared to receive messages for transmission to all vessels equipped with its instruments. It is expected to thus make it possible for all the great steamships plying between Europe and America to keep in touch with the world as well as with each other. Every Postal Telegraph office is an office for the Marconi business.

Central Station Depreciation.

One of the most interesting discussions at the recent Cincinnati Electric Light Convention dealt with methods of determining the actual depreciation of central station plants, and the timeliness of the topic as well as the need of definite ideas and information was well illustrated by the diversity in the views expressed.

Mr. W. L. Abbott expressed the opinion that electrical apparatus depreciates much faster than we realize, if it is considered that besides wearing out the chances of apparatus becoming obsolete must be taken into account. Apparatus that has been used in the business for the last 15 years has not had an average life of over 6 or 8 years. Mr. Abbott said he found in making an estimate for depreciation, his figures are always higher than those of anybody else, which perhaps is because he has been in the business longer than most other people who figure on depreciation. While depreciation is not so rapid now as in the past, it should not be taken at less than 15 or 20 per cent. during the first few years; after that the depreciation will be correspondingly less. Mr. I. B. Smith, of Cedar Rapids, Ia., said that depreciation will vary from 2 per cent. up to 10 per cent. for different classes of apparatus, depending on what the apparatus is. On the power house many companies consider that two per cent. is a fair depreciation. A point to be considered also aside from actual wear and tear is that apparatus may either decrease or enhances in value. The last few years has actually shown an increase in the value of some electrical apparatus, whether it is old or new. To adopt any particular system will give rise to complicated problems, and it may be better to guess at it and see how one comes out.

Lieut. James B. Cahoon, of New York, took issue with Mr. Abbott on the question of making the depreciation 15 per cent. for the first five years of the use of electrical apparatus. While this was perfectly true of electrical apparatus in the past, it is not true of the electrical apparatus sold to-day. The question of depreciation is a new one, comparatively speaking. It has been the custom of many companies in the years gone by to let depreciation look after itself, and they have run along declaring dividends when they could, and all at once had to meet the issue that their apparatus was obsolete, or had gone to pieces and had to be replaced, with no depreciation fund to cover this expense. The English method of setting aside a definite amount for depreciation, and placing that at interest, is better than any of the methods adopted in this country. Some engineers here have advocated shaving off 5 per cent. on certain pieces of apparatus and carry it along at 5 per cent. for the whole period of its life. Then certain engineers have recommended that if we set aside five per cent. for depreciation, this should not be put into a bank, but considered a fund against which should be charged improvements and betterments, so that the value of the plant shall remain the same at all times; in other words, thus keep the plant up to the same general level of efficiency as in the first place, or keep the plant always at 100 per cent. That is to say, instead of charging improvements and betterments to the construction account, they are charged against this depreciation fund.

Mr. Cahoon considered that the best plan would be to take each piece of apparatus of to-day, estimate its life and therefore rate of depreciation; then set aside annually, say, at three per cent. an amount which at that rate of interest will equal the original cost of the apparatus. If this plan were carried through for each class of apparatus, engines, boilers, dynamos, buildings, lamps, lines, etc., etc., a pretty fair estimate would be arrived at as to the depreciation.

Mr. W. L. Abbott said that to further illustrate his previous remarks, suppose the case is taken of a new direct connected unit costing $100,000—a generator connected to reciprocating engine. The next year we may find that we can get a unit of the same output as economical as the reciprocating engine, in a turbine unit, for, say, $70,000. It would then be quite proper at once to write off $30,000 for depreciation, or 20 per cent. After that, depreciation would not be so rapid.

Mr. Arthur Williams said that many engineers allow nothing for depreciation on the ground that repairs and renewals offset the depreciation. But in an isolated plant you must charge off depreciation either through several years or in the last year, and it is important to have an established rule. This question was brought up at the meeting of the American Institute of Electrical Engineers at Boston in 1800, and the general feeling was that ten per cent. on the cost of any electrical plant was a fair depreciation charge annually. Nothing was said as to whether it should be at single interest or compound interest. The New York Edison Company's charge is eight per cent. which represents 12 years of life, the depreciation coming about in several ways—through the wearing out of machinery, or its profitable replacement by other forms of machinery, and also by the limitation of the useful life of the machinery due to greater competition of the central station companies; this competition increasing by lower manufacturing costs on the one hand, and the increase in efficiency of translating devices, such as the Nernst lamp, or the substitution of arc lights for incandescent lights, on the other hand.

Mr. Leonard Andrews, of Hastings, England, said that this is a question which has been discussed in England for some time. There is in Great Britain an association of municipal electrical engineers, the managers of municipal stations, and during the last few months they have been discussing this question of depreciation pretty fully. But a short time ago at a meeting of practically all the members of the association, it was almost unanimously agreed that if about three per cent. per annum were set aside for depreciation, that would be sufficient. Of course, the depreciation is not at the same rate as here, as plants are not scrapped quite so quickly.

Mr. Charles R. Price, of New Bedford, Mass., agreed with Mr. Williams that when it comes to the substitution of incandescent arcs for the old open arc, it practically results in scrapping machines which cost several thousand dollars, and therefore ten or fifteen per cent. is a safe depreciation charge per annum. In reply to a question Lieut. Cahoon said that if a company takes the betterments ordinarily put into a plant from year to year, and instead of charging that off to construction account, charges it to maintenance and operation, it is for all practical purposes maintaining the plant at 100 per cent. Referring to Mr. Abbott's statement in regard to charging off on a $100,000 plant $30,000 because some turbine comes up to replace the ordinary reciprocating engine, Lieut. Cahoon said he did not think that is doing justice to the plant. The difference in efficiency between the steam turbine, so far as we know at the present time, and a first-class reciprocating engine, is not great enough to warrant that amount being charged off. No plant can stand such a heavy charge being made against it any one year. If it is thought desirable to charge off, it should be charged to expense account and distributed over five years; otherwise dividends are deferred, stockholders will make objection, and a small plant cannot stand such a system. Mr. Harry Bottomley, of Bellows Falls, Vt., said that the Gas and Electric Light Commission of Massachusetts when estimating in their annual returns the cost of lighting in municipal plants, add in as a factor of the cost of the lighting the sum of five per cent. on the total capital invested as a depreciation fund. Mr. D. F. McGee asked if on the basis of 10 per cent. depreciation, and a plant worth $100,000 when it is installed, and if improvements are made to the amount of $5,000, should the value of the plant at the end of the first year be $90,000 and the next year ten per cent written off from that amount? In reply Mr. Arthur Williams said that if the plant cost $100,000 and during the first year $5,000 in improvements were made, then the total cost of the plant is $105,000, and at the end of the first year 10 per cent. on $105,000 should be written off.

A motion was made to the effect that it is proper to charge off to depreciation 10 per cent. annually on electrical and mechanical equipment, and a similar motion was made placing the percentage at seven and one-half per cent. Some opposition having developed the matter was referred to a committee for report. Subsequently in answer to a question as to whether a distinction should be made between boiler and engine room, or whether they should be classed as a whole. President Doherty said he thought they should be distinct; that every piece of apparatus should be distinct. There are no two classes of apparatus that will depreciate at the same rate, nor are there any two makes of apparatus that will depreciate at the same rate. Mr. J. Walter Gillete, of Evansville, Ind., said that in his experience depreciation has been more rapid in the boiler room and the pipe room—at the steam end of the plant—than in the dynamo room where proper care has been bestowed on that end of the plant.

Old Time Telegraphers.

The Old-Time Telegraphers have issued a circular of their meeting for the twenty-second annual reunion, at Salt Lake City, on September 10, 11 and 12. The U. S. Military Telegraph Corps will meet as usual at the same time. The local committee has as its chairman Mr. C. B. Horton, assistant superintendent Western Union Telegraph Company, Denver. Headquarters will be at the Kenyon.

English Municipal Railways.

In his address as president of the Incorporated Municipal Electrical Association, which was delivered at the seventh annual convention of that body, held in London last month, Mr. J. H. Rider pointed out that in the United Kingdom there are 36 electric street tramways in operation which are owned by municipalities, and 16 more in progress of construction. The overhead trolley system in England, as in America, occupies the field almost entirely to the exclusion of other forms of construction, and Mr. Rider expressed the opinion that under present conditions there is no reason why all the street railways of Great Britain should not be operated by the trolley system, and that there can scarcely be any excuse for the introduction of other systems. He admits that the overhead construction in some of the English towns is not as attractive as it should be; in fact, that it is often ugly in appearance, but he points out that this is a fault of the designer and not of the system, as it is perfectly easy and practicable to design and erect an overhead line which will look well in almost any locality. One of the principal difficulties in designing neat overhead construction is the use of guard wires, which are called for by the rules laid down by the board of trade and the local authorities. Instead of affording additional protection, he considered that these guard wires are not only cumbersome and unsightly but they are often a source of positive danger. The only practical solution of the problem Mr. Rider believed to be the placing of the telephone wires under ground, which will remove the necessity, or rather the excuse, for guard wires.

The Investments in Telegraphy and Telephony.

The financial organs of Boston and New York have recently had some very interesting figures as to the relative investment value of the shares of the American Telephone and Telegraph Company, the Western Union Telegraph Company and the Commercial Cable Company. Owing to the fact that a considerable portion of the share earnings of the American Telegraph and Telephone Company is not reported, but remains in the treasuries of the sub-companies as undivided earnings, the actual earnings on the shares of the parent company have been more or less a matter of conjecture, thus making an accurate comparison with other companies very difficult. There is a method, however, by which we may figure the approximate share earnings of the Telephone Company. Subscribers in central districts, like New York and New England, pay about $60 per annum, and in the West about $30 per annum. The average number of Bell subscribers in the United States in 1901 was 1,119,706. Assuming that the average amount paid by each subscriber was $45 per annum, the gross telephone business of the country in 1901 was about $50,400,000. Of this amount, $6,000,000 represents the direct gross operations of the American Telephone and Telegraph Company in its long-distance system. Approximately one-half the remainder, or $22,000,000, represents the parent company's share in the business of the sub-companies.

All disbursements of the sub-companies before dividends average about 70 per cent. This would leave the parent company's share of surplus earnings at about $7,000,000, or 30 per cent. of $22,000,000. That this figure cannot be far from correct is shown by the fact that in 1901 the American Telephone and Telegraph Company received in dividends from the sub-companies $4,988,208, and companies paying, say, $5,000,000, may fairly be assumed to be earning $7,000,000, or the ratio of 7 per cent. earnings to 5 per cent. dividends. It is probably safe, therefore, to estimate the amount of the American Telephone and Telegraph Company's undivided earnings in the treasuries of the sub-companies for 1901 at a round $2,000,000. Having settled this point, the three companies, American Telephone and Telegraph, Western Union, and Commercial Cable, may be compared on the same basis.

Since the last report, Dec. 31, 1901, the telephone company has issued $21,937,000 new stock on the basis of one new share for every four outstanding, so that the amount outstanding at the time of the issue of new stock was $87,748,000, against $82,836,300 at the close of the fiscal year. Apparently about $5,000,000 was sold from the $32,110,200 held in the Bell Company's treasury.

The capitalization of the three companies as outstanding at present compares as follows:

	Am. Tel.	*West. Union.*	*Com. Cable.*
Stock outstanding	$109,685,000	$97,370,000	$13,333,300
Bonds outstanding	15,004,500	19,660,000	20,000,000
Total capital	$124,689,500	$117,030,000	$33,333,300

The total selling values of the companies in the market, taking the bonds of all three companies at par, compare as follows:

	Am. Tel.	*West. Union.*	*Com. Cable.*
Price of stock	$ 165	$ 87	$ 160
Market value of shares	180,980,250	81,711,900	21,333,280
Bonds at par	15,004,500	19,660,000	20,000,000
Total selling value	$195,984,750	$101,371,900	$41,333,280

Taking gross earnings of the telephone company at $28,000,000, as estimated above, and net earnings at $2,000,000 more than shown in the report for the last fiscal year, the operations of the three companies can next be compared. Western Union's figures below are for the year ended June 30, 1901; those of the other two companies are for the year ended Dec. 31, 1901:

	Am. Tel.	*West. Union.*	*Com. Cable.*
Gross earnings estimated	$28,000,000	$26,354,150	$3,592,129
Expenses and interest	18,601,715	20,625,062	*2,061,166
Net earnings	$9,398,285	$5,729,088	$1,530,963
	7½ per cent.	5 per cent.	8 per cent.
Dividends paid	$5,050,023	$4,868,007	$1,066,664
Surplus	$4,348,262	$861,081	$464,299

Western Union's gross earnings may be expected the coming year to fall off slightly on account of the loss of the Pennsylvania lines. The amount of decrease in net earnings will depend upon the cost of operating these lines, whatever that may have been. A Western Union official has declared that operating expenses on these lines were quite equal to the receipts.

Adding to Western Union's figures the gain in surplus for the six months to Dec. 31, share earnings and the returns to an investor figure as follows:

	Am. Tel.	*West. Union.*	*Com. Cable.*
Price	$165	$87	$160
Dividend to price, per cent	4.54	5.74	5.00
Earned on par value, per cent	8.56	6.38	11.47
Earned on price, per cent	5.18	7.33	7.16

The return on American Telephone shares has been calculated on the basis of the present amount of capital stock. To indicate the real earnings of the shares, apart from rights, there should be taken the amount of stock outstanding last year. On the $82,836,300 stock outstanding Dec. 31, 1901, earnings were 11.2 per cent., or about 6 per cent on the price at 185. It is not singular that the earnings of the American Telephone Company show a lower return on the price. A low return to the investor is an almost sure indication of the gilt-edged character of a security.

Although the ratio of earnings to price is larger for Western Union and Commercial Cable, it is held to be doubtful if these stocks will yield so large a return in the next five years as American Telephone. Rights of 10 per cent. to 15 per cent. may be expected each year on the shares of the latter company, so that in five years an investor may be receiving 7½ per cent. on stock whose net cost has been reduced by subscription rights to about par.

Experimental Physics.

The Société Francaise de Physique has authorized the compilation of a work under the auspices of the Société, to be entitled, "A Collection of Elementary Experiments in Physics." The co-operation was invited of the members of the Société in the preparation of this work, which will cover both lecture and laboratory experiments. The requirement is that the experiments shall be such that they can be made in a small laboratory not supplied with special apparatus.

* Includes $150,000 to reserve for repair steamer, etc.

Recent Progress in Electrochemistry.

BY CLINTON PAUL TOWNSEND.

REDUCTION METHODS.

Two patents of the current issue deal with the reduction of oxids, the one, granted to Ramon Chavarria Contardo, of Santiago, Chili, depending upon the heat developed by the arc, and the other to Dr. Frederick C. Weber, of Chicago, upon the reaction, either exothermic or endothermic, of aluminum. The methods differ utterly in character, but are alike in that the object of the improvement in either case is to bring the reaction under complete control. In this

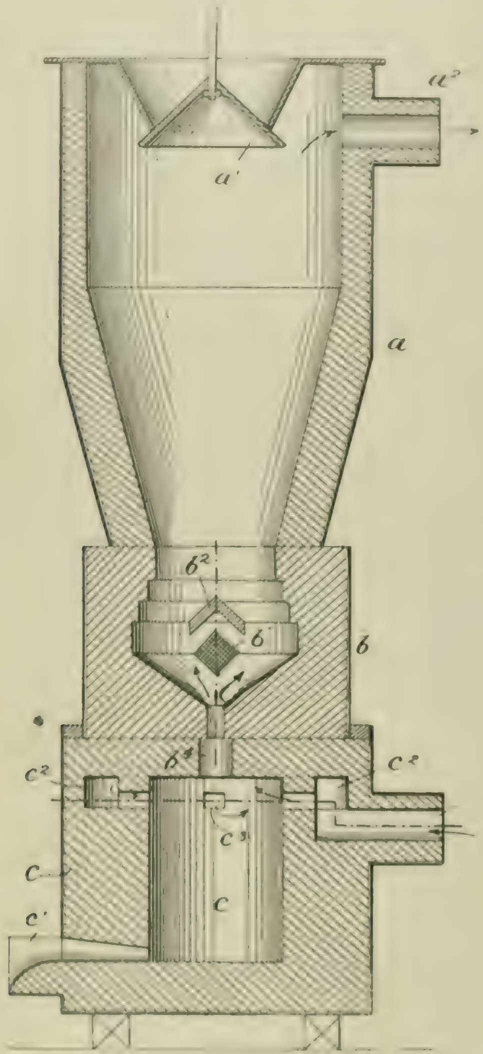


FIG. 1.—CONTARDO'S METHOD OF REDUCING IRON ORES.

they are illustrative of recent inventive attitude toward high temperature reductions, the accomplishment is assumed, and the object sought is a regulated continuity.

REDUCTION OF IRON ORES.

In the direct production of iron or steel from the ore three elements are to be considered, namely, a source of heat, a reducing agent and a carbon supply. In the ordinary blast furnace the combustion of carbon performs these three functions, whereas Chavarria Contardo's plan is to render them entirely independent of one another. To this end the temperature is reached through the agency of an arc, so protected from the charge that the carbon of the electrodes cannot enter into the reduced metal; the reducing agent is a gas which cannot influence the carbon content; and the carburetting agent is another gas, the quantity of which is subject to exact regulation. The apparatus comprises a stack, *a*, smelting hearth, *b*, and a crucible, *c*; the carbons, b^1, extend diametrically through the smelting chamber and are protected from the charge by an angular refractory cover, b^2. The stack is provided with the usual charging bell, a^1, and gas outlet, a^2, and the crucible with a tap or cast, c^1. In operation the ore, unmixed with any reducing agent, but containing a suitable flux, is charged into the stack, and the heat conveyed to it by radiation from the arc and by convection by the reducing gas, hydrogen or carbon monoxid, introduced through the flues, c^2, c^3, b^4. Through the same flues flows a hydrocarbon gas in quantity determined by the desired carbon content of the resulting product.

REDUCTION BY ALUMINUM.

Dr. Weber attributes the occasional explosive violence of the "thermite" reactions largely to the presence of water, free or combined, in the reducible oxid, and avoids the difficulty by a preparatory treatment through the agency of electrically applied heat; for initiating the reaction, it suffices to fuse a portion of the aluminum, and this is accomplished by its inclusion in a second circuit. The objects attained are thus a regulation of the reaction and the avoidance of a contamination of the product by the base of an easily reducible oxid such as is ordinarily used, with aluminum or magnesium, for producing the initial high local temperature. The arrangement of the charge is shown in the accompanying figure, in which *A* is a metal crucible, *B* a lining of graphite or of lime, and *C* an additional lining of mineral wool, mixed if desired with lime or magnesia. In the bottom of the crucible is a spiral, *a*, of fine aluminum wire connected in the circuit *D*, *d*; this wire is surrounded by its atomic equivalent of an oxid, *g*, in a state of very fine division. A sheet of tissue paper, *f*, separates this oxid from the main charge comprising granulated aluminum in admixture with the oxid, such as boron trioxid, to be reduced. In this main charge also, atomic proportions of oxid and aluminum are observed, the weight of the main aluminum helix, *b*, and of a supplemental crucible lining, *c*, of aluminum, being

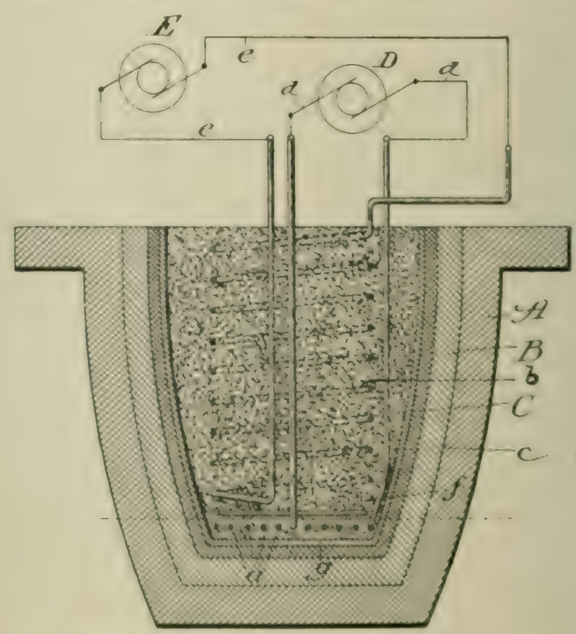


FIG. 2.—WEBER'S METHOD OF REDUCING ALUMINUM.

considered in estimating the proportions. This large helix of aluminum is included in the circuit *E*, *e*, and in operation sufficient current is passed to thoroughly dry and otherwise prepare the charge, whereupon by shifting the current through the smaller helix, *a*, the wire is fused and its reaction with the surrounding oxid, *g*, initiates the general reduction; as the reaction spreads rather slowly through the coarse mixture it is possible to add additional quantities as required. It is stated also that by heating the mixture by means of the main helix to a temperature just short of the fusing point of aluminum, reactions may be obtained with oxids which require for their reduction a higher temperature than is furnished by the oxidation of aluminum.

Wireless Telegraphy in Italian Navy.

It is announced from Rome, under date of August 4, that the Government has ordered Marconi apparatus to be placed on all Italian warships.

A Telephone Relay.

The issue of the Patent Office for July 29 contains two telephone patents, both, however, referring to the same invention, which is a strikingly original method of reinforcing telephone currents imposed upon long lines. This invention is due to Mr. Joseph Lyons, of Washington, D. C., and the patents are assigned to the American Telephone and Telegraph Company. The original application was filed September 2, 1899, and was divided, and a second application covering the system and apparatus (the first covering the method) was filed April 23 of this year. The invention is based on that of Hutin and Leblanc of a machine for reinforcing alternating currents by causing them to produce an alternating field, within which field are rotated closed circuits at a speed exceeding a certain critical speed. Rather than risk destroying the interest of the description of Mr. Lyons' highly ingenious system let him speak for himself:

"The reinforcing of the faint telephone currents I accomplish by reducing the apparent resistance of the line to those currents continuously and practically to any desired extent. In accordance with my invention the telephone currents are primarily caused to produce an alternating field or fields of force varying in frequency and intensity with the frequency and the variations of intensity of the telephone currents, and within such field or fields there are rotated electric circuits that are closed upon themselves with a speed that exceeds a certain critical speed. By the rotation of such circuits within the initial magnetic field or fields the electro-magnetic reactance of the telephone-circuit is reduced, whereby the initial field or fields and the exciting-currents are reinforced.

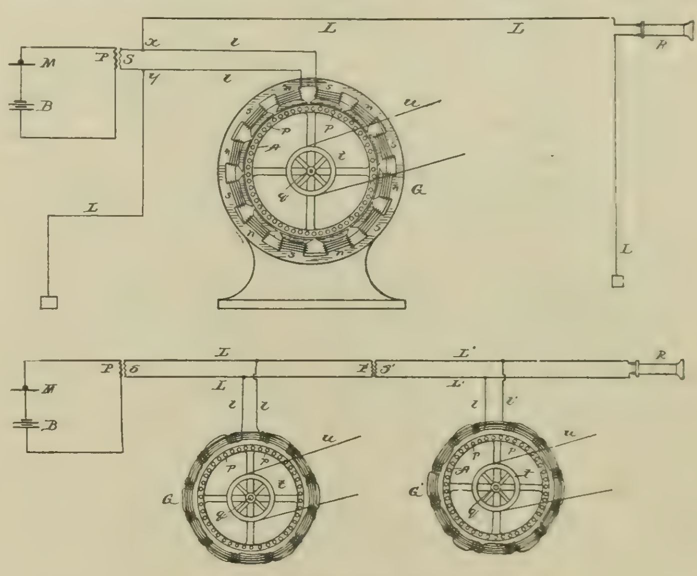
"Machines for reinforcing faint alternating currents of one definite frequency by causing them to produce an alternating magnetic field or fields and rotating within the latter circuits closed upon themselves with a speed exceeding a certain critical speed, have heretofore been suggested for use as constant-potential alternating-current generators, and such machines are set forth in United States patent to Hutin and Leblanc, No. 606,762, dated July 5, 1898. Such machines, however, have heretofore been used only each for the reinforcement of an alternating-current of one definite frequency, and the speed given to the closed circuits was calculated and determined with reference to the frequency of the single current that was led to and reinforced by the machine.

"The rule which governs the operations of such machines is that if the frequency of the alternating current led to the machine is designated by $\frac{1}{T}$ and if the number of poles of the field excited by these currents is designated by $2n$, then in order that the initial field and the initial current be reinforced, the number of revolutions of the circuits closed upon themselves must exceed the quantity $\frac{1}{nT}$. This rule may also be stated in these words: The number of rotations of the rotor must exceed the frequency of alternations of the alternating current that excites the stator divided by half the number of poles of the latter. My invention is based upon the utilization of the principle embodied in these reinforcing generators for the reinforcement of multiperiodic varying currents—that is to say, the reinforcement of telephone currents.

"In the practice of telephony alternating currents of constantly-varying periodicities and intensities are generated, and it has been found that the currents corresponding to the highest pitch of sounds uttered against the telephone transmitter rarely exceed the frequency of 800 per second. All other frequencies that occur in practice are below 800 per second. In order to reinforce alternating currents of the frequency of 800 with a machine of the Hutin and Leblanc type, if the same has, for instance, twelve field poles, the circuits closed upon themselves have to be rotated at a speed exceeding one hundred and thirty-three revolutions per second. If this is done, then not only the currents having the frequency 800 will be reinforced, but all other currents of a lower frequency will also be reinforced and upon the recognition of this fact my invention is based.

"Accordingly my invention is practiced by passing the faint telephone currents at any point on the line through the field coils of a machine of the Hutin and Leblanc type and rotating the armature of such machine with a speed exceeding the number of periods of the highest frequency current that occurs or is likely to occur in telephony divided by half the number of poles of the field-magnet. By this process the lower-frequency currents are more reinforced than the higher-frequency currents; this does not vitiate the reproduction of speech, but, on the contrary, improves it, since lower-frequency vibrations must be of higher amplitude than those of higher frequency in order to produce sounds of the same intensity as the latter."

In the drawings the upper one illustrates the invention applied to an unbroken line, and the lower one to a line divided into sections. The usual local telephone circuit is shown, *M* being the transmitter, *B* battery, and *PS* induction coil. At two points, *xy*, the line is tapped by wires *ll*, leading to and completing the circuit of the field-coils of a reinforcing alternating current generator of the Hutin and Leblanc type above referred to. This reinforcing-generator *G* is ordinarily composed of a stationary iron field-ring having inwardly projecting radial pole-pieces *ns*. The pole-pieces are wound alternately reversed and are here shown as connected in series (although they may be connected in multiple arc), so that a current which produces in one pole-piece a north pole will produce in the next succeeding and in the next preceding pole-piece a south pole. This is indicated in the drawings by the letters, *ns*. The rotary part of the reinforcer is ordinarily made of an iron ring, faced on each side with a flat annulus, *A*, of copper, and the iron ring as well as the two copper rings are perforated, so as to receive copper pins, rods, or bars *p*, riveted at each end to the copper rings; all in the manner now well known and set forth in detail in the Hutin and Leblanc patent above referred to. The copper rings, *AA*,



LYONS TELEPHONE RELAY.

together with the pins *p*, form a great number of electric circuits of low resistance closed upon themselves, and this system is secured upon a spider, as indicated, and the whole is mounted upon a shaft *q*, carrying a pulley *t*, around which passes a belt *v*, by which motion is given to the shaft from any suitable source of power.

In the lower figure the main line is divided into two parts, *LL* and *L'L'*, connected inductively by the induction coil *P' S'*. In each branch there is a reinforcing machine, *GG'*. This division into sections, which may be carried much farther, permits the use of small reinforcing-machines upon moderately long sections of lines and the practice of telephony over very long distances. It is not necessary that the sections be all metallic or all grounded, nor that the two or more reinforcing machines be all driven at the same speed. It is sufficient if each machine be driven above the critical speed indicated; so long as this rule is observed it is immaterial what the speeds of the reinforcing-machines are. The system operates as follows: Speech uttered against the transmitter, *M*, causes alternating currents to be generated in the secondary *s* of the induction coil. One branch of these currents passes through the field coils of the reinforcing-machine by *ll* and another passes to the line *LL*. Both current branches are exceedingly weak, and the branch passing to the line is too weak to cause an audible reproduction of sounds in the receiver, *R*, if the line exceeds a certain length; but if now the rotor of the reinforcing-machine is rotated with such speed that its number of rotations per second exceeds the number of periods of the current due to the sound of highest pitch that is uttered against the transmitter divided by half the number of poles of the field, then the initial and exceedingly weak alternating field excited by the telephone currents is reinforced, and

those currents themselves are reinforced. This reinforcement of telephone currents may be carried practically to any desired extent, depending upon the size and speed given to the reinforcing generator and also depending upon the electromagnetic reactance of the reinforcer. This reactance should be made as small as practicable and for this purpose the amount of iron entering into the construction of the machine should be made very small, and the iron, if employed at all, should be highly laminated, as is usual with machines of this character. The reinforcing machine may be in series in the line instead of in a branch derived therefrom.

Mr. Lyons says that while the invention is well-adapted for use in connection with the ordinary magneto telephone receivers, it is preferable to use telephone receivers without iron or steel cores, and, similarly, it is preferable to use induction coils without iron cores. Altogether the electromagnetic reactance of the system should be made as small as possible.

It will be interesting to see the results attained by Mr. Lyons' system in actual practice. While difficulties may develop through the distortion of some currents and through noise from the machines being introduced to the line this is certainly a highly ingenious and original solution of the telephone relay problem.

Large Power Plant for Wyoming.

The Edison Electric Company has filed incorporation papers at Cheyenne, Wyo. The company is composed of Chicago and San Francisco members of the Wells-Fargo Express Company and the concern is capitalized at $10,000,000, $6,000,000 of which is preferred stock and $4,000,000 common stock.

The company proposes to establish a large power and light plant somewhere in the vicinity of Evanston in the southwestern part of the State and in the Uinta oil fields, and furnish light and power to the towns that are building around those fields. The company will also build and operate electric railways, furnish power to run the drills and pumps in the oil fields, and also transmit power to distant mining camps, such as Park City, Utah, and possibly to Ogden and Salt Lake City. The concern will also operate lumber mills in the mountains and prepare material for building.

The incorporators and leading officers of the Edison company are Andrew Cooke, Maurice K. Baker and Peter A. Tagg.

CURRENT NEWS AND NOTES.

MARCONI AND WIRELESS TELEGRAPHY.—A Boston newspaper quotes Prof. Elihu Thomson as follows: I believe Marconi is entitled to all the credit he has been given for wireless telegraphy. He has done the practical work and developed the theory. Others have theorized on it, but Marconi has put the thing to practical use. I have given this matter a good deal of study and I am convinced that Marconi deserves all he has got.

LONDON TUBES.—A cable dispatch from London, of July 28, says: The Parliamentary committee dealing with Charles T. Yerkes's proposed tube transportation system for London, to-day elicited the fact that only £2,000,000 out of £5,000,000 stock of the new District Road is held in America. Sir. Lewis McIver, Bart., chairman of the committee, said he did not care where the money came from as long as it was good money. Mr. Yerkes testified that it was his intention to give the British workman as much of the electrification work as possible, and to buy all materials in England except the ironwork, which would come from Germany. He believed two pence should be the universal underground fare for the metropolis.

NEWS BY TELEPHONE.—The Lafayette (Ind.) Telephone Company has recently instituted an "Information Desk," for the benefit of its 1,700 patrons. This obviates any difficulty that may arise by reason of "no telephone directory," forgotten or misplaced spectacles, or subscribers not in telephone directory. Patrons in a "great hurry" may also obtain connection by request of the "information desk." A call made to central asking for "information desk" will be promptly complied with. The following information may be obtained on request made to the "information desk": Arrival and departure of all trains; correct time of day; base ball news and all other sporting events; election returns; theatre attractions; weather indications; location of fires; telephone numbers of the subscribers.

LIGHTNING IN CHICAGO.—It is stated from Chicago that since June 1 over 500 buildings in that city have been struck by lightning. Of these, over 400 were struck in July. This is believed to break all records. The electrical storm, which began July 7, struck 68 buildings, 28 on the evening of the 7th, and 40 after midnight. This, however, was far surpassed by the storm of July 17, when 127 strokes were reported. That these figures do not begin to measure the number of times lightning struck in Chicago during July is shown by the fact that they are taken from the record of adjusted insurance losses reported to the fire insurance patrol. For weeks the insurance adjusters have been complaining of the number and size of the lightning losses they were being called on to pay. Up to July 31, 418 lightning losses had been reported, with an aggregate loss to the companies of $31,782.

BRITISH TELEGRAPH EFFICIENCY.—The confessed inefficiency of the British Post-office telegraph service is revealed in a circular of instruction to the effect that a considerable percentage of the 3,00 operators employed in the central office at London are inexperienced and inefficient, and directing operators at outside offices to adapt their rate of working to the capacity of the receivers in the central office. Mr. Austen Chamberlain, financial secretary to the Treasury, endeavored to explain the matter in the House of Commons on the theory that there must always be many recruits employed, but older telegraphists deny this, and point out that years of instruction were required formerly, while now only three months' preparation is exacted before actual service is begun. The inefficiency, it is claimed, is due wholly to new economies undertaken in the department, since plenty of efficient employees are available. It is considered extraordinary that in the entire telegraphic service no typewriters are used except in a few instances, in the foreign departments.

AUTOMOBILES IN JAPAN.—Mr. E. C. Bellows, U. S. Consul General at Yokohama, reports that up to date 13 automobiles had been imported into Japan, where it is not likely the machine will ever be as popular as it is in Europe. There is, however, a fair prospect that automobiles may gradually come into use for purposes of business. The postal authorities are now considering the advisability of purchasing automobiles for the transportation of the imperial mails at Tokyo. The mails are now carried in wagons or carts, each drawn by a single horse. The Government must keep several relays of these horses, which are a continual source of annoyance and expense. Should the postal authorities decide to buy automobiles, those that are run by steam would be considered objectionable because of the real or fancied danger of fire to the imperial mails. At present, gasoline is exceedingly expensive in Japan but plans are in progress for its manufacture. If these plans prove successful, gasoline will undoubtedly become as cheap as in America and its use for generating motive power will increase rapidly.

MANHATTAN FIRE ALARM.—Mayor Low of New York City has decided to sustain Fire Commissioner Sturgis in revoking the permit of the Manhattan Fire Alarm Company, on the general ground that such a relation between a private company and the city is contrary to public policy. The mayor says, however: In view of the fact that this decision affects injuriously a considerable investment made upon the faith of the city's permit, although that permit was revocable by its terms; and, in view of the further fact that the device controlled by this company is valued by many as an additional protection of their premises against fire, I have suggested that the city might be willing to enter into negotiations for the purchase of the company's plant, with a view to the city's using this protection itself. The company has notified me that it will confer with me on the basis of my suggestion. Before any action is taken, the matter will require careful consideration, and, eventually, legislation, in order to make my suggestion practicable. If after consideration, this plan appears to the city to be wise, it can then be carried out. In the meantime, the whole subject will be carefully investigated.

INDUCTANCE COILS FOR TELEPHONE CIRCUITS.—Two patents issued July 29 to John C. Lee relate to inductance coils such as are employed for reducing the distortional and attenuating effect of telephone lines. The specifications state two main requirements of such coils are that the resistance of winding shall be

low and the inductance high. The latter may be fulfilled by using a core of iron, but when coils containing iron cores are employed in circuits carrying telephone currents the development of eddy currents is thereby facilitated, thus giving rise to adverse effects in telephonic working. The object of the present invention is to provide a practical substitute for iron. This is done by making the core of magnetic oxide or of ferroso-ferric oxide (Fe_3O_4). Thin plates or ribbons or very small wires of iron are assembled, lapped or wound into a loosely-built or partly openwork structure corresponding in form and dimensions to the core desired. This structure is then submitted to the action of heat in an atmosphere capable of yielding oxygen to the iron until the iron is reduced or converted into magnetic oxide. The core thus made is thus composed of artificial magnetic oxide, and while retaining the form in which it was originally built up, has become condensed, continuous and compact. It is stated that such a core possesses in a high degree the desired qualifications of permeability and high specific electrical resistance, and in consequence of the latter, has no tendency to serve as a circuit for the development of eddy currents.

Letters to the Editors.

Submarine Cables as Accessories to Land Telegraph Lines.

To the Editors of Electrical World and Engineer:

Sirs.—In the recent correspondence on the telegraph situation in the United States, it seems to me that the value of submarine cables in maintaining communication during the periodical collapses of the landline system has not received the attention which it deserves. This value will be sufficiently illustrated by the fact that New York has never been cut off from Europe during at least the last ten years, and the system of cables in the North Atlantic is so complete that the probability of such a thing happening is extremely remote.

The question of coast cables to maintain telegraphic communication between London and Scotland during the annual breakdowns of the aerial lines has already been ventilated in England, and there are many who think that such cables would be a more satisfactory solution of the problem than underground cables. There are, naturally, many points to be considered before it could be said that a system of coast cables would be useful, reliable and economical in the case of the United States, and most of these points could only be decided by those in possession of the requisite data.

There may be some doubt as to the suitability of the submarine cable for emergency work, but I think it may fairly be claimed that a submarine cable of the present type is not very inferior in actual work to a landline of equal length, provided the lengths are moderate. The traffic carrying capacity of a telegraph circuit is necessarily greatly dependent on the electrical stability of the line, and when one considers the violent electrical changes to which aerial lines are subject, more particularly during storms, the practical failure of automatic systems when most required is not surprising. On the other hand, the electrical condition of a submarine cable is practically stable and automatic working is successfully and extensively used.

Then, again, we are probably within measurable distance of considerable improvements on the lines of Prof. Pupin's patents, and it is evident that the electrical stability of the submarine cable will allow of the application of the inductance coils under the most favorable conditions, provided mechanical difficulties can be overcome. Distortionless circuits so constructed would be ideal lines for high speed automatic systems, and, wherever practicable and advisable, would prove invaluable in promptly handling a large amount of traffic when suddenly called on by a collapse of the aerial-line system.

Lima, Peru. A. Davidson.

The Thunder Storm.

To the Editors of Electrical World and Engineer:

Sirs.—In my letter on thunder storms which appeared in your issue of July 12, 1902, I stated I believed that heat, initial charge and a rotation of some kind are necessary for the production of thunder storms. In what follows I propose to give some reasons for the above conclusions, more especially why a rotation is necessary.

If a cloud acts simply as a condenser and no rotation is necessary, there appears to me to be no reason why other clouds in the neighborhood should not be thunder clouds also, or that a thunder cloud should remain one until dissipated and not cease as such, as it often does. It cannot be that the other clouds do not receive initial charges, for the air being well charged with electricity, they certainly should become charged also by induction. If a rotation is necessary for a thunder cloud, all is explained. In the one case the non-thunder clouds have not been thrown into a rotating or tumbling motion by the wind, and in the other case the thunder cloud ceases as such when the rotation has been spent.

As regards the combination of drops of water into larger drops raising the potential, in the first place consider how small is the radius, and consequently the surface, of a drop of water. It does not appear possible that such a minute surface as a drop of water by combination with others, which must result in but a small increase, could raise the potential and current strength of a discharge to such great proportions as to give rise to a spark miles in length. If the drop discharges are "in parallel," if such an expression is permissible, the potential of the discharge could not be higher than that of a single drop of water. If the drop discharges are in series, which I do not think is a supposable case, the current strength of the discharge could not be more than that of a single drop. The rending of trees, melting of metals, etc., all show a great potential as well as great current strength. If the cloud is charged as a sheet and is in rotation, all is clear as explained above. I think it likely that clouds which do not discharge to earth during a thunder storm may be charged, but their potential is too low to discharge of itself to any great distance. The thunder cloud may discharge to the cloud not in rotation, but the cloud not in rotation takes but little part in the spark, the spark coming from the thunder cloud almost entirely.

If a thunder cloud consists of separately charged drops of water of a high potential, how could the cloud hold together? The repulsion between the separate drops would be considerable, and the cloud would be quickly scattered by the repulsion on the outside drops. Any part of the cloud that would have drops opposite each other charged in the opposite sense, would be forced together, and that part of the cloud would be a solid mass of water. Sometimes a great number of clouds are seen near each other, and flashes of lightning are seen between them, but no thunder is heard. In this case I assume that the clouds are charged as sheets, and possibly discharge comparatively short sparks between each other; there may be some small cloud having a tumbling motion near them, but the cloud is too small to produce discharges to earth.

Baltimore, Md. Alfred G. Dell.

Alternating Current Hydro-Mechanical Analogies.

To the Editors of Electrical World and Engineer:

Sirs.—Such hydro-mechanical analogies as those presented by Professor Eddy in your issue of July 26 are especially interesting to me. In all essential points, I have used the same analogies in the class-room. I have presented to my students the double-acting cylinder and piston with the pipe leading out from one end and back into the other as an imaginary apparatus that could be made to illustrate accurately an alternating sine wave flow. I have pointed out that an elastic pipe would affect the flow as capacity does an electric current; and I have shown that by substituting a heavy liquid for a light one we could simulate the effects of self-induction. But the student who is to get a correct idea from the analogy should, I think, be impressed at this point that self-induction is a property of the circuit or the conductor itself, as much as are the resistance and the capacity. An induction coil can be represented by a rotary type of water motor, inserted in the pipe and having a flywheel of perceptible inertia attached to it. Such an arrangement becomes a part of the conducting circuit, and does not require any modification of the liquid flowing in the conductor to change the apparent inertia of the flow. Moreover, if the waves of this motor and its flywheel rotate without any friction, it represents an air-cove induction coil, while if the apparatus has friction this may be taken to represent hysteresis in an induction coil, and most appropriately so, since it is a different kind of friction from that between the liquid and the pipe, but one that affects the flow exactly as if the other friction had

been increased. Thus it accurately represents the way in which hysteresis seems to increase not the reactance of a circuit, but its ohmic resistance.

Byron B. Brackett.

Rutgers College, New Brunswick, N. J.

Free Lamp Renewals.

To the Editors of Electrical World and Engineer:

Sirs.—It was much to be regretted that the time available at the last convention of the National Electric Light Association did not permit the reading of papers in the discussion "Are Free Lamp Renewals Desirable?" This discussion quite positively and clearly demonstrates that free lamp renewals ARE desirable, and this fact is shown even in the arguments advanced by those opposing the idea.

Some of the arguments advanced against free lamp renewals are thorough boomerangs, and I should like to call special attention to one offered by Mr. H. J. Greene, which is both illuminating and amusing. Mr. Greene states that he opposes free lamp renewals because "the rapid increase of business, in the face of hard competition with gas, being difficult to provide for with increased capacity, owing to manufacturing delays and engineering difficulties, makes any check to growth, as may result from charging for lamp renewals, desirable."

In other words, Mr. Greene agrees that unless free lamp renewals are supplied, the growth of the lighting business is checked and retarded. No better argument, it seems to me, could be offered in favor of free lamp renewals.

Harrison, N. J. F. W. Willcox.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Induction Motors.—Rothert.—A communication referring to the controversy between Eborall and Meyer, recently noticed in the Digest. Eborall is of the opinion that squirrel-cage rotors should not, as a rule, be used beyond 5 hp or 8 hp, this limit depending upon the starting load. Meyer argued in favor of a more general use of the squirrel-cage rotor, preferably in connection with compensators. This difference of opinion is said to represent the difference between European Continental and American practice. The present author says that in the early days of polyphase working the squirrel-cage motor enjoyed the same favor on the Continent as it does now in the States, but Continental experience is in favor of even a stricter rule than that of Eborall. "Squirrel-cage rotors are invaluable for small motors for mining work in general—but with exceptions—and in many special cases, but they never ought to be used where a rheostatic motor presents more advantages, and this can only be decided by experience. Continental experience, which is older and more extensive than American, speaks in favor of Eborall and against Meyer."—Lond. *Elec.*, July 11.

Induction Motors.—Meyer.—Another communication in which he continues the discussion on the relative advantages of squirrel-cage and slip-ring induction motors. He admits to Eborall and Rothert that the squirrel-cage motor, like the rotary converters, requires considerable discretion in its installation, otherwise it is liable to give trouble, which tends unjustly to prejudice the public opinion against it. This he has found to be the case on the Continent of Europe, where, probably due to some faulty installation made in the early days of the art, both the squirrel-cage motor and the rotary converter are avoided in a great number of cases where they are successfully used in the United States. In regard to the efficiency of polar-wound motors when compared with squirrel-cage motors, he agrees that theoretically the former, neglecting the slip-ring losses, should have as good or even a better efficiency than the latter, which has to start, say, under 30 per cent. of full load torque, with not more than full load current. However, in actual practice, most of the standard slip-ring motors, even of the very best Continental make, show a poorer efficiency than the corresponding squirrel-cage motors, this result being due to the desire of every designer to obtain a motor which is cheap to manufacture. He explains this a little more in detail. He hopes that the development in English mining and mill work will offer an opportunity to prove that the Continental views in this direction are too conservative to be "the best engineering practice."—Lond. *Elec.*, July 18.

Electric Pumps.—A well illustrated description of high pressure electrically-driven centrifugal pumps of Sulzer Bros., used in a Spanish mine; 250-hp, three-phase induction motors, running at 850 to 900 r. p. m., are in use; the voltage is 1,000; the short-circuited armature has been adopted.—Lond. *Eng'ing*, July 18.

References.

Double-Current Generators.—Ruthven Murray.—A paper read before the Brit. Mun. Elec. Assn. He describes in general the construction of double-current generators and states that there will soon be at least four electric plants in Great Britain using these machines. In the discussion which followed, C. F. Scott, of Pittsburg, participated.—Lond. *Elec., Elec. Eng.*, July 4. An editorial referring to Ruthven-Murray's paper. It is said that had these machines been thought of 10 or 15 years ago, the uneconomical employment of the single phase system of distribution would never have obtained the foothold which it has acquired, as the main argument in favor of it was that it rendered accessible those districts which are distant from the station. The double-current system would often have been employed, with direct-current distribution near the station, and alternating current in the distant parts.—Lond. *Elec.*, July 11.

Flywheels for Alternators.—Begtrup.—An article illustrated by diagrams, in which he gives the formulas for calculating the weight of a flywheel required to keep the small periodical variations of the speed of direct-connected alternators within given limits. Numerical examples are added.—*Am. Mach.*, July 10.

Efficiency Tests.—The first part of an illustrated article on direct-current dynamos.—*Elek. Anz.*, July 6.

Power.

Steam Turbines.—Jebden.—An abstract of a paper read before the Brit. Mun. Elec. Assn. He expresses his confidence in the steam turbine for large sizes—200-kw to 300-kw and upwards—and not small sizes, provided that surface condensers are used. The large steam consumption recorded in the early day were, he believes, due to the turbines being small and running non-condensing, and he is convinced that the larger steam turbines now on the market can hold their own in the matter of steam consumption against any triple-expansion engine yet produced. Besides a good vacuum, a high degree of superheating is a condition which he considers important. In the discussion which followed, Kilgour agreed with the author as to the advantages of steam turbines over reciprocating engines, but did not agree with him that they must be in large sizes and be run with surface condensers. Concerning the cost, Martin, of the Parsons Company, state that the cost of small sets, say up to 100 kw. was about the same as of the best quality of reciprocating engines, and those of larger size were cheaper. Wordingham and other speakers referred to the commutator difficulty on direct-current turbo-generators, stating that the commutators of turbine-driven machines wear very rapidly, and that it is impossible to use carbon brushes, as they catch fire on account of the friction at the high speed of the engine. Ferranti, in criticizing the steam turbine, admitted that it was all the fault of the dynamo, but thought that neither for direct nor alternating current could turbine-driven generators compare with those driven by moderate-speed engines. Several speakers discussed the question of wet steam; the result was that steam turbines will run without trouble with very wet steam, but at a much lower efficiency than if the steam is dry. Andrews, of Hastings, said he had found that a 500-kw turbo-alternator takes no more steam on the very light day load which they have than other machines of 100 kw. He had found that his Parsons

machines, would run in parallel with Mordey alternators.—Lond. *Elec.*, July 4.

Steam Turbines and Power Stations.—A long editorial referring to Fedden's recent paper. He is said to have been amply justified in equipping the new Sheffield plant with 1,500-kw steam turbo-alternators. It is expected that before long recognized and common practice will sanction not merely 1,500-kw units, but turbo-alternator sets capable of developing double or treble this power. The steam turbine is a better engine the larger its size. It is too early to say whether for electricity supply purposes or for electric traction it is likely to exceed some 5,000 hp, but, in the utilization of steam turbines in the naval and mercantile marine, it is not unlikely that larger turbine engines even than this size will be built before many years have elapsed. The importance of superheating for the steam turbine is emphasized. Not only in mere steam economy, but also in heat economy, superheating has the advantage over dry saturated steam. Steam turbines in electric stations enable one to save money in many ways. The question is asked why steam turbines are not in more general use, and it is answered that this is due not only to the "inherent conservation to which British engineers are only too liable," but also to the fact that the steam turbine is not sufficiently pushed in a commercial way.—*Lond. Elec.*, July 18.

Engines for Generating Stations.—Day.—An abstract of a paper read before the Brit. Mun. Elec. Assn. on "the correct type of engine for large generating stations." He favors the slow-speed horizontal engine on account of its low steam consumption, and maintained that the question of space occupied is not important with large units. He thinks that the question of an even turning moment has been made too much of, and states that there are "single-crank, three-phase machines" on the Continent with a variation in the angular velocity of 0.3 per cent. In the discussion which followed, Ferranti said that if people were prepared to pay for horizontal engines and the larger buildings they require, excellent results can be obtained, but taking the interest and sinking fund into account, the less efficient vertical engines are cheaper in the end.—Lond. *Elec.*, July 4.

REFERENCE.

Thury D. C. Series System.—Guilbert.—The first part of a very long and well-illustrated description of the electric power transmission from St. Maurice to Lausanne with the Thury system, which has already recently been noticed in the Digest.—*L'Eclairage Elec.*, July 12.

TRACTION.

Arnold System.—Arnold's recent A. I. E. E. paper, in which he proposed the use of a single-phase, alternating-current system for electric traction, with the aid of compressed air, is abstracted, and the following remarks are made on the system: "In his system both the armature and the field of the single-phase motor may rotate, the former going when the train is running, and the latter when it is stopped. Mr. Ferranti suggested this a very long time ago, but got no further with it. He proposed to start the train by simply braking the revolving field till it stopped. Assuming the mechanical difficulties overcome, there is, therefore, sheer waste of power at all intermediate speeds below synchronism. Mr. Arnold makes his revolving stator store energy by compressing air, and a start is made not by a friction brake, but by throttling the air-compressing engine. Incidentally, since this engine can run backwards and drive the field in the same direction as the armature, the speed of synchronism is not the maximum speed. Also, the train can be run on its store of compressed air alone, if for any reason it be desired to omit the overhead conductor for a short distance. It is amazingly pretty, but, at first sight, it looks very like adding the weight and expense of a compressed air locomotive to the train. Mr. Ward-Leonard and his friends add that of a motor-generator instead."—Lond. *Elec. Times*, July 17.

Mountain Railway.—An illustrated article on the electric railway of Bex-Gryon-Villars, in Switzerland. This line is divided into three sections, two operated by adhesion and a central portion fitted with a rack rail. The cars are operated by direct current of 600 volts by an overhead wire. The power station is located near the middle of the heaviest grade, which greatly simplifies the distribution of current. Both motor cars and electric locomotives are used on the road, but only the latter are fitted with pinions for service on the rack section, and the motor cars are not aiding on this section. The motors of the locomotive are connected to the rack-pinions by intermediate gearing, effecting a total speed reduction of 8 to 1. Under all normal conditions the descent of the rack section is made with the motors reversed and acting as dynamos. The current which they generate is turned into a large rheostat built up of corrugated iron and placed in the center of the car, directly over the motors. To prevent this rheostat from overheating an electric fan is installed to blow air through it, and the current connections are so arranged that the fan is automatically set in operation whenever the locomotive is descending, but it is switched off when it stops or runs up grade. For emergency use, the locomotive is also equipped with two-hand-brakes acting upon the rack-pinions; also a hand belt-brake for the motors, and a screw-brake acting automatically upon the motors when the normal speed of 7.5 miles per hour is expected in descending, or when the electric current is intercepted from any cause whatever.—*Le Genie Civil;* translated in *Eng. News.*, July 17.

REFERENCES.

Electrolysis of Pipes in Alternating-Current Traction.—See the abstract on Alternating-Current Electrolysis under Electrochemistry.

Multiple-Unit System.—P. L.—A continuation of the illustrated serial. This article deals with the Auvert system.—*L'Ind. Elec.*, June 25.

Installations, Systems and Appliances.

Indicator of Synchronism.—A description of an instrument for paralleling alternators. It is really a non-synchronous motor with identical stator and rotor windings, with two phases for use with single-phase alternating current, and with three phases for three-phase currents. The stator is connected to the network and the rotor to the alternator, which is to be connected in parallel. In the case of single-phase current, the windings of the two phases are connected to two terminals, the one through a non-inductive resistance, and the other through a self-inductance as great as possible, in order to get as nearly as possible a phase difference of one-quarter of a period. It is so arranged that the magnetic fields produced in the windings of stator and rotor revolve in the same direction. It follows that at synchronism the rotor remains at rest in space, and that it turns in one direction or the other when one of the fields revolves more quickly than the other.—*L'Ind. Elec.*, July 10.

St. Petersburg.—Multhauf.—An illustrated description of the central station of the Electricite and Hydraulique Company, in St. Petersburg. This is one of three electric plants of about equal size, the three cable networks of which, for private light consumers, cover the same area, while for street lighting the city is divided. The two other plants are that of Siemens & Halske, where 2,000-volt, three-phase current is used, and that of the Helios Company, with single-phase current. The station of the Electricite and Hydraulique Company (a Belgian company) is intended to have a capacity of 7,000 kw, 20 generating sets each of 350-kw being planned, 15 of which have been installed. Single-phase current at 2,000 volts, with a frequency of 42.5 periods per second is used. For the total length of the network—about 300 km.—concentric cables with rubber insulation are used, the outers being earthed. Transformers are placed in the houses.—*Elek. Zeit.*, June 19.

High-Tension, Direct-Current Systems.—Barnard.—A paper read before the Brit. Mun. Elec. Assn. He endeavors to show that for pressures of 2,000 to 3,000 volts, at least, there are some advantages to be gained by using direct current for both transmission and distribution. He describes the experience which he has had at Hull, where the main generators are of the four-pole type, coupled direct to high-speed engines, and giving an output of 510-kw each, at 2,250 volts. From their satisfactory behavior he thinks there should be no difficulty in designing dynamos for very much larger outputs at the same or higher pressure. He says that the direct-current generator is cheaper than the three-phase alternator, and that a direct-current, high-tension to low-tension converter sub-station needs less attendance than an alternating direct-current converter sub-station. In Hull the converters in the substations are started and stopped and entirely controlled by an attendant at the central switchboard in the generating station. The "long-range" switch consists of a single-pole, low-tension switch, whose moving part is actuated by an electromagnet, the coil of which is placed in circuit, through a pilot wire, with a voltmeter at the generating station. By short-circuiting this voltmeter the resistance of the whole pilot-circuit is sufficiently reduced for a predetermined current of, say 5 amperes, to pass. This is enough to attract the armature of the electromagnet, and in so doing to close the low-tension side of the converter. In Hull, three-core pilot wires are used—one wire being connected to the negative

low-tension mains (which are also permanently connected through a plug-board to the negative side of the converters), one to the positive low-tension main, and one to the positive side of the converter. By means of a two-way switch at the generating station the attendant can assure himself that the e. m. f. of the transformer is the same as that of the mains before operating the long-range switch. The third pilot wire is a valuable adjunct, as while it is necessary to have one wire permanently showing the pressure on the mains, yet, in the event of a breakdown when the low-tension mains were "dead," there would be no power available on that wire to operate the long-range switches. With the three pilot wires from each, a number of converters may be started up and switched simultaneously on to the "dead" network, although they are fixed in sub-stations possibly a couple of miles apart. In the discussion which followed, Snell doubted whether alternators are really more expensive than direct-current dynamos, and said that the advantages claimed thus resolved themselves only into the saving of superintendence in sub-stations. He said, an engineer should give the matter most serious consideration before he decided to have a sub-station with running machinery and without an attendant to look after it. Wyllie, of Walsall, said he had found the high-pressure, direct-current system reliable; he employs one man, "a junior," to look after all nine of his sub-stations, and this man has time to do other work, such as putting up meters, as well. Ferranti said that the only thing that direct-current is necessary for, is for lifts, say, 3 per cent. of the total energy; the single-phase system has the advantage of saving both capital and works' costs, by establishing a uniform system without complications.—Lond. *Elec.*, *Elec. Eng.*, July 4.

REFERENCES.

Preventing No-Load Loss of Transformers.—Schmidt.—A very long article, illustrated by diagrams. To prevent the no-load loss in transformers when they are not used, a "high-voltage, long-distance switch" has been introduced by Schnecker & Co., by which the primary coils of the transformer are disconnected, when it is not to be used. This switch has already been noticed in the Digest. In the present article a number of different connections, which can be used for this article, are described. It is thought that no special difficulties will be experienced with it in practice.—*Elek. Zeit.*, June 12, 19.

Rules.—A reprint of the regulations of the Association of German Electrical Engineers for underground electric installations in mines; also of the regulations for electric installations in theatres.—*Elek. Zeit.*, June 5. (See editorial comment this issue Electrical World and Engineer.)

Wires, Wiring and Conduits.

Three-Wire Systems.—Snell.—Some brief notes on a Brit. Mun. Elec. Assn. paper, in which he endeavored to show that the three-wire system of distribution is "an over-rated thing," and that a simple two-wire system is preferable. In the discussion, Ruthven-Murray claimed that the figures which are worked out in support of this contention are based on a wrong assumption, namely, that of equal current density in the network instead of equal percentage fall of volts. Snell's case was that the actual economy in the conductors arrived at by using the three-wire system is counterbalanced by the trouble of balancing, and the incidents arising out of the necessity of a balanced load, by switchboard complications, less reliability of supply, and, finally, by the increase of leakage from the negative pole by using an earthed middle wire.—Lond. *Elec.*, July 11.

Earthing.—[illegible].—A brief note on a paper read before the Brit. Mun. Elec. Assn., in which he seems to recommend earthing the middle wire of a three-wire system at several places instead of only at the station, and furthermore to insert fuses in the middle wire, whatever the conditions of earthing or not-earthing. In the discussion the speakers did not favor earthing of the middle wire at several places, on account of the desirability of being able to remove the earth connection for testing purposes. The opinions concerning the whole question of earthing and fuses were greatly divided.—Lond. *Elec.*, July 11.

REFERENCES.

Aluminum Lines.—Izart.—An article in which he compares copper and aluminum for transmission lines, and gives formula for the most economical current density. His conclusions are in favor of aluminum. —*L'Ind. Elec.*, July 10.

Calculating Line Wires.—Cahen.—A further mathematical communication, in which he continues his discussion with Teichmueller on the calculation of line wires for economy.—*Elek. Zeit.*, June 5.

Electro-Physics and Magnetism.

Limits of the Graphical Treatment of Alternating-Current Problems.—Teichmueller.—A mathematical article. The method of treating alternating-current phenomena graphically by means of vector diagrams, starts from the assumption of pure sine waves. The author investigates whether the graphical method is also correct for any wave form. He first shows that in general for any wave form the average real power and the apparent volt-ampere power can be represented as the hypothenuse and one side of a rectangular triangle, while the cosine of the angle between both lines represents the power factor. He then discusses the geometrical addition of the vectors representing several impedances in series. In the general case for any wave form, the rule of the geometrical addition of the vectors is here correct only if the product of self-inductance and capacity has the same value for each impedance; the rule is generally valid if all impedance have only resistance and self-inductance, or if all have only resistance and capacity. He then discusses the rule of geometrical addition of the vectors of the admittances of several circuits in parallel; in the general case of any wave form this rule is valid only if the power factors of all the circuits in parallel are equal; if these circuits contain only resistance and self-inductance, or only resistance and capacity, the condition is that the inductances are proportional to the resistances, or if the capacities are inversely proportional to the resistances. He thinks there is every reason to doubt the reliability of many results obtained by the graphical treatment of alternating current problems.—*Phys. Zeit.*, July 1.

Phase Difference.—Orlich.—A mathematical article on the definition of phase difference for any wave forms of e. m. f. and current. He first refers to the usual definition of the phase difference as the angle, the cosine of which equals the ratio of real power to the volt amperes. He remarks that in special cases this definition is not suitable. He recommends the following more exact definition: First, under the given conditions calculate the time integral of the product of e. m. f. and current over a whole period, and divide by the time of the period; this gives a value A; then displace the e. m. f. curve against the current curve, without changing these curves, until the value of A becomes a maximum which may be called B; then the phase difference is defined as the angle, the cosine of which is the power factor, and is given by the ratio of A to B.—*Elek. Zeit.*, June 19.

Steinmetz Hysteresis Formula.—Doery.—A highly theoretical paper in which he arrives at Steinmetz's well-known formula for the hysteresis loss by purely theoretical considerations from Maxwell's theory. The exponent 1.6 appears here as twice the ratio of the distance between the poles to length of the magnetized rod. This ratio varies, according to Kohlrausch, between 0.81 and 0.85. If it is assumed to be 0.8, the exponent becomes 1.6, as in Steinmetz's formula. According to the strict theory, the coefficient of hysteresis and the exponent should depend somewhat on the density of magnetization.—*Zeit. f. Elek.*, July 6.

Lenard Rays.—Durack.—An account of experiments in which he measured the velocity of the Lenard rays as the pressure of air in the discharge tube was altered. The velocity varied from 5,000,000,000 cm. per second for the high discharge potentials to 3,200,000,000 for the lower; none of the velocities measured was smaller than this, but probably higher velocities could be obtained with good discharge-tube insulation. He also investigated the variation of the ionization produced by the rays with the pressure in the discharge tube, the charge in the Lenard-ray current under the same circumstances, and the ionizing power of the Lenard rays.—*Phil. Mag.*, July.

Hall Effect.—[illegible].—An account of an experimental investigation of the Hall effect in gold for weak magnetic fields. His results show that it is a constant, at least for all fields between 12 and 21,500 c. g. s. units.—*Phil. Mag.*, July.

[illegible] in Bismuth.—Wills.—Bidwell had found that when a bismuth rod was magnetized lengthwise under a gradually increasing magnetic field, an extension could be measured, the effect increasing much more rapidly than the field; the maximum field used by him was 842 c. g. s. units. The present author has studied this effect under higher fields. The arrangement for measuring any possible change in length of the bismuth cylinder consisted of a system of two levers and a high power micrometer microscope. In these experiments the field was varied, reaching a maximum of 3,200

c. g. s. units; but neither with the maximum field nor with any of the various intermediate fields could any effect be detected, which was not due to one of the following two causes: either a heat effect, in which case time was required to produce it, or an effect due to the action of the magnet on the currents induced in the levers themselves; in the latter case a sudden jerk was observed when the magnetic circuit was made or broken, and the pointer would return to its zero position immediately. This effect was much more marked when the circuit was broken than when it was made.—*Phys. Rev.*, July.

REFERENCES.

Magnetostriction.—NAGAOKA AND HONDA.—A very long account of an experimental investigation of the magnetization of steel, nickel, cobalt and nickel-steels; the change of length by magnetization in steel ovoids, nickel ovoids, cobalt ovoids, reversible nickel ovoids and reversible nickel-steel wires; the effect of mechanically elongating cobalt and nickel-steels on magnetization, and the reciprocal relations with the change of length; the change of volume by magnetization in steel, nickel, cobalt and nickel-steel ovoids; the Wiedemann effect in iron, nickel and nickel-steel wires.—*Phil. Mag.*, July.

Discharge of Positive Electrification by Hot Metals.—STRUTT.—An account of experiments which show that the discharge of positive electrification by hot metals can be detected at much lower temperature than has hitherto been supposed, becoming apparent very far below a red heat, and increasing rapidly with the temperature.—*Phil. Mag.*, July.

ELECTRO-CHEMISTRY AND BATTERIES.

Alternating-Current Electrolysis.—TROTTER.—A note on experiments, in which he passed a small alternating current between two lead surfaces a few inches apart, and separated by moist earth, and observed the effect on the lead after a protracted period. First two 18-inch lengths of 1¼-inch pipe were laid parallel to one another about 6 inches apart, and a current of 1 ampere at a frequency of 83 was passed between them. The pressure was 100 volts, the dampness of the earth being adjusted to maintain 1 ampere. A distinct and sharply defined incrustation on the lead, evidently due to electrolysis, was observable in six weeks. It was confined on each pipe to about 45 sq. in. This effect was then compared with that of still lower current densities by burying a series of plates in the same way, the first plate having a surface of ¼ sq. in. exposed—the remainder of the plate being painted—the second a larger surface, and so on up to 9 sq. in., the current sent through the series being 0.000625 ampere, so that the current density at the surface of the first plate was 0.025 ampere per sq. in., the same as on the pipes, and on the last 0.000694 ampere per sq. in. The incrustation on the first plate was comparatively thick, and even on the largest plate of 9 sq. in. surface, showed slight but unmistakable signs of corrosion. The outermost faces of the series of plates showed only very slight traces of corrosion. This latter effect was observed after four weeks. The earth used was taken from the garden in front of his office. He regards the result as a proof that alternating currents will electrolyze lead pipes at current densities lower than 1 ampere per sq. in., and he considers that the burden of determining the amount of this electrolysis should rest with those advocating electric traction by alternating currents.—Lond. *Elec.*, July 11.

Probable Source of the Heat of Chemical Combination.—T. W. RICHARDS.—A paper in which he brings forward the very suggestive generalization that the contractions exhibited during different chemical combinations are in many cases approximately proportional to the heats evolved; hence he believes that the chief source of heat of chemical combination is the work performed in compressing the material. On the same basis he gives an explanation of the mechanism of the heat of absorption, adhesion and change of allotropic form. He is led, from these consideratons, to the hypothesis of compressible atoms, which is given in detail and with applications.—*Proc. Am. Acad.*, v. 37, p. 399; *Zeit. Phys. Chemie*, v. 40, p. 597; briefly abstracted in *Am. Jour. Sc.*, July.

Silver Electrodes for Alkali Storage Batteries.—A description of a patent of Gahl, who makes porous silver oxide electrodes (as used in the Jungner cell), as follows. Fused silver chloride is mixed with about 15 to 20 per cent. of lead chloride. To remove the chlorine, the plate is used as cathode in an alkaline hydrate solution; afterwards the lead is removed by using the plate as anode in another solution (not described), whereby the lead is dissolved and deposited on the cathode, while the silver is oxidized.—*Centralbl. f. Accum.*, July 15.

REFERENCE.

Troubles with Stationary Batteries.—WEHRLIN AND LANGSTEIN.—An article in which they discuss the different troubles experienced in the use of stationary batteries, and the various reasons of the gradual destruction of the plates.—*Centralbl. f. Accum.*, June 15, July 1.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Standard Cells.—JAEGER.—An abstract of a paper read before the German Electrochemcal Society. A standard cell must represent a reversible chemical system and would theoretically have the best forms, if the electrolyte is also present in solid form, for instance solid crystals of zinc sulphate with water of crystallization in the Clark cell. The depolarizer is best when solid and a good conductor. When mercurous sulphate is used, there are complications due to its solubility. He gives some results of tests of Clark cells and Weston cells obtained in the German Reichsanstalt, where nearly every year a greater number of Clark cells and Weston cells (with solid cadmium sulphate) are compared for e. m. f., and the ratio of the e. m. f. of these two cells is determined. This ratio has not changed in four years by more than 0.0001. The average of all the measurements in these four years is as follows: The ratio of the Clark cell at 0° C. to that of the Weston cell at 20 degree is 1.42280; the ratio of the Clark cell at 15° C. to that of the Weston cell at 20° C. is 1.40669. In the cadmium cell, made by the Weston Company, the electrolyte is not saturated and is not present in solid form; its e. m. f. is nearly independent of the temperature and is higher by about 0.0005 volt than that of the cell with solid form at 20 degrees; the e. m. f. of the latter is 1.0186 volt.—*Centralblatt f. Accum.*, July 15.

Measuring the Angle of Lag and the Power Factor with a Voltmeter.—MAYER.—A brief communication referring to the article of Hanchett in ELECTRICAL WORLD AND ENGINEER, Nov. 2, 1901. If the non-inductive resistance $X\ Y$ in Fig. 1 of that article is so chosen that the voltage A at its terminals is (arithmetically) equal to the voltage B at the secondary terminals of the auxiliary transformer, a single relation enables one to easily find the phase difference, if the vector sum C of A and B and their vector difference D are measured. A diagram is given showing that then C is perpendicular to D, and the tangent of half the angle of phase difference is equal to the ratio of D to C.—*Elek. Zeit.*, June 5.

REFERENCE.

Permeameters.—ARMAGNAT.—The first part of an illustrated article, in which he discusses in general the methods used in some new permeameters.—*L'Eclairage Elec.*, July 12.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—WIEN.—An investigation of the features of Braun's "coupled" system of senders and receivers in wireless telegraphy, which has been adopted by both Marconi and Slaby. This system consists in exciting the vibrations, not in the strongly damped mast-wire itself, but in a feebly damped primary electric circuit of great capacity; by induction the vibrations are transmitted to the mast-wire which forms the secondary. He gives a very illustrative acoustic analogy to the coupled instrument. The independent exciter corresponds to a tuning-fork, which radiates little energy and is only slightly damped. The mast-wire corresponds to the resonance box, which takes up energy and sends it out. The transmission of vibration from one tuning fork to another is greatly enhanced when both are provided with resonance boxes, though the latter by themselves can possess only very slight energy of vibration. He distinguishes between "loosely coupled" and "closely coupled" systems, which differ by the value of the mutual inductance between the circuits coupled together, this being low in the former and high in the latter. The closely coupled systems are especially adapted for long-distance telegraphy, as the energy radiated is great. The loosely coupled systems radiate less energy, as the damping is great, but, on the other hand, they admit of close "tuning," so that they make simultaneous telegraphy possible. He sketches a system of combined long-distance (single) and short-distance (multiplex) telegraphy which should not interfere with each other. The coast station would be advised by the long-distance system of the approach of a vessel, and could prepare its loosely coupled systems for communication at short range. Of such communications, 50 or so could be carried on simultaneously. The tuning should not be more difficult than that of a good piano.—*Ann. d. Phys.*, No. 7; abstracted in Lond. *Elec.*, July 11.

Wireless Telegraphy with a Relay Telephone Receiver—TAYLOR.—An illustrated description of a relay-telephone receiver for wireless telegraphy, which is very simple and consists essentially of a dry

coil, a high resistance relay and a telephone receiver. While experimenting with single-contact coherers he had used the secondary circuit of a relay, but with rather poor success. The principal difficulty with the relay was, as with other coherers, that decoherence was liable to derange the adjustment, and the platinum contacts did not seem as sensitive to electrical waves as a nickel coherer. He, therefore, substituted nickel contacts for the platinum, and the result was a very sensitive coherer. The arrangement is illustrated.—*Phys. Rev.*, July.

REFERENCES.

Wireless Telegraphy.—Marconi.—A reprint in full of two Royal Society papers, read by him on a magnetic detector of electric waves, which can be employed as a receiver for space telegraphy, "and on the effect of daylight upon the propagation of electromagnetic impulses over long distances." The principal contents of both papers have already been recently noticed in Electrical World and Engineer.—*Lond. Elec.*, July 18.

Wireless Telegraphy.—A well illustrated description of the system of wireless telegraphy devised by Braun and used by Siemens and Halske.—*Sc. Am. Sup.*, July 5.

Wireless Telegraphy.—Turpain.—An illustrated article on recent progress in wireless telegraphy; experiments of Marconi, Slaby's method of tuning, Foresio's repeaters are described.—*L'Eclairage Elec.*, July 5.

Wireless Telephony.—Collins.—An illustrated article on his system of wireless telephony.—*Sc. Am.*, July 19.

MISCELLANEOUS.

REFERENCES.

Canadian Electrical Association.—A full stenographical report of the proceedings and discussions at the recent annual convention in Quebec. The papers by Dion on the use of storage batteries in electric distribution systems, by Lambe on the electrical equipment of an ordinary street car, and by Green on arc lighting, are also reprinted in full, with illustrations.—*Can. Elec. News*, July.

Tait.—MacFarlane.—A biographical sketch, with good portrait, of Peter Guthrie Tait.—*Phys. Rev.*, July.

New Books.

Standard Polyphase Apparatus and Systems. By M. A. Oudin, M. S. Third Edition; revised. New York: D. Van Nostrand Company. 289 pages, 169 illustrations. Price, $3.00.

The appearance of a third edition within three years is an indication, if not of the value of the book, at least of the reception accorded to it. In the preface to this third edition the author states he has taken advantage of republication to bring the work up to date, and this has increased the size of the original book by some eighteen pages, though it has resulted in no essential changes other than the addition of a few illustrations and some minor changes in text.

The inevitable introductory chapter in which the definition of alternating current terms is attempted presents the usual mixture of analytical and graphical notions, which can scarcely be of much service to those readers whose scanty mathematical knowledge precludes an adequate conception of such matters. The art of which this book aims to be an exponent has reached such a stage of development that the title of the book should be adhered to rigidly in the selection of its materials. A reader not otherwise prepared might better be referred to one of several elementary text books for explanations. In the definition of "wattless current," for illustration, the usual statement of the relation in quadrature is given; and though the writer hints at the physical cause of lag or advance, he fails to make clear that such relations follow the establishment and change of the electromagnetic or electrostatic fields of the circuit.

The two chapters on generators are very well handled, and deal not with questions of design, which are really foreign to such a work, but with matters of installation. They lead up in a fair way to those considerations which govern the choice of such machines for a given installation, and are concluded with a good discussion of the particular frequency to be adopted, and the relations between cost and frequency.

Possibly the best chapter in the book is that on Induction Motors; and here the subject matter is well illustrated by numerous diagrams of connections and curves of torque and such details. The discussion is essentially practical, and the matter is well selected and is representative of best present practice. It is, however, to the disadvantage of the book that this portion has not been enlarged to include more varied types of induction motors, and to contrast American, especially with Swiss and German practice.

The chapter on the Synchronous Motor is brief and inadequate, nor is the discussion satisfactory which has been attempted. The extent to which this type of motor is used, especially in the West, would seem to demand a more explicit and extended treatment. The paragraphs on Torque and Output and on Voltage, pages [illegible], are singular attempts at definition, and are by no means clear and connected, though the Power Factor, page [illegible], is handled somewhat better. The chapter following, on Rotary Converters, while better in its statements, is yet too brief, nor can the author be considered altogether fortunate in his treatment of the Static Transformer.

A second excellent chapter is then given to Station Equipment and Apparatus, and the writer properly lays stress upon these details, for within the past few years much of the advancement in polyphase working has been in such auxiliaries. But it could be wished that some of the more notable switchboard work by the Westinghouse engineers had received not only mention, but discussion in a fair and impartial spirit. The rather remarkable Mershon compensator is deserving of more notice than that contained in four lines and one illustration. The subject of Current Rectifiers, for instance, is disposed of in some thirteen lines, and Synchronizing Devices in a paragraph much too brief. The well informed author should certainly be aware of the very special thought which has been given to synchronizing and phase indicating apparatus, especially abroad, and could doubtless have given it a more satisfactory treatment. Commendation must be given for the very clear discussion of transformer connections and combination with which Chapter X is introduced. The illustrations and text are remarkably clear on a matter which is not usually given the attention it merits.

Turning to the preface, the statement is made: "The three-phase system has been found to be almost universally applicable. It has largely replaced the two-phase, and to a still greater extent the monocyclic system(s)." This must be conceded to be by no means a fair statement, for the generation and local distribution by currents of two phases, as those must know who are conversant with the subject, has in the past been, and is still very largely used. A second anachronism is the retention of a long chapter descriptive of the hybrid known as the monocyclic system, especially after having averred it has been supplanted in practice.

The book is closed with a good presentation of the choice of frequency, and a chapter covering the usual matter on the calculation of transmission lines. A questionable appendix has been added to this edition, which is neither more nor less than that portion of the report of the committee on standardization of the American Institute of Electrical Engineers, which applies to alternate-current working. A brief and inadequate index is provided.

A loose expression, "electrical degrees," has frequently been used by the author. It is evident that the term "degree" cannot be qualified; and besides the angles so referred to belong to and of magnetic and not electrical position. On page [illegible] will be found a most singular attempt at definition: "The condenser consists of numerous thin sheet conductors, separated by still thinner dielectrics, the whole electrically connected to form two conductors." It is singular that such a meaningless combination of words should have escaped the attention of the author in revision, but it is only fair to assert that the book as a whole should not be judged by such a statement as this. Numerous infelicities of style too are found throughout the book. Prominent among these are the "split" infinitive; and just why this particular literary sin should characterize so many excellent engineering works is not readily answered. That however it is only too general, is shown by works of such prominence and value as Wood's "Thermodynamics" and Johnson's "Materials of Construction," which are notably marred by these blunders in speech. These things are marks of crudeness which must inevitably be laid against the profession and be charged in part to the spirit of commercialism always impatient of everything but the gross results.

The proof has been fairly well read, though on page [illegible] the word "[illegible]" occurs, evidently meant for "[illegible]," while on page [illegible] the omission of the initial word "The" of a sentence is noted. The book is neatly printed, and the illustrations are well selected, but the half-tones, more especially, are often too large. We are glad to note the cordial reception given to this valuable practical work by electrical readers.

DIE TELEGRAPHIE OHNE DRAHT. By Adolf Prasch. Wien: A. Hartleben. 272 pages, 202 illustrations. Price, 5 marks.

Germany is intensely interested in wireless telegraphy; and this fact is apparent in the large amount of literature published in that country on the subject. Heretofore Dr. Braun and Prof. Slaby have been mainly responsible for such treatises, but each of these advocates the merits of a special system which is constructed in conformity to individual theoretical conclusions, so that to the time of the publication of the book under consideration no popular and unprejudiced work had appeared in Germany.

Dr. Prasch has written a concise history and treatise embodying the general principles of the art. The author does not confine himself to a review of the spark-gap and coherer system alone, but gives data concerning the conductivity, inductivity and electrostatic systems of wireless telegraphy as well. While the work, as a whole, contains little that is new in the technique of the art, it concludes with a *resumé* of the Marconi, Braun and Slaby-Arco apparatii in such form that they may be easily compared, and this is evidently just what the author intends giving his readers an opportunity of doing.

The litigation which has been so bitterly waged by the opposing Siemens & Halske and German General Electric companies and the pent-up interest in the validity of the Marconi claims, undoubtedly make the book a timely and welcome one, and, since it is written in a popular manner, it should have a large circulation. Mr. Prasch has been careful to cite his references employed in the preparation of the work and mentions ELECTRICAL WORLD AND ENGINEER as the authority on wireless telegraphy in the United States. The volume is well illustrated in outlines taken from many sources, including patent office drawings.

Directory of Electrical Societies, Etc.

AMERICAN ELECTROCHEMICAL SOCIETY, Secretary, C. J. Reed, Philadelphia, Pa. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa. Next meeting, Mount Washington Hotel, White Mountains, N. H., Sept. 9, 1902.

INDIANA ELECTRICAL ASSOCIATION, Secretary, Hal. C. Kimbrough, Muncie, Ind. Next meeting, Indianapolis, Sept. 17 and 18, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

THE OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION, Secretary, John Brandt, 195 Broadway, New York. Next meeting, Salt Lake City, Utah, Sept. 10, 11 and 12, 1902.

U. S. MILITARY TELEGRAPH CORPS, Secretary J. E. Pettit, Postal Telegraph Company, Chicago, Ill. Next meeting, Salt Lake City, Utah, Sept., 10, 11 and 12, 1902.

VERMONT ELECTRICAL ASSOCIATION, Secretary, C. C. Wells, Middlebury, Vt.

Multiple Wireless Telegraphy.

During the last week two operators of the De Forest Wireless Telegraph Company accomplished a feat, we are informed, which, while new in the annals of wireless telegraphy, is significant of the possibilities of the "responder" or automatic receiver in combination with the telephone. At the 17 State Street station, on the roof of the Chesebrough Building, New York City, two messages were received and read simultaneously by the two operators, listening in on two separate telephone receivers, attached to one and the same responder, and without any special attuning or syntonizing device in circuit. One message was from the Staten Island Station, and was sent quite rapidly—thirty words per minute—with a high-frequency spark (120 per second). The other was from some foreign station, evidently a Marconi installation. The speed was about ten words per minute, sent with a low-frequency interrupter. Mr. Horton concentrated his attention upon the Staten Island message, while Mr. Barnhart was able to pick out by their peculiar drumming sound the signals from the other station.

The result is no more remarkable than the fact that two conversations can be carried on simultaneously over the same telephone wire, if the two voices differ considerably in pitch and timbre. But the fact that without any tuning device this can be accomplished with one and the same responder would certainly seem to demonstrate the advantage of the telephone receiver over sounder or tape-recording device, and the greater immunity of such a system from atmospheric and foreign disturbances.

So far as has been published, two simultaneous messages is the record to-day for any tuned or syntonized system in its present development, and it is interesting to learn that, with two styles of interrupter, and sending speed sufficiently diversified, the same result can be accomplished by the human ear listening in a telephone connected with an automatic responder. Last week also, the De Forest operators established a new record as to speed in short-distance wireless transmission. A commercial message (not of selected words), 48 words in length, was transmitted and successfully read at the rate of 52 words per minute. This is far and away the fastest speed yet attained by the wireless telegraph; being five times as rapid, it is asserted, as is ordinarily attained by coherer systems.

Oil Switch With Circuit-Breaker Attached.

The accompanying illustrations show a type of oil switch which differs materially from the usual form. As will be seen, it is a combined switch and circuit-breaker and is adapted for installation on the ordinary switchboard. Fig. 1 shows the part of the switch on the front of the board and Fig. 2 the part which is on the rear.

The special features claimed for this switch are its simplicity in

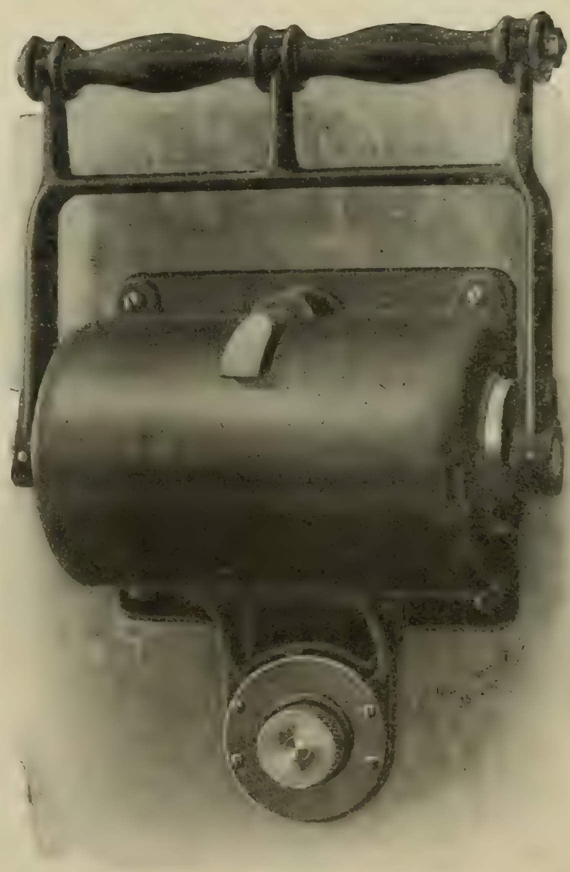


FIG. 1.—PART OF SWITCH ON FRONT OF BOARD.

construction and operation; the use of a special long break between the terminals and the blades; high insulation of working parts from the front of the board; a design which permits installation to suit a great variety of conditions; zinc tipped blades for high currents; and a separate tank for each pole, which is self-contained and removable, and affords free access to the working parts, even when the switch is carrying current.

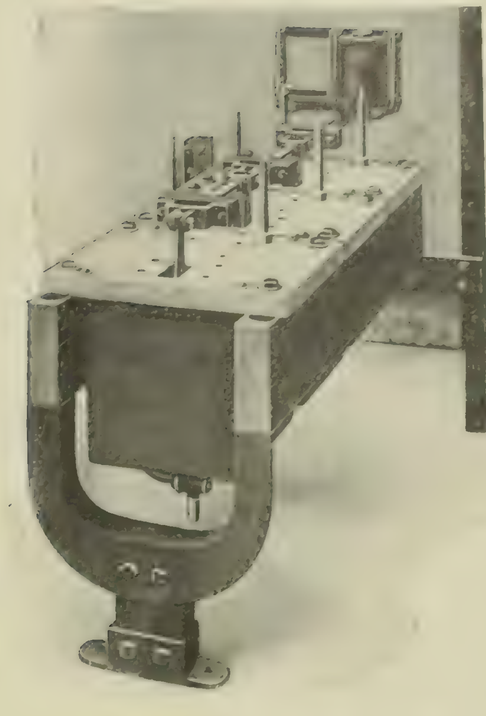


FIG. 2.—PART OF SWITCH AT REAR OF BOARD.

While a switch breaking in oil needs to have only a relatively small break, it is nevertheless wise to make the break distance as long as practicable in view of the fact that often such a switch controls the whole output of a station. Moreover, although the break is made in oil, zinc tips are desirable, as experience has demonstrated that a slight pitting of the blades leading in time to bad contacts, is inevitable. The zinc tips minimize this action and are easily removed and replaced by new ones.

Immersing each pole in a separate procelain-lined compartment of the tank precludes leakage from pole to pole through the oil and, obviously, is a precaution against any short circuit inside the switch. The white porcelain lining facilitates the detection of the collection of any sediment.

Provision is made for drawing off and filling, without removing the tanks from place. By taking out four screws, which pass through the marble cover and without having to draw off the oil, the tank may be removed without in any way disturbing the switch and while it is carrying current. The line terminals are covered by cherry boxes, protecting against extraneous contact.

Fig. 3 shows a quick-break, three-pole switch with the tanks extended in a line back of the board. For narrow panels this construction is used. Where there is sufficient room the tanks are placed side by side along the board.

Fig. 4 shows a two-pole double-throw switch. This style is so mounted on a separate base that the entire switch may be removed from the board and be replaced, or another switch put in its place within a few minutes' time. The oil switches, single-pole, double-pole, three-pole, and four-pole, are made both single and double-throw for voltages from 4000 to 15,000 and currents from 1000 to 100 amperes respectively. The manufacturers do not advise the use of switches with four poles, being of the opinion that it is better practice to provide two double-pole switches.

The circuit-breaker attachment possesses the same characteristics as that on the slide switches of the same makers—the Stanley Electric Mfg. Company—and affords at minimum expense a combined switch and circuit-breaker claimed to possess all the advantages and many extra ones of two separate devices. It may be added to switches designed for as high as 200 amperes. By turning the disk, which is mounted directly under the operating handle (Fig. 1), the point at which the circuit-breaker attachment will operate may be changed at will.

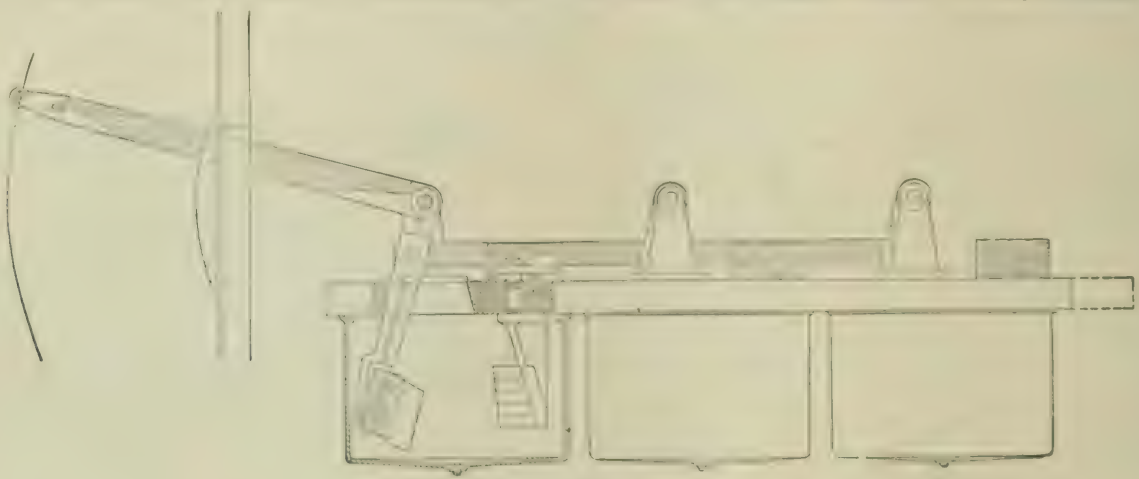


FIG. 3.—THREE-POLE SWITCH.

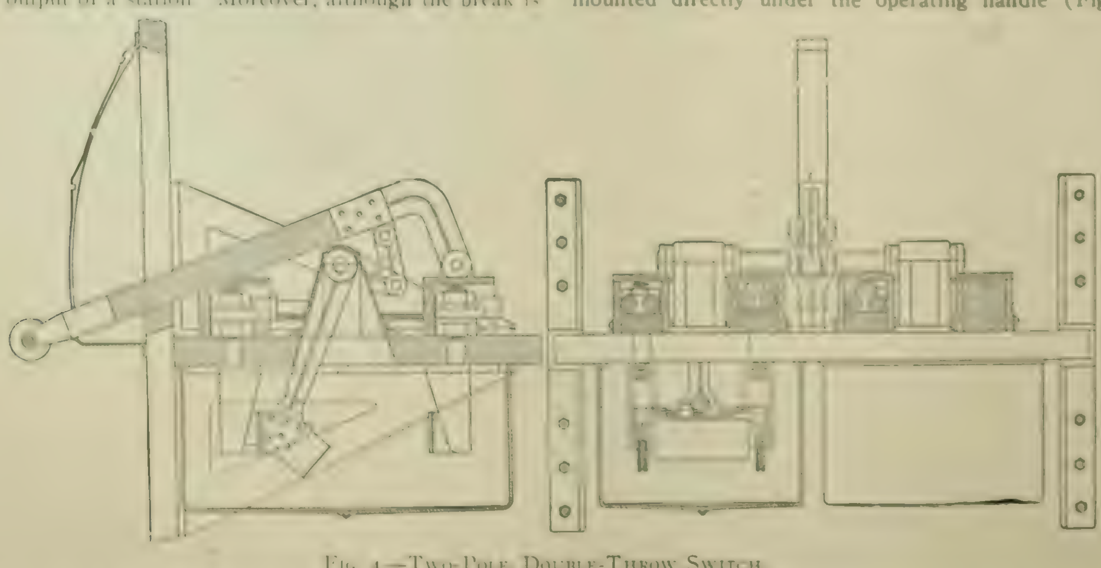
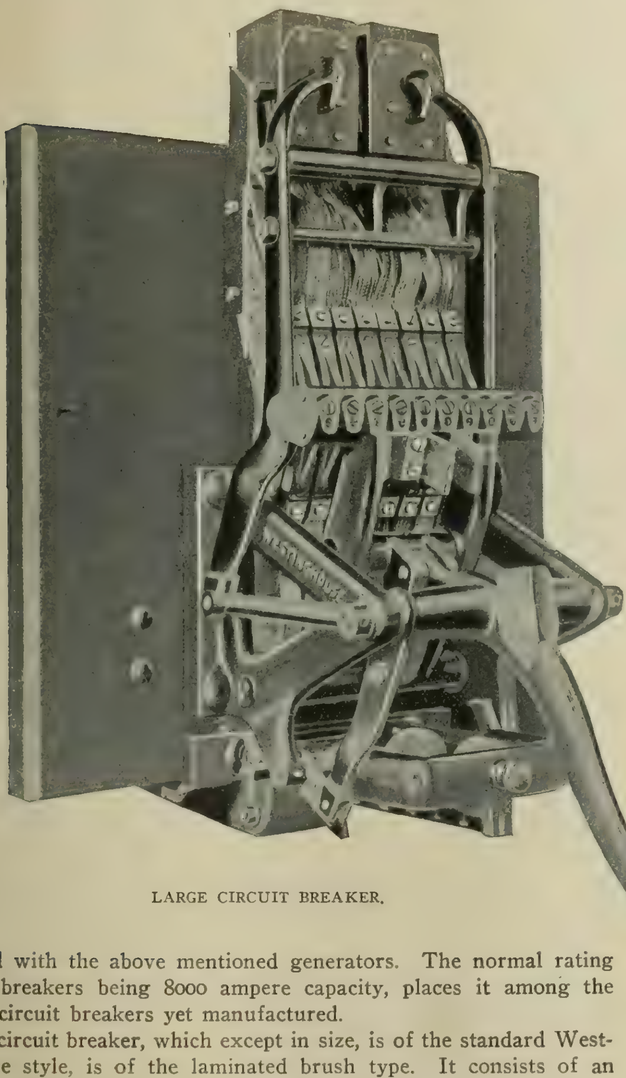


FIG. 4.—TWO-POLE, DOUBLE-THROW SWITCH.

Large Capacity Circuit Breaker.

For the direct-current generators recently constructed by the Westinghouse Electric & Mfg. Company, for the Boston Railway Company, it was necessary to build switchboard apparatus of unusual size, the most notable of which is an automatic circuit breaker. In the accompanying illustration is shown the type of circuit breaker



LARGE CIRCUIT BREAKER.

supplied with the above mentioned generators. The normal rating of the breakers being 8000 ampere capacity, places it among the largest circuit breakers yet manufactured.

This circuit breaker, which except in size, is of the standard Westinghouse style, is of the laminated brush type. It consists of an upper and lower contact block connected together by laminated copper brushes. Upon these brushes phosphor bronze springs are placed and upon these are the carbon contacts or arcing points. The brushes are held in contact with the contact blocks by means of a toggle mechanism locked by a trigger attached to the scale beam. The circuit breaker can be easily closed by hand and will open automatically throughout its entire range. (The 8000 ampere breaker has an adjustable range between the limits of 2,000 and 10,000 amperes.) To avoid any possibility of arcing at the laminated copper brushes, woven-copper cables are fastened from these brushes to the carbon arcing points. The automatic action is obtained in a very simple manner and without the use of coils by surrounding the lower contact block with a "U" shaped magnet of laminated iron and the magnetic circuit is completed by an armature of laminated iron attached to the scale beam.

In operation, the action of the circuit breaker is as follows: The passage of the circuit through the lower stud brushes and upper stud energizes the "U" shaped magnet which attracts the armature. This releases the trigger unlocking the toggle joint and copper spring brushes throw the breaker open. In breaking contact, the copper brushes leave the contact block first, aided by the pressure of the brushes which act with the releasing spring instead of against it, followed by the phosphor bronze spring. Then the carbon block or arcing point of the out-moving breaker armature separates from its carbon contacts and its circuit is broken. By this method the current is gradually shunted from the carrying brushes to the carbons, thus preventing any arcing from the metal parts of the breaker.

Gas Engine Generating Unit.

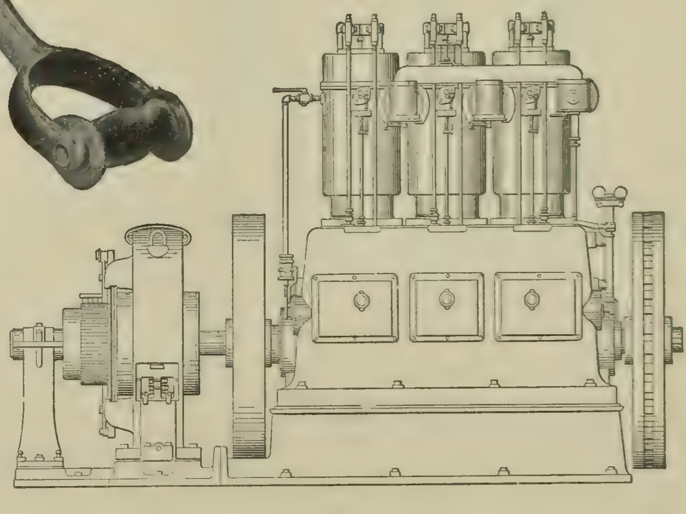
We illustrate herewith a 75-hp gas engine unit recently shipped by the MacKay Engineering Company to Japan. The unit consists of a 75-hp three-cylinder Walrath gas engine direct connected to a General Electric generator.

The Walrath gas engine, made by the Marinette Iron Works Manufacturing Company, Marinette, Wis., is especially designed for close regulation and is thus particularly adapted for running electric generators. During the past several years it has rapidly come to the front for this latter use, a long list of Walrath gas engine electrical generating units being in use at the present time in high-class electrical installations. As the type of generator illustrated is well known, a description of the unit will be confined to the gas engine.

This engine is the vertical crank-case type, a mechanical design which combines strength and simplicity with a handsome appearance. Among the advantages of the vertical type is that it does not require a massive foundation, has more durability as to wear of cylinders and pistons, and requires a minimum of floor space.

The engine is particularly noticeable for its simplicity. The intermediate shaft with its gearing and shaft is enclosed in a case, and being self-oiling, the wear and tear is reduced to a minimum. The serious objection to oil passing the piston and covering the igniter, thus stopping the engine, which is a common occurence with other vertical self-oiling types, has, it is claimed, been entirely overcome in this machine. The crank shaft is a solid forging of open hearth steel, without welds, and is fitted with main bearings easily removed or replaced without disturbing the shaft.

The cylinders fit into a bore on the top of the base made to receive them, it thus being impossible for them to get out of alignment. Being of the vertical type they are free to expand. A notable advantage of this method of mounting the cylinder is that should one cylinder become damaged it can be readily removed and replaced. The valves are placed within the cylinder head in cages, and as all the piping is connected to the cylinder proper, the head can be readily removed. The valves, which are of the poppet type, are two in number, one for the inlet or explosive mixture and the other for the exhaust. The pistons are of the open trunk type and are kept tight by six snap rings of cast-iron. Balance weights are fastened directly to the crank shaft. While this is more expensive than to put the



THREE-CYLINDER GAS ENGINE.

balance weignts on the flywheel, the manufacturers consider the extra expense more than justified by the better results.

The igniter consists of a casting containing two electrodes, one of which is stationary and insulated from the main body of the casting. The second electrode is movable and is operated by a cam which causes it to make and break contact with the insulated electrode. The contact points are of special metal adapted to withstand great heat.

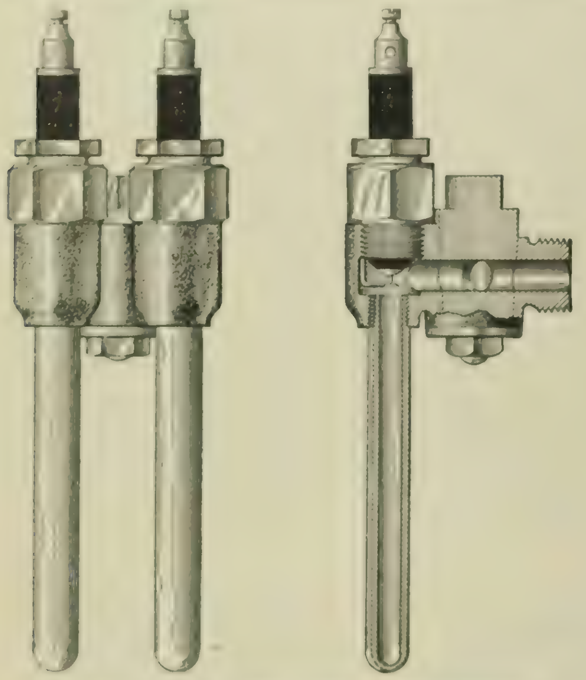
The governor is of the fly-ball type driven by means of beveled gear. It is made to operate a piston valve, which regulates the exact amount of explosive mixture required for each impulse to maintain a steady speed under all conditions and variations of load. This method of governing gives an impulse every two-thirds of a revolu-

tion in the three-cylinder type, irrespective of the load being driven. The sensitiveness of this arrangement is evident from the fact that scarcely two per cent variation in speed can be discerned in throwing on or off full or part load.

The Walrath engine is adapted to run on natural or artificial gas or gasoline. A brake hp-hour is produced on approximately 11,000 to 12,000 B. T. U., corresponding with natural gas to a brake hp-hour for 10 cubic feet of gas, the quantity being greater, of course, with illuminating or producer gas. The amount of gasoline per brake hp-hour will vary from one-tenth to one eighth of a gallon, the gasoline varying from 70 to 76 degs.

The Cotton Duplex Igniter.

Since the use of the gas engine has so largely increased through its application to many different purposes for individual power, there have been a number of devices produced with a view to making more certain and continuous the operation of explosive motors. A recent interesting improved type is the Cotton duplex igniter, which is illustrated herewith. This igniter consists of a T-shaped casting, provided with a pair of spark-plug receptacles; a three-way valve and a



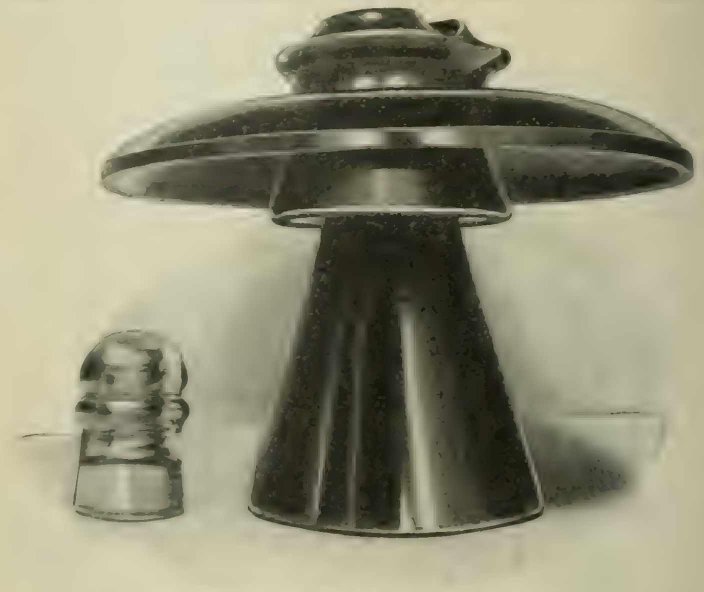
REAR AND SIDE SECTIONAL VIEWS, DUPLEX IGNITER.

nipple. A compression tube enters each plug receptacle. In the application of this device the nipple is screwed into any canal leading to the compression chamber of the engine cylinder. The nipple is made to fit a ½-inch pipe thread, or smaller to order. On engines fitted with hot tube ignition it is very convenient to screw out the tube and insert the igniter in its place. In the operation the gas is compressed through the nipple to one of the plugs when it is ignited at the desired period; the expansion cycle of the engine then taking place. On the return or cycle of exhaustion the gases in the igniter are exhausted to substantially that pressure of the engine, or near atmospheric pressure, leaving a certain quantity of dead gas which is forced into the compression tube on the next compression cycle to such an extent that the combustible gas passes through and fills the plug receptacle with absolute surety of ignition under a variable compression. The advantages attained through this device are self-evident. Troubles caused through deposits of carbon or other electrical conducting material on the insulation of the plug are entirely obliterated through gaseous friction, the insulation and electrodes being always in a polished condition. It is evident that the operation of the engine can be continued indefinitely, for if any missing of ignition through defects in the active plug is detected, the current can be switched to the other plug, while at the same time the valve is turned. The defective plug can then be removed and a new one inserted.

The Duplex Igniter is manufactured and exclusively for sale by the Automobile Equipment Company, at [illegible] Quincy Street, Chicago. It will be sold separate without other gas engine devices, but the company intend to push the Hydra double battery and jump spark coils in connection with this device. The Hydra is the well known German dry battery just put on the American market, for which the company have secured a general agency.

Insulator for High-Voltage Transmission.

It is quite natural that the progressive rise in transmission line voltage should have introduced insulation problems of no mean proportions in long-distance power transmission engineering, but, perhaps, few realize the consequent revolution that has been worked in types of pole-line insulators. As an illustration of this we show



HIGH-VOLTAGE TRANSMISSION INSULATOR.

herewith a view of one of the latest types of these insulators alongside a standard glass telegraph insulator. The former is 14 inches across the hood, 11½ inches high and weighs 18 pounds. The manufacturer, Fred. M. Locke, of Victor, informs us that the insulator is made of a special mixture of clay known only to himself, and that it will withstand a test voltage of 160,000 and a working voltage of 80,000.

A New Bending Machine.

The accompanying illustration shows a machine for bending electric conduit to any desired curve. The machine weighs about 100 pounds, and is adapted for five commercial sizes of such conduit, namely, ½, ¾, 1, 1¼, and 1½ inches.

The curved surfaces of the machine are so designed as to prevent as far as practicable the bulging of the conduit at the sides during

BENDING MACHINE.

curvature. In making long or short elbows a length of the conduit is entered in the hole of the proper size and then lifted up with one stroke for a short curve, or with several short strokes for a long curve of larger radius. In making long curves the conduit is progressively pushed forward a little at each stroke. A 3-inch extension of the base acts as a heel to bear down on it in making offsets or straightening curves. The manufacturers of this machine are Wm. W. Benson & Co., 1001 Chestnut Street, Philadelphia, Pa.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 4½ per cent. for 60 to 90 days, and 4⅝ to 5 per cent. for four, five and six months; it was offered with some freedom. The stock market was slightly reactionary, mainly on account of the large gold shipments and their prospective continuance. Public interest in speculation, however, fell off sharply. Industrials were neglected, the steel stocks being heavy on the delay in the bond litigation. At the latter part of the week i dustrials and traction stocks were a little more active, there being renewed pool support in both Brooklyn Rapid Transit and Manhattan. Brooklyn Rapid Transit reached 70⅛ during the week, the lowest point being 67⅞, and the closing, 69¾. The transactions were heavy, the number of shares sold being 96,850. General Electric closed at 185⅛ on sales of 5,400 shares, being a net loss of 2¼ points. The extreme quotations were 181¾ and 186. Metropolitan Street Railway closed at 149¾, which was ¾ of a point below the highest quotation reached, and ¾ of a point higher than the lowest, the net loss being ¼ of a point. The sales were 5,900 shares. Western Union Telegraph made a net gain of 1¼ points, closing at 87½ on sales of 41,100 shares. The prices ranged between 85, the lowest, and 88, the highest, the closing price representing a net gain of 1¼ points. Westinghouse closed at 210½, a net gain of ½ point. This was the lowest price of the week, the highest being 214. Following are the closing quotations of August 5:

NEW YORK.

	July 29.	Aug. 5.		July 29.	Aug. 5.
American Tel. & Cable.	—	93⅞	Hudson River Tel......	—	—
American Tel. & Tel..	164	164	Metropolitan St. Ry...	149⅜	149
American Dist. Tel....	—	—	N. E. Elec. Veh. Trns..	—	10½
Brooklyn Rapid Transit.	68¼	69¼	N. Y. & N. J. Tel....	—	—
Commercial Cable	—	—	N. Y. E. V. T. Co....	—	—
Electric Boat	30	25	Tel. & Tel. Co. Am....	—	—
Electric Boat pfd......	50	50*	Western Union Tel....	86⅛	89
Electric Lead Reduc'n..	—	2½	West. E. & M. Co.....	—	—
Electric Vehicle	7	7⅛	West. E. M. Co. pfd..	210½	—
Electric Vehicle pfd....	—	14½			
General Electric	184½	185¼			

BOSTON.

	July 29.	Aug. 5.		July 29.	Aug. 5.
American Tel. & Tel..	164	163¾	Mexican Telephone	—	2¼
Cumberland Telephone .	125	—	New Eng. Telephone...	144	142
Edison Elec. Illum....	280	280	Westinghouse Elec.	—	—
Erie Telephone	—		Westinghouse Elec. pfd.	—	—
Western Tel. & Tel....	—	—			
Western Tel. & Tel. pfd.	—	—			

PHILADELPHIA.

	July 29.	Aug. 5.		July 29.	Aug. 5.
American Railways	47	47¾	Phila Traction	99⅞	99¾
Elec. Storage Battery..	92	—	Phila. Electric	5 9/16	5⅝
Elec. Storage Bat'y pfd.	—	—	Pa. Elec. Vehicle......	—	—
Elec. Co. of America..	8⅞	8⅞	Pa. Elec. Vehicle pfd..	—	-

CHICAGO.

	July 29.	Aug. 5.		July 29.	Aug. 5.
Central Union Tel.....	—	—	National Carbon pfd....	107½	102½
Chicago Edison	177	—	Northwest Elev. com...	37	—
Chicago City Ry.......	220	210	Union Traction	15¼	—
Chicago Tel. Co........	127¼	—	Union Traction pfd....	—	47
National Carbon	—	30			

* Asked.

GERMAN ELECTRICAL SECURITIES.—A special cable dispatch from Berlin, of August 3, says: With the exception of the shares of a few domestic railroads the Bourse was pronouncedly weak along the line last week. All industrial securities were sluggish, and declines were universal. This department was under the influence of the report of the Schuckert Electrical Company, of Nuremberg. It was also influenced by the reduction of the dividend of the Bochum Cast Steel Company to 7 per cent., as against 13⅓ per cent. last year, and further reports of the coal trade, which represented conditions to be unsatisfactory. Iron and coal shares declined during the week, but not to the extent of the week previous, and Friday and yesterday brought a partial recovery in prices. Shares of other electrical companies fell in sympathy with those of the Schuckert Company, the latter losing 9½ points. The *Frankfurter Zeitung,* commenting upon the report of the Schuckert Company, says it shows the evil effects of the system which prevailed with electrical manufacturing companies during the boom of unduly pushing the organization of traction and lighting plants in order to make work for themselves, and also taking shares in such plants.

ROCHESTER GAS AND ELECTRIC.—N. W. Harris & Co. offer to investors at 101 and interest, $650,000 first mortgage forty-year 4½ per cent. gold bonds of the Municipal Gas and Electric Company of Rochester, principal and interest guaranteed by the Rochester Gas and Electric Company, and are optional on any interest payment date on and after April 1, 1912, at 102½ and interest. The Rochester Gas and Electric Company has acquired all the property franchises, etc., of the Municipal Gas and Electric Company, and has assumed and guaranteed the payment of the principal and interest of its bonds. For several years the company has paid dividends at the rate of 6 per cent. on both common and preferred shares, and according to local quotations on the stocks, the market value of the equity is over $4,000,000. The Rochester Gas and Electric Company now controls the entire gas and electric business of Rochester, operating under franchises unlimited as to time. Within the city limits of Rochester the Genesee River has a fall of about 260 feet, and about 90 per cent. of this water power is owned by the Rochester Gas and Electric Company.

DIVIDENDS.—The directors of the National Carbon Company have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable August 15. The Louisville Gas Company has declared the usual semi-annual dividend of 2½ per cent., payable to stockholders of record July 7. The old officers, including President Snead, have been re-elected. Nothing has been heard for some time of the proposition to bup up the two gas and the two electric companies for merger with the street railway, but the securities of all those corporations are very strong. Directors of Electric Company of America have declared the regular semi-annual dividend of 25 cents per share, payable August 18, out of the net earnings for the six months ending June 30, 1902, being at the rate of 6⅔ per cent. per annum. The directors of the Westinghouse Electric & Manufacturing Co. have declared the regular quarterly dividend of 1¾ per cent. on the assenting stock, payable August 15.

GERMAN-AMERICAN CABLE.—The German Atlantic Telegraph Company in Cologne is issuing 4 per cent. debentures to the amount of 20,000,000 marks, to provide for the cost of laying a second cable between Germany and the United States, the present cable having already proved inadequate for the increasing traffic. A new agreement has, at the same time, been concluded between the company and the Imperial Postal Administration, whereby the company's privilege is extended until 1945, and the following stipulations are made: "Provided that by 1904 the second cable is ready, as far as the Azores, the imperial exchequer will pay the company for the year 1904 a fixed compensation of 750,000 marks, and provided that the whole cable is ready in January, 1905, the company will receive from the exchequer a yearly subsidy of 1,710,000 marks until 1944."

NEW ORLEANS TROLLEYS.—The purchase of the St. Charles Street Railroad in New Orleans has caused great activity in the securities of the New Orleans Railways, the consolidation of the gas, electric and street railway properties. The St. Charles was the last one of these properties to be purchased by the Pearson syndicate. It is nineteen miles long and has valuable franchises,and was bought for $210 a share, the market price of the shares being 201. It has a capitalization of $1,000,000 of common stock and $15,000 of preferred, and no bonds. Mr. Pearson will pay $50 down for each share held by the 350 stockholders and the remainder in 4 per cent. bonds.

EVANSTON LIGHTING SALE.—A telegram from Chicago, of August 1, says: Mr. Samuel Insull has purchased the Evanston Electric Illuminating Company. This concern has been owned for a number of years by the Westinghouse Electric Company. It supplies Evanston with electric light. With this purchase Mr. Insull becomes the owner of all the electric lighting plants in the important cities along the lake shore from the city limits to the Wisconsin State line, a distance of between 15 and 20 miles. Mr. Insull is president of the Chicago Edison Company, but that corporation has no present interest in the lake shore electric plants which he has purchased. Eventually, it is presumed, these various concerns will be under one organization.

LOS ANGELES EDISON.—N. W. Harris & Co. has closed a contract for the purchase of a block of about $3,000,000 of the bonds of the Edison Electric Company of Los Angeles, California. These bonds will probably be placed on the market early in September.

ST. JOSEPH CONSOLIDATION.—The St. Joseph, Mo., Railway, Light, Heat & Power Co. has passed from the hands of the Harriman syndicate to E. W. Clark & Co. and J. & W. Seligman.

AMERICAN UNION ELECTRIC.—Last week we noted the consolidation of the Union Railway Power and Electrical Company, the Morris Electric Company, Fountain Manufacturing Company, and five other established railway equipment and electrical companies under the name of the American Union Electric Company, with a capital of $7,000,000, of which $5,000,000 is outstanding. The company, which has an extensive plant at East Orange, is building a large addition to its plant. The business consists in the manufacture of rail bonds, trolley wheels, fare registers, trucks and sweepers, headlights, car trimmings and electric devices, such as panel boards, switches and switchboards, junction boxes, etc., and brass castings. The management of the company is under the direction of Elmer P. Morris, S. M. Young, E. P. Ewing and J. Fountain, with New York headquarters at 15 Cortlandt Street.

SPRINGFIELD, ILL., TROLLEYS.—The securities of the Springfield Consolidated Street Railway have been strong upon the report that E. W. Clark & Co. are trying to purchase the property, and the electric and lighting plants in Springfield, Ill., in the interest of consolidation. The stock is controlled by four or five men, and they are not willing to sell except at a good price. The road is said to be showing earnings now at the rate of $200,000 a year, against $142,000 last year. It has a capitalization of $750,000 in 5 per cent. bonds and $750,000 in stock.

Commercial Intelligence.

THE WEEK IN TRADE.—Quietness prevailed in trade, while attention was concentrated on crop and industrial development. Generally lower prices for farm products point to the crops being large, though the passing of the July period of manipulation is a weakening influence. In industrial affairs the outlook is satisfactory, says *Bradstreet's*. The iron and steel situation is still a strong one, but isolated examples of weakness show themselves. The coal strike continues, but it is looked upon to be in its last stages, though the final ending may be long drawn out. The railway situation is one of the best in years, and the outlook as to tonnage is a flattering one, marred only by the prospect of car shortages later on reducing or curtailing industrial operations. Fiscal year earnings returns are exceptionally good and it is probable that, taken as a whole, railway earnings for the first half will exceed those of the same period last year, despite the strike reducing anthracite coal miners' earnings. Hardware is active, especially for building; the 1901 record of building will, it is stated, be surpassed this year. Business failures, according to *Bradstreet's*, number 168, as against 178 the week previous, and 160 the same week last year. The copper market is unchanged, the demand being slight and no increase in export business being reported. Quotations are 11.75 to 12c. for Lake, 11.75 to 11.90 for electrolytic, and 11.65 to 11.75 for castings.

STORAGE BATTERY INSTALLATIONS.—Among the most recent contracts closed by the Electric Storage Battery Company, of Philadelphia, for "Chloride" accumulators in railway service are the following: Providence and Danielson R. R., Providence, R. I., 107 kw; Mahoning Valley Railway Company, Youngstown, Ohio, 351 kw; Kansas City-Leavenworth, Wolcott, Kan., 160 kw; Detroit United Railway, Detroit, Mich., 172 kw; Connecticut Railway and Lighting Company, Derby, Conn., 175 kw; Los Angeles and Pacific Railway Company, Los Angeles, Cal., 126 kw; Harrisburg Traction Company, Harrisburg, Pa., 264 kw; Eastern Ohio Traction Company, Gates Mill, 259 kw; East Bangor, Portland and Delaware River Railway Company, East Bangor, Pa., 87 kw; Greenville and Turner's Falls Street Railway Company, Cheapside, Mass., 83 kw; Capital Traction Company, Washington, D. C., 173 kw; Consolidated Railway Traction and Power Company, 119 kw; York County Traction Company, Red Lion, Pa., [illegible] kw; Orange and Passaic Railroad Company, Orange, N. J., 209 kw; Milwaukee Electric Railway and Lighting Company, 2 batteries aggregating 1,700 kw; Portland and Brunswick Street Railway Company, Brunswick, Me., 72 kw; Ottawa Electric Railway Company, Ottawa, Ontario, 599 kw; Danville, Paxton and Northern Railway Company, Georgetown, Ill., 65 kw. An increase of 50 per cent has also been made in the Peekskill Light and Railway Company's battery, which originally consisted of 87 kw. Other contracts recently closed embrace a battery of 8,000 amperes at 120 volts, for the Edison Electric Illuminating Company, of Brooklyn; a residential plant for C. Ledyard Blair, Far Hill, N. J.; batteries for the Wolvin Building, Duluth, Minn.; John D. Rockefeller for West Side Neighborhood House, New York; Merck & Company factory at Rahway, N. J.; John R. Sherman, residential plant, Port Henry, N. Y.; J. Hurst Purnell, office building, Baltimore; Hanover National Bank, New York; New York Stock Exchange; J. Samuels & Brother, of Providence, R. I.

ARMSTRONG-ORLING APPARATUS. — The *Westminster Gazette*, of London, announces that a company has been formed with a nominal capital of £175,000, privately subscribed, for the purpose of operating the Armstrong-Orling system of wireless telegraphy. The paper says it is informed that this company will begin operations on a large scale almost immediately. Two factories will be erected, one in Buckinghamshire, England, and one in France, at places which have already been selected. Everything in connection with the new scheme, down to an illustrated catalogue and price-list, is ready. According to advance proofs of the price-list, the charge for transmitters for sending Morse signals short distances will be £10, and for long distances, £15, in addition to a royalty of £1 per year. A complete telephone outfit for short distances will cost £4 a year, and a royalty of £1. This system has already been noted in these pages.

THE CROCKER-WHEELER COMPANY, of Ampere, N. J., is finding an ever-increasing demand for its various lines of direct-current machinery, as is evidenced by the necessity for large increases of floor space. A new building, now half-way to the roof, will nearly double the present capacity, while clearing out many small machines in the main shop will permit of the placing of new and heavier machinery to accommodate larger sized generators and more rapid work on large orders for the smaller standard machines. The new building is of brick, slow-burning mill construction, three stories in height, and intended for the winding departments and light machine tools. A portion of the basement space will be used for the experimental laboratories, whence emanate the changes in design that maintain the reputation of Crocker-Wheeler apparatus.

PAWLING & HARNISCHFEGER, Milwaukee, Wis., makers of electric cranes and hoists, have just acquired the Gardiner-Campbell Company property, adjoining their works. It is 200 x 150 feet, and the three story building is being entirely remodeled to supply additional machine shop facilities, also to provide extra pattern storage. The foundry is being changed over, and an addition made thereto, and in the entire building will be placed a modern foundry equipment. Among the improvements will be two P. & H. electric traveling cranes. The present power plant is being much enlarged, and new boilers, engines and another generator will be provided. It is stated that these improvements will considerably shorten the time required to complete a crane or hoist. Various supplies and details will be needed.

ELECTRIC LOCOMOTIVES ORDERED.—Contracts have been awarded by the Baltimore and Ohio Railroad Company to the General Electric Co. for the two largest electric locomotives in the world. Each machine will weigh 150 tons, and be capable of drawing 1,500 tons of freight up the heavy grades of the belt-line tunnel, which runs nearly two miles under the city. Passenger trains have been drawn through the tunnel by electricity since it was opened in 1895, but the motors now in use are not capable of pulling the heavy freight trains. The motors will be designed to haul twice the load the steam locomotives at present pull through the tunnel.

ELECTRICAL EXPORTS.—According to the preliminary figures of the Bureau of Statistics for the fiscal year lately closed, exports of electrical machinery fell off $432,969, and instruments of all kinds, including electrical, $1,071,755. These declines appear to be wholly attributable to the production of American apparatus abroad in new factories. The total of manufactured exports for 1901-2 is $412,155,066, or about $20,500,000 less than in the year preceding. The grand total of exports is $1,460,462,806, or $90,000,000 more than in the previous year.

THE STERLING ELECTRIC COMPANY, of La Fayette, Ind., are very active on common battery installations now building or in prospect. They report having secured in the last week contracts for complete exchange equipment and telephones at the following points: Newark, Ohio, 3,000 capacity; Davenport, Ia., 4,000 capacity; Rock Island, Ill., 4,000 capacity; Moline, Ill., 3,000 capacity; Paris, Ky., 3,000 capacity.

THE HELIOS-UPTON COMPANY has secured an order for a 3,000-ampere battery from the Grand Rapids Edison Company, of Grand Rapids, Mich. This is the second large contract for storage batteries secured from Edison central stations by this company, the other contract being for a large battery installed by the Edison Company, of Kansas City, Missouri.

BALL ENGINES.—The Ball Engine Company, Erie, Pa., has supplied the engines for an electric plant for power and light being installed by the National Color Type Company, Chicago. The Ball Company is also supplying to the Jos. Dixon Crucible Company, Jersey City, N. J., an engine for direct connection to a 100-kw generator.

THE LUNKENHEIMER COMPANY has recently purchased a large number of Westinghouse induction motors, for the equipment of its new works at Cincinnati, Ohio.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended August 2: Argentine Republic—33 pkgs. material, $722; 20 pkgs. machinery, $7,170. Amsterdam—1 pkg. machinery, $110. Antwerp—43 pkgs. material, $1,946; 13 pkgs. machinery, $1,994. Brazil—112 pkgs. material, $4,536; 57 pkgs. machinery, $39,332. British East Indies—1 pkg. machinery, $120; 16 pkgs. material, $1,025. British Possessions in Africa—6 pkgs. machinery, $462. Bremen—19 pkgs. material, $1,217. Brussels—10 pkgs. material, $220. British Guiana—11 pkgs. material, $384. British Australia—2 pkgs. material, $60; 29 pkgs. machinery, $1,571. British West Indies—58 pkgs. material, $689. Cuba—94 pkgs. material, $1,359. Christiana—1 pkg. machinery, $40. Chili—2 pkgs. material, $130. Central America—9 pkgs. material, $279. China—1 pkg. material, $93. Copenhagen—4 pkgs. machinery, $1,519. Dutch East Indies—1 pkg. material, $30. Ecuador—3 pkgs. material, $516. Frankfort—10 pkgs. machinery, $390. Glasgow—50 pkgs. machinery, $567; 15 pkgs. material, $1,335. Genoa—14 pkgs. machinery, $1,000. Havre—46 pkgs. material, $1,515; 22 pkgs. machinery, $875. Hamburg—14 pkgs. machinery, $1,320; 48 pkgs. material, $1,340. Japan—1 pkg. machinery, $92; 95 pkgs. material, $3,196. Liverpool—307 pkgs. machinery, $56,947; 40 pkgs. material, $1,378. London—187 pkgs. machinery, $5,663; 178 pkgs. material, $9,018. Mexico—88 pkgs. material, $1,799. Moscow—5 pkgs. machinery, $390. Manchester—412 pkgs. machinery, $36,417; 8 pkgs. material, $572. New Zealand—50 pkgs. machinery, $7,840; 137 pkgs. material, $6,963. Philippines—19 pkgs. material, $1,370. Peru—60 pkgs. material, $2,100; 1 pkg. machinery, $36. Rotterdam—4 pkgs. machinery, $200. Riga—5 pkgs. material, $92. Stockholm—1 pkg. material, $15. Sheffield—2 pkgs. machinery, $700. Siam—35 pkgs. material, $2,622. San Domingo—5 pkgs. material $75. Southampton—6 pkgs. material, $205. U. S. Colombia—2 pkgs. material, $13. Vienna—2 pkgs. material, $50. Venezuela—5 pkgs. material, $161.

THE BUFFALO FORGE COMPANY, Buffalo, N. Y., notes a few of the orders recently received through its different branch houses: Two 70-inch steel plate steam fans, for heating and ventilating, direct connected to two Buffalo Forge engines, and one 130-inch, ¾-housing standard steel plate pulley fan, for mechanical draft, are to be shipped to Copenhagen, Denmark. One induced draft plant and one 23-hp engine for electric light plant in Dutch Guiana, S. A. Five engines of 45 hp each, for driving generators, and one 38-hp engine for a pumping equipment, to be installed in a sugar factory, now being built near Manzanillo, on the south side of Cuba. One 20-hp engine, to be shipped to Gustemunde, Germany. One 15-hp, double vertical, single acting engine, to Gothenburg, Sweden. One 60-inch standard steel-plate fan, for ventilation, to a point near Glasgow, Scotland. One 140-inch steel plate fan with heaters, complete, for heating and ventilation, Barrow-in-Furness, England. One standard 80-inch fan and heater, complete, and one 90-inch pulley fan for ventilation, and one 30-hp horizontal engine, to London, England. One 120-inch fan and six 60-inch fans, to Manchester, England. One 80-inch standard steel plate fan, for mechanical draft, to Victoria, B. C. One 110-inch steel plate pulley fan, direct connected to a cylinder above-shaft engine, for mechanical draft, to Halifax, N. S. One 70-inch fan and one 100-inch fan, for heating and ventilating purposes, to Portland, Ore. One standard 40-inch steel plate fan, to College Station, Tex. One 100-inch steel plate fan, direct connected to a single vertical engine, to San Francisco, Cal. Two special 60-inch steel plate fans, to New Orleans, La. One 25-hp horizontal engine, to Gretna, La.

SOME HARRISBURG ENGINE ORDERS.—The Harrisburg Foundry and Machine Works, New York, offices 203 Broadway, have taken a contract from the New York, New Haven and Hartford Railroad Company for a 300-hp Ideal engine, also a 105-hp, one for installation in the Newport, R. I., shops. The first-mentioned engine will be double direct connected to two 100-kw generators, built by the General Electric Company. The smaller engine will be double direct connected to 35-kw General Electric generators. The equipment will serve for light and power purposes. The New York Central Railroad Company's new shops, at Oakgrove, Pa., are to be furnished with two 225 Harrisburg standard, tandem-compound engines, each to be direct connected to 150-kw General Electric generators. The outfit will also be for both light and power. The Hebrew Orphan Asylum, now under construction at 136th Street and Amsterdam Avenue, New York, is to be equipped with one 120-hp standard engine and a 75-hp machine for lighting use. The Harrisburg people have also secured an order for a 75-hp standard engine for the West Point Military Academy. The engine will be direct connected to a 50-kw Westinghouse lighting generator.

LARGE ELECTRIC SHIPBUILING CRANE.—The Brown Hoisting Machinery Company, of Cleveland, Ohio, through its New York offices, of which Mr. W. A. Stadelman is manager, has just been awarded an interesting contract by the United States Government for a large electric cantilever crane, to be installed in the New York Navy Yard, Brooklyn. The equipment will be erected in the building slip where one of the three large battleships, for which Congress recently made appropriation, is to be built. The crane, it is said, will be one of the largest electrically operated shipbuilding outfits of its description ever constructed. The trestle, a Brown hoist steel one, will be 500 feet in length and 60 feet in height. The crane will have a capacity for lifting 30,000 pounds 60 feet either side of the center, and 10,000 pounds 95 feet. The equipment is to be driven by a motor of 80 hp (nominal), which will be supplied by the Elwell-Parker Electric Company, of Cleveland, Ohio. The crane will be ready to begin working in nine months. The value of the contract is said to be $110,000.

TROLLEY POLES FOR SYDNEY.—The National Tube Company, through the American agents of the New South Wales Government, R. W. Cameron & Company, 33 South William Street, New York, has secured a contract for a number of trolley poles, which will be forwarded to Australia for use on the Sydney city and suburban electric traction system. This road is being constructed with American material, the General Electric Company having secured the contract for some $800,000 worth of power-house equipment. The capacity of the plant will be practically doubled shortly, which will result in an expenditure of fully $500,000. The boilers in the initial plant are of Babcock & Wilcox build. The engines are of Allis manufacture. The present capacity of the Sydney central power station is somewhat over 6,000 horse-power. It will be increased to 11,000 hp. The poles will be manufactured at the Morris-Tasker Works, Philadelphia.

CATALOGUES WANTED.—Mr. W. J.. Martin, of the electrical department of the George A. Fuller Company, 137 Broadway, New York City, wishes to receive electrical catalogues of all kinds for office files and reference, and for immediate ordering, etc. This concern is the largest in the world as a builder and operator of real estate, and its electrical necessities are of a very large and important kind in every class of apparatus. As many of our readers are aware, it has just absorbed, in a new and larger company, several of the big New York real estate corporations, making its business of a greater magnitude than ever. Every electrical manufacturer will do well to put his catalogues in the hands of the company's electrical department as requested.

CAR TRUCKS AND EQUIPMENTS FOR SOUTH AFRICA.—The British electrical engineering and contracting firm of Macartney, McElroy & Company, whose New York offices are in the Havemeyer Building, has placed a contract for 10 trucks with the J. G. Brill Company, of Philadelphia, and a similar number of 58-type motor equipments with the General Electric Company, for 10 cars, the bodies of which will be manufactured in England for an extension to the Durban municipal electric traction system, South Africa.

THE KELLOGG SWITCHBOARD & SUPPLY CO. has just closed a contract with the Keystone Telephone Co., Philadelphia, Pa., for a switchboard for its Fourth District Exchange of 7,200 lines ultimate capacity, and 3,420 lines present equipment. Included in this contract is all necessary power apparatus, distributing frames, sneak current and lightning arresters. This exchange will be complete in all its details, and embody the latest improvements.

BIG SOUTH AFRICAN TRACTION PROJECT.—The Anglo-African house of Wernher, Beit & Co., which financed the construction, withAmerican equipment, of the City of Mexico and the Lisbon, Portugal, electric traction systems, is reported to be largely interested in the project to build extensive trolley lines in the city of Johannesburg, South Africa. It is anticipated that the bulk of the material, equipment, etc., will be purchased in America.

A 6,000-HORSE-POWER POWER PLANT is to be erected by Nelson Morris & Company, the Chicago meat packers, for the purposes of furnishing light and power. Contracts are being let through Purchasing Agent Grassell. Babcock & Wilcox will furnish the boilers—12 batteries of 500-hp each. John A Mead & Company, of 11 Broadway, are to supply the coal and ash handling machinery, capable of handling 45 tons per hour.

WESTINGHOUSE GAS ENGINES. The Atlantic Refining Company has placed a contract with Westinghouse, Church, Kerr & Company for two 500-hp Westinghouse, horizontal, double-crank gas engines, for direct connection to 325-kw alternating-current generators, built by the General Electric Company. The equipment is to be utilized for general power purposes in the company's plant at Point Breeze, Philadelphia.

MR. G. M. GEST, the conduit contractor, has been awarded the contract for the additions to the subway system of the Edison Electric Illuminating Company, of Brooklyn.

General News.

THE TELEPHONE.

BIRMINGHAM, ALA.—The annual meeting of the stockholders of the People's Home Telephone Company has been held. A dividend of two per cent. on the capital stock of $200,000 was declared. The officers are H. H. Stambaugh, president; Henry B. Gray, vice-president; W. H. Hassinger, secretary and A. F. Adams, treasurer.

BEEBE, ARK.—The Beebe Telephone Exchange has changed owners, O. L. Dye selling out to M. Price. Beside the local exchange several interior lines belong to this property.

RIVERSIDE, CALIF.—The Home Telephone Company, which is installing a complete system in Los Angeles, has made application for a franchise to carry on business in Riverside, Calif.

DUNSMUIR, CALIF.—The Electrical Construction Company, of San Francisco, recently installed an inter-communicating telephone system in the Dunsmuir Hotel, Dunsmuir, Calif. It is a central energy system with a Manhattan board.

HAMILTON, CAN.—The formation of the Modern Telephone Company, of Hamilton, Limited, is announced. It has a share capital of $300,000. The provisional directors are: Oscar Wentworth Rogers, Fritz Leoffler, of New York; Staunton King, William Asahel Johnson, Henry Alexander Drummond, Whitford Vandusen, Samuel Clarke Biggs and Joseph Boardman Scovell, all of Toronto.

NEW CASTLE, IND.—The Mount Summit Telephone Company has been incorporated and the capital stock increased from $2,000 to $10,000. The incorporators are: Frank Shiveley, Matt Williams, R. R. Leath, Perry Jeffries and Thomas Rogers.

INDIANAPOLIS, IND.—The Indiana Telephone Company and the Mooreland Rural Telephone Company were incorporated during the week. The capital stock of the former is $560 and the directors are Charles L., N. M. and J. T. Graves. The capital stock of the latter is $10,000. The company will construct a system and operate in Henry, Wayne, Randolph and Delaware Counties, with headquarters at Mooreland.

ROCKFORD, ILL.—The Home Telephone Company announces that unless the unforeseen happens, it will be in working order by August 15.

DAVENPORT, IA.—The Union Electric Telephone and Telegraph Company of Davenport has let contracts to the People's Construction Company for a conduit system in that city.

SHENANDOAH, IA.—The Independent-Mutual Telephone Company has been duly organized, articles of incorporation filed and officers chosen. The board of directors consists of Jas. A. Swallow, president; Fred Fischer, vice-president; C. Brown, secretary; U. G. Reininger, treasurer.

DES MOINES, IA.—The Hawkeye Telephone Company, which has had its headquarters in Perry since its organization, and which has lines reaching over a wide stretch of territory northwest of Des Moines, will remove to Des Moines in about a month and that city will be the headquarters. George N. Bandy, who has recently become general manager of the Mutual here, is president of the company and organized it.

BEDFORD, KY.—The Cumberland Telephone Company is putting in an exchange here. Lines are being extended to all parts of Trimble County.

PERRY, LA.—The Hawkeye Telephone Company is putting in a line from Redfield to Earlham and all the farmers along the line are putting it into their houses.

KITTERY, ME.—The Microphone Transmitter Company has been formed for making and dealing in transmitters, receivers and telephone instruments of all kinds; capital, $500,000. President, Charles C. Smith; treasurer, C. M. Prince, Kittery, Me.

OAKLAND, MICH.—The Oakland and Alma Telephone Companies have completed arrangements for uniting their companies at Holly.

GRAND RAPIDS, MICH.—The annual meeting of the Citizens' Telephone Company has been held. A quarterly dividend of 2 per cent. was declared and the officers and directors were all re-elected as follows: President, Charles F. Rood; vice-president, Edward Fitzgerald; secretary, E. B. Fisher; treasurer, William J. Stuart; Philip Graham, Robert D. Graham, C. E. Perkins, L. J. Rindge, E. G. Studley and J. B. Ware, of Detroit. The report of the secretary showed that the company's system in this State on July 1 contained 10,496 telephones, against 6,963 a year ago; a gain of 51 per cent. Of the increased number 935 were placed in Grand Rapids. The gross income of the company was $108,110.98, out of which $76,854.60 was paid in dividends and $31,000 added to the surplus after paying the running expenses and cost of maintenance of the system. The earnings of the last quarter of the year were in round numbers $16,000 more than for the first quarter. The reports showed that exchanges were established during the year at Ionia, Belding, Diamondale, Sparta, Freeport, Grandville, Cascade Springs and Greenville, and are now being established at Empire, Kingsley and Tustin, while a franchise has been secured at Portland.

MARSHALL, MO.—The Saline County Telephone Company of Marshall has filed articles showing that it had made an increase in its capital stock from $35,000 to $50,000.

SHELTON, NEB.—The Farmers' Home Telephone Company of Shelton has completed its telephone line to Gibbon and is now operating with a list of ninety new subscribers. Since the completion of this line the Nebraska Telephone Company has reduced its rates between these two points from 25 cents to 15 cents for three minutes' talk, while the Farmers' Telephone Company is only 10 cents and time not limited. Arrangements are now being made to connect the new company's lines with the exchange of the Independent Telephone Company of Kearney by August 15. A new company is also formed to run a line from Cozad here, connecting with the Independent company of this city.

GOSHEN, N. Y.—The Warwick Valley Telephone Company has secured the right of way for a line to Amity and Pine Island, and will begin the erection of poles in a few weeks.

TROY, N. Y.—The United Traction Company is about to have put in private telephone service between all of its offices, power stations, storehouses and car barns. An agreement has been entered into with the Hudson River Telephone Company by which the United Traction Company will have direct and exclusive communication between all of its branches. The instruments to be used will be the property of the telephone company. The service will extend through Troy, Watervliet and Albany.

RISING SUN, OHIO.—The Central Union Telephone Company will install an exchange in this place.

CHARDON, OHIO.—The Chardon Telephone Company has increased its capital stock from $10,000 to $25,000.

COLUMBUS, OHIO.—The East Telephone Company of Jefferson County has been incorporated with $6,000 capital stock.

PAINESVILLE, OHIO.—The Painesville Telephone Company is considering buying a new switchboard and other apparatus.

GREEN CAMP, OHIO.—The Marion County Telephone Company has secured a franchise to build a local exchange at Green Camp.

PORTSMOUTH, OHIO.—A contract has been placed with J. A. Grimes of this city for a telephone system at the mines of the Big Fork Coal Company and along the B. & O. Ry.

FINDLAY, OHIO.—The Home Telephone Company has opened its service to Arcadia. A toll station is there. The country line service on the Port Clinton road has also been cut in.

CLEVELAND, OHIO.—It is announced one or two more of the properties of the Federal Telephone Company will be sold out and then the remaining companies will be reorganized under a new head.

COLUMBUS, OHIO.—The Chittenden Hotel Company has closed a contract with the Central Union Telephone Company to install a branch exchange in the hotel with long distance instruments in each of the 275 rooms.

NEWARK, OHIO.—W. H. Crumb & Company, of Chicago, have commenced the work of rebuilding the exchange of the Norwalk Telephone Company. The company's new exchange at Utica started operation August 1.

SPRINGFIELD, OHIO.—A permanent injunction has been secured restraining the Central Union Telephone Company from removing a certain telephone in this place. The company attempted to raise the rate and the subscriber brought suit on the grounds that he was being discriminated against.

AKRON, OHIO.—The Akron People's Telephone Company has declared its first dividend of one per cent., and it is expected that this dividend will be declared quarterly. The company has been meeting with great success and has over 32000 telephones in service, in Summit County. The exchange was placed in operation in June, 1900.

BUCYRUS, OHIO.—Stockholders of the Bucyrus Telephone Company held their annual meeting recently and elected the following: E. Blair, president; J. A. Chesney, vice-president; J. C. F. Hull, secretary-treasurer; A. G. Unger, manager. The company has completed a most prosperous year and 5,000 feet of cable has recently been strung. A line is being built to Sulphur Springs, where three pay stations will be installed.

CLEVELAND, OHIO.—J. B. Hoge, secretary of the United States Telephone Company, announces that the sale of 12,000 shares of the common stock and 2,000 shares of the preferred stock of the company is assured, thus giving the company funds to make needed improvements and extensions. It is claimed that an attempt was made by the Bell people to buy up this stock in a block, but it was all sold to interests friendly to the Everett-Moore syndicate.

NEW RICHMOND, OHIO.—The City and Suburban Telephone Association has just completed the erection of a new exchange at New Richmond, Clermont County. Arrangements are also completed for the opening of an exchange at Milford within a few weeks. Quite a number of long distance lines have been extended into Clermont County and places which for years were isolated as far as telephone connection was concerned, are now connected with the local and long distance lines. At Goshen an automatic switchboard of a dozen lines has been installed.

CLEVELAND, OHIO.—No action has thus far been taken by the Cleveland council in the matter of granting the application of the Cuyahoga Telephone Company for permission to increase rates. The company claims it is losing money on the present rates. It asks permission to increase business rates from $48 to $72 for unlimited service, $48 for two party lines. The present residence rate is $36 and the company desires to increase it to $48 for unlimited service, $36 for two party line and $24 for four party line. The council will investigate the books of the Cuyahoga Company and ascertain what it costs to operate.

READING, PA.—At the Philadelphia and Reading collieries the telephone system is about to be introduced to take the place of the telegraph. One hundred and fifty men are now employed stringing wires and making the necessary changes for the operation of the new system.

EAU CLARE, WIS.—The Ludington Telephone Company has been formed. Capital stock, $3,000. Incorporators: E. G. Ingraham, George M. Hudson, Wesly Baker and others.

KENOSHA, WIS.—The Chicago Telephone Construction Company, at Winthrop Harbor, south of this city, has passed into the hands of a receiver. The receivership was granted on the petition of the Equitable Trust Company of Chicago, and D. F. Foley, general manager of the plant, was appointed receiver. The assets are said to reach $200,000.

ASHLAND, WIS.—The new independent telephone company in Ashland wants long distance connections with the People's Company in Superior and arrangements will be made to accomplish that end this season if possible. C. V. Haymaker is the president of the news company in that city, which recently got a franchise and has already commenced setting poles.

ELECTRIC LIGHT AND POWER.

RANDSBURG, CALIF.—The Mammoth Coal Company has made plans to install a large generator to supply electricity for Randsburg, Calif.

INDIANAPOLIS, IND.—It is now almost certain that the city of Indianapolis will hold the new public lighting contract over until the legislature meets and amends the law so as to provide a ten years' contract. The present charter provides for a one-year contract and it is found that no company except the local company will bid on the contract for one year.

RICHMOND, IND.—The city council has accepted the $300,000 municipal electric light plant erected by the Varney Construction Company of Indianapolis. It will be managed by three commissioners appointed by the mayor. This enterprise has had a stormy time, suit after suit being filed to prevent consummation. The concern is now denominated the "White Elephant."

CRAWFORDSVILLE, IND.—The municipal electric light plant is being operated under a new management and all persons are required to pay monthly. In case of default the current is cut off and a fee of 50 cents charged to get it back. Heretofore, political favoritism played such a part as to allow many delinquents to continue indefinitely in the enjoyment of electric light without pay.

ST. LOUIS, MO.—The West St. Louis Water and Light Company has certified to a paid-in increase of capital stock from $80,000 to $1,000,000. The assets are stated at $80,000 and the liabilities at $1,500,000.

FILLMORE, N. Y.—The Wiscoy Falls, Fillmore, Allegany County, N. Y., are to be developed for the operation of a $25,000 plant for the manufacture of drugs and chemicals by the Signa Chemical Company. The falls, of 75 feet, are thought capable of developing 1,500 horse-power.

STATEN ISLAND, N. Y.—The Richmond Light Company, Borough of Richmond, has been formed; capital, $3,000,000. Directors: Arthur Corlies, Jonathan T. Lauman, Brooklyn; Benjamin R. Seaman, Elizabeth, N. J.; John B. Summerfield, Queens; Robert P. Barry, Jr., New York.

CELINA, OHIO.—The council has appointed a committee to secure estimates on a lighting plant. The probable cost is about $10,000.

COLUMBUS GROVE, OHIO.—The village has issued $15,000 worth of bonds to secure money to purchase the local lighting plant. Improvements will be made.

HUBBARD, OHIO.—The council has decided to call for proposals for the building and equipping of the municipal lighting plant to replace the one destroyed by fire some time ago.

ELYRIA, OHIO.—The Elyria Plumbing, Heating & Electric Company has been incorporated with $10,000 by Edward B. Gale. C. J. Wurst, E. H. Wurst, Nettie Reedy and E. H. Wurst, Jr.

MARION, OHIO.—The Marion Electric Light & Power Company is preparing to make extensive improvements to its power house and system. A new generating set of large size has been ordered.

CLEVELAND, OHIO.—J. A. Erner & Company, of this city, who have the contract for the electrical part of the new lighting plant for the State institution for the blind at Columbus, will install the engine, generator switchboards and a storage battery.

CINCINNATI, OHIO.—Citizens have brought suit against the Cincinnati Gas & Electric Company to test the right of the company to charge what is alleged to be an arbitrary price for electricity furnished consumers instead of calculating the amount by meter and charging at so much per thousand watts.

GOLD HILL, ORE.—An electric light and power plant will be installed near Gold Hill, Ore., for C. Ray, who operates the Braden and the Perry mines. The equipment will include a 200-kw, 3-phase generator to be driven by a water wheel operating under a head of 20 feet. The transmission line will be five miles in length with a two-mile branch. The buildings of the Braden and Perry mines will be lighted and power will be supplied for other mines in the district. The hydraulic development will be sufficient for 3,000-hp to permit of enlarging the electric plant. The dam will be 419 feet in length and 27 feet in height at its highest point.

SUSQUEHANNA, PA.—The Susquehanna County Electric Company has been incorporated; capital, $30,000.

GILMER, TEX.—The Gilmer Electric Light Company has been incorporated at Gilmer, Tex., with a capital stock of $5,000. J. E. Croley, T. C. Mitchel and C. H. Becurr.

SPOKANE, WASH.—The Yakima Water, Light & Power Company will enlarge its plant to double the present capacity. The old canal is to be made wider and deeper and the objectionable flume near the river removed. This is done to make the power plant more permanent.

MILWAUKEE, WIS.—Amendments have been made to the articles of incorporation of the Wisconsin Light, Heat and Power Company, increasing capital stock to $1,000,000.

THE ELECTRIC RAILWAY.

BISBEE, ARIZ.—A company has been incorporated with a capitalization of $50,000 to build a street car line from the smelters near Douglas to that city, a distance of a mile and a half. James Douglas, Jr., C. L. Beckwith, W. H. Brophy and S. F. Meguire are the largest stockholders in the enterprise.

MILAN, ILL.—The Western Illinois Electric Railway Company has been formed; capital, $15,000; incorporators: Franklin E. Caldwell, Robert E. Little and Elmer E. Reynolds.

MUNCIE, IND.—The Muncie, Hartford City & Ft. Wayne Traction Company has increased its capital from $100,000 to $1,000,000.

HUNTINGTON, IND.—The Ft. Wayne & Southwestern Traction Company, operating between Ft. Wayne & Wabash, has doubled the capacity of its power house in this city. It now has two 750-hp engines in service. The company is now contemplating the building of a line from Wabash to Marion by way of Warren.

MUNCIE, IND.—The Union City, Winchester & Muncie Traction Company has been incorporated with $10,000 capital stock to build a line from Union City to Muncie. Dr. J. E. Lowes is at the head of the company and the line will be the Indiana extension of the Dayton & Northern Traction Company, of which Dr. Lowes is president.

LEBANON, IND.—The legal fight between the Indianapolis, Lebanon & Frankfort electric railway company and the Indianapolis and Lafayette Rapid railway company for possession of the right of way from this city east alongside of the Big Four Railroad has resulted in a substantial victory for the Lebanon company. The grading of the latter company's line is completed to Whitestown and a five-acre lot secured for the power house in this city. The power house and the road will be completed this year.

WARSAW, IND.—A franchise for an electric line has been granted by the Warsaw council to the Winona, Warsaw, Elkhart and South Bend Traction Company. The line will connect these places and form a link in the system of the Fort Wayne, Dayton and Cincinnati line, now being built, which eventually will connect with electric lines now running into Chicago from Indiana. The line is for passenger and freight traffic and is to be in operation within eighteen months. George A. Yuille, for several years general manager of the West Chicago Street Railway, will have charge of the construction and equipment of the line.

SIOUX CITY, IA.—It is said the Sioux City Traction Company owning the property of six former companies, has been bought by Swift & Co., the new controlling owners of the Sioux City stockyards, through Col. I. C. Elston, president of the stockyards. Negotiations are also being made, it is said, for the purchase of the Sioux City Gas and Electric Company, owning the monopoly in gas and electric business. The purchase of the two concerns means a $2,000,000 deal. The traction company owns forty-nine miles of street railroad. The capital stock of the company is $1,200,000. The sum of $80,000 has been paid to bind the deal for the purchase of the traction company.

MALDEN, MASS.—A new street railway company has been organized in Malden, to be known as the Maplewood & Danvers Street Railway Company. It proposes to build a line from Eastern Avenue and Broadway, Malden, over the old "Newburyport turnpike," through Saugus, Lynnfield, Danvers and Middleton to Boxford. The capital stock is $190,000 and the directors are: George H. Chase and George F. Marshall, of Malden; Isaac C. Day and Solomon W. Howe, of Boxford; Herbert B. Newton and Edmund B. Fuller, of Haverhill; and William A. Butler, of Georgetown.

OWOSSO, MICH.—Robert Cherry, representing Stephenson Brothers, of Philadelphia, announces that arrangements have been made for financing the Owosso-Durand road and it is probable that construction work will start at once.

KALAMAZOO, MICH.—The Railway Companies General, of Philadelphia, who own the city lines at Kalamazoo and Battle Creek, have decided to make improvements and extensions. Thirty new cars will be purchased for Kalamazoo and twenty for Battle Creek.

MINNEAPOLIS, MINN.—Electric railway construction toward the head of the Lakes is regarded as a certainty at Taylor's Falls. Surveys for the first link, between the Twin Cities at that place are now being made. The survey is for the purpose of locating an electric railway to Taylors Falls and probably to the head of the Lakes. It is well known the route via Taylors Falls and up the St. Croix River is the best between the Twin Cities and Lake Superior.

KANSAS CITY, MO.—The Kansas City Outer Belt and Electric Railroad Company of Kansas City, with a capital stock of $1,500,000, has been chartered. This will give the Stilwell interests of Kansas City a connecting railroad. The road is to extend around Kansas City and in Kansas City, Jackson and Clay Counties, and is to be eight miles long. The stockholders and promoters are A. E. Stilwell, E. E. Holmes, Ben Schnierle and Bennett N. Simpson.

CONCORD, N. H.—The Railroad Commissioners have granted the incorporators of the Newport and Sunapee Electric Railroad the right to issue $60,000 of stock and the same amount of bonds to meet the cost of construction, and the contracts for the work of building and equipping the line will be let immediately. The road will be seven miles long, one of its termini being Lake Sunapee.

ATLANTIC CITY, N. J.—The Atlantic City and Surburban Traction Company has been formed. Principal office, Atlantic City, N. J.; object, transportation; capital, $500,000. Incorporators: Edward R. Spensler, Harrisburg, Pa.; C. Taylor Leland, Philadelphia, Pa.; and Albert M. Jordan, Atlantic City, N. J.

OSSINING, N. Y.—The board of highway commissioners has granted a franchise to the Westchester Traction Company, which bought the local trolley line, to run its road to the town line of the town of Ossining, in the W. W. Law farms, on condition that it will be completed in six months. This is on the proposed extension to Pleasantville. The grant covers about two miles and is mostly along a private right of way. The rest of the way to Pleasantville is through the town of Mount Pleasant.

ROCHESTER, N. Y.—Two suburban trolley lines, the Rochester & Sodus Bay and the Rochester & Irondequoit Park, have been consolidated for business reasons. A year ago the Sodus line took a lease for 999 years of the old Glen Haven Road and these two lines have been merged under the title of the Rochester & Sodus Bay Railroad, with a capital stock of $1,850,000. The directors are: T. J. Nicholl, G. G. Morehouse, Rochester; C. A. Burbank, Joseph E. Buckley, New York; D. W. Gibbs, Montclair, N. J.; John L. Lockwood, Roseland, N. J., Arthur C. Vaughan, Garden City, N. J.

ALBANY, N. Y.—The Vermont and Whitehall Railway Company, with principal office in New York City, has been incorporated with a capital of $500,000 to operate an electric street railroad, nine miles long, from the Delaware & Hudson depot in Whitehall, to the Vermont State line, to intersect the proposed route of the Rutland Street Railway. The line lies in Washington County. The directors are: Daniel A. Slattery, J. Osgood Nichols, K. C. Morhous, Paul M. Mowrey, Leroy W. Baldwin, Harry M. Gough, Clinton E. Breaine, Donald K. Brown, and Ezra A. Tuttle, of New York City.

YOUNGSTOWN, OHIO.—The Youngstown & Sharon Railway Company will shortly install a telephone system over its entire road.

CINCINNATI, OHIO.—The Cincinnati, Georgetown & Portsmouth Railroad, formerly a steam road, is now being changed to electric power.

TOLEDO, OHIO.—The Toledo, Bowling Green & Southern Traction Company is erecting a temporary power station at Cygnet. A 300-hp unit is being installed.

CANTON, OHIO.—The Canton-Akron Railway Company has closed a deal for extensive frontage on Springfield Lake near Akron and it is the intention to erect a hotel and pavilion.

MIDDLEFIELD, OHIO.—At a meeting of citizens of Vernon, Orangeville and Kinsman final steps were taken to insure the construction of an electric line from Middlefield, Ohio, to Sharon, Pa.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company, which is preparing to extend its line from Garrettsville to Leavittsburg, will erect a new storage battery station between the two towns.

YOUNGSTOWN, OHIO.—The county commissioners have granted a 50-year franchise to the Mahoning Valley, Southwestern Railway Company for its proposed line to Struthers. The line is to be built at once.

CINCINNATI, OHIO.—Bids have been received and contracts will be awarded in the near future for the erection of the new interurban terminal station on Sycamore Street. The estimated cost is $75,000.

CLEVELAND, OHIO.—Holcomb & Lattimer, promoters of the Cleveland, Painesville & Ashtabula Railway, have accepted the franchise granted in Geneva. The road is to be completed and in operation by July 1, 1903.

AKRON, OHIO.—The Northern Ohio Traction Company will apply to the city council for a renewal of the city lighting contract. The company has made numerous improvements to its plant to take care of the growth of the city.

NEWARK, OHIO.—The Newark & Granville Railway, which was recently consolidated with the Columbus, Buckeye Lake & Newark Traction Company, is being thoroughly rebuilt. New rails are being laid and new cars will be installed.

YOUNGSTOWN, OHIO.—The council has passed an ordinance granting a franchise to the Mahoning Valley Railway Company to build a line the entire length of Mahoning Avenue. The ordinance was bitterly contested by residents along the route.

FOSTORIA, OHIO.—An oil well drilled on the right of way of the Toledo, Fostoria & Findlay Railway is flowing 100 barrels a day. Other wells will be drilled. There is just room for the cars to pass without grazing the edge of the derrick.

CLEVELAND, OHIO.—Universal transfers, seven tickets for a quarter; nine hours and good wages for employees, are the terms which the United Trades and Labor Council will ask the city council to consider in exchange for a general extension of all street railway franchises.

DAYTON, OHIO.—Officials of the Appleyard syndicate have decided to give Springfield the go-by and erect the new cars, barns and repair shop for the Dayton, Springfield & Urbana Railway at Dayton. The structure will cost about $50,000. R. G. Gotwald, of Springfield, is preparing plans.

WESTON, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Railway Company has commenced work at Weston on a section of 21 miles running south of town, along which entire right of way has been secured. As soon as track is laid, the road will be operated temporarily by steam motor cars.

CINCINNATI, OHIO.—H. H. Kirkpatrick, of Jonesboro, Tenn., is to buy material for a line to be built between Jonesboro and Johnson City. The project has been financed by a syndicate headed by Wilfred Jessup, of Richmond, Ind. A large national soldiers' home is to be built between the towns mentioned.

BUCYRUS, OHIO.—The Ohio Central Traction Company proposes to use nothing but old cars on the Bucyrus end of the line because the town will not permit the company to put in a loop so that cars can be turned. The company has just received several new interurban cars from the St. Louis Car Company.

MANSFIELD, OHIO.—The Citizens' Electric Railway, Light & Power Company, which owns the city line and the Shelby-Mansfield Railway, has placed an order with the Phœnix Electric Company, of Mansfield, for a new 300-kw generator. Other improvements are to be made at the power station of the company.

CONNEAUT, OHIO.—The Conneaut & Southern Railway has obtained a franchise to build into the center of the village. C. [illegible], the promoter, claims that the work will start by September, [illegible]. The right of way from Conneaut to Youngstown has been obtained. The power house will be located at Andover.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Railway has commenced work on its line north of Delaware. It has been decided to build by way of Prospect and it is quite probable that a spur line will be built to take in Richwood and Magnetic Springs. Rails are being received for the northern extension.

CLEVELAND, OHIO.—The Muncie, Hartford & Ft. Wayne Traction Company, which is owned largely by Cleveland people, has increased its capital stock from $[illegible] to $[illegible]. The road is now being built between Muncie and Hartford and will be extended to Ft. Wayne as soon as the first section is completed.

YOUNGSTOWN, OHIO.—Park & Hamilton, contractors, have commenced the work of building the extension of the Pennsylvania & Mahoning Valley line along the south bank of the Mahoning River to Struthers, the ultimate intention being to extend to Poland. The company already operates to Struthers on the north side of the river.

CONNEAUT, OHIO.—The promoters of the Conneaut & Eastern Railway announce that on account of the inability to secure rails, nothing can be done on the line this fall except to build the power house. Sixteen miles of rails have been secured to complete the line between Erie and Girard and the balance will be built next year.

YOUNGSTOWN, OHIO.—Contracts have been awarded to E. M. Scofield Company of New York for the erection at Hasleton of large car barns and power house for the new extension of the Pennsylvania & Mahoning Valley Railway. The car barn will be a steel structure and it will cost about $40,000. Work will commence at an early date.

CLEVELAND, OHIO.—The Everett-Moore syndicate is planning to double track the Lake Shore Electric Railway between Cleveland and Lorain. The business of this section of the road is developing rapidly and at times it is necessary to operate fifteen-minute service. When the freight business opens up the line will be more crowded than ever.

TOLEDO, OHIO.—Work is to be started at once on the extension of the Toledo & Monroe Railway from Monroe to Detroit over right of way secured when the road was originally laid out. A supply of rails has been secured for immediate delivery. The line will be independent of the Detroit & Toledo Shore Line, the fate of which is still undecided.

OBERLIN, OHIO.—Unknown parties are securing a right of way between Oberlin and Lorain. It is believed that the Everett-Moore syndicate is back of the project with a view of building a branch line. It is claimed that passengers could go to Cleveland considerably faster over this route than by way of the Cleveland, Elyria & Western.

FREMONT, OHIO.—A. H. Jackson and B. R. Dudrow, promoters of the proposed Fremont-Sandusky Railway, are meeting with unexpected success in securing right of way, practically no one opposing the project. The power house will be located on Sandusky Bay and a pleasure resort will be located adjoining. Franchises in the two cities will shortly be asked for.

COLUMBUS, OHIO.—The Central Market Street Railway Company has increased its capital stock from $500,000 to $1,500,000. Three-fourths of the amount of increase is in preferred stock. S. B. Hartman is president and F. W. Merrick, secretary of the company, which was formed to operate the city portion of the interurban lines owned by the Appleyard syndicate.

MANSFIELD, OHIO.—The Mansfield, Wooster & Canton Traction Company has been incorporated with $10,000 capital stock to build a line from Mansfield to Canton by way of Wooster, a distance of about 60 miles. George H. Billman, J. H. Sigler, J. M. Downey, M. S. Abel, George H. Taylor and M. S. Abel, of Cleveland, are the promotors. James Ritchie formerly city engineer, of Cleveland, is making the surveys.

CLEVELAND, OHIO.—The new road which is projected to extend from the Middlefield terminus of the Eastern Ohio Traction Company's road to Sharon, Pa., will be known as the Cleveland & Sharon Railway, temporary organization having been effected. Much of the right of way has been secured and citizens of the various towns along the route have agreed to subscribe to the bonds of the company. The promoters are Cleveland and New York people.

CLEVELAND, OHIO.—The Everett-Moore holdings in the Scioto Valley Traction Company, amounting to 60 per cent. of the capital stock, have been sold to Cyrus Huling and other Columbus parties who have been interested in the project. The road is being built from Columbus to Circleville and from Columbus to Lancaster. Construction will now be pushed as rapidly as possible. The only change in the organization will be the retirement of Barney Mahler as president and Messrs. Everett and Moore as directors.

CINCINNATI, OHIO.—The Cincinnati & Northwestern Traction Company has been incorporated with $15,000 capital stock by Judge Dennis Dwyer, Albert Emanuel, C. F. McCrea, C. L. McCrea and E. M. Hopkins. It is proposed to build a line from Cincinnati to Dayton, and a deal has been closed whereby the company secured a private turnpike leading out of Cincinnati 15 miles to Bond Hill, Reading and Sharon. The promoters decline to state who are backing them; but they claim the Appleyard syndicate, which is seeking entrance to Cincinnati, is not interested.

CINCINNATI, OHIO.—Officials of the Cincinnati, Milford & Goshen Traction Company announce that construction work on the line will start August 15. The road will be built along the turnpike and will be double track as far as Milford; it will be [illegible] miles long. Those interested are E. H. [illegible], W. C. Compton, W. A. Goodman, Eugene Barney and J. L. Zimmerman. Mr. Barney is a member of the Barney & Smith Car Company, Dayton, and Compton owns the turnpike over which the line will be built. It is stated that a company headed by Senator Roudebush is securing private right of way for a line over a similar route.

TORONTO, ONT.—Thomas L. Childs, of Akron, who has promoted several roads in Ohio, represents Cleveland capitalists who propose to build a line from Toronto to Hamilton, a distance of [illegible] miles. A charter has been granted for a line between these two cities and the impression is that the Cleveland people will attempt to construct their line under it. The route is considered one of the most desirable in Canada.

LATROBE, PA.—It is said that the Latrobe electric road will be extended to Derry as that town is enjoying a boom. The road, it is also said, may cross the Loyalhanna at Youngstown, pass through Baggaley and Whitney and come into West Latrobe by way of Dorothy and St. Vincent.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company has closed a contract with the Chattanooga Light and Power Company to furnish a large amount of additional power, which has been rendered necessary by the increase in the number of lines of the Electric Railway Company.

THE AUTOMOBILE.

INDIANA AUTOMOBILE LINE.—Rhodes Bros. have organized a company to establish an automobile line between New Albany and Vincennes. The new autos will carry 16 persons each and will displace the old time "Deadwood" stage coaches that have been carrying passengers between these points for many years.

NEW YORK-BOSTON RUN.—The committee of the Automobile Club of America in charge of the proposed 500-mile reliability run, from this city to Boston, has fixed on Thursday, Oct. 9, for the start of the trip. The route will be via Norwalk, Bridgeport, New Haven, Hartford, Springfield, and Worcester, arriving in Boston on the afternoon of Saturday, Oct. 11. Sunday will be spent in Boston, the start on the return trip being made on Monday morning, Oct. 13, over the same route, arriving in New York on Wednesday afternoon, Oct. 15. Each vehicle will carry an official observer, who will be provided by the club, and the run will be open to all classes of self-propelled vehicles made either in the United States or abroad.

NEW INDUSTRIAL COMPANIES.

THE SIMPLEX ELECTRIC HEATING COMPANY has been formed. George U. Crocker, president; C. A. Morss, Jr., treasurer; capital, $80,000.

THE HUGHES TELEPHONE MANUFACTURING COMPANY, of Baltimore, has been incorporated to manufacture telephone supplies, etc.; capital, $100,000.

AMERICAN FIRE EXTINGUISHER COMPANY has been formed under the laws of New York by L. A. Richter, J. C. Blanche, and E. R. Huckel, with a capital stock of $100,000.

THE HARRISON WILLIAMS COMPANY, Toledo, Ohio, has been incorporated under the laws of Delaware with $200,000 capital stock to manufacture railway and electric railway supplies.

DIAPHRAGM STORAGE BATTERY COMPANY has been formed under the laws of New York with a capital stock of $10,000. The directors are J. H. Robertson, E. Edwards and G. Wexler, of Brooklyn.

BLANCHE FIRE ALARM COMPANY, of New York City, has been founded under the laws of Delaware to make and sell thermostats under the patents of Joseph C. Blanche, with a capital of $50,000.

H. W. McCANDLESS & COMPANY, to be interested in electrical lamps, has been formed under the laws of New York with a capital stock of $10,000. Directors: H. W. McCandless and J. E. McCandless, of Orion, Ill.

THE AUTOMOBILE RENTING COMPANY, of St. Louis, has been incorporated with a capital stock of $2,000, all paid. The incorporators are Harry S. Turner, Jr., Max R. Orthwein, Ralph H. Orthwein and others.

THE WARREN LIGHT AND MANUFACTURING COMPANY, of Minneapolis, Minn., has been formed; capital, $10,000; incorporators: Benjamin Warren, Jr., and L. H. Murray, of Peoria, Ill, and J. B. Christian, of Minneapolis.

THE ELECTRIC SIGNAL COMPANY, which has been incorporated in Arizona with a capital stock of $30,000,000 by P. A. McClain, H. H. Hallowell and J. C. Foering, of Philadelphia, proposes to do a general electrical business, making a specialty of electric signals for railroads.

THE GENERAL ELECTRICAL INSPECTION COMPANY to prevent electrical fires is being formed with these officers: President, Charles H. Simmons; vice-president, T. P. Gilvan; general manager, F. M. MacDonald; secretary, H. Hardy; treasurer, George M. Hard; electrical engineer, Charles E. Knox.

THE MISSISSIPPI VALLEY AUTOMOBILE COMPANY, manufacturers, filed articles of incorporation last week. The paid-in capital stock of $48,000 consists of 480 shares, valued at $100 each. Harry S. Turner, Jr., holds 240 shares, Max R. Orthwein 162, Ralph H. Orthwein 48, H. M. Coudrey 10, Geo. A. Myer 10, and Henry Koehler, Jr., 10.

LEGAL.

LANCASTER, OHIO.—Edmund Dickey, a director of the Consumers' Carbon Company, has brought suit to restrain Charles Britton *et al.* from issuing $60,000 of treasury stock.

HAVANA LIGHTING.—The Spanish-American Light and Power Company has appealed to the Supreme Court at Havana, Cuba, asking that body to declare null the resolution of the Council of Secretaries to the effect that the Secretary of Public Works is the proper one to decide in the matter of a concession to Señor Castaneda for the construction of an electric plant. The President of the Supreme Court has decided that, though the Constitution of Cuba gives the Supreme Court power to decide questions of constitutionality, it also speaks of a law regulating the organization of and powers of courts and the method of their exercising their functions, which law has not yet been made; and that, therefore, it cannot enter into a matter such as the one brought before it until the law shall have been made.

PERSONAL.

MR. HORACE PORTER, for some time assistant superintendent of the Cincinnati Traction Company, has become superintendent of the street railway at Paducah, Ky.

MR. M. A. OBERLANDER, purchasing agent of the Western Electric Company, New York City, is taking a long needed rest by the enjoyment of a few weeks' vacation at the Thousand Islands.

MR. O. E. OLESON, for six years chief engineer of the power plant of the Toledo Railways & Light Company, has resigned to accept a similar position with the Rapid Transit Company, of Minneapolis.

MR. EDWARD SPELLMAN, of Cleveland, has been appointed superintendent of the Ohio Central Traction Company's lines, which are the property of the Pomeroy-Mandelbaum syndicate of Cleveland.

MR. H. B. CAMP, vice-president of the Cleveland, Richfield & Akron Traction Company, has resigned his position because he claims it is not possible to secure a franchise from the council of Akron without the liberal use of money, to which he declines to be a party.

MR. T. GRAHAM LITTLEBOY, M. I. E. E., of Brymbo, England, who has been for several weeks at Sydney, Cape Breton, installing an important plant of special electrical apparatus, has visited New York the present week, and will look up electrical matters while in the United States.

MR. J. C. BENNETT, auditor of the Westinghouse Electric & Manufacturing Company of East Pittsburg, sailed for England recently on business connected with the British Westinghouse and Electric Manufacturing Company. Mr. Bennett was given a dinner by his office force as a "send-off."

MR. C. J. GLIDDEN and his wife are now traveling through Europe in their latest automobile, the termini of the trip being London and Venice. The round trip, never going twice over the same ground, will cover 3,820 miles. Mr. Glidden is as enthusiastic an automobilist as he once was a telephonist.

MR. F. W. WEISS, formerly of the firm of Jalden, Walker & Weiss, New York City, has, since its dissolution, established himself in offices at 123 Broadway, where he will continue the practice of corporation, commercial and legal accounting in all its branches. Mr. Weiss is very well known in the electrical and street railway field.

MR. H. E. CHACE.—The appointment has been made of Horace E. Chace to the position of assistant superintendent of telegraph for the Atchison, Topeka and Santa Fe Railroad systems to succeed Mr. Andrew Smith, deceased. He will be in charge of the telegraph system of the railroad on all lines west of Albuquerque.

MR. HUGH J. McGOWAN, president of the Indianapolis Street Railway Company, has subscribed $10,000 to the fund now being raised to secure a national technical institute in that city. Mr. McGowan says that if young men receive the necessary training to fit them for a place in the commercial and mechanical world the social problem will be solved.

MR. C. O. BAKER, JR., has been appointed, with his brother, residuary legatee of his uncle, Mr. C. O. Baker, the banker, of Newark, who died recently leaving a very large estate. A Baker memorial fund is created, and there are some 38 specific personal and charitable bequests ranging from $1,000 to $60,000. It is understood that the remainder of the estate will reach a considerable figure.

Trade Notes.

CINCINNATI, OHIO.—The Ritter Electric Company of Cincinnati has increased its capital stock from $15,000 to $50,000. John C. Mulvihill is president and C. A. Hofling, secretary of the company.

BULLOCK ELECTRIC MANUFACTURING COMPANY'S ornamental calendar card for August bears an excellent portrait of Werner von Siemens, and on the back is a succinct sketch of his career.

TECHNICAL ADVERTISING.—Mr. Ray D. Lillibridge, who prepares and handles the advertising for a number of well-known concerns, has just issued a neat and pithy circular devoted to his business and announcing his change of address to 170 Broadway, New York City.

WARREN, OHIO.—The Colonial Electric Company has completed its annual inventory and the factory has been put into shape to take care of increased business. The fan department has been unable to keep up with its orders and the advance orders for incandescent lamps indicate another very busy season in that line.

THE CHAPMAN LIGHTNING ARRESTER for telephone and telegraph lines is a new efficient and thoroughly reliable type of arrester for the protection of instruments, poles and other property. The Electric Appliance Company, Chicago, are sending out circulars illustrating and describing it, and which they will gladly mail upon application.

LATHBURY & SPACKMAN, of Philadelphia, inform us with regard to our recent article on the Alsen American Cement Works on the Hudson, that they were the engineers of this interesting plant. We are glad to note this fact and to give them the credit due for a notable power installation, which was made under their plans, specifications and supervision.

BUFFALO FORGE COMPANY, of Buffalo, N. Y., have just issued a new edition of the catalogue on their improved ventilators. The previous catalogue is exhausted and the new one is likely to be in as large demand. The data is presented interestingly and clearly, and the apparatus has qualities of great merit.

THE AUTOMOBILE & CYCLE PARTS COMPANY, of Cleveland, Ohio, will, after Aug. 1, transact business under the name of the Federal Manufacturing Company. The change in title will not in any way affect the management of the company or the business of its factories. The products of the company's factories are so diversified that a more comprehensive name became necessary; hence the change.

THE CHICAGO FUSE WIRE & MFG. COMPANY state that since offering their souvenir paper weight a few months ago, this little article has come to be in great demand and they have sent out already a great number of them on requests from their customers; also that they have had a large number of requests from others on their proposal to send this article for 10 cents to cover postage and packing. This company reports a steadily increasing demand for their popular line of fuse wire and links and telephone supplies.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 28, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

705,549. SIGNAL DEVICE; H. S. Balliet, Bethlehem, Pa. App. filed April 10, 1902. An electric fan is put inside of a signal box and kept running, to prevent the deposit of moisture or dust upon the instruments.

705,558. ELECTRIC CLOCK; J. Butcher, New York, N. Y. App. filed Oct. 16, 1901. Details of the circuit closing apparatus.

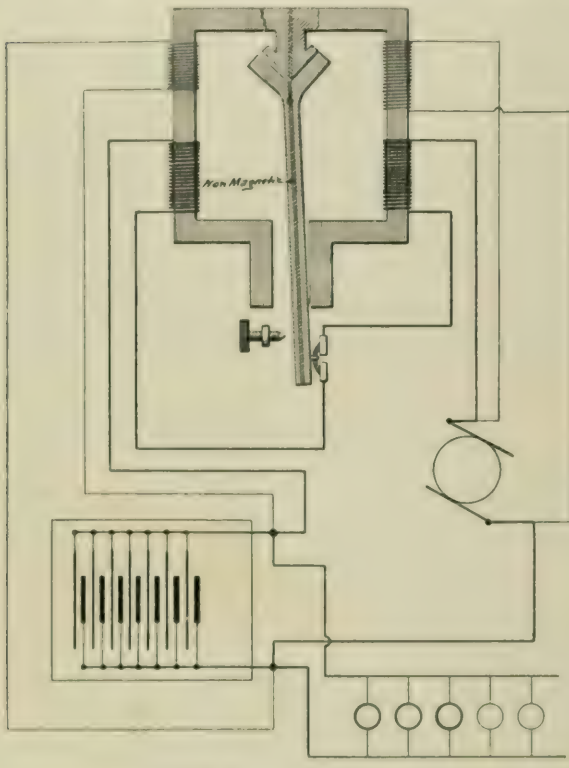
705,561. RHEOSTAT; William H. Chapman, Portland, Me. App. filed Dec. 14, 1901. The segments are very thin plates set on edge and insulated so as to occupy the smallest possible linear space, for the travel of the contact.

705,583. ELECTRIC SIGNAL; A. J. Haycox, Mansfield, Ohio. App. filed April 10, 1902. A signal lamp, one terminal of which is connected with the trolley wire, while the other leads through a hand switch to the return.

705,584. SIGNAL MECHANISM; Reinhold Herman, Crofton, Pa. App. filed Oct. 25, 1901. Details.

705,597. ELECTRIC SIGN; Thomas E. Murray, New York, N. Y. App. filed Feb. 11, 1902. Each socket is formed with a flange which is secured by screws to the front plate of the sign.

705,616. GALVANIC BATTERY; Charles B. Schoenmehl, Waterbury, Conn. App. filed Dec. 1, 1900. The elements are held fixably in position in the cell by rigid arms attached to the cover and by making the zinc in the form



705,786.—Automatic Switch.

of a cylinder and forcing it towards the side walls of the cell by means of a spring ring, the depolarizer being in the space between the cylinder and the cell walls.

705,630. SEPARATOR FOR ELECTRIC ACCUMULATION PLATES; Richard Alexander Katz, Berlin, Germany. App. filed Oct. 18, 1901. A double grid in which the bars of one cross the spaces of the other.

705,631. REDUCTION OF METALS FROM THEIR ORES, ETC., IN ELECTRICALLY HEATED FURNACES; R. C. Contardo, Sevres, France. App. filed Dec. 1, 1897. (See page 218.)

705,662. ELECTRIC SIGNAL FOR RAILWAY CABS; Joseph W. Frost, Washington, D. C. App. filed Jan. 25, 1902. The signal instruments are in a local circuit on the cab, which is controlled by a relay in a circuit shunting the car motor.

705,668. ELECTRIC HEATER; William S. Hadaway, Jr., New York, N. Y. App. filed Sept. 24, 1898. A plate having an upwardly turned flange all around; a heater suitably insulated on the bottom of the plate, and a cover plate deposited upon the insulation and held by the overturned flange.

705,685. TELEPHONY; J. Lyons, Charmian, Pa. App. filed Sept. 2, 1899. (See page 219.)

705,686. TELEPHONY; J. Lyons, Washington, D. C. App. filed April 23, 1902. (See page 219.)

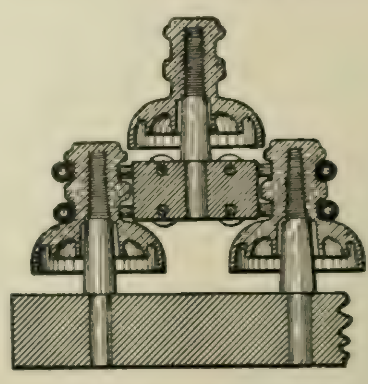
705,727. METHOD OF TREATING METALLIC OXIDS IN THE PRODUCTION OF METALS AND ALLOYS; F. C. Weber, Chicago, Ill. App. filed April 15, 1901. (See page 218.)

705,773. DEVICE FOR LIGHTING LAMPS BY ELECTRICITY; S. M. Meyer, Brooklyn, N. Y. App. filed Jan. 3, 1898. Details.

705,786. AUTOMATIC SWITCH; Herman A. Poppenhusen, Evanston, Ill. App. filed Oct. 31, 1901. In a system wherein a storage battery is charged from a dynamo the automatic switch carries two coils, one in a shunt to the battery, and the other in a shunt across the dynamo. When the voltage of the battery exceeds that of the dynamo the main circuit is opened.

705,798. TROLLEY; William L. Von Hardenburg, Brooklyn, N. Y. App. filed June 22, 1901. A specific construction of that type of trolley wheel in which a spiral groove leads from the hub to the tread of the wheel so that the displaced trolley wire will be returned to its proper position.

705,802. CABLE TERMINAL BOX FOR ELECTRICITY SUPPLY PURPOSES; George Wilkinson, Harrowgate, England. App. filed April 21, 1902. The ends of the cable and the ends of the service conductors are in the form of discs strung upon a core suitably insulated from each other where necessary and held in proper contact by spring pressure.



705,811.—Insulating Support for Metallic Circuits.

705,805. ELECTRIC ANNUNCIATOR; William R. Winter, Trenton, N. J. App. filed Nov. 15, 1901. A non-interfering signal box.

705,811. INSULATING SUPPORT FOR METALLIC CIRCUITS; John Scott Allen, Los Angeles, Cal. App. filed Nov. 30, 1902. Two knob-insulators set upon the cross arm support between them a block upon which a third insulator is mounted, the latter carrying the wire.

705,825. TROLLEY HEAD AND WHEEL; Walter A. E. Davis, Toledo, Ohio. App. filed Dec. 18, 1901. Details.

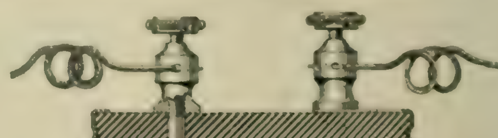
705,848. ELECTRIC RAILWAY; Charles J. Kintner, New York, N. Y. App. filed Feb. 28, 1902. A switch journaled with its axis of rotation parallel with the track rails and provided with means for adapting it to be rotated gradually and continuously about its axis as a car passes over it.

705,850. ELECTRICAL PANEL BOARD; Hubert Krantz, Brooklyn, N. Y App. filed March 12, 1902. A protecting cover over the board is provided with openings through which the handles of the several switches project.

705,854. GENERATING APPARATUS FOR CAR LIGHTING; Albert F. Madden, Newark, N. J. App. filed Feb. 24, 1902. The dynamo is flexibly mounted and carries a friction pulley; another friction pulley on the axle is connected with the first mentioned by a third friction pulley mounted on the end of a movable link.

705,882. TROLLEY; Thomas W. Sutton, Pittsburg, Pa. App. filed May 7, 1902. Details of a device for preventing a wheel from leaving the wire.

705,919. ELECTRIC BATTERY; Edwin R. Gill, New York, N. Y. App. filed Nov. 15, 1901. The upper end of the zinc cylinder of a dry cell is screw



705,919.—Electric Battery.

threaded to receive a cap which carries the binding posts and makes ready contact with the poles of the battery when it is applied thereto.

705,935. MAGNETIC CORE FOR INDUCTANCE COILS; J. C. Lee, Brookline, and E. H. Colpitts, Boston, Mass. App. filed Nov. 30, 1901. (See Current News and Notes.)

705,936. LOADED ELECTRIC CIRCUIT; J. C. Lee, Brookline, and E. H. Colpitts, Boston, Mass. App. filed Nov. 30, 1901. (See Current News and Notes.)

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NEW YORK, SATURDAY, AUGUST 16, 1902.

CONTENTS.

THE METRIC SYSTEM.

One of the most interesting and important steps taken by the Colonial Conference that has just been sitting in London is the adoption of a resolution in favor of the metric system for all the British colonies. Perhaps too much weight may be attached to this expression of opinion, but the colonial statesmen met strictly for business, and would certainly not approve of such a change or policy unless they knew that it was in harmony with the sentiments of their people, whether in Canada, at the Cape, or away off in Australia and New Zealand. We are inclined ourselves to derive encouragement from this formal utterance, and to believe that in a short time necessary steps will be taken to give it force, wherever the state of the law so requires. The progressiveness of the British colonies is a familiar social phenomenon, and their approval of the metric system will do much to assist in moulding opinion and action in the United Kingdom, as it has already done in other matters. The benefit to international intercourse cannot be overestimated, and we may be sure that the colonial officials did not go on record without adducing weighty arguments of that nature in support of their resolution. We are not aware what process exists for giving force and validity to these verdicts and decisions reached by the statesmen of Greater Britain, but it is safe to infer that practical leaders of colonial politics do not meet merely to pass resolutions. Their function is indeed growing rapidly into one of vast significance and utility, and it was never exerted to more beneficial unifying effect than in helping to create throughout the wide dominion of King Edward a simple, universal system of weights and measures.

IMPORTANCE OF ELECTRICAL DEVELOPMENT.

In our comment last week upon the wholesale adoption of electricity in New York City, to meet every one of the new transportation problems, we remarked that this evidence of the importance of modern electrical development was encouragement to all engaged in the field, being but symptomatic of corresponding work and plans in other cities and in other parts of the world. As we have noted in another discussion of trolley work, the electrical engineer and manager finds himself by sheer growth and evolution of his work launched on enterprises and responsibilities the magnitude of which he is prevented from realizing by the mere activity itself that is thus forced upon him. It was but the other day that they were building cable lines in New York; it was but the other day that electrical tests on the elevated road were abandoned as unpromising; and yet all of a sudden the electrical engineer is aroused to the fact that all old and present work is swept away to make room for him and his methods.

The distance that has thus been traveled in some ten years was admirably and strikingly brought out a few weeks ago by Mr. George H. Gibson before the American Association for the Advancement of Science, and brief note was made in these columns at the time of his paper, which, devoted to the economic influences of the electrical industries of Pittsburg, made a splendid generalization of electrical development as a whole as a measure of civilization. Recurring to his impressive figures, it may be noted that the total electrical power in kilowatts per 1,000,000 people in the whole world, outside of the United States, is 640; in Great Britain, the highest outside of the United States, 7,000; while in the United States it is 26,320. The total capital invested in electrical under-

takings in the world outside of the United States is 45 cents per capita; in Great Britain, the highest outside of the United States, it is $4.25, and in the United States $38.18. The miles of electrically operated railway are, in the whole world, outside of the United States, 4.64 per million people; in Germany, the next highest of foreign countries, 41.8 miles, and in the United States, 276.2 miles. Even more striking is the fact that the new plant of the Manhattan Elevated Railway, of New York City, will have a total power, available for traction, of 40,000 kilowatts, equal to the total electric power available for traction purposes in France. Further, if we take New York City as a unit, the total power now available, or shortly to be available, will approximate that at present found in the Empire of Germany. The five mammoth power houses on Manhattan Island have a total normal rating of some 322,500 hp, and a maximum rating of 478,000 hp. This is enough power to lift the whole population at the rate of 80 feet per minute, or much faster than an athletic man can for any length of time run upstairs. In other words, the work of these five central power plants is more than could be done by all the people on the Island working continuously. In the United States is developed 69 per cent. of all electricity available in the world, 76 per cent. of all that portion available for traction, 76½ per cent. of all the electric railway mileage, and 83½ per cent. of all the trolley cars.

These are, indeed, profoundly impressive and suggestive figures, so far as the lighting and power of this country are concerned, and might even be carried further. If we take into account the consumption annually of electrical apparatus in the United States, and add to it the amounts spent on trolley riding, electric lighting, telegraphy and telephone service, it is soon seen that we are spending more as a nation for electricity than for daily bread. The sum spent on electricity certainly reaches between $7 and $8 per head, in the United States; a figure far surpassing the corresponding expenditure of any other nation.

The Submarine Torpedo-Boat.

We note with pleasure that during the recent French naval manœuvres the electric submarine boats "Gymnote" and "Zede" scored handsomely against three battleships. It looks as if this type of underwater warfare had come to stay. Apparently the French are a bit in the lead in its development. Our own Holland boats seem to be exceedingly well designed and manageable, but they have not yet been tried out so thoroughly as the foreign craft, which, of course, have the material advantage of a much longer period of experimentation. The most serious difficulty with submarine boats seems not now to be the mere question of motive power or mechanism generally, but the far more serious one of finding the object of attack. The French boats, we believe, have observation tubes, which enable them to get at least a transient view of the enemy when still just under the surface, but even with this advantage, steering the proper course must be no easy matter, particularly as attacks must generally be made under cover of darkness. Aside from this the mere presence of such a deadly instrument has a moral effect that can hardly be overestimated. Even the bravest men may well wax nervous in the presence of such a foe that deals a stab in the darkness and slips away unseen.

If submarine boats become fairly common, they will tend to develop new lines of naval tactics; of just what kind it is hard indeed to say. There seems to be at present no definite reply to a submarine attack. One can hardly organize a similar underwater defense, for the foe could only be found by accident, and the present boats at least are somewhat lacking in means of offence against their own kind. One thing is certain, that in future wars a blockade will be vastly harder to maintain than it has ever been before, for the tactics pursued at Santiago, of closing in at night and using searchlights, would be highly dangerous in face of submarine boats, to say nothing of the gun fire of an active and vigilant enemy. If it becomes possible to construct craft with a large radius of action, even when running on the surface, they will be still harder to deal with. Under water, a light and powerful storage battery would add greatly to their terrors by giving increased range and speed; but even in their present state they are dangerous neighbors indeed.

The Perennial Trolley Accident.

We have been having this summer the usual ghastly series of trolley accidents, and without desiring to be unduly censorious we must say that it is time to utter a note of warning. Years of experience have taught that single track systems must be operated with extreme caution if accidents are to be avoided. It is not enough to provide turnouts and then to trust the rest to the sometimes meagre discretion of engineers and conductors. So long as trolley cars were built and operated on the general lines of the old horse cars, there was little danger of serious trouble, for the cars were light, easily checked with hand brakes, and were run at very moderate speeds. If a car were off its schedule and another came around the curve ahead, there was little trouble in bringing both to a stop. But the increasing demands upon trolley service have changed all that, and now the larger electric lines run cars little lighter than ordinary steam passenger coaches, at speeds fully as great as those attempted on the less pretentious class of steam roads. With these severer conditions of service, the measures taken to insure safety have not improved in equal measure, so that we now have many electric lines which are operating in a manner that would be considered unsafe by any competent steam railway man.

The evil is not, we think, at all due to recklessness on the part of electric railway managers, but to lack of full appreciation of the conditions which really exist. Speeds have increased gradually, and cars have slowly grown longer and heavier, and the whole subject has been approached from the street railway side by a process of evolution. Most electric railway managers, even on the large systems, are graduates of tramway service, and their extra-urban systems pass into serious railway work without a conspicuous break. Hence, they are taken to a certain extent unawares. But a line that operates fast and heavy cars on a single track is not relieved of any moral or material responsibilities by the use of electricity as a motive power. A considerable proportion of the long electric lines in this country are ordinary railroads in all save motive power, and they must face the situation squarely, and employ all the available safety devices known in railway practice or face the inevitable consequences.

If the present series of fatalities keeps on, due to careless motormen on single tracks, we shall be treated to some drastic legislation, which will be a real injury to electric traction. This is the time for averting it, for in the very near future it will be too late. When a road attempts high speed with long and heavy cars, it must approach the matter from the true railway standpoint, and take full advantage of all that years of experience in railroading have taught. Power brakes, a fully developed block system, and, more than all, proper methods of train dispatching are needed on every important suburban electric line; and if such precautions are not adopted willingly they will be forced upon the unwilling with no gentle hand. Something should be done, and done promptly, to relieve the present situation. On progressive lines, ample safety devices have already been installed, and the sooner their example is followed the better for all concerned.

The Direct Measurement of Reactive Power.

On page 245 we print an article by Mr. Frankenfield, which may be useful to many students of electrical engineering. When an alternating e. m. f. produces a current in a circuit, then on the assumption of simple or sinusoidal waves, to which the most complicated cases can be virtually reduced, the current will usually be out of step with the e. m. f. The actual current may, however, be analyzed theoetically into two components, one of which is completely in phase with the driving e. m. f., and may be called the working current; while the other component is in quadrature with the driving e. m. f., or completely out of step therewith, and may be called the wattless component, or reactive component. This analysis is a fiction of the imagination, but it represents in a simple ideal fashion the essential facts of the phenomena actually occurring in the circuit.

If we multiply the driving e. m. f. in volts by the working component of current in amperes, we obtain the average rate of doing work, or the average power, in watts, expended in the circuit. The expenditure may be all useful in the ideal case of a motor devoid of electrical, magnetic or frictional resistances; or it may be all useless, as in the case of a circuit composed wholly of resistances. But whether usefully or uselessly expended, the watts of the working current represent irreversible expenditure, in which the power leaves the circuit finally, or beyond recall. It is power delivered by the circuit to its environment; either as heat or as chemical power, or as mechanical power. The central-station manager calls it real power.

If we multiply the driving e. m. f., in volts, by the reactive component, in amperes, we get as the product, in watts, the average rate of doing work upon an elastic medium. The elastic medium may be ether magnetically stressed, as in the air-core of a reactive coil, or it may be ether electrically stressed, as in the air-film of a condenser; but whichever form of energy is involved, magnetic or electric, the watts accompanying the reactive component of current are expended reversibily in the elastic media environing the circuit. In each alternation the power is first poured out of the circuit into the surrounding medium, where it is stored up temporarily, either as electric energy or as magnetic energy, and then at the wane of the alternation the energy pours back from the medium into the circuit.

The reactive power is just as truly power as the real power. It is just as correctly described in watts as the real power. The only difference is that the one is reversible and recoverable, being alternately directed into and out of the circuit, so that its final sum total in either direction is nil; while the other is irreversible or irrecoverable, and represents the average drain of power from the system. From the central-station manager's point of view, the reactive power is "wattless" or imaginary, because it is not directly available for sale. Instead of being pushed through the consumers' meters at so much a joule or kilowatt-hour, it comes back on his hands twice in each cycle. In the "real" watts accompanying the driving component of current, all the power is pushed through the customers' meters, and sold, except the incidental quantity expended as heat, on the journey, either in wires as copper-loss, or in transformer-cores as iron-loss.

To the station manager, the reactive power is worse than unsalable power. It is an obstacle preventing the machinery from taking its paying load, because the reactive component of current fills up the generator or takes up a share of its current capacity, whereby the machine is unable to absorb and deliver its full rated power from the steam engine on the one hand, or to the consumers on the other hand. Mr. Frankenfield shows how to connect a wattmeter with a balanced three-phase circuit so as to reveal and measure the reactive power, as distinguished from the ordinary method of connection, in which the expended or useful power is indicated. There can be no doubt that it is advantageous to be able to put the reactive power in evidence, since what the eye sees the memory apprehends much more fully than when the suggestion is purely inferred. Moreover, it is advantageous to be able to measure every electric quantity that assumes any practical importance.

If alternating-current circuits had cycles many seconds in length instead of many cycles per second; then the reactive power would have to be supplied by the engines rhythmically. That is to say, the engines would have to work harder and supply both the "real" watts and the "wattless" watts during the ascent of each alternation, and then the stored energy would come to the rescue during the descent of the alternation, and the engines would only be called upon to supply the difference between the "real" watts and the "wattless" watts. Such a low frequency is quite beyond existing commercial practice; but at existing frequencies the same condition exists, only the cycles are so rapid that the mechanical inertia of the moving parts obliterates the fluctuations of power delivered to the generators. Consequently the steam engine indicator-cards do not show the "wattless" power.

It is pointed out in the article that power-factor indicators are now in use as switchboard instruments. While this is indisputable, we are inclined to think that the fewer instruments that are placed on switchboards the better. One of the few objections to the three-phase system is the number of switchboard instruments that its use involves. The fewer pieces of apparatus that are permanently connected to a switchboard, and which the attendants have to examine and maintain, the less will be the likelihood of accidental derangement. Of course it is desirable that the engineer should have all the information necessary for a full comprehension of the working of the system, and such information may involve the use of power-factor measurements, frequency-indicators, reactive-power indicators, etc. All such measurements can, however, be made specially and by the occasional direct application of portable instruments to the terminals of the switchboard, thus dispensing with the necessity of extra permanent space, connections and inspection. The ideal central station would have no switches, no switchboard and no indicating instruments. Such a realization is, of course, at present impossible, and we are obliged to use a very considerable number of switches and of instruments. One can only say, the fewer the better.

For a similar reason we cannot favor the suggestion of providing a reactive watthourmeter in addition to the ordinary watthourmeter for furnishing the data for a more equitable system of charging consumers. Imagine the perplexity of the ordinary consumer operating an alternating-current motor, in addition to incandescent lamps, from a three-phase alternating-current distributing system of street mains when he saw two meters on his premises, one of which showed the kilowatt-hours he really used, while the other showed the kilowatt-hours that passed into and out of his motor in rapid succession without his being able to capture and use them; but for which he was called upon to pay a certain percentage. Apart from the difficulty of getting him to understand the situation, there would be the difficulty of persuading him into paying for those "wattless" kilowatt-hours that he did not convert and use mechanically. A better plan, and one in extended use, is to meter the lamps and the motors separately and charge a price per kilowatt-hour for motor consumption higher than that for lamps, in accordance with the added cost of the reactive power involved.

Governmental Conditions for Pacific Cable.

President Roosevelt has made public the conditions under which the Pacific Commercial Cable Company must operate. The memorandum is as follows:

"The President, having fully considered said application, herewith consents that the company may lay, construct, land, maintain and operate telegraphic lines of cables on the Pacific Coast of the United States and the various territorial waters of the United States, to connect the city of San Francisco, Cal.; the city of Honolulu, Island of Chua, Hawaiian Islands, and by the way of the Midway Islands and the Island of Guam, the Island of Luzon, Philippine Islands, and a point on the coast of the Empire of China, not yet determined.

The conditions are summarized thus:

1. That the company has not received any exclusive concession or privilege, and is not combined or associated with any company or concern having such concession or privilege, such as would exclude any other company or concern formed in the United States of America from obtaining the privilege of landing its cable or cables on the coasts of China, or connecting them with other cable lines or inland lines of China.

2. That the company's cable shall touch at no other than American territory on the way from the United States to the Chinese Empire. The line from the Philippines to China shall be constructed by said company and operated independently of all foreign companies.

3. That the rates to be charged for commercial messages shall be reasonable. (The schedule of rates referred to is as follows: To charge not exceeding 50 cents per word for transmission of messages between San Francisco and Honolulu, and to reduce such rate to 35 cents per word within two years after the proposed cable between San Francisco and Honolulu is in operation. To charge not exceeding $1 per word for the transmission of messages between San Francisco and Manila. To charge not exceeding $1 per word for the transmission of messages between San Francisco and China. To be content to accept from the United States Government half rates for the transmission of government messages.)

4. That the government of the United States or any department thereof, its officers, agents and insular or territorial governments upon the route of such cable, shall have priority for their cablegrams or cablegrams to them, over all other business, at such rates as the Postmaster-General shall annually fix.

5. That the United States shall at all times have the right to purchase the cable lines, property and effects of the said company at an appraised value to be ascertained by disinterested persons.

6. That the government of the United States shall have authority to assume full control of the said cable when at war or when war is threatened.

7. That all contracts entered into by the said company with foreign governments for the transmission of messages by the said cable shall be null and void when the United States is engaged in war.

8. That the United States shall have authority to serve at discretion all branches which may be connected with the main cable line aforesaid during war or threatened war.

9. That the operators and employes of said company (above the grade of laborers), after said cable shall have been laid, shall be exclusively American citizens.

10. That the citizens of the United States shall stand on an equal footing as regards the transmission of messages over said company's lines with citizens or subjects of any other country with which said cable may connect.

11. That the company shall agree to maintain an effective speed of transmission over the main cable route from California to Luzon of not less than 25 words per minute.

12. That the cable laid shall be of the best manufacture.

13. That ample repair service for said cable shall be maintained.

14. That the line shall be kept open for daily business and all messages in the order of priority heretofore provided for be transmitted according to the time of receipt.

15. That no liability shall be assumed by the government of the United States by virtue of any control of censorship which it may exercise over said line in the event of war or civil disturbance.

16. By the grant of this permission the United States Government does not insure or indemnify said Commercial Pacific Cable Company against any landing rights claimed to exist in favor of any company or companies in respect to any of the insular possessions of the United States.

17. That the consent hereby granted shall be subject to any future action by Congress or by the President, affirming, revoking or modifying, wholly or in part, the said conditions and terms.

Galileo Ferraris Award.

We have received inquiry lately as to the Galileo Ferraris award, and as others among our readers may like to have information on the subject we give below copy of a notice which has been furnished to us by Mr. John W. Lieb, Jr., of the New York Edison Company, who was a member of the Ferraris Memorial Committee in this country. The notice is signed by T. Villa, president, and A. P. Palestrino, secretary, and is dated at Turin, April, 1902.

The commission for the Galileo Ferraris award, which was instituted in 1898, composed of representatives of the Executive Committee of the Association of the General Italian Exposition, in Turin, 1898, of the Chamber of Commerce and Arts, of the Royal Academy of Sciences and of the Royal Italian Industrial Museum of Turin, has decided to reopen an international competition for the conferring of this premium on the occasion of the inauguration, which will take place in the second half of September next, of the monument to be erected in Turin to this illustrious scientist.

The premium consists of 15,000 lire and interest from 1899 up to the date of the assignment, and will be conferred upon the author of any invention from which results a notable progress in the industrial applications of electricity.

Competitors can present papers, projects and drawings, as well as machines, apparatus or constructions relating to their inventions.

The jury nominated by the association above named will have most ample powers to execute practical experiments with the inventions presented.

Competitors must present their requests and deliver their works, machines, apparatus or anything else connected with their inventions, not later than the 18th day of September, 1902, at the office of the secretary of the association, which office is located at the administrative committee headquarters of the First International Exposition of Modern Decorative Art, 1902, in the palace of the Chamber of Commerce and Arts of Turin, via Ospedale, No. 28.

A Notable Engineering Medal.

It has already been noted in these pages that early in the year representative members of the four national engineering societies organized for the purpose of celebrating suitably the eightieth birthday of John Fritz, the celebrated American ironmaster and inventor. Under discussion the plan developed until it was decided to establish a John Fritz Medal, to be awarded every year "to the originators of the most useful scientific or industrial achievements, in perpetual honor of John Fritz and to the glory of engineering." This is the first combined action of the four great American engineering bodies. In order that the subscribers to the fund should be numerous, it was deceided to permit each one to contribute $10. Enough has now been subscribed to insure the success of the project, but there is still an opportunity for those who wish to be enrolled. Several thousand dollars have been received.

The purpose is that this medal shall be awarded by a perpetual committee of 16, to be appointed or chosen in equal numbers from the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. Rules for the award of this medal have been prepared. The field is the world. The committee may select any person of any nationality. No award shall be made until after at least one year of consideration, and it must have the affirmative vote of at least three-fourths of the board. The hope and belief is that this medal will be a distinction not second to the Bessemer Gold Medal, awarded by the Iron and Steel Institute of Great Britain.

The public celebration of Mr. Fritz's eightieth birthday and of the foundation of this memorial will be held in New York City, October 31. This celebration will take the form of a dinner at the Waldorf-Astoria, in which the subscribers to the fund will have the first opportunity to participate. Any of our readers who are interested in this matter, and who may wish to be enrolled among the subscribers to the medal fund should write for particulars to John Thomson, treasurer, 253 Broadway, New York City. The present list of subscribers comprises the flower of American engineering talent and distinction.

The Largest Electrical Transmission of Water Power in Massachusetts.

BY ALTON D. ADAMS.

WATER powers are more conspicuous through large numbers than great individual capacity, in Massachusetts. This is particularly true of those water powers that are electrically transmitted, because the greater powers have been utilized by local factories in most instances. A notable exception to this general rule is presented by a water power of which the development for electrical transmission has recently been completed in the towns of Wilbraham and Ludlow. At Red Bridge, between the towns just named, on the Chicopee River, a dam and dike 880 feet long have been built, the level of the river water raised nearly 50 feet, a fall of more than 5,000-hp capacity developed, and an electric generating station erected and equipped for the utilization of this power. From this station a transmission line extends some four and one-half miles to factories, where the energy drives machinery engaged in the manufacture of ropes and twines. The Ludlow Manufacturing Company, Ludlow, Mass., has made this extensive development and transmission of water power for use in its own factories.

The keynote of American success is individual enterprise and initiative seeking its own advantage, whether business is conducted in the personal, partnership or corporate form. Of this fact the corporation just mentioned is a notable example. Here in an obscure town, with a population, in 1900, of 3,536 persons, 90 miles from tide water and dependent on railway transportation, one of the largest manufacturing enterprises of its kind in the United States or the world has been built up. Many thousands of tons of jute and hemp from far away India, Russia, the Philippines and other minor sources are annually transported to this inland, insignificant New England town, and there converted into products that find a world market.

This line of industry requires relatively large amounts of power for the operation of its machinery, and this power is an important item at a point where all coal must come at least 90 miles by rail. The extensive mills of the company, all of the most substantial stone, brick and timber construction, were, therefore, located at falls on the Chicopee River that yield about 2,500 horse-power. This capacity of local water power has long since been outgrown, and steam engines with an aggregate capacity of 2,400 hp were added. But fuel for the steam plant is expensive, and the same sort of business sagacity that has built up these great works cast about for more water power. Finding no such power available, one has been created, and the equipment for its electrical transmission installed.

The discharge of water by the Chicopee River is notable for its volume and constancy, due to its wide drainage area. A little less than three miles up stream from Red Bridge, where the new dam is located, is Three Rivers, so called from the gathering of the waters. At this point the Swift River, from the hills to the north; the Ware River, so called from the ancient weirs where salmon were caught, and the Quaboag River, whose name smacks of the Irish emigrants who settled Palmer, the town in which Three Rivers is located, about the year 1727, unite to form the Chicopee. This river thus secures a drainage area above the new dam of the Ludlow Company that approximates 200 square miles, and contains many small lakes. Two important considerations which influenced the height of dam selected by the Ludlow Company were the amount of power to be developed and the storage of water for dry seasons. Both of these

FIG. 2.—REAR VIEW OF DAM WITH RIVER DOWN TO OLD LEVEL.

requirements were favored by a dam of the greatest practicable height, and it was accordingly decided to raise the level of water behind the dam to a point more than 40 feet above the then banks of the Chicopee River. Some idea of the lake thus created behind the dam may be got from the photograph which gives a view looking down stream from a point above the dam when the gates at its foot are open so that the water stands at its old natural level. To the left of the river may be seen a cleared area which is covered with water up to the tree line when the water is up to the top of the dam. In order to clear the space up stream from the dam for the great lake to be formed there, it was necessary to relocate the tracks of the Athol branch of the Boston and Albany Railroad, which ran along the river bank, also the highway which crosses the river at Red Bridge. The elevation to be given the water made it necessary to give the dam proper across the original bed of the river a length of 300 feet, a dike at one end of the dam, a length of 316 feet, and a dike at the other end, 165 feet. At the shore end of the longer dike comes the canal with a width of 86 feet 2 inches; and 13 feet added for the abutment at the entrance brings the total length of the dam and its side structures up to 880 feet 2 inches. The dam construction is solid masonry faced with cut blocks of granite. At its base are three gates to let out the water from behind the dam when desired. The height of the dam above the bed of the river is more than 50 feet at one end.

FIG. 1.—GENERAL VIEW OF DAM AT RED BRIDGE.

FIG. 3.—DAM AT RED BRIDGE.

FIG. 4.—CANAL, LOOKING TOWARD ENTRANCE.

FIG. 5.—POWER HOUSE AT RED BRIDGE.

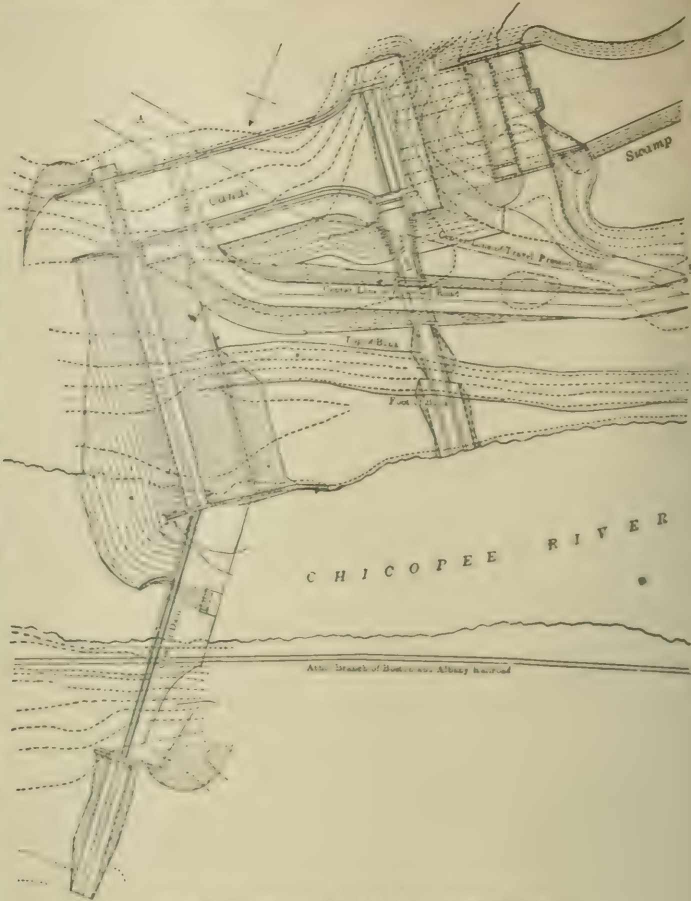


FIG. 6.—CONTOUR PLAN, RED BRIDGE DAM.

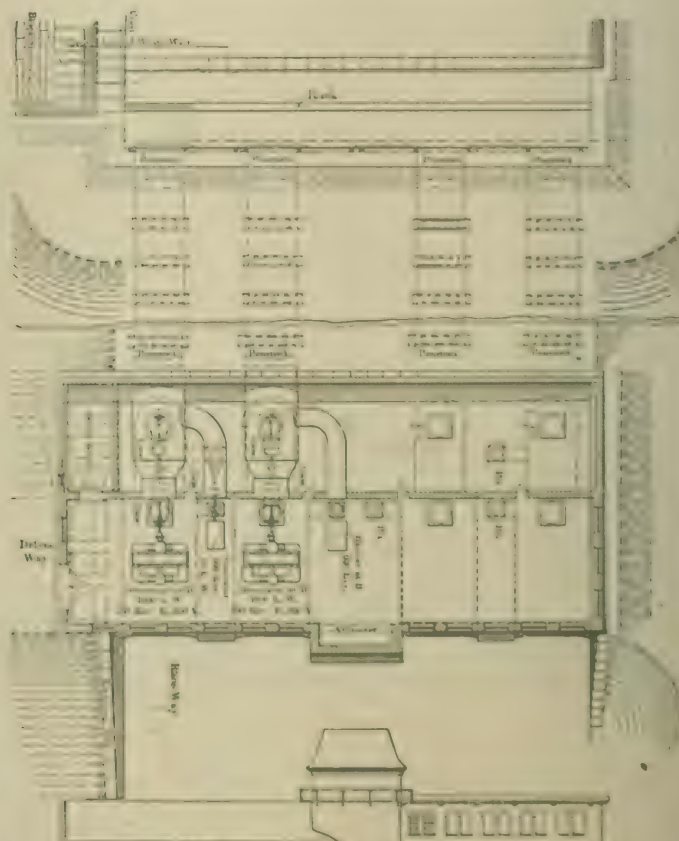


FIG. 7.—PLAN AND ELEVATION, POWER PLANT.

LARGEST ELECTRICAL TRANSMISSION OF WATER POWER IN MASSACHUSETTS.

The great dike at either end of the dam is 9.5 feet higher than the dam crest and about 50 feet above the original banks of the river on which it rests. At its base this dike has a width of about 218 feet, and it is 25 feet wide on top. On its up-stream side, the only one subject to the action of the river water, the dike is paved with rubble and block stone. At the center of the dike is a great core wall of concrete, 65 feet high and 26 feet wide at the base. Beneath the center of this core wall is a row of 8-inch sheet piling. The canal has an inside width of 73 feet and a depth of 13 feet below the top of the dam. Its floor is of concrete, and its sides are of masonry. From entrance to head gates the canal is 340 feet long. These head-gates admit the water to four steel penstocks, each 97 feet 8 inches long and 13 feet inside diameter. Each penstock terminates in a wheel case of 14 feet diameter, which contains a pair of horizontal turbine wheels of sufficient capacity to operate a generator of 1,100 kw, at the speed of 240 r. p. m.

From one side of each of these large wheel cases extends a case of five or six feet diameter, for smaller wheels that are to drive exciters or generators of 200 kw each. Draft tubes extend from the turbine wheels to points below the surface of the tail water, which is 24 feet below the centers of the turbine shafts. The surface of the tail water is 49 feet below the top of the dam, so that the wheels get the pressure incident to this depth of water when the river is just up to the crest of the dam.

The power house, in which are located the water wheels and electric generators, is a substantial brick and stone building with concrete floor throughout, and roof of three-inch plank laid on 10 x 16 timbers over the larger part. On the ground the power house measures 145 feet by 69 feet 10 inches outside, and the interior is all finished as one story. The interior of the power house is divided into two parts by a brick wall two feet thick and running its entire length. One of these parts is 141 by 29 feet inside, contains most of the wheel cases already mentioned, and has a height of 20 feet 6 inches from the concrete floor to the roof at its lowest point. The other part is 141 feet by 33 feet, 4 inches inside, and has a height of 32 feet from floor to roof. This larger and higher portion of the power house contains one end of each wheel case and all the electrical equipment. At an elevation of 21 feet above the floor the wall on each of the two longer sides of the larger room changes in thickness from two feet to one foot, thus forming ledges, each one foot wide, to support the traveling crane that sweeps the entire room. The electrical equipment for this room includes six main generators, two exciters and the switchboard with the usual instruments. Four of the main generators have a capacity of 1,100 kw at 11,500 volts each, and the other two have a capacity of 200 kw at 11,500 volts each. These six generators are direct connected to their respective wheels, and the four larger ones operate at 240 r. p. m., delivering current of 40 periods per second, three-phase. The two smaller generators operate with their wheels at 600 r. p. m.

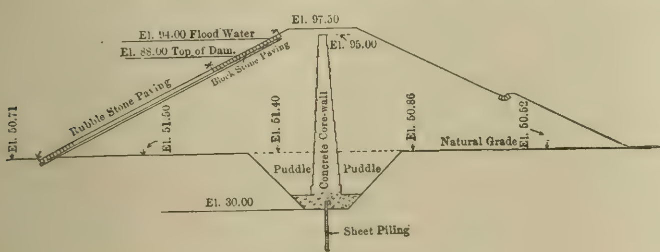


FIG. 8.—CROSS-SECTION OF DIKE.

The two exciters are also direct connected to their respective wheels and operate at 600 r. p. m. All of these generators and exciters were made by the General Electric Company. From this water-power station at Red Bridge, in Wilbraham, to the mills of the Ludlow Company, in Ludlow, a distance of about 4.5 miles, a transmission line of bare aluminum cables is carried on poles with dry glass insulators. The voltage of transmission is 11,500, the same as that of the generators, no step-up transformers being used at the water-power plant. Six cables make up the transmission line, each cable being constructed of seven strands. These six cables form two circuits for the three-phase energy between the generating plant and two sub-stations at the mills of the company. These mills are located in two groups and are known as the upper and lower. Each group has its sub-station, and the two are approximately one-fourth mile apart. At each of these sub-stations is located a bank of three transformers, each transformer having a capacity of 300 kw, and operating with about 11,500 volts at the primary, and 575 volts at the secondary terminals. These transformers are all of the air-cooled type, and made by the General Electric Company. The equipment of transformers is not yet complete, as may be noted by a comparison of the 1,800 kw of transformer capacity with the provision for 4,800-kw capacity in generators at the water power. From the sub-stations three-phase current is distributed to induction motors throughout the mills at the alternating pressure of 575 volts. These motors are all of the three-phase type, built by the General Electric Company, and are in each case belted to short lines of shafting that operate a number of machines each.

Besides the equipment at the new water-power station, the Ludlow Company has one alternating generator of 750 kw, 575 volts and 40 periods per second, and one 250-kw, 500-volt direct-current generator at its mills. These generators are both driven by steam. The 750-kw machine is direct connected to its engine, and operates at 120 r. p. m., and the 250-kw dynamo is belted. Both of these generators supply motors.

The motor equipment at the Ludlow mills is far from complete, but the following numbers of the several capacities each have been installed up to date:

Horse-power.	*Number.*	*Horse-power.*	*Number.*
360	1	20	3
150	4	10	5
100	2	5	5
75	3	3	2
50	2		

The number of these motors is 27 and their combined capacity 773 hp. One 360 and one 50-hp motor operate with direct current; the other motors are all of the three-phase, induction type. As soon as possible the motor equipment will be completed and the steam plant closed down.

Direct Measurement of Wattless Power.

BY BUDD FRANKENFIELD.

IN the ordinary method of measuring power factor in an alternating current circuit, an ammeter, a voltmeter and a wattmeter are properly connected in the circuit and the power factor is taken as the ratio of the wattmeter reading to the volt-amperes in the circuit. This method is a crude one, but until power factor indicators come into general use, it will continue to be the prevailing method. Power factor indicators are now in use as switch-board instruments, but a portable type has not as yet been placed on the market. There is a great demand for just such an instrument. It should be accurate over a wide range of current and pressure, and independent of frequency and wave form; but should take into account any dissimilarity in the pressure and current wave forms in so far as the power factor is affected.

The average student in electrical engineering experiences considerable difficulty in forming a proper conception of the term wattless current; the term wattless power is equally confusing. This may possibly be due, in part, to the fact that both are misnomers—reactive current and reactive power are better expressions—but the terms have been in use so long that it is not likely that a reform can be instituted. To the man who has not learned to think in vectors, the wattless component of power is an evasive sort of spook that bobs up in the most annoying manner. He is not in the habit of measuring it, and its effect is seldom manifested directly, but rather in a roundabout way in conjunction with some other effect.

Wattless power is generally computed by squaring two quantities, taking the difference of these squares, and putting it under the radical; or by rummaging through a set of trignometric tables for the sine of an angle whose cosine is obtained by dividing a certain observation by the product of two other observations. This is not said in disparagement of mathematical analysis, but to bring out what a really complicated train of thought is followed. If it was not for the assistance of graphical methods, it is doubtful if the average student in electrical engineerng would ever get a working knowledge of alternating currents.

It has occurred to the writer that the whole matter can be simplified by the use, in experimental work, of an instrument that will measure the wattless power directly. Education is largely a matter

of sensual experience. What we see, touch or measure directly, is always more easily understood than the results of deductive reasoning. After one has measured the apparent watts in a circuit, the true watts, and the reactive watts, he has all three sides of his vector triangle in the flesh, as it were; and there is then no excuse for difficulty in interpreting the theory.

Professor William Hand Browne, in a paper* before the American Institute of Electrical Engineers, showed that in a single-phase circuit the wattless power, $E\ I\ sin\ \theta$, could be read on a wattmeter if its pressure coil were connected in series with a condenser or an inductive reactance, or to a phasing transformer delivering pressure in quadrature to that of the line. He also showed that, in a balanced two-phase circuit, the wattmeter would indicate the watt-

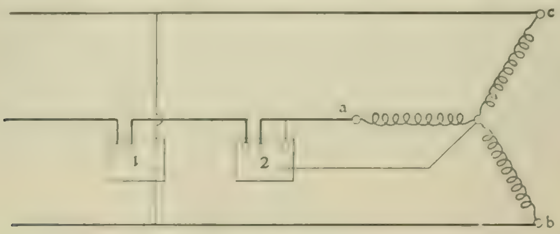


FIG. 1.—DIAGRAM OF CONNECTIONS.

less power if the current coil were connected in one phase, and the pressure coil across the other.

The writer has devised a method for reading wattless power directly in a balanced three-phase circuit.

In Fig. 1, *a*, *b*, *c*, represents a three-phase receiver. It is taken as star connected for simplicity. Wattmeter 1 is connected with its current coil in series with line *a*, and with its pressure coil across the circuit *bc*. Wattmeter 2 is connected so as to read the true watts in one-third of the circuit.

Fig. 2 is a vector diagram of the circuit. It shows that the pres-

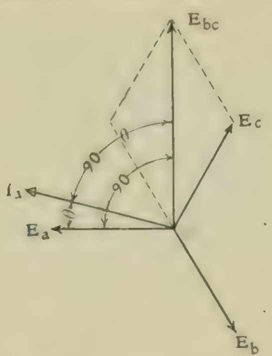


FIG. 2.—VECTOR DIAGRAM.

sure E_{bc} is in quadrature with E_a. Counter-clockwise rotation is taken as positive, and I_a represents a lagging current in *a*.

Let E = pressure from any wire to neutral.
I = current in any wire.
θ = angle of lag between E and I.
W_1 = reading of wattmeter 1.
W_2 = reading of wattmeter 2.

Then,

$$W_1 = \sqrt{3}\ E\ I\ cos\ (90° - \theta),$$
$$= \sqrt{3}\ E\ I\ sin\ \theta,$$
$$= \sqrt{3} \times \text{wattless power per phase.}$$

If θ is negative, or an angle of lead,

$$W_1 = \sqrt{3}\ E\ I\ cos\ (90° + \theta),$$
$$= -\sqrt{3}\ E\ I\ sin\ \theta;$$

and the instrument will have to have its pressure coil connections reversed, unless it be of the central zero type.

Aside from giving a visual indication of the amount of wattless power, this method has an advantage over the method of computation, where the phase difference is slight, in that instrumental errors are not so great. With three instruments, the errors are often cumulative, and it is not uncommon to get power factors greater than unity; here the instrument is bound to show reactance if it be at all sensitive; and in addition, its readings are all increased by the factor 1.73.

The method also suggests an application to commercial metering. It is generally conceded that a customer of a central station should be made to pay something for his wattless power, in addition to the charge for the power he consumes. An integrating wattmeter connected so as to rotate at a speed proportional to $E\ I\ sin\ \theta$ will, in conjunction with the regular meter, furnish the data for a more equitable system of charging. Such a sytem can have but one result: better voltage regulation, due to the stimulus that will be given to the manufacture of high power factor motors. A high power factor motor will be placed on the market just as soon as the purchaser finds it to his advantage to pay the necesarily increased price. He will pay that price if by so doing his bills are reduced a sufficient amount.

The above discussion suggests, as an interestng corollary, a method of measuring power factor. Referring to Fig. 1, wattmeter 2 is connected so as to read one-third of the true watts in the circuit. In the case of a mesh connection an artificial star could be used.

$W_2 = E\ I\ cos\ \theta.$

Taking the ratio of the two readings.

$$\frac{W_1}{W_2} = \frac{\sqrt{3}\ E\ I\ sin\ \theta}{E\ I\ cos\ \theta} = \sqrt{3}\ tan\ \theta$$

$$\therefore\ \theta = tan^{-1}\left(\frac{W_1}{\sqrt{3}\ W_2}\right)$$

One wattmeter could of course be used to take both readings by properly connecting its pressure coil through the medium of a double throw switch.

Fig. 3 shows how the readings vary with the phase angle. There

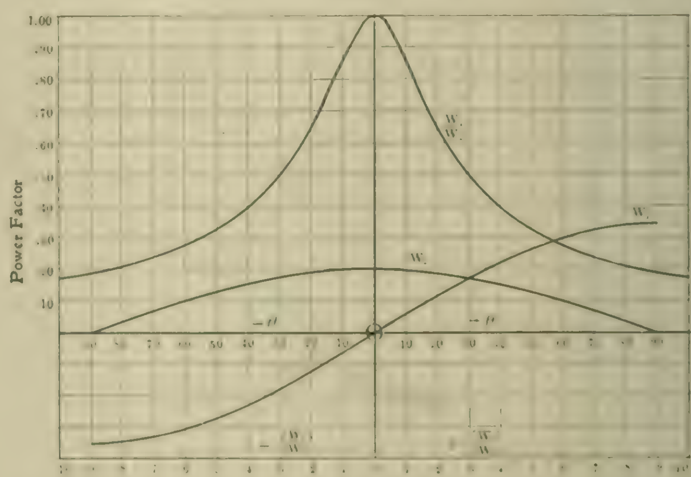


FIG. 3.—CURVES OF POWER FACTOR.

is also a curve of the ratio $\frac{W_1}{W_2}$ plotted against power factor as ordinates. This curve enables one to determine the power factor for a given ratio of readings. The method is analogous to one presented in these columns some time ago.* It has a greater degree of accuracy for power factors between 40 and 60 per cent., and a practical range of accuracy from about 20 to 95 per cent. This makes it suitable for induction motor tests. In this case the current is always lagging, and there will be no reversal of the instruments as in the method referred to. For general use, however, it is inferior.

Wireless Telegraphy in the Navy.

Communication between Washington and Annapolis was established last week by wireless telegraphy under the auspices of the Navy Department. The distance is about 35 miles, which in view of other achievements the officials have decided not to treat as sensational.

* Power Factor Indicators, August 22, 1901.

* Frankenfield, Vol. xxxv, p. 178.

High Tension Circuit-Safeguards.

By Joseph Martin Roman.

HIGH TENSION is the keynote of successful long-distance transmission, but its utilization has augmented the opportunities for and possibilities of dangers to the transmission system, dangers which are destructive in a far greater ratio than the increase in tension. To effectually safeguard the apparatus and make possible its successful manipulation, the design of controlling and safety appliances has necessarily progressed hand-in-hand with the design of the apparatus itself, and to-day a switchboard controlling and distributing alternating-current output calls into requisition a class of appliances differing materially from what was formerly used.

Fuses and circuit breakers, the latter with the complexity of the magnetic blowout or carbon-break, suffice on continuous current boards to safeguard the system. On the other hand, a consideration of the many electrical transmissions now in operation, of their extent, and the necessity of their maintaining a continuous line, will show how vital is the question of inserting safety devices of proper type and construction at proper points in the line, and when the number and uses of these safety devices is considered it is seen how many annoyances and troubles a well designed protective system can obviate.

The simplest device for rupturing the circuit consists of the fuse, but in alternating work, due to the high voltages used, the tendency is for the voltage to jump the gap formed when the fuse blows, by taking the bridge of heated air as a path, and thus maintain a destructive arc, or else to jump to a point on the other side of the circuit, and thus short circuit the line between the safety devices and the source of energy. To obviate such tendencies, special means must be employed in the design of the fuse-block (or cut-out) and the fuse itself, to effectively maintain the circuit open after the fuse has blown.

These special types vary in size and in construction according to the pressure and capacity of the circuit to be opened, but in all the fuse is well insulated from adjacent parts of the circuit and dependence is placed on the expulsion of the arc from the block into the surrounding air, thus elongating the break, disrupting the circuit and simultaneously causing the heated air that formed the path of the arc, to be diffused throughout the cooler air. The fuse blocks may be mounted on the switchboard panel, preferably at the top or else on separate marble bases, supported by brackets behind the switchboard. This latter position is the most desirable one, provided nothing is sacrificed in accessibility, or immunity from contact with the line wires.

The two ends of the line into which the fuse is to be introduced are soldered into terminals, these two terminals supporting a fuse block. Each terminal consists of a flat piece of cast brass, at one end thickened by a semi-cylindrical addition which receives the wire; at the other end soldered to it is a piece of rolled copper, bent in the form of jaws like switch clips. The length of these jaws is about three-quarters the thickness of the supporting marble panel, which latter has two rectangular holes cut through it 3½ inches apart; into each hole the jaws of one terminal (which is fastened on the back of the panel) extend. Evidently these jaws form the gap which is to be bridged by the fuse. The connection between the fuse and the terminal jaws is made by two chisel-like copper pieces which protrude from the extremities of the fuse block into the gaps between the two pairs of terminal jaws, the block being held in position, by the friction of the contact, on the front of the panel.

For alternating-current circuits of 2500 volts or under a type of fuse holder called simply an expulsion fuse block is made. This consists of a porcelain receptacle, having a rectangle recess hollowed out, into which a piece of lignum vitæ is placed. At each end of the receptacle a copper stud—an extension of the chisel contact piece—comes up through the porcelain, these holding in place a cap, also made of lignum vitæ, provided with a vent hole, but otherwise covering the top of the fuse block, the cap being held firm by insulated thumb-screws on the studs. Joining the copper studs, the fuse is placed between the lignum vitæ pieces and under the vent in the upper one, thus making the arc occur between practically non-combustible materials and causing it to be blown into the outer air by the resulting explosion.

On circuits where the existing potential is above 2500, mechanical means are used to rupture a fuse, when its tensile strength is lowered upon approaching the fusing point by the excessive heating of an overload current. By thus breaking the circuit before the actual melting point is reached, the volume of hot air across the gap, and hence the subsequent arc, is reduced, the tendency to shower out molten metal no longer exists, and a more rapid rupture is possible, thus relieving the generator of the strain of the overload; after the break the ends of the fuse are drawn apart. This mechanical rupture is accomplished by means of a device known as a spring expulsion fuse block, which is inserted in the circuit in the same manner as the ordinary expulsion block, but because of being used on high-tension lines, it is more safeguarded in construction. This device consists of a base and two side pieces of hard wood, varnished and rendered fireproof. Mounted on this base and between the terminals of the circuit is a lignum vitæ block.

Each of the chisel pieces by which the fuse block is connected to the circuit and held in place on the panel, passes through the base and is connected by means of flexible copper straps to a copper piece having mounted on it a stud with nut and washer. This copper piece is shaped much like an inverted U, the legs being supported on a pin and the piece rotating in the plane of the chisel piece. A strong spring on the pin makes the normal position of this copper piece recumbent on the base of the fuse block. When a fuse is in place, it rests on the lignum vitæ block, and is of such length that it holds these terminals in an upright position. A fuse of the form shown is

FIG. 1.—HIGH-TENSION FUSE.

strong enough to prevent the tendency of the terminals springing back on the base; but when the tensile strength is lowered by excessive heating, the fuse is finally ruptured and the circuit broken. A cap of lignum vitæ, with a vent, is placed over the fuse, and hard fiber strips at the end of the block entirely enclose the live portions of the device. The side pieces protrude for two inches or more beyond the enclosing strips, and thus form barriers effectually preventing the possibility of arcing over when the break occurs.

On circuits above 5000 volts the connections of this block are insulated from the panel by moulded rubber tubes, which also hold the block and the circuit connections behind the panel, several inches from the marble surface. These blocks are designed to protect circuits with line voltages up to 20,000, and of current capacity up to 100 amperes. The blocks for high-tension service are always mounted on marble slabs, distinct from the switchboard panels, and as an additional precaution against arcing across the line, marble barriers are placed between the blocks.

For each panel mounting these fuse blocks, an extra one with fuse in place is always kept in readiness. When a fuse blows, the operation of replacing consists simply in pulling out the block from its contacts, and mounting the extra one in its place, thus leaving nothing to be desired in simplicity of handling.

On circuits of high tension or carrying large amounts of power, however, the use of fuses is no longer desirable or possible, and a method of automatically breaking the circuit becomes imperative.

The type of circuit breakers used on alternating-current lines differs radically from its prototype on direct-current circuits. Unlike the latter, it is not, except in large installations, used in conjunction with a main switch; but is itself the main switch usually operated by hand, but so constructed that it may be automatically tripped and thus open the *circuit*.

Switches for alternating circuits are of two kinds, those with a quick-break contrivance, which open the circuit in the atmosphere and called "air break"; and those contained in a closed and almost air-tight vessel, and open the circuit beneath the surface of a specially prepared oil—the latter being known as "oil-break" switches.

Air-break switches are used on low-tension circuits, not exceeding 2500 volts, beyond this limit oil switches being built to operate safely on tensions up to 40,000 are now demanded by standard practice. For circuits of higher tension than this (a few of which are in operation), air break switches are again designed. These latter are of special and involved construction, and used in connection with a fuse, which is surrounded by an incombustible compound. But it is the oil-break switch which is found practicable for the range of line tensions in use at the present time, and in conjunction with an automatic tripping device becomes an automatic circuit breaker.

Oil switches are made in several styles, for various voltages and capacities, being single, double and triple-pole and single or double-throw. They range from the switch designed for 100 amperes on a

2500-volt circuit up to 40,000 volts and 100 amperes. The largest current capacity is for 800 amperes at 12,000 volts, this being the capacity of the type now designed for the Niagara and Manhattan Railway equipments.

Usually switches of this type are operated directly from a handle on the front of the panel by means of a system of levers. In the very largest power installations, however, the operation is effected by some electrical or pneumatic auxiliary. This type has been described at length.[1] Since the great bulk of oil switches are intended to be under ordinary circumstances hand operated, the following remarks regarding location apply especially to them.

Oil switches intended for low-voltage circuits are often mounted directly on the back of the panel, with the operating handle—connected by a single lever—on the front. This position is not the most approved practice, mainly because the oil will creep over the iron parts of the switch to the marble panel and permeating it will disfigure the front, despite any means to prevent its occurrence; though all panels controlling oil switches, whether the switch be located on or contiguous to the panel, have several coats of French varnish applied on the back, and often are polished on the back and then coated with varnish to insure freedom from disfigurement.

It is the usual practice to mount oil switches operated on circuits of low voltage on an iron framework behind the switchboard, but when for above 2500 volts they are placed in cells, built of brick with tiled floors and soapstone tops and barriers. There should be no metal of any kind extending through the cell, hence connection between the operating levers and the levers on the switch is made by a stout piece of hardwood, such as hickory, dried and coated with an insulating varnish. This wood is given a test of twice the normal voltage at which the switch works, the potential being applied between contacts at its extremities, to be certain that it will offer no path for leakage.

The mechanism for operating these switches is so devised that the

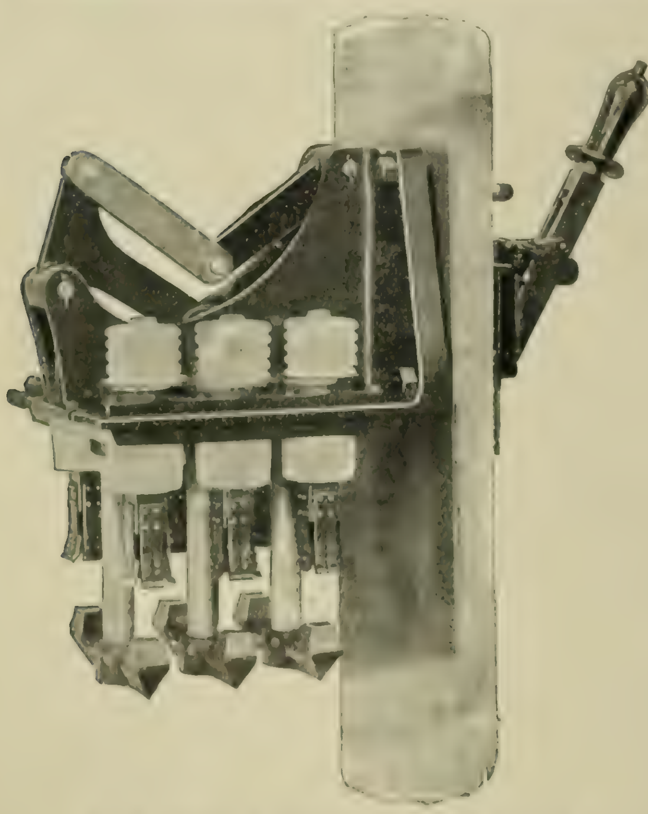


FIG. 2.—OIL BREAK SWITCH AND CIRCUIT-BREAKER.

switch itself may be placed as safety and convenience dictate, on the floor above or below the switchboard, or on either side of the controlling panel. The mechanism may control one, two or three switches simultaneously, the latter two in the case of polyphase circuits; and it is often preferable, especially on high-tension circuits, to use three single-pole switches, placed in separate cells, in place of one triple-pole switch.

The oil in which the break takes place is contained in a sheet iron case, lined with three layers of alum wood treated to insure good insulating qualities. The case is divided, when intended for double or triple-pole switches, into compartments by partitions built up of three layers of this wood, the grain of the middle layer being at right angle to the outer ones, thus forming effective barriers between the switch contacts.

Small oil switches, usually single-throw intended for low voltage circuit, are arranged with pivoted arms, which are moved upward until their extremities make contact with stationary pieces precisely as the method of making contact in the railway controller.

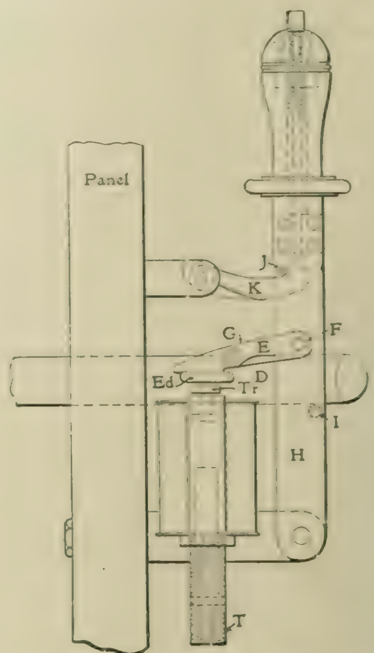


FIG. 3.—DETAIL OF CIRCUIT-BREAKER.

Another type, which is much used where only hand control is desired, is made for single or double-throw, and double or triple-pole breaks, and depends for its operation on a cylindrical piece of wood, turned about its axis by the lever arrangement. This wooden piece has U-shaped pieces of copper fastened to it, which bridge the gaps between the ends of the circuit arranged side by side, but separated by wooden barriers.

Neither of these types of oil switches is to any extent used as an automatic circuit breaker, since for this purpose they are both surpassed in simplicity, surety and promptness of action by the type of which a description follows.

As shown in Fig. 2, the contacts of the moving parts of the switch are wedges, which enter the fixed contacts of the switch, springing them apart, the resultant pressure making a most satisfactory contact surface.

The connecting parts of the switch are made of cast copper, these being supported by stout, well-seasoned hickory rods from a cast iron piece, which is in turn supported by a bell crank. This moving portion is quite heavy, and its weight, in addition to the flexure of the sprung copper contacts, tends to open the switch.

The lever handle is made up of two steel links pinned together at the top and supporting the vulcanized rubber portion which is grasped by the operator. Two pieces, *E*, *E* (Fig. 3), are connected together by two pins, *F* and *G*; one of these, *F*, pivots the pieces to the links of the handle, and the other, *G*, rests in a notch, as seen in the link, *D*, of the operating mechanism.

The link *D* is supported at one end by the bell crank, and simply rests on the pin *I* in the links of the handle. When the switch is to be closed the pin *G* catches in the notch in the link *D*, and transmits the motion of the handle to the mechanism, closing the switch. As stated, the weight of the moving parts and flexure of the sprung contacts now tend to push the link *D* and handle outward, but this is prevented by the spring catch *K*, which grips another pin *J* in the levers of the handle, thus securely holding the handle and keeping the switch closed.

Evidently then the moving portion of the switch cannot now drop out of contact as long as the linkage system is rigid, but by disengaging one of the links from its adjacent member, the opening can be effected. This is automatically accomplished by a solenoid attract-

[1] ELECTRICAL WORLD AND ENGINEER, Vol. XXXVIII., No. 10; Vol. XXXV., No. 15.

ing an iron plunger which acts as a hammer against the trigger *Tr*. Each of the pieces *E* ends in a projection, or ear, *Ea*, which, when the switch is closed, rests directly over the trigger of the contiguous solenoid. The two solenoids are energized indirectly by series transformers placed in two of the legs of a three-phase system, or one in each circuit of a four-wire, two-phase system. The projecting tubes *T* contain iron plungers, the vertical position of which may be so adjusted that they are pulled up by the solenoids when the exciting current reaches some fixed value.

The operation of this breaker is very simple. An overload by over-exciting the current transformer closes an auxiliary circuit, which closes the energizing circuit. The solenoid pulls up the plunger, which latter raises the trigger *Tr*, knocking the pieces *E* and the pin *G* upwards. The link *D* no longer under the restraint of the spring catch *K*, moves outward as the moving portion of the switch falls. Meanwhile, the handle *H* remains upright, and the link *D* protruding abnormally, indicates to the attendant that the switch has opened and that there has been trouble on the line.

This is the arrangement used when the oil circuit breaker is fastened directly to the panel. When, however, it is placed in a cell at some distance from the switchboard, the arrangement of operating mechanism becomes more intricate and involves more moving parts. This position of the switch makes it impracticable to place the tripping device on the switchboard, since the opening would involve the moving of a long system of cranks, the friction of which on their supports would prevent a rapid break.

In Fig. 4 is shown a switch mounted in a soapstone cell, situated behind and to one side of the controlling panel. Fig. 5 shows in detail the arrangement of links directly connected to the switch, with auxiliary signal switch.

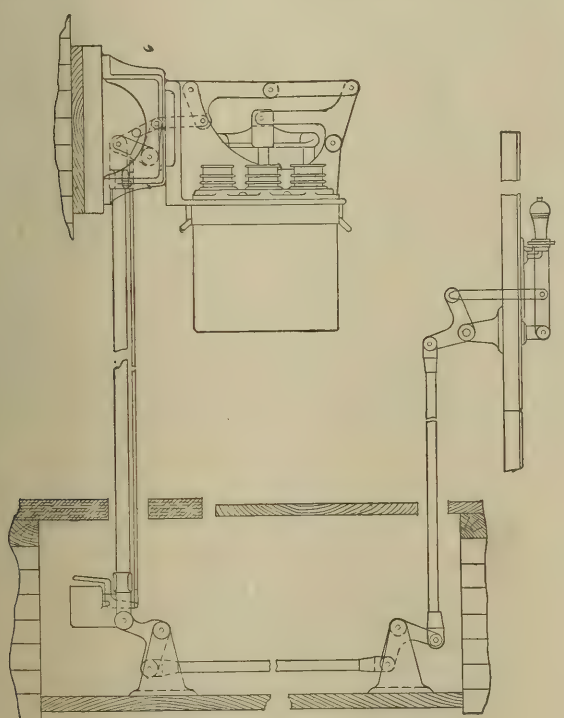


FIG. 4.—OIL CIRCUIT-BREAKER.

The iron pot *M* is rigidly attached to the piece *C*, which clamps the wood rod *H*, the whole being supported on the bell crank of the mechanism. This pot has an iron core, about which a solenoid *E* is wound, the leads coming out at the bottom. The cover *K* of the pot is pivoted at *D*, and supports a clamp for a second and lighter wooden rod *h*. This rod is so supported that its motion is always parallel to *H*, and, moreover, its upper clamp *C*—3 is made longer than necessary and thus heavier, increasing the force of a blow which it can give. By comparing the two figures, it is evident that the position of the links is such that the switch is closed.

The link *U* is attached to the bell crank *B*, of the switch, and the four links *N*, *O*, *P* and *S*, fixed at *J*, take the place of the bell crank of the ordinary non-automatic tripping mechanism. The pin *R* in the link *N* prevents this combination from collapsing when the switch is being closed. In this position the points *X*, *Y*, *Z* of the links are in line, and the tendency of the switch to open is transmitted through links, rods and cranks, and is restrained by the spring catch on the handle, as in the previous case.

When an overload occurs on the line, the solenoid in *M* is energized, and to decrease the reluctance of the magnetic circuit, claps down the cover *K*, which raising the rod *h* causes the piece *C*—3 to strike the triangular link *S*; the sharp blow throws this piece upward, which mars the rigidity of the crank formation, allowing the switch to open, the link *U* moving forward as *N* revolves about the fixed point *J*.

Since no movement of the link or handle has taken place, there is no indication on the front of the board as to the position of the switch, although the instruments on the line would show the condition of load. That the attendant may have instant indication when the breaker opens, a small indicating switch is so connected with the levers of the tripping mechanism, that their opening closes an auxiliary circuit, which causes the illumination of red signal lamps on the front of the board.

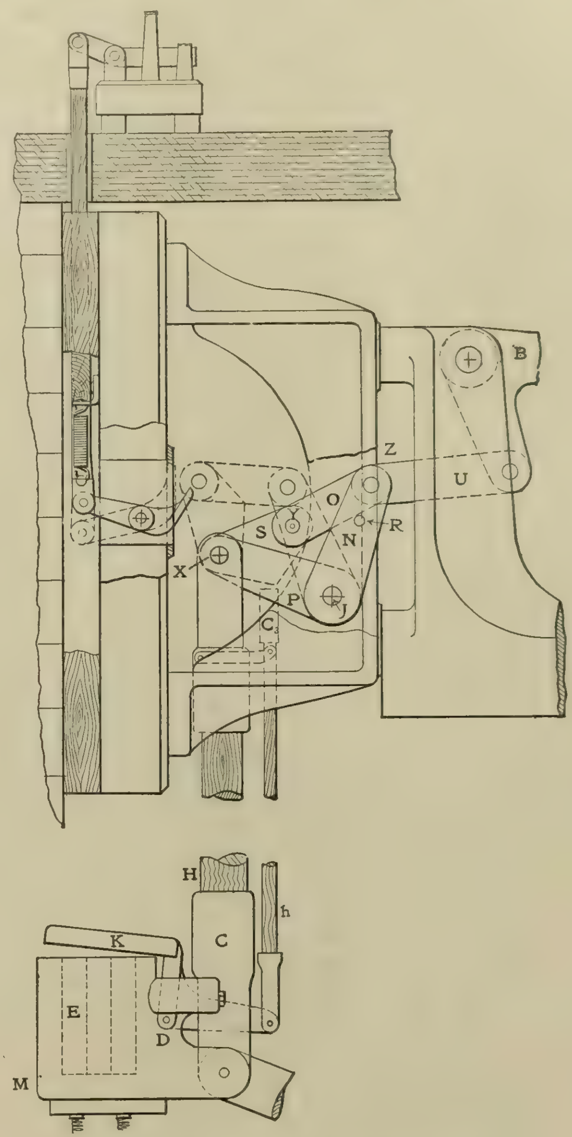


FIG. 5.—DETAIL OF TRIPPING MECHANISM.

The solenoids used in connection with the foregoing circuit breakers are in all cases where possible, energized by direct current, whereas their operation is dependent upon the overload in the alternating line. It becomes necessary, then, to use an intermediary device which actuated by alternating current proportioned to that in the line, shall close a direct-curent circuit in series with the tripping magnet. This device, because of its analogy to similar devices in telegraphy is called a relay. The current transformers operating these relays have their primaries connected in series with the line to be protected, and since their secondaries are grounded, all danger of shock from the relays operated on high-tension lines is removed; also on low-tension lines, the transformer makes unnecessary the use of heavy leads to excite the relay solenoids.

Two relays are required on a three-phase line, having their solen-

oids excited from two of the legs; and on a two-phase system from each of the separate circuits. The use of relays is especially advantageous, since they respond to conditions other than the ordinary overloads, and open the circuit automatically when the desired conditions are attained. Three notable types are in use at the present time, namely, overload relays, overload time relays and reverse current relays.

THE OVERLOAD RELAY.

The overload relay shown in Fig. 7 opens the line on overload or short circuits just as would a fuse or circuit breaker. It consists

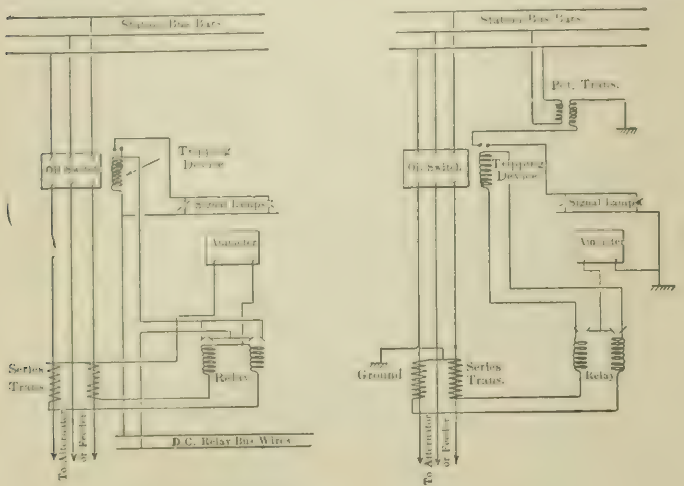


FIG. 6.—CONNECTIONS OF OVERLOAD RELAY.

of a solenoid surrounding an iron plunger which may be drawn up vertically, causing a second piece placed above it to impinge on contacts and close a local circuit to the tripping magnets on the oil-circuit breaker. The plunger of this relay is supported by a disk in the tube extending beneath the solenoid, which disk may be moved vertically, and hence adjust the position of the plunger for different current strengths. In many recent installations, especially in the small substations of long railway lines now being installed, it is desirable to

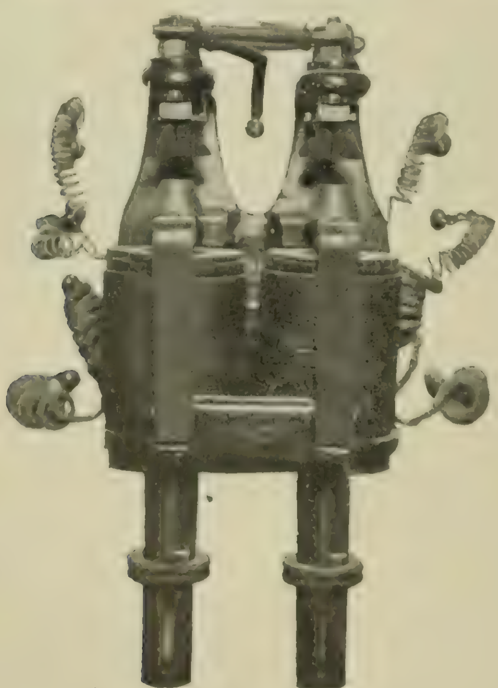


FIG. 7.—OVERLOAD RELAY.

do away with the direct current and to use the same transformer which operates the relay to trip the breaker. In this case practically the same type of relay is used. The tripping device on the oil switch is connected in series with the relays and secondary of the current transformer. A connection is made which, under normal conditions, short circuits the tripping device. The plunger of the solenoid in this case opens this short circuiting connection when drawn up, and allows the tripping magnet to be actuated.. A diagram of the connection of each case is shown in Fig. 6, including the wiring of the signal lamps.

THE OVERLOAD TIME RELAY.

This type of apparatus is designed to operate the circuit-breaking device if the overload continues for a predetermined and adjustable length of time, remaining unaffected if it continues for less than this time. This relay meets two conditions that arise in practice.

First, it takes care of temporary overloads. In the many cases of crosses or short circuits on lines which burn themselves clear, it is undesirable to open the circuit unless such effect should continue When starting up induction motors or synchronous apparatus slightly out of synchronism, a heavy rush of current occurs, which subsides as the machine comes up to speed.

Second, it tends to localize the effect of the overload, causing its removal by the opening of the proper device in the network nearest such overload. An alternating circuit protected by time relays may feed a rotary having ordinary breakers on its direct-current side. An overload on this side of the line will immediately blow the direct-current breaker, but will not affect the alternating-current side, thus leaving the rotary running light and obviating the inconvenience of starting up each time an overload occurs. An alternating-current station distributing its energy through an extended system of feeders and sub-feeders may best be protected by taking advantage of the time adjustment feature of these relays. In the main feeders, relays designed to open the circuit in five seconds may be placed; in the sub-feeders may be placed relays operating in three seconds, and the local circuits may be protected by the ordinary instantaneous overload relays. Thus an overload or short circuit in a local circuit would open the circuit immediately; in a sub-feeder would have to continue for a certain length of time, and the main line would only be opened if a short circuit of some duration occurred between the generating and feeding points. The advantages attendant on the use of this apparatus are obvious, mainly precluding the possibility of a short circuit in a feeder opening all the other branches, thereby occasioning an unnecessary cutting off of all light and power.

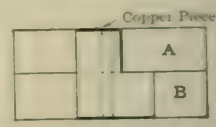


FIG. 9.—A DETAIL OF TIME-LIMIT OVERLOAD RELAY.

TIME-LIMIT RELAY.

The time limit relay (Fig. 8) is operated by clockwork. On one of the shafts of a gearing having a slow motion two wooden disks (1 inch diameter) are mounted side by side. A piece of copper is placed on their peripheries, as shown in Fig. 9. Two contact pieces of spring

FIG. 8.—TIME-LIMIT OVERLOAD RELAY.

brass are so arranged that one always presses against the disk *B*, but the other is so held that normally it is just out of contact with the surface of *A*. On the same shaft with the wooden disks is mounted a circular piece of brass having a notch in its periphery, and in this notch a ratchet catches, which prevents the motion of the clockwork.

On another shaft of the mechanism having a high rotative speed four aluminum vanes are mounted at right angles to one another.

The variable time interval is controlled by these damping vanes, since varying the angle between their planes and the plane of revolution causes a variation in speed of the clockwork, and hence changes the time per revolution of the wooden disks; the variation of time is from 3 to 10 seconds. When the mechanism is inoperative, one contact piece rests on the extension of the copper piece on *B*, the other rests over, but not touching, the wooden periphery of *A*, and so placed that when the disk rotates the copper strip turns away from it.

These contact points are in the auxiliary circuit taken from a low-voltage direct-current line in the station, having the tripping magnets of the oil switch in series, and thus forming the break in this auxiliary line.

Two small cylindrical iron pieces about one inch long, joined together and supported by a spring allowing vertical motion, are so mounted that one is directly beneath a lever attached to the ratchet previously mentioned and the other beneath the spring contact over the disk *A*. The two solenoids are excited by current transformers, and the two small pieces are pushed upwards; one releases the ratchet and the iron pieces which are attracted by their cores are arranged as levers, each beneath one of the small iron pieces referred to.

When a short circuit occurs, one or both, of the coils are energized, and allows the movement of the clockwork, the other presses the contact against the disk *A*. During the continuance of the short circuit, these magnets continue energized and hold the parts in the position just noted. If this continues for the interval that it takes the disks to revolve, a position occurs when both contacts touch the copper strips on the periphery of the disks and close the auxiliary circuit; if, however, the trouble is removed, the iron pieces are pulled back into their normal position by springs, removing the contact pieces from the surface of disks *A*, and allow the ratchet to stop the mechanism when one revolution has been made without tripping the breakers. The solenoids close their magnetic circuit against the adjustable tension of a spring, and it is by these springs that calibration is effected. The time limit relay is placed in a glass case to protect the contacts from dirt or injury, and is mounted on the panel which controls the outgoing line.

REVERSE CURRENT RELAY.

In consequence of the duplication of transmission lines, this type of apparatus finds a field where maintenance of the continuity of power service is imperative. To insure the connection between main and sub-station on all high-tension circuits, these are tied together by two parallel transmission lines, being usually protected by circuit breaking devices at their outgoing and incoming ends. The main station has two sets of bus-bars, and from each set one line leaves the station; but it is often the case that these lines are connected to one set of busses at the sub-station. A short circuit or excessive overload on either line will have the same effect as a short circuit on both lines through the sub-station bus-bars, and the result will be the opening of all the breakers if overload types of relay are used, thus completely severing the power service to the sub-station.

The reverse current relay meets an emergency of this nature, opening the circuit when current flows through it in the reverse direction, but remaining uneffected by normal flow. In a transmission line overload breakers are put in the line at the outgoing main station end, the incoming sub-station end being protected by relays of the reverse type. An overload on either line will open its overload breaker at the main station end, and the current backing up into this line from the sub-station will operate the reverse relay there, thus completely opening this line at both its ends, but leaving the other intact.

Reverse relays also find a use to open the circuit or give visual indications in other cases. For instance, when several generators are running in parallel on the station bus-bars, if one should for any reason cease to generate and tend to run from the bars as a motor, this action would not be indicated by the instruments; but a reverse relay might open the main switch of this generator or else indicate it to the attendants by means of signal lamps or alarm bells.

The device is also used in the same way on rotary circuits when the rotaries are running in parallel with other apparatus, or charging storage batteries. If the alternating source of power should cease, the rotaries would then run inverted, occasioning liability to serious strains, if not trouble, when the power again comes on. This relay consists simply of a direct-current motor of small size, usually about 1/8 hp. Its fields are energized from a current transformer in series with the line, and its armature circuit takes current from a potential transformer across the line.

When current flows through the lines to be protected in the proper direction, the motor armature tends to turn in a certain direction, clockwise, let us say, but is really blocked to prevent such turning. On the frame of this motor are mounted two contacts arranged thus / \ which are the ends of the circuit energizing the tripping device on the oil switch in the line to be protected. The motor shaft has mounted on it a V-shaped carbon piece which fits in these contacts. Normally, the motor tends to turn away from them, but when the current in the line reverses, the field current of the motor is reversed in consequence, the direction of flow in the armature remaining unchanged. The motor then turns in the counter direction through about one-eighth of a revolution. The V-shaped piece impinges on the contacts, closes the magnetizing circuit, and thereby instantly trips the breaker, or else lights up the signal lamps, as the case may be. The circuit connections of Fig. 10, including the switch for automatic and hand control, show the arrangement of apparatus.

Another arrangement of reverse current relay consists of a device like the ordinary overload type. Each solenoid has two coils, wound differentially, one winding being energized from a potential transformer and the other from a series transformer. Normally the attractive force of the solenoid on the plunger is *nil*, but if a reversal of current in the line occurs, the series excitation decreases, allowing the winding from the potential transformer to close the auxiliary circuit and open the line.

A new device recently developed is a reverse-current, time-element relay combining the functions of all three of the previous noted devices, and designed to open the circuit, as the name indicates, when a reverse current of a certain magnitude continues for a predetermined time. This goes a step further than the time element relay. Using the same piece of apparatus the solenoids are differentially wound, one winding being taken from a potential transformer across the line, the other winding from a series transformer. Normally, the attractive force of the solenoid is *nil*, but if the reversal attains a certain value for which the device is calibrated, the clock mechanism is operated, and if the reversal continues at this value for the predetermined time, the circuit is broken.

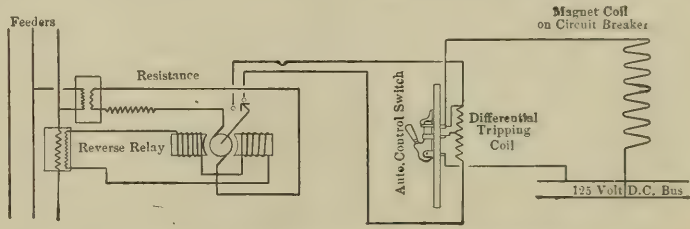


FIG. 10.—CIRCUIT CONNECTIONS OF REVERSE-CURRENT RELAY.

It has been repeatedly pointed out that the sudden opening of a high-tension circuit, especially when a short circuit exists on the line, is an operation fraught with some consequence, due to an attendant resonant rise of potential and maintenance of the arc.

The results of recent experiments by Steinmetz, Rice and others at Kalamazoo, where high-tension circuits under working conditions were suddenly broken showed, however, that while the arcs produced with air-break switches were tremendous in size and continuity, yet with oil-break switches up to the limits of voltage used in practice, the arc was almost entirely wiped out. It is because of this that the oil switch can be relied upon as a circuit safeguard.

The tendency of modern switching development is to make all operations automatic. In large capacity switches this is accomplished by use of small motors and properly devised springs. In smaller types, a plunger working in a solenoid, with a catch to hold the switch closed, may accomplish the purpose. A small snap switch on the front of the board is the means by which the auxiliary device is energized, green or ruby lamps being used to denote the open or closed position of the switches.

Another radical step in advance made possible by the system of auxiliary control is the automatic closing of machine switches when the machine is properly synchronized with the line or station bus-bars. This is effected by adding to the ordinary synchronizing schemes, a device to introduce a time element effect into the auxiliary switching circuit. To these developments the oil-switch lends itself most readily, and from its extended use to-day it seems safe to say that as tensions increase with the distances of transmission, it will be the oil switch, perhaps in a higher state of perfection, upon which transmission manipulation will solely depend.

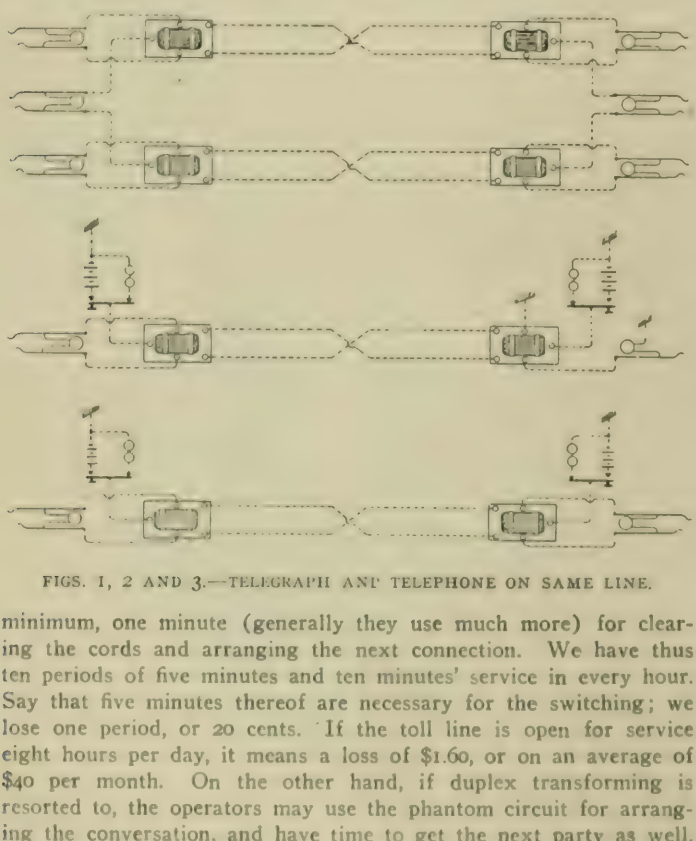
Telegraph and Telephone Over the Same Line.

By K. Weman.

In the July 5th number of Electrical World and Engineer appeared an abstract of a paper read at Dublin before the Institute of Electrical Engineers, on "Railway Blocks and Telegraphs; Recent Practice," referring to combinations of telephone and telegraph on the same line. This is not very recent practice in other parts of Europe, as by using duplex transforming several combinations have been made with very satisfactory results, not only with the object of removing inductive disturbances, but also, and more so, in order to get as much service as possible out of the lines. This has especially been the case on telephone toll lines where it is a matter of getting as much interest as possible on the capital invested in expensive lines.

As remarked in the paper, the line branches must have the same resistance. This is easily balanced by a rheostat, but what is more important, the transformers must be perfectly balanced in every respect, and the loss of efficiency a minimum.

The National Telephone Company, in England, after much experimenting, obtained very satisfactory results and have been using the duplex transformer for several years on their lines. In the Scandinavian countries they are also used extensively, and with excellent results. For instance, on a busy toll line where every period of four or five minutes is worth a certain amount—say only 20 cents for a five-minutes' conversation—the operators use, as a minimum, one minute (generally they use much more) for clearing the cords and arranging the next connection. We have thus ten periods of five minutes and ten minutes' service in every hour. Say that five minutes thereof are necessary for the switching; we lose one period, or 20 cents. If the toll line is open for service eight hours per day, it means a loss of $1.60, or on an average of $40 per month. On the other hand, if duplex transforming is resorted to, the operators may use the phantom circuit for arranging the conversation, and have time to get the next party as well, while conversation is going on on the line proper; and, therefore, when the clearing-out signal is given, the next connection is made without any "palavering" between the operators, or any loss of time.



FIGS. 1, 2 AND 3.—TELEGRAPH AND TELEPHONE ON SAME LINE.

Or take a less busy toll line, where the minutes need not be counted and the operator has ample time to get through the service on the same line. By putting in duplex transformers at each end, a phantom circuit is obtained, which may be rented to a broker or a newspaper for exclusive use. Now, if the broker or paper should talk ordinarily over the toll line, says five times per day at the rate of 20 cents per conversation, it would cost him daily $1. If the phantom line is rented to the party at $20 per month, he saves $10 per month, and the exchange has no extra maintenance or switching to do, but makes a clear profit of the rent.

Another combination is to use two railway telegraph lines, and at each station have two duplex transformers with a Morse set between the neutral points. A bell and a telephone are then used as a block system between each two stations. This reduces the resistance of the telegraph line considerably, and the telephones are all working on metallic circuits.

Referring to the diagrams, Fig. 1 represents a metallic toll line through duplex transformers, terminating at both ends in metallic jacks in a board and the phantom line in a telegraph instrument used for service between the operators, or rented. Or instead of the telegraph instrument, another pair of jacks and drops, with ground as return, may be had.

Fig. 2 shows a similar line between two places, the one having metallic circuit, the other single line subscribers. In this case there might be some disturbance on the single lines, but this may be overcome by using an ordinary transformer between the duplex and the jack.

In Fig. 3 are shown two toll lines passing through two duplexes at each end, whereby a third metallic line is obtained. This is extensively used, and gives excellent results. It is evident to what extent time and money are saved where the two lines are expensive and very busy, not to speak of the complete metallic line which may be had at the expense of four transformers. In Fig. 4 a step further is taken, and we have here not only the three metallic circuits but a telegraph circuit besides.

In one of the largest combinations of this kind installed there were eight single lines, or four metallic circuits, out of which were taken six metallic circuits and two single lines. There is, theoretically, no limit to the combinations, but in case the balance is upset in some way, the whole combination is useless, and it is, therefore,

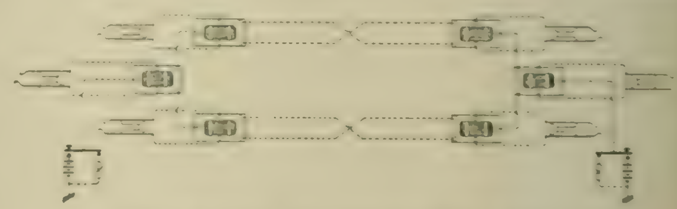


FIG. 4.—TELEGRAPH AND TELEPHONE ON SAME LINE.

seldom carried further than to the two metallic circuits. In case one of the lines should get out of order, the transformers may be switched out, and if then one line should be faulty the other may still be used as an ordinary metallic line.

An Idaho Water-Power Plant.

A water-power plant for the supply of current to Boise, Idaho, is nearing completion, and is expected to be in operation by October.

The foundations of the power house are of cement and laid six feet below low water mark. The water-wheels rest on a massive wood floor, which is laid on a solid natural gravel foundation.

The canal is 34 feet wide at the bottom and carries water 6 feet deep, and is 3½ miles long, a considerable portion having been built through solid rock which had to be blasted out, requiring much time and great expense. The canal is now entirely completed ready for use. Five concrete conduits run under the canal at different places, to carry off the storm water, which is not allowed to enter the canal.

The pole line to Boise is being pushed toward completion. It is expected that the line will be completed the entire distance to the power house (21 miles), with a two-mile branch to Peorle, by August 15. The company has secured a lot in Boise where work will begin shortly on a sub-station fire-proof building, 25 x50 feet in dimension. This building will be the Boise headquarters of the company, where the main transformers will be located.

The current, which enters the building direct from the power plant, will have a voltage of 20,000. By passing through the step-down transformers it will be changed to 2,000 volts and less as may be desired.

Three cars of machinery, consisting of two 15,000-hp turbine water-wheels of the latest Leffel pattern, with shafting, belting, etc., are on the ground. The wheels are of the horizontal pattern, and will be connected direct with the two generators. The generators are each of 500-kw capacity, made by the Westinghouse Company. They are of the very latest design, and weigh 65,000 pounds each. They will be completed in time to reach Boise by Oct. 1. The order was placed six months ago. The exciter will be on the same shaft with

the generator. The water power will be controlled by Lombard governors.

The two wheels now on hand will be installed early in August. Room for a third has been provided, but it will not be put in until more power is in demand than can otherwise be furnished.

The current will be brought to Boise on three separate uninsulated cables. Each cable is made of seven strands of aluminum wire, twisted and held firm by small bands of the same material. The splices are made by means of an aluminum sleeve, which is cramped tightly around the ends, thus forming a complete connection. The plan of using aluminum was an afterthought. The company had purchased 25 tons of copper wire some time ago, which was sold recently at a neat profit. The wires are placed on either side and are on the tops of the poles, making an equilateral triangle.

The company installing the plant, the Electric Power Company, Ltd., is composed of local capitalists. The officers are H. O. Pope, president; H. D. Pope, vice-president, and M. D. Dobson, secretary.

Safety in Elevators.

By O. F. Shepard.

The article under this same head which appeared in the issue of this paper of July 12, is of much interest to those familiar with the construction and operation of electric elevators. It gives, however, an impression, first, that electric elevator accidents are very numerous, and second, that one of the frequent causes is the lack of retarding torque in a compound-wound motor when driven as a generator by the load on the car.

On the contrary, to one who has given the subject any study, the very few elevator accidents, in proportion to the number of elevators in operation, is really a great surprise, especially when one considers that nine-tenths or more of elevators installed receive no other attention than that given them by the janitors of the buildings where the machines are situated. Furthermore, it is very unlikely that the cause of the accident mentioned was due to the reasons set forth. Not knowing the particular type and make of the machine in question, conclusions can be drawn only from the duties of some of the standard makes.

The efficiency of electric elevators ranges between 45 per cent. and 75 per cent., reaching 75 per cent. only under the most favorable circumstances; 60 per cent. would be a high average. Suppose we assume for a problem, an elevator requiring 100 amperes at 220 volts to raise its maximum load. Then of this 100 amperes at 60 per cent. efficiency, only 60 amperes are actually used in lifting the load, the other 40 taking care of the losses in the motor, in the worm or other gearing, and in the friction of journals, cables, guides, etc. Now, in descending, the same load is capable of yielding the equivalent of the 60 amperes (at 220 volts) of energy. Assuming the efficiency of the machine when driven backward to be the same, *i. e.*, 60 per cent., we then have 36 amperes given back to the line—a little over one-third of the maximum capacity of the motor. In reality this will be less, for the efficiency is less when the machine is driven backward, or when the motor acts as a generator.

The writer has tested some machines which gave 75 per cent. efficiency when lifting maximum load, but which gave back to the line when the same load descended but one-third of the current required in lifting, the voltage remaining practically constant. From numerous tests of electric elevators it is found that a retarding torque of one-third is sufficient for every case, and in the majority a much less torque would suffice to restrain the maximum load, and prevent a runaway.

This brings us to the question as to when a differentially-wound motor becomes a motor of constant torque—a point which was also raised in the article mentioned. Assuming the magnetization curve to be a straight line, we readily see that the ampere-turns of the series winding at full load must equal two-thirds of the ampere-turns supplied by the shunt winding, in order that the motor when driven as a generator (within practical limits) may act with a constant torque of one-third that yielded when the motor is acting as a shunt motor. This, then, would be a limiting value for the series winding of an elevator motor, and being the limit it would not be safe to leave in circuit such a series winding to act differentially. But if the series winding at full load equalled in m.m.f. but half the shunt m.m.f., the motor would readily supply the necessary retarding torque without much increase in speed.

Take the example above of the 100-ampere machine. Consider it to descend and generate 40 amperes back current. Then, as at 100 amperes the series field equals one-half the shunt, at 40 amperes it would be one-fifth of the shunt; therefore, the effective m.m.f. would be four-fifths normal, and assuming strength of field to decrease proportionately, the motor would run at 25 per cent. over speed. This 40 amperes with field four-fifths as strong would give the required one-third torque. It will be found, however, to be greater than this, and the speed will not increase 25 per cent., for, as is well known, the magnetization curve rises above a straight line. However, it is not thought that any responsible elevator concern uses a series winding of so much as 50 per cent. of the shunt winding upon its motors, after they are started. Generally but 25 per cent. to 35 per cent. is permitted to remain in circuit.

There is, however, a source of danger in descending with heavy loads on an electric elevator. This is when after starting, the power supply circuit is opened, either in the supply feeders by the opening of the wall switch, or by a poor contact in the elevator controller. In this case there is no limit to the speed of the motor, even if purely a shunt mtor, because it can speed up and generate an exceedingly high voltage; but there being no circuit to which to supply current, there is practically no resistance to rotation. An opening of the circuit in some such way, or perhaps an opening of the shunt circuit of the motor, was no doubt the cause of the accident mentioned by Mr. Rennerfelt in his article. It seems that the only means to prevent a runaway in such a case is in the use of a speed governor. But this is supplied with the safety catch upon the car, and so there is no need of adding another.

At this point it may be well to mention another very common fallacy regarding electric elevators. Many manufacturers maintain that an electric brake or an electric operating device will take care of just these cases of failure of power supply or the opening of the supply circuit; hence it is the general impression that a solenoid brake is safer than a mechanical brake, for it is thought that in case of failure of current supply, the electric brake would come on and stop the elevator, while the mechanical brake would remain off and permit the machine to run away, unless the operator had presence of mind to apply the brake. But in descending with load (or going up with empty car, which is heavily overweighted) in case the power supply fails, one of two things will happen—either the load will drive the machine and run the motor as a generator, or the car will stop. If the load drives the machine the motor will act as a generator and furnish current to the electric brake or to the electric operating device, and thus hold them in the running position and hence be no safer than the mechanical control.

"The Battle of the Tubes" in London.

A recent cable dispatch from London says: The "battle of the tubes," as the Morgan-Speyer contest for franchises to construct and operate underground lines here is termed, is going favorably to the Speyer group. Their bill was practically approved by the Parliamentary Committee, while consideration of the Morgan application was adjourned to the autumn session.

Before a special committee on the proposed London tube-railways Balfour Browne, K. C., said he wished to deny emphatically the report that the Morgan and Yerkes interests had combined. Personally, he said, he was altogether opposed to Mr. Yerkes's proposals. The parliamentary committee on the proposed tube-railways decided to make a report giving the Yerkes Underground Electric Railway all needed legislative right of way for the completion of its entire system. The Morgan company's bills to authorize the paralleling of the main portion of Yerkes's routes have been put over until next session.

The dispute between the Morgan and Speyer interests affects only some small connecting links in the London underground system. The Speyer-Yerkes franchise covers lines already in operation within the city; the Morgan group controls some outside transportation lines.

Sea Telephone Cable.

Connections were made last week on the new telephone cable across Vineyard Sound, between Vineyard Haven and the mainland, and communication by telephone was established. The cable is four miles long, with terminals at Nobscot Lighthouse and Lamberton Cove, near Vineyard Haven, opening on the Atlantic.

The Tube Electric Railways of London.

In the August 2 issue of ELECTRICAL WORLD AND ENGINEER a report was given of the proceedings in London of the International Tramways Congress, including an abstract of the interesting paper on "The Tube Railways of London," by Mr. P. V. McMahon, chief engineer of the City and South London Railway. We are now able to supplement the abstract by some further details from the paper, as to the results obtained on Mr. McMahon's road, which, with its extension is now about 6¼ miles long, and runs from Clapham Common through the city to the Angel at Islington, with 13 stations,

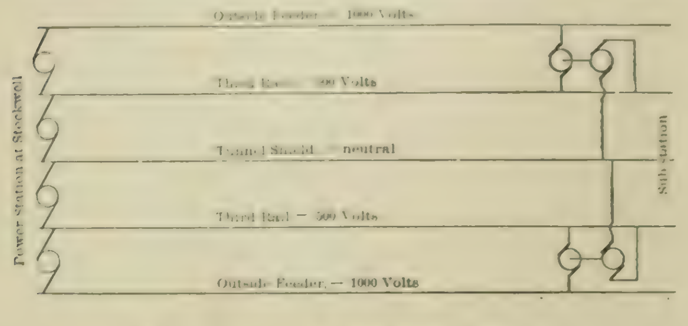


FIG. 1.—DIAGRAM OF DISTRIBUTION SYSTEM.

the average distance between stations being about 850 yards. The generating station is situated at Stockwell, about one mile from the south end of the line. Originally the line to King William Street was worked on the ordinary two-wire system at 500 volts, but with the extension north the two-wire system at 500 volts was no longer available, and the method of distribution was changed to the three-wire system with 1,000 volts across the outers, the running rail forming the middle wire. There are two sub-stations, one at London Bridge, 2¾ miles from Stockwell, and the other at the Angel, 5¼ miles from the generating station. These sub-stations are fed from Stockwell on practically a five-wire system, *i. e.,* 2,000 volts across the outers. A particular feature of the system is, that although distribution is effected at 2,000 volts, the maximum voltage across any one commutator is 500 volts and only half of the electrical energy sent to the substations is transformed, and thus a high efficiency is maintained.

One or two novel points had to be settled before installing the system. In the first place, there had been the problem of getting from the negative to the positive side, and several automatic devices had been considered, but the way out of the difficulty had finally resolved itself into a simple break of 30 feet in the working conductor at the crossings. That had given rather a flickering light in the train, but the break had been reduced afterward to 15 feet by putting conduc-

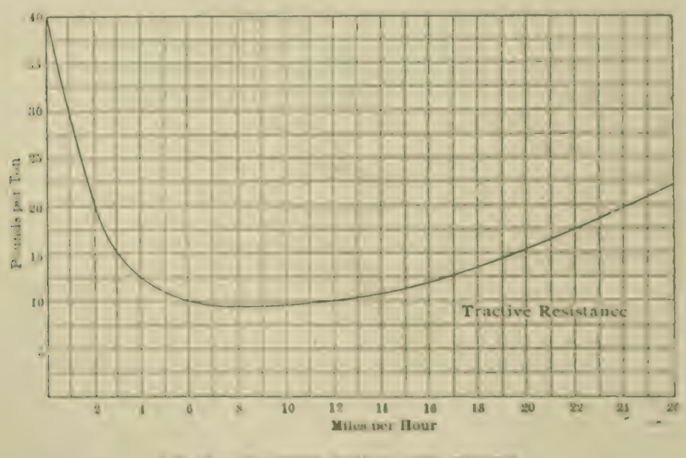


FIG. 2.—TRACTIVE RESISTANCE CURVES.

tors in the middle and a fuse between, so that if, by any chance, two locomotives were crossing and caused a short-circuit, the middle piece would become disconnected from the main conductor. Another question decided had been whether two machines should be used at 500 volts, one on each side of the system, or 1,000-volt machines across the outers, with smaller machines for balancing. Many things had pointed to the use of generators working at 1,000 volts, but one point that had seemed to be very important was that a bad short-circuit, such as might be caused by a car running off the road and directly connecting the third-rail to the ordinary running rail, might raise the pressure to 1,000 volts between the running rail and the working conductor. The circuit-breaker would probably work, but in the meantime the pressure might be raised on the motor and lamps, and a lot of the lamps would be blown out by the temporary rise in voltage.

As to the sub-station efficiency, it may be mentioned that the continuous-current, high-tension reducers have an efficiency of 90 per cent. at quarter load, 94 per cent. at half load, 96 per cent. at full load, and about 96 per cent. at 50 per cent. overload. This high efficiency is especially noticeable at the sub-station at the Angel, where the high tension reducer system with reversible boosters in connection with a large battery was in use; a very high efficiency, indeed, was obtained, because the high-tension feeders supplying the sub-station at 1,000 volts had an almost steady load all day long of between 75 amperes and 80 amperes, while the current going from the sub-station bus-bars to the line varied between zero and 450 amperes. If a system of that sort were applied all over, the size of the units in the generating station and the size of feeders could be reduced for the same number of trains. At London Bridge sub-station there was a battery almost as large, but it had failed to take the peaks with the ordinary boosters, and was not much good as a regulator; in fact it would do very little work at all, unless additional cells were switched in and the battery was allowed to discharge on the whole. It was used in case of a heavy load, and the cells had to be switched in to make a discharge.

The elevator and lighting circuits were fed from the same bus-bars

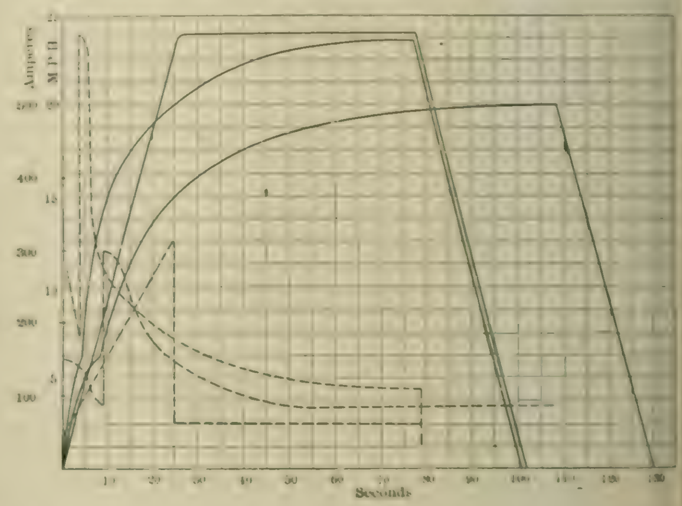


FIG. 3.—STARTING CURVES WITH TWO AND FOUR-MOTOR EQUIPMENTS.

but in the case of a heavy short-ciruit on the working conductor an automatic cut-out operated, and threw the lifts and lights on the battery, thus maintaining the station lighting and lifts supply in case of the working conductor blowing its fuses.

Comparing the continuous-current, three-wire system used on the City and South London Railway with the three-phase system, it would be seen at once that a good deal less needed to be spent in copper, on account of the steady load on the feeders. There was very little difference in the rail drop between 5¼ miles and about three miles, and it would seem that the limits for the three-wire system had not, by any means, been reached. Previous to the installation of the system it had been thought there might be some difficulty in the balancing, but none had occurred. Ordinary balancers were installed at Clapham Common, Moorgate Street and the Elephant and Castle, and it was found that the continuous-current reducers acted so well as balancers that only one of the balancers needed to be used. The ammeters in the reducer motor armature circuit at the sub-station showed that the current was fairly steady, while the generator armature currents were varying from zero to the maximum, showing that they were acting as balancers as well as reducers.

The present City and South London trains consist of four bogie carriages, having a total seating capacity of 128 passengers. The empty train weighs 28.16 tons, and 36.16 tons fully loaded.

The locomotives are each fitted with two gearless motors, one of which is capable of doing the work in case of the other getting temporarily disabled. The locomotive weighs complete 13.65 tons. Thus, the locomotive and fully loaded train weigh 40.8 tons. The maximum number of trains running at one time is 25, giving a se

vice slightly under three minutes between trains in busy traffic. This service is reduced to about 18 trains during the periods of light load. The average speed, including stops, is 14.4 miles per hour, and, excluding stops at stations, 16.75 miles per hour.

The kw-hours per ton mile at the above speed measured on board the locomotive are 0.0552. At the generating station switchboard the unit per ton mile for the past half year was .068. This figure includes shunting, sub-station and cable losses, which are not, of course, included in the measurement on board the locomotive. For the same period the number of train miles run were 650,000, and the passengers carried about 9,000,000. The coal per unit generated was 3.9 lbs., which includes all boiler house losses, getting steam and banking fires. This result was obtained with North Country and Midland small coal. With a coal of a slightly higher calorific value, during a month of this period, the coal per unit (kw-hour) was 3.28 lbs., including all boiler house losses.

Expressing this result, as in steam railway practice, we get a coal consumption of about three ounces per ton mile, which compares favorably with main line practice, when one considers that published steam locomotive tests are specially taken and over a short period only. Also the traction resistance in tunnels, as shown by exhaustive tests on the South London line, is about double that which obtains on main lines, and short sections, which means that the train is being accelerated for about half the total running time. The output in Board of Trade units per half year is 3,781,000. The tractive resistance per ton in the City and South London Railway is given in Fig. 2.

While on the question of speed it may be well to discuss the matter of very rapid acceleration, which is receiving a lot of attention at the present moment. When the present South London locomotives were designed, it was carefully considered how far the company could go in the direction of rapid acceleration without paying too much for it. It was found that with the locomotive under consideration, locomotives and trains weighing about 49 tons with passengers, the time taken on a short section of 2,700 feet would be 130 seconds, the maximum speed being 19.7 miles an hour, and the units per ton mile 0.054, with an average speed of 14.25 miles per hour. It had been thought that a much better service might be obtained by having a four-motor equipment, the total weight remaining at 49 tons, but with a reduction in seating capacity. The units per ton mile were reduced to 0.0377, the maximum speed was 20.6, and the average 14.25 miles per hour, as before. This reduced units per ton mile were obtained by increasing the acceleration, but the peaks at starting were increased from 300 amperes to 600 amperes. That had a very important bearing on the size of a generating station, and the copper in feeders and the size of the working conductor. The results given above assumed that the current could be shut off as soon as full speed was obtained and the locomotive allowed to coast, but that would hardly apply in practice. Running the above locomotives at their maximum speed and keeping the current on until the brakes were applied, the times for a 2,700-foot section were 122 seconds and 103 seconds, while the units per ton miles were 0.0659 and 0.0745, respectively. Considering this effect on the power station of a line with ten such sections, allowing ten seconds at each station, and running a two-minute service with 30 trains leaving the terminus per hour, we find that the maximum current demand was 2,085 amperes, and with four motors, 4,300 amperes. The time for the journey with the two-motor equipment was 21.8 minutes, and with the four-motor equipment 18.67 minutes. The difference was an increase of 13.5 per cent. in the units per ton mile, with the higher acceleration, and the power house had to be enlarged by 63 per cent., while only 14.3 per cent. was saved in time. Unless the competition with trams and other means of locomotion was very severe, such extra expenditure, in order to obtain very high rates of acceleration, was not warranted. Another thing was that the power turned out would not be turned out so economically with a very varying load. It would almost appear that when a very rapid acceleration was required some such system as the Ward-Leonard system, where there were not very high peaks, would meet the case, although it had not been tried.

However, the diagram (Fig. 3) shown illustrates the results of such a system in comparison with the two and four-motor equipment above referred to. The starting current is much lower, and a uniform acceleration obtained. Compared with the four-motor equipment the time for the section is the same, but the four-motor consumes less energy, taking 98.6 watt-hours, as against 105 for the Ward-Leonard; but the latter requires a maximum current of only 318 amperes, as against 600 amperes for the four-motor equipment. The two motor equipment requires the same energy as the Ward-Leonard, but takes 20 seconds longer to run the section.

A practical example of the effect of very rapid acceleration may be found in the new motors on the Liverpool Overhead Railway, where the old motors took starting currents of 140 amperes to 150 amperes for an average speed of 12.5 miles per hour, and the new motors 700 amperes to 800 amperes, the average speed being 19 miles per hour. The time for the journey is, however, reduced from 32 to 20.9 minutes. The increased generating plant, feeders, etc., is no doubt justified by tramway competition.

Electric Railway Patents.

The budget of patents of July 22 was unique in that it consisted almost exclusively of patents relating to the electric railway. Six of the patents were assigned to the General Electric Company, the patentees being W. B. Potter, E. M. Hewlett, F. W. Hill, S. B. Stewart, Jr., and C. E. Barry. One of the three Potter patents adds another to the numerous devices for averting the evil effects of arcs at switch points. The present device is specifically a detail in sectional conductor switches, and consists of a means of separating the switch contacts when they may be welded or stuck together by arcing. The principal feature of the invention is the arrangement of the plunger and switch arm in such a way that there is lost motion between the former and latter, so that the plunger in descending strikes a hammer blow on the switch arm, which is more effective in separating the stick jaws than if the moving parts wer all one piece. Another Potter patent relates to a blow-out magnet device, applied to sectional conductor systems, the principal feature of which is to make the blow-out magnet core of steel, having a high coercive force so that it will remain permanently magnetized after the line current has ceased. The object is to give the magnet greater strength than it would possess in virtue of the line current alone, in order that it may successfully extinguish arcs that occur when the line current is small; for if the core were built of soft iron the line current would not magnetize the magnet sufficiently strong in this case to blow out the arc. The third Potter patent is on a three-jaw switch, also for a sectional contact system. It covers a number of convenient features of construction in combination with a three-jaw switch. These features relate principally to resiliently mounted jaws, reducing the hammer blow, a closed secondary around the magnetic circuit to reduce the reactive kick of the bobbin, non-magnetic tips to the electromagnetic air gap to prevent sticking, and similar well-known devices, all being claimed in combination with this particular type of switch.

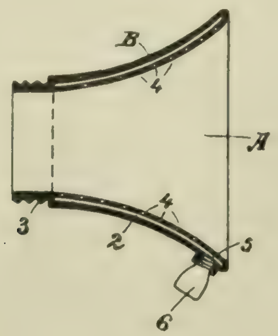
Still another patent relating to the sectional conductor system was issued to E. M. Hewlett. This invention has for its object the improvement and construction of switches used in sectional conductor work. The important features of the improvement are a semi-universal joint for the moving contact members so as to enable them to adjust themselves to a truly accurate position with reference to stationary jaws; an arrangement permitting the contact members to have lateral play for the same purpose; and means for draining the bottom of the electromagnetic solenoid of condensed moisture.

A patent, issued to F. W. Hill and S. B. Stewart, Jr., relates to improvements in the underground conduit system of electric railways. The invention has reference to means whereby covers in the conduit can be automatically raised by the car itself to enable the inspection and repair of the plow. It consists essentially of a system of levers, arranged to be engaged by the car collector and thereby operated to move a cover in the conduit so as to enable the shoe to be inspected.

Certain details of a train-control system are the subject of a patent issued to C. E. Barry, the object being to render the action of the sub-controller more certain. The pilot motor which actuates the sub-controller is controlled by magnetic switches actuated by a current in the main motor circuit. The action of the controller to the extent desired is made to depend upon the rotation of the switch itself. The claims are quite broad and cover means for operating the controller whenever the current in the motor exceeds a certain amount, which means may be controlled in part by current in the motor circuit, and in part by the master pilot controller in any desired combination. In the arrangement shown, the pilot-motor circuit is open-circuited by the electromagnetic switch whenever the current rises above a certain value, thereby preventing the pilot motor from advancing the controller further.

New Telephone Patents.

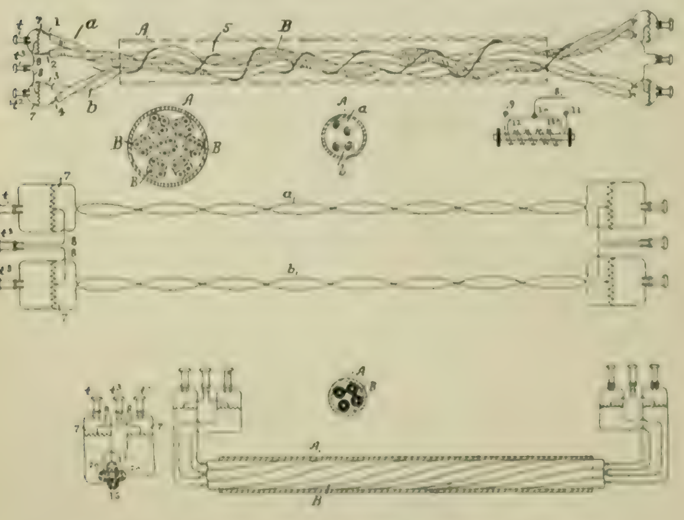
The issue of the Patent Office for August 5 contains four telephone patents, three being of distinct interest. The belief that is held by many that the mouthpiece of a telephone transmitter may be the means of communicating disease has impelled Mr. William M. English and Mr. George A. Burns, both of San Francisco, to conspire together to invent an antiseptic telephone mouthpiece, which consists of a double mouthpiece joined together at the inner and outer edges so as to form a circular space or chamber. The inner mouthpiece or lining is pierced with holes, and to the outer is attached a small receptacle containing any antiseptic or sterilizing material which will vaporize and fill the interspace between the double sides of the mouthpiece and be discharged through the holes in the lining of the mouth-



ANTISEPTIC MOUTHPIECE.

piece. The drawing illustrates the device quite clearly. *A* and *B* are the inner and outer shells, of the usual form; *A* being pierced with a series of holes, 4, and *B* having a single opening, 5, at its lowest point, to which is attached the receptacle, 6, for the antiseptic material. The vapor arising from this and passing through the numerous holes in *A* "will act to sterilize and destroy any products which may be deposited within the mouthpiece from the breath of the persons using it, so that the danger arising from subsequent use of a mouthpiece will be avoided. The receptacle, 6, can be recharged at any required interval." Should this device be adopted to any extent, a delicate job will be added to the work of the instrument inspector in the refilling of the receptacle 6. It seems to be overlooked that should the vapor fail from the contents of receptacle 6, or should receptacle 6 be allowed to become and remain empty, the perforated lining, *A*, and the inner space are admirably adapted to collect and retain "any products which may be disposed within the mouthpiece," and the last state of that mouthpiece would be worse than the first.

The issue of a patent to Marcia J. Farnham, as administratrix of



FIGS. 1 TO 6.—FARNHAM TELEPHONE CIRCUIT.

Isaiah H. Farnham, recalls the horrible tragedy of which Mr. Farnham was a victim about a year ago. The invention which Mr. Farnham filed with the Patent Office shortly before he was killed relates to a telephone circuit in which a phantom circuit is obtained, enabling two pairs of conductors to be used for three telephone circuits. In Mr. Farnham's specification he traces the adoption of metallic circuits, and points out that "as the art of telephony broadened out composite circuits were devised in which telegraphic and telephonic services were performed upon the same circuits and also composite circuits were arranged for telephone service whereby the conductors of two telephone-circuits were employed as the limbs of a third telephone circuit, which are known as phantom circuits." In obtaining his phantom circuit, Mr. Farnham takes each two pairs of conductors in a telephone cable and twists them together in a reverse direction to the twist of the conductors. Each set of two pairs when twisted is bound with a thread of some distinctive color in order more easily to identify the pairs, and the whole of the conductors when thus arranged in sets of two twisted pairs are formed into a core within the sheath in reverse layers. Each two pairs of twisted conductors constitute a unit, which when the cable is in place is adapted to form three independent circuits, *i. e.*, the two metallic circuits and a third or phantom circuit in which the conductors of each metallic circuit are employed as one limb or conductor—and in a thirty-pair cable there will be 15 such units and 15 phantom circuits. By means of the invention it is possible greatly to increase the circuit capacity of a cable and obtain completely balanced circuits in each of the said units in their relation with one another and in relation to the powerful foreign currents conveyed upon conductors strung in proximity to the cable.

In the drawings, Fig. 1 is a view in diagram of one unit of the improved cable, and Fig. 2 an end view. Fig. 3 is an end view of a cable having a plurality of such units. Fig. 4 is a diagram of an impedance coil, and Fig. 5 is a diagram of circuit connections. Fig. 6 is an end view of a modified cable, and Figs. 7 and 8 are diagrams of the circuit connections of Fig. 6. In Fig. 1 the two pairs *a* and *b* of paper insulated conductors are shown twisted together reversely to the twist of the pairs and held by the thread 5. At each end the conductors are bridged by an impedance coil, 7, and from the center, 10, of the coil-windings wires 8 extend to telephone t^2 to form a third or phantom circuit, of which the pair *a* forms one side and the pair *b* the other side.

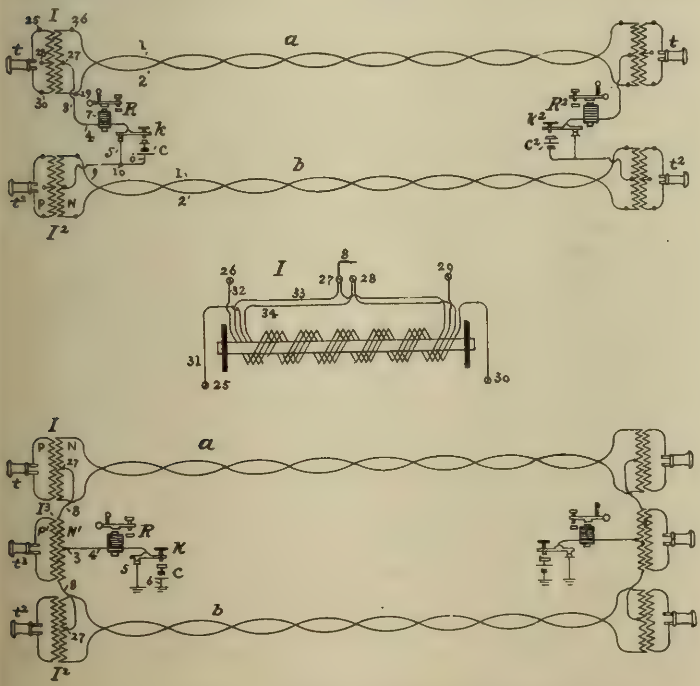
Fig. 4 shows in diagram the windings of the impedance coils, 7, the helices of which are wound on in parallel, and the outer ends, 9 and 11, are connected to binding posts, while the inner ends, 12 and 13, are connected to the bridging-post, 10, and the circuit from 9 is from the binding-post, 10, by one winding and from said post to 11 by the second winding. In operation the currents from the instruments *t* in, say, the circuit *a*, circulate through the helices of the coil winding in series and have an inductive effect upon the core of the coil, while the currents from the instruments t^2 circulate by the connecting-branch, 8, to the center of the helices of the coils and thence through the said helices differentially to the circuits *a* and *b*, and have no inductive effect upon the cores. The coils are thus wound so that a perfect balance is obtained between the two conductor metallic circuits *a* and *b* and the third or phantom circuit, *c*.

The specification says that in the experiments that were made previous to this invention it was found impossible to obtain quiet phantom circuits with the ordinary type of cable having twisted pairs arranged in reverse layers, as there would in all cases be more or less "cross-talk," but by the formation of two pairs of such metallic circuits into units it has been found that phantom circuits connected between the pairs of such units are quiet and without perceptible cross-talk or disturbances of any kind.

Two patents are issued to Mr. Martin H. Howell, of Melrose, Mass., bearing on the same general subject as the Farnham patent, and, like it, are assigned to the New England Telephone and Telegraph Company. The Howell patents both refer to composite circuits and depend upon a peculiar type of repeating coil of Mr. Howell's invention. Fig. 1 shows Mr. Howell's composite circuit, Fig. 2 the repeating coil and Fig. 4 an arrangement of circuits by which from two metallic telephone circuits are obtained both a phantom telephone circuit and a phantom telegraph circuit. Referring to Fig. 2, showing the form of repeating coil used, 31, 34, 32 and 33, are insulated conductors which are twisted together and have their right hand ends respectively brought out to the screw-posts 28, 30 and 29, and their left hand ends to the screw-posts 25, 28, 26 and 27, respectively, so that each conductor passes through the coil in two windings in series with one another, the points 27 and 28 being in the center of the respective windings, both sides of which are balanced and symmetrical. These coils are indicated in Fig. 1 and in the other figures by the reference letter *I*, and the extensions, 8, from the point, 27, on the side, *N*, of the coils at each end of the circuit, *a*, connect with the

electromagnet of the sounder, *R*, and then to the keys, *K*, of the telegraph apparatus, *I*, whose back and front contacts are connected by wires 5 and 6, with the extensions, 9, from the point 27 of the repeating coils, I^2 of the circuit *b*. Batteries *c* and c^2 are included in the wires 6 at each end of the main circuit. By this arrangement the circuit *a* serves as one side or limb, and the circuit *b* the other side or limb of the telegraph line. The telephones, *t* and t^2, are in a local circuit, comprising one side or winding of the repeating coils *I* and I^2. In the operation of the telegraph apparatus, when the key is pressed current from battery *c* passes by conductor 8 to point 27 on the *N* winding of the coil, where it splits, going through the helices in opposite directions and coming out at the points 26 and 29, and continues over the respective conductors 2 and 1 to the points 26 and 29 at the opposite end of the circuit, and thence through the helices of the winding *N* of the coil in opposite directions to the point 27, where the current unites and continues by the conductor 8 to the helices of relay R^2, and in case of metallic circuit return, shown in Fig. 1, the current passes by the rear contact of the key to the sides of the metallic circuit *b* to the opposite pole of the battery, and in the grounded circuits, shown in other figures, the return is by the earth. As the current splits at the point 27 and goes in opposite directions through the helices, as described, one side neutralizes the other. Therefore no inductive effect is produced in the core, and, consequently, there is no disturbance in the telephones at either end, and when the telephone is used the currents generated thereby enter the *P* windings of the coil and traverse the winding thereof in series, and an inductive effect is produced in the core of the coil, and similar currents are induced in the winding, *N*, of the coil, which traverse the helices thereof in series, and are propagated over the conductors 1 and 2 of the circuit and pass through the helices of the winding, *N*, of the coil at the opposite end of the circuit and are inductively transferred to the winding, *P*, through whose helices they circulate in series, and are received by the telephone in the local circuit of the winding. The impedance of the telegraph instruments prevents any leakage through them of the telephone currents.

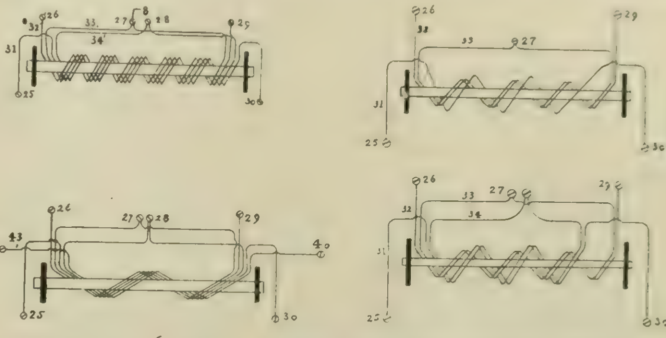
Fig. 3 shows the arrangement for obtaining both a phantom telegraph circuit and a phantom telephone circuit from two metallic circuits, a third repeating coil, I^3, being inserted between the points



FIGS. 1, 2, AND 3.—HOWELL COMPOSITE ELECTRIC CIRCUIT.

27 of the coils *I* and I^2 connected to the metallic circuits. The inventor further points out and illustrates that by connecting together the central points in the repeating coils in various telephone toll lines a continuous series phantom telegraph circuit may be obtained, serving a number of widely-separated places.

Mr. Howell's second patent also has reference to composite circuits and specially to a special type of repeating coil—considered an improvement over the impedance coil adopted in the Farnham patent—and the combination of the repeating coils in the line-circuit, by means of which the third or phantom circuits may be obtained. The repeating coils consist, essentially, of two separate windings upon a soft iron core. The helices of one winding are in series from one terminal to the other, and are inductive to alternating currents circulating through the second winding of the coil, and the helices are provided with two end terminals and also with a third central terminal. The helices of the second winding are provided with two end terminals and with a third central terminal, and the helices are inductive to alternating currents entering or circulating from an end terminal and continuing through the helices in series, but are non-inductive to currents which enter the central terminal, divide, and pass to the helices at either end of the said winding. Figs. 4, 5, 6 and 7 illustrate the repeating coil devised by Mr. Howell, the coil being substantially the coil shown in the previous patent and intended



FIGS. 4, 5, 6 AND 7.—HOWELL COMPOSITE ELECTRIC CIRCUIT.

to replace the impedance coil used in the Farnham patent. Referring to Fig. 4, the helices of the coil are composed of four conductors, 31, 34, 32 and 33, which are preferably twisted together, and their right-hand ends are respectively brought to the posts 28, 30, 27 and 29, and the left-hand ends to the posts 25, 28, 26 and 27, so that each conductor passes through the coil in two windings in series with one another, the points 27 and 28 being in the center of each of the two windings. Both sides of the coil are balanced and symmetrical. Fig. 5 shows a coil similar to that shown in Fig. 4, having a third winding which has a grounded branch, by means of which static line charges detrimental to good telephone work are provided with ground-escapes. All five wires are preferably twisted together before being wound upon the bobbin, and their ends are brought out as indicated. Fig. 6 shows a repeating coil, in which the two wires, 32 and 33, are twisted together before they are wound on the bobbin, but for sake of clearness are not so represented in the drawings, and the single wire 31 is then wound over them, and in Fig. 7 the two wires, 32 and 33, are twisted together and then wound upon the bobbin, after which the wires 31 and 34, which are twisted with one another, are wound above them. The application of the coil is shown in the previous patent. Mr. Howell claims it to be especially effective in producing a phantom circuit free from disturbance or cross-talk, even when circuits of unequal length are joined together, one of which is subject to the inductive influence of a strong current circuit—a condition well known to be peculiarly unfavorable to telephone working.

Electricity and Plants.

Another use of atmospheric electricity for plant growth is reported by Consul-General Guenther, of Frankfort. Speaking of Mr. J. Fuchs, a wine producer of Elba—presumably the island—he says: "He planted, some years ago, four fields with native grapevines, in the midst of a district infested with phylloxera, and treated two of these fields with 'air electricity.' The difference in the development of the grapes of the fields was apparent; those treated with electricity yielded better results, both in quantity and quality, and were not infected with phylloxera, while the other fields were. Mr. Fuchs has demonstrated, it is said, that electricity increases the fertility of the soil. It is not sufficient to simply conduct air electricity to the earth, but there should be a direct metallic connection of the electric conduit with the main stem of the plant. On a field of about 2½ acres, five masts are erected, the tops of which are supplied with an arrangement for accumulating atmospheric electricity. These accumulators are connected with each other by wires. Wires are laid in the soil about 1½ feet deep, forming an evenly distributed metallic net. Every accumulator is connected with this metallic net by a wire running along the mast. Short wires connect with the plants, the free ends being stuck into the stem or into the main root thereof."

Some New Electric Furnaces.

By Clinton Paul Townsend.

Three electric furnaces of the current patent issue represent the three classes into which such furnaces are usually divided—arc, incandescent and electrolytic; it is characteristic, however, of the looseness of a classification based upon the form taken by the current in traversing the heat zone, that in the absence of a knowledge of the charge under treatment it would be impossible to determine the fact from the structure.

The arc furnace, designed for the production of calcium carbide, reverts to the original crucible and vertical electrode type of Willson, with the additional feature, adopted by many of Willson's successors, of a slow and constant rotation of the pot to distribute the otherwise localized heat of the arc over the charge. A further feature, and one possessing both merit and originality, is the form of the vertical electrode—a flattened or ovoid carbon pencil extending diametrically across the rotating pot, and hence traversing every portion of the surface of the charge twice in each revolution. The construction is due to Arthur Parker, of Chorley, England.

The incandescent furnace is a modified form of the Taylor carbon disulphide furnace, described and figured in the Electrical World and Engineer, issue of December 21, 1901. In the construction then described the current was introduced through opposing electrodes, over and between which divided conductive carbon was fed, the heat developed therein determining the combination of the sulphur and carbon of the charge. According to the present modification the opposing carbons are omitted, and the broken conductive carbon is fed to the furnace through carbon conduits; it is to these conduits that the electrical connections are made. A further improvement consists in carrying the heat zone nearer to the base of the furnace, with the result that it is found practicable to tap off the accumulation of slag resulting from the impurities in the charge. This type of furnace is an assured success, the output of carbon disulphide from the electric furnaces of the Penn Yan installation having exceeded 3,000,000 pounds to date.

In the electrolytic furnace, the invention of August Voelker, of Cologne, Germany, the electrolyte is molten glass, and the heat is developed therein by the passage of an alternating, or, it is said, of a continuous current of electricity, between carbon electrodes. The purpose is to maintain the glass for a considerable time in the state of complete fluidity essential to settling and clearing. The furnace bears a general resemblance to the structure already figured in these columns (May 10, 1902), the chief differences being that the arcs employed for the preliminary melting of the charge are arranged in radial channels which converge to the refining tank before mentioned, and that the heated gases from these arcs are burned beneath the working-out basin.

Prevention of Cable Cutting.

The United States and Haytian Telegraph and Cable Co. has appealed to the State and Navy Departments to prevent the cutting of its cable at Cape Haitien. According to information received in New York the Haitian gunboat Crete-a-Perriot, which is under the command of Admiral Killick, who has allied himself with the revolutionary government under General Firmin, and who has been appointed Secretary of War and Navy under the revolutionary government, intends to sever the company's cable between Cape Haitien and New York. The company appealed to the authorities to instruct Commander McCrea, of the gunboat "Machias," to protect the cable from violence. Acting Secretary of State, Adee and Acting Secretary of the Navy, Darling, held a conference and decided that it was proper for this government to issue the instructions, and accordingly a cablegram was sent to Commander McCrea, directing him to prevent the cutting of the cable. The Haitien Cable Company is understood to be a French concern, and under ordinary circumstances its interests would be looked after by the French Government, which has the "Suchet" and several other war vessels in West Indian waters. But the company has American affiliations, and a large amount of American business passes over its lines. Some of this is for the United States Government, which uses the line in part to maintain its communication with war vessels at various points in the West Indies. It also is a partial dependence for government communication with Porto Rico. The State and Navy Department officials felt that protection of this cable came within the general policy of protecting American interests.

CURRENT NEWS AND NOTES.

METRIC SYSTEM FOR THE EMPIRE.—A cable dispatch from London, of August 12, says: The final meeting of the Colonial Conference was held yesterday in the Right Hon. Joseph Chamberlain's room, at the Colonial Office. A resolution adopted provides for the metric system of weights and measures throughout the empire. The proceedings of the conference will not be published, but the resolutions adopted will be issued in a parliamentary paper.

MARCONI AND SOLARI.—The following cable dispatch from the Marquis Solari gives, as we indicated last week, just what is the truth of the situation, and vindicates Mr. Marconi from the absurd and atrocious insinuations against him: "London—Utterly untrue that Marconi has acknowledged that I am inventor of his wireless telegraph system or that the accessory invented by me, which, by desire of the Italian Government, was provisionally protected in Marconi's name, is necessary or important for his system. I make no such claim. It is a mere accessory. I am here buying Marconi apparatus for the Italian Government. Letter follows."

INDUCTION MOTOR METER.—From Canada comes an invention in induction motor meters, accredited and patented to Mr. G. L. Gowland, of Peterboro. One object is to provide a meter having a large range and provided with a rotating armature that shall run at a speed exactly proportionate to the amount of current passing through the meter. Another object is to provide a meter which will work equally well with either inductive or non-inductive loads. This meter, Mr. Gowland remarks, should not be confounded with any meter having the usual so-called "90-degree lag," or any similar phenomena. It differs from such a meter in this respect—namely, that the flux produced at the poles of the magnets on the so-called "voltage" side of the meter is a stationary flux and is not of a revoluble nature. He obtains the rotation of the disk partly by using a so-called "voltage-magnet," the core of which is split into two members and a flat bar of copper inserted there-between. Mr. Gowland states that he has found that a flux-plate composed of thin sheets of laminæ or copper disposed in planes parallel with each other and also parallel with the plate when excited by a magnet in immediate proximity to said plate produces a considerable rotative effect. This effect appears to be governed largely by the amperage rather than by the voltage of the current. With a meter of the type described, the aluminium disk need not be placed so near the magnet-poles as is required in most other meters. This fact presents the considerable practical advantage that particles of dust or dirt accumulating upon the plate do not interfere with its action, and any slight distortion of the disk is less objectionable than is the case with ordinary meters.

POLE-PIECE EXTENSIONS.—Mr. J. M. Burke, formerly one of the designers of the General Electric Company, but connected for sometime past with the Bergmann interests in Germany, has just taken out a patent on an ingenious improvement in dynamo pole-pieces. It is a well-known practice to provide the pole-pieces of dynamo-electric machines with extensions forming enlarged end surfaces in order to cover a greater portion of the armature-surface than would be covered were the cross-sectional area of the end of the pole-piece the same as that where the magnet-winding is supported. Various arrangements of such polar extensions are employed; but the most common construction comprises a separate extension bolted upon the end of the pole-piece after the magnet-winding has been slipped on. Such constructions, however, Mr. Burke holds, are objectionable, because the removal of the extension for the purpose of taking out the magnet-winding is often difficult without dismantling the machine and also because the extension cannot be brought to the highest degree of magnetic saturation, owing to the reluctance interposed by the cut between extensions and pole-piece and the fact that the extension is not directly surrounded and magnetized by the windings. Mr. Burke's invention, therefore, has for its object the construction of pole-pieces having enlarged end surfaces which shall be of the maximum magnetic intensity and also the provision of means whereby the extension may be readily removed to permit the insertion or removal of the magnet-windings. Several drawings are shown in which, generally, the pole-pieces are provided with angular offsets or recesses, into which complementary parts fit, which, when combined, form the pole-piece of the machine. Various ways of bracing these are also illustrated.

WATER POWER IN FRENCH ALPS.—A cable dispatch from Paris says: A prominent electrical concern of Paris, which is closely connected with the General Electric Company, of New York, is now securing all the water power available in the Department of the Alpes Maritimes, with the object of supplying electric light and power to towns on the southeastern cost of France. The company also hopes to supply power for the electric locomotives which the Paris-Lyons-Mediterranean Railway proposes to test on the Cannes-Monaco Railway during the winter.

CABLES AND WIRELESS TELEGRAPHY.—A cable dispatch from London, of August 2, says: At a meeting of the Anglo-American Telegraph Company yesterday, the chairman, Francis A. Bevan, said that nothing had occurred, so far as he knew, to alter the opinion of the directors, that although wireless telegraphy would carry a certain class of telegrams, such as those between ships, or between ships and the shore, there was no reason apparent why it would compete in the class of telegrams sent by cable companies. During a conversation the other day with Lord Kelvin, the latter said to Mr. Bevan: "I have given careful consideration to this subject, and I do not believe the shareholders of your company need be alarmed at the prospect of wireless telegraphy."

GERMAN TELEPHONE FIGURES.—The telephone service of Germany is carried on by the Post Office Department. According to an official report, the cost of the entire plant, up to April 1, 1902, amounted to about $42,000,000. Up to April 1, 1901, the cost had been $36,600,000. At the begining of the present year, 2,024 places had public telephone stations, with 322,281 miles of line. These stations averaged 2,205,966 conversations per day, or about 804,000,000 per year. The following cities have the greatest number of public telephone stations:

	Number.
Berlin	51,561
Hamburg	20,823
Frankfort	9,271
Dresden	8,914
Leipzig	8,725
Cologne	7,484

The total number of employes is 8,189, of whom Berlin has 1,712.

TELEGRAPHY IN ENGLAND.—A cable dispatch to the New York *Herald* from London, of August 9, says: "The young King of Spain is reported to have satirically remarked the other day that, while a hundred years ago it took a day to carry news from one given point in Spain to another, now with the telegraph, it took two days. Things are not much better in England. I referred last week to the extraordinary order given to provincial operators to have mercy on the poor, young, inexperienced telegraph operators of London and not send messages too fast. This order has raised a great storm, chiefly in commercial circles. Everybody wants to air grievances and tell how business is upset by the frequent delays of the telegraph, and the confusion and incorrectness of messages. It is a rare thing for a foreign telegram to arrive correctly. Even inland messages have words omitted or words inserted which were not given in for transmission. A telegraph clerk in the London central station throws light on the system, which causes the complained-of delays. If, for instance, a repetition is required by the clerk at the central station, or a word has to be queried, the greatest difficulty is experienced. Not infrequently the query has to be sent round by another wire to an office in the same vicinity and carried to the offending office by messenger, the telegram waiting for correction all the time." Possibly the new postmaster-general, Mr. Chamberlain, will change this condition of affairs.

TIME-LIMIT CIRCUIT-BREAKER.—Mr. Henry M. Hobart, of Berlin, Germany, has patented, in this country, a time-limit circuit-breaker, under an application filed in January, 1901. As is well known, in many cases it is desirable that circuit-breaking devices should not operate on heavy loads of only a few seconds or a fraction of a second duration. His invention consists of a circuit-breaker so arranged as to respond to an overload only after the overload has lasted a predetermined time. To accomplish this mode of operation, he arranges the tripping-coil of the circuit-breaker in a divided circuit, the branches of which are of different time constants and are connected to the circuit upon which the circuit-breaker operates. In the branch containing the tripping-coil is placed a device which serves to retard the growth of current in this branch when the current in the main circuit varies. The other branch of the divided circuit is formed so as to offer no impediment either to the growth or decay of rapidly-varying currents. The result of this plan is that when the current in the main circuit suddenly increases, the portion of the same passing through the tripping-coil increases but slowly, while that in the branch circuit about the tripping-coil rises instantly to its full value. Unless the main current is maintained for a predetermined interval, for which the parts are proportioned, the circuit-breaker will fail to act, the main current returning to a value or values below that for which the circuit-breaker is set. In case, however, the overload current lasts a length of time sufficient to allow the current in the tripping-coil branch to rise to a steady value the circuit-breaker will then operate.

COMPENSATED ALTERNATORS.—A patent has been issued to Mr. Henry G. Reist, on improvements in "compensated alternators," or alternating-current generator the field of which is supplied with direct current from a synchronously-driven exciter. The voltage of the exciter is automatically controlled by passing current derived from the main alternator through the armature of the exciter, thereby varying the armature reaction of the exciter, which in turn varies the field strength and regulates the voltage. The alternating current is fed to the exciter in such a manner as to produce in the armature-winding a rotating magnetic field, moving with respect to the armature in a direction opposite from the direction of rotation of the armature. As the exciter-armature moves forward with the same speed with which the rotary field therein moves backward, the field as a consequence remains stationary in space as long as the power factor of the load remains constant. To secure the necessary initial adjustments of this field with respect to the field-magnets upon which in practical operation it reacts, Mr. Reist devised a structure in which the field-magnets of the exciter are mounted so that they may be angularly displaced, thereby adjusting the angle at which the armature-flux is permitted to act upon the field. Another feature of his arrangement consists in bridging over the field-poles of the exciter by a band of magnetic material, which by reason of saturation does not allow an undue short-circuiting of the field-flux. He finds that the presence of this bridge makes the compounding more regular. Mr. Reist has also introduced other features of novelty and advantage, which have now become more or less familiar in this class of apparatus, in which his own work follows up that of Mr. E. W. Rice, Jr.

MARCONI SHIP MESSAGES.—A scheme has been promulgated at Liverpool to establish a post office and signal station, not in mid-ocean, but 110 miles west of the Lizard, a place where, for British commerce at least, information from the shore is more valuable than it would be further out at sea. The purpose is to moor there a ship equipped with a powerful searchlight and the Marconi apparatus. The water at that point is 70 fathoms deep, and to overcome the tendency of a mooring chain as long as that to pull down the bows of the ship in heavy weather, the chain is to enter through a hawse pipe in the bottom of the hull at the heel of the foremast, so that the weight may be distributed evenly along the whole keel. With her light illuminating the clouds this vessel will be easily "picked up," even at night, from a distance of 60 miles, and, situated right in the fairway of the Channel, it is expected that great advantage will be derived from the distribution of orders sent from shore by owners for vessels passing in or out. For instance, a ship from the south or west, on reaching this station, could be directed to proceed up either the English, Bristol or St. George's Channel, without delay, thus avoiding pilotage and port dues, to say nothing of waste of time, and, in winter, danger in making the land and entering and leaving port. As a reporting station to be approached in any state of the weather, for the purpose of transmitting important information, the value of the floating post office will be large, while as a salving station, lying as she will at the junction of the three great streams of British and Continental traffic, she should have many opportunities of rendering assistance, especially as her boat, designed primarily to pick up bottles or bags of letters dropped by passing vessels, will be so constructed as to withstand the roughest seas. The terms on which these diverse services will be rendered have not yet been announced, but, of course, they will all cost money, as the enterprise is a private one, and not governmental, as some may think it should be.

TELEPHONY IN PARIS.—A cable dispatch from Paris says: The Parisian telephone girl has received a shock. She will no longer be permitted to interrupt conversations by switching people on some one else. An order has gone forth that no interruption shall take place until the person using the apparatus gives a signal that the conversation is ended.

LIGHTNING STROKES seem to have been unusually numerous this year, but the Weather Bureau has issued a bulletin which tends to prove that the danger to life from lightning is really very small. It covers the observations of eleven years, during which period every reported case of death or physical injury from lightning has been investigated. The statistical average is 2.53 deaths for each area unit of 10,000 square miles. Probably no other cause of death admitting of statistical classification would show so low a mortality record. Taking the figures for one year, 1900, they are less reassuring. In the United States 713 people were killed or received fatal injuries from lightning. The number of those more or less seriously, but not fatally, injured by lightning during the year was 973. Of the total number of 1,686 killed or injured in 1900, the number in houses or barns at the time of the accident was 593. Roughly, the number killed or injured in this one year was about 4.45 to each 10,000 of population; but the man who is struck has no use for averages.

THE TESTING OF THERMOSTATS.—Mr. T. M. Heaphy, whose name is well known in connection with electricity in its relation to fire insurance rules in England, has just been granted, here, a patent on means for testing thermostats for fire purposes, or in incubators, etc. At present the indicator circuits of thermostats are easily tested to prove that they are in working condition when not closed by the thermostat-contacts; but there is a difficulty in testing them to prove that the circuits will be closed and the alarm given by a rise of temperature in the thermostat itself. This difficulty is so great that the thermostats are seldom or never tested as thermostats after being installed. This is a great disadvantage, as the thermostats may get out of working order and not be able to give the alarm or signal when required. For example, a mercury thermostat may fail through the mercury not being able to close the thermostat-circuits, owing to the glass tube or bulb being broken, or the thermostat may get injured either accidentally or maliciously or get so out of order that it cannot act at all when the requisite rise in temperature takes place, caused by a fire, and yet the present tests might indicate that the alarm or signaling-bell and indicator-circuits were in perfect condition, and so cause a feeling of false security to be engendered, and the building containing the thermostats be from a fire-risk point of view in a worse condition than if thermostats had not been used, as watchmen and other precautions might have been in consequence dispensed with. In any case the defect in the thermostat may not be detected, owing to there being no proper way of testing it. It is obvious that the consequences of this inability to test the thermostat may be very serious. To remove this difficulty, Mr. Heaphy heats the thermostat artificially by an electric current from any convenient source, passing through a suitable resistance close to or in contact with the thermostat. This produces the same effects so far as the thermostat is concerned as a rise of temperature in the air surrounding the thermostat (or as a rise of temperature in the room or place in which the thermostat is situated), due to a natural or other cause, which rise of temperature when it has reached a given amount the thermostat is intended to indicate. It, therefore, tests not only the thermostat itself, but all the electric circuits and any mechanism connected with or controlled by the thermostat

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LETTERS TO THE EDITORS.

Graphical Calculation of Synchronous Motors.

To the Editors of Electrical World and Engineer:

Sirs.—I read with much interest, in your issue of May 19, 1902, the very clear and able article by Prof. F. G. Baum on the graphical calculation of synchronous motors. I may be permitted to say that this method and the corresponding diagram (p. 861, Fig. 2) are identical with those published by me some years ago in the first edition of my little book, "Moteurs Synchrones" (1896). The same diagram is employed throughout the second and enlarged edition of the same book (published by Gauthier-Villars at the end of the year 1900), and which you honored with an able and friendly review in one of your numbers of 1900—for which I take advantage of this opportunity to offer my thanks. In this second edition I carried the theory somewhat further by taking in account the effect of saturation of the fields, which is neglected in the ordinary theories as well as in the single diagram alluded to. Moreover, in another paper presented to the Electrical Congress of 1900, and published in the middle of 1901 in *L'Eclairage Electrique,* I extended the same theory to rotary converters, of which I gave the first purely graphical treatment.

It is very gratifying to me to see that these methods are now finding favor and receiving practical development in the hands of able American engineers, and I hope that in the future their clearness and simplicity in comparison with the purely mathematical treatment will help many students to grasp at once consequences which are otherwise difficult to understand. I am grateful to them for perusing my publications on these subjects.

PARIS, FRANCE. A. BLONDEL.

Theories of Hertzian Waves.

To the Edtors of Electrical World and Engineer:

Sirs.—For a brief, popular summation of the knowledge held today of the field of force in wireless telegraphy, the editorial appearing in a recent issue of ELECTRICAL WORLD AND ENGINEER leaves little to be desired. The explanation there given of the probable means of propagation of electric force is as elegant in expression as it is clear and succinct. In this day of diagrams and cold mathematics it is refreshing to think of "invisible cobwebs of electric lines in warp and magnetic lines in woof"—an analogy as apt as it is poetic. With such elements in our philosophy there seems no time for quibblings over nomenclature or harsh feelings as to definition. Truth is the object of search, and it is of far too noble dignity to trifle with.

If we speak simply of *"waves,"* electromagnetic waves, following the constant example of Mr. Heaviside, whether these be "free" or "guided" waves, we shall, perhaps, avoid any confusion of terms. Certainly the electrical engineer has not yet appropriated this term for alternating currents generally.

There are certain statements appearing in Mr. Collins's contribution to the subject under discussion with which I cannot agree. It has been proven repeatedly by various investigators of admitted skill that salt water is highly opaque to electric waves—its opacity depending on the wave length of the vibration. A coherer placed within a block of damp cement is found to be completely protected from Hertzian waves. Even with a wire laid along the bottom of a lake to guide the waves, and directly connected to a coherer, Prof. Fleming was unable to transmit an impulse from a spark through the water. In his admirable letters on this subject, appearing last year in the London *Electrician,* he points out that substances containing the hydroxyl molecule ($H\ O$) or $N\ O_3$ are opaque to waves of a few inches long or longer, although dry ice ($H_2 O_2$) is an exception. Substances following Maxwell's law are transparent to these waves. His lucid explanation of the anomalous action of water in this connection and of its "quasi conductivity" will correct the impression that "salt water conducts only by electric action" at these high frequencies. For this idea we are by no means indebted to Monsieur Guarini Foresio!

In view of what European physicists have established, Mr. Collins's experiment across the Schuylkill River affords simply illustration that the Hertzian waves very easily cease to be free etheric vibrations, but become sliding or guided waves. As well assert that sound heard in the free air in one basement from the other traveled through the intervening earth and water as that the electric waves did so.

The idea of grounding transmitting and receiving antennæ to effect resonance there-between is, so far as I know, novel. Resonance with dead beat vibrations is simply a contradiction of terms. Grounding an upright conductor makes it as nearly deadbeat as it is possible to do. A 50-foot simple antenna operates better with a 30-foot upright than does one of less height; a 75-foot antenna will answer better yet—the longer the better. "The

reason is simplicity itself"—there is here no resonance possible, properly so termed. Lodge, the authority quoted, Marconi, Braun, Blondel, have all pointed out this principle that the grounded system is rapidly damped, its resonance poor, or nil. Braun seeks to free his from the ground for this very reason, as Mr. Collins himself very naively points out. The capacity between earth and antenna is not always the same; is not necessarily large. It follows a simple mathematical law.

The "adherents of other dogmas" and "pseudo-hypotheses" referred to (among whom may be humbly enumerated Lecher, Blondel, S. P. Thompson, Abraham) may not be altogether ignorant of the "simplest law of optics," but I am not sufficiently familiar with rectilinear propagation of light around a corner to admit the analogous explanation of the guided electric wave's ability to accomplish this gymnastic feat—for a quadrant of the earth's circumference; neither is it clear why diffused particles in the upper atmosphere, of dimensions comparable only with those of light waves, should seriously reflect vibrations of a million times that wave length. Moreover, experiments with balloons in the upper atmosphere, such as I mentioned in your columns, July 5th, seem to prove very clearly that the field of force is confined quite closely to the earth's surface.

In "getting wireless telegraphy out of its swaddling clothes" let us incidentally acquaint ourselves with known optical laws, and if we find that we cannot entirely explain the action of a solenoid by comparing it with a searchlight, hesitate before we fetter any theory on unsuspecting posterity, "for whatever time the existing theory of light shall prevail, or as long as the electromagnetic theory endures, and to the finality of belief!"

JERSEY CITY, N. J. LEE DE FOREST.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Direct-Current Dynamo.—NOWAK.—An illustrated description of a 650-kw, 500-volt, direct-current dynamo. The number of poles is 30, the number of revolutions 90, the armature diameter 5,000 mm., the armature length 210 mm. As it was desired not to have a separate flywheel, this large armature diameter was chosen, in order to put into the armature the total momentum required to obtain a good degree of uniformity of speed in one revolution. The details of the construction are described and illustrated.—*Elek. Zeit.*, July 17.

POWER.

Electric Mine Draining Plant.—A very well illustrated description of an electric generating installation for working a draining pump, exhibited by Lahmeyer & Co., at the Dusseldorf exposition. The primary installation generates 2,000-volt, three-phase currents, the capacity being 750 kw. The dynamo is excited by a three-phase, direct-current converter, which is supplied with current from the dynamo. The exciting current at starting is given by a storage battery; this is recharged by the converter when the engine is working. The underground pump motor is a 650-hp machine, keyed direct on the pump shaft. The speed is 60 r. p. m.—Lond. *Eng'ing*, July 11.

Power Transmission in New Zealand.—HAES.—The first part of a paper on an electric power transmission plant at Rotorua, in New Zealand. The power house is at a distance of 13 miles from Rotorua. The single-phase, alternating-current system is used. Current is generated at 4,000 volts, about 1,000 volts are lost on the line, and in the city the voltage is reduced from 3,000 to 100. The power house contains two 100-hp turbines, driving two 50-kw alternators of the Mordey inductor type.—Lond. *Elec. Rev.*, July 11.

REFERENCES.

Electricity in Mining.—CLARKE.—An illustrated article in which he first describes several three-phase installations in American mines. He then discusses briefly the different uses to which electric power is put in mines, as for pumping, hoisting, coal cutting, drilling and ventilation.—*Cassier's Mag.*, July.

Mining Elevators.—KOETTGEN.—A long abstract, with a series of diagrams, of a paper on the methods of starting electric lifting machines for mines.—*Glueckauf*, July 5.

Ventilators.—PERCY.—A well-illustrated article on colliery ventilating machinery.—*Cassier's Mag.*, July.

Vertically-Driven Generators.—PERKINS.—Some illustrated notes on vertical shaft turbine generators in various European power plants.—*Sc. Am. Sup.*, July 19.

Canadian Water-Power Plant.—PERKINS.—An illustrated description of the hydroelectric power plant at Shawinigan Falls on the St. Maurice River, near Quebec.—*Elec. Rev.*, July 26.

TRACTION.

Main-Line Railway Traction—C. T. CHILD.—A general discussion of electrical problems of main-line railway traction. Direct current would not do. Alternating-current transmission and converter substations he considers as a "make-shift." A true alternating-current system has the disadvantage of the low power factor and unsatisfactory speed regulation of induction motors, and difficulties in the construction of the feeding system. The third rail is looked upon as a temporary device which may survive for a time on absolutely restricted rights of way, but is impracticable on a main-line right of way. A system in which alternating current is taken from the line of conductors and converted into direct current by a substation on the train to feed the direct-current motors, "while very interesting, would be more satisfactory to railway engineers if it had been tried long enough to give date of costs of operation and maintenance, and, above all, of certainty of operation." The first place for electrical equipment on main lines is on suburban sections, for the handling of heavy passenger traffic. The introduction of electric traction on main lines is still considered to be far off, unless the induction motor can be brought under more perfect control.—*Eng. Mag.*, August.

Electric Locomotives for Mine Haulage.—GIBBS.—An article on the modern practice and the economies of electric mine locomotives. He reaches the following conclusions. Small mines should use the simplest possible system, both for power plant and wiring; for these he recommends a direct-current generator and the distribution of current at 250 volts pressure. The power system in extensive mining plants should be planned like any other large distribution scheme; by the use of a combined alternating, direct-current system all the advantages of simple alternating motors for auxiliary uses, economical high-tension distributing, and a low and safe direct-current locomotive haulage system, may be obtained, thus rounding out a complete modern power system for all the principal mine operations. The average saving to be expected by the adoption of electric instead of mule haulage is from 4 to 5 cents per ton of output, and in large mines with heavy grades the saving is frequently as great as 8 cents per ton.—*Cassier's* Mag., July.

REFERENCES

Mechanical Engineering of an Electric Railway.—QUICK.—An illustrated article in which he discusses in detail the mechanical problems met and methods used in the operation of a road, the relations of the various departments to one another and the scope of their work, and in particular that of the mechanical departments.—*Eng. Mag.*, July.

Battery for Traction.—An illustrated description of the stationary storage battery and booster equipment of the Chicago City Railway. —*West. Elec.*, July 5.

Telpherage.—CLARK.—An illustrated paper, read before the Civil Eng. Club of Cleveland, in which he discusses various details of construction in telpherage.—*Jour. Ass. Eng. Soc.*, June.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Installation of an Apartment House.—A. L. RICE.—A very long and well-illustrated description of the power plant of a

large apartment house in New York. There are 18,000 electric lamps. Each apartment has a telephone. The elevators are hydraulic, the seven dumb waiters electrically driven and automatically controlled by a push-button system from any floor; the lift being about 200 feet. There is a complete system of ventilation provided. Air, tempered to 70° F., is supplied by two 140-inch blowers, each driven by a 30-hp motor. Each apartment is provided with a panel box; each has a meter and circuit breaker, and a separate feeder is installed for the current for electric cooking. The wiring is done in concealed enameled conduits, which for the risers are run in vertical boxes, and for the horizontals are placed between floor and ceiling, with only four quarter bends allowed between pull boxes. The arrangement is such that all current can be taken from the street supply or from the generating plant, the change being made by double-throw switches and bus-bars on the switchboard. The lamps are supplied from a three-wire system; the motors for elevators, blowers, etc., from a two-wire system. A storage battery operates in parallel with the generators on the three-wire system. There are five generating sets; three of 250-kw, and two of 125-kw capacity.—*The Eng.*, August 1.

REFERENCE.

Two and Three-Wire Systems.—SNELL.—His Mun. Elec. Ass. paper in full, on the relative advantages of two and three-wire distribution, an abstract of which was noticed recently in the Digest.—Lond. *Elec. Eng.*, July 25.

WIRES, WIRING AND CONDUITS.

Self-Induction and Capacity in Transmission Lines.—BAILLIE.—The first part of an article, in which he considers to what extent self-induction and capacity should be taken into account in practical work. He gives a collection of formulæ, applicable to the different systems of transmission, and in accordance with slide-rule requirements. He first discusses self-induction and deals with single-phase, three-phase and two-phase, both with four and five wires. He gives formulæ for the value of the self-induction of parallel wires; also diagrams with a curve for the self-induction between two parallel wires as a function of the ratio of their distance to their diameter; and curves for the drop of pressure due to self-induction in percentage of the resistance drop, for various diameters and for various distances between the wires. On lighting circuits the effect of self-induction is negligible; in the secondary the power factor is unity, and in the primary, though the excitation of the transformers can produce a large lag at low loads if no transformers be cut out of circuit, yet the high-tension mains are comparatively small, and so have a negligible self-induction drop. As an extreme case may be cited one of the St. Petersburg lighting companies, where the power factor of the primary is as low as 0.53 at low loads; but even then the presence of a self-induction drop would tend to assist regulation rather than hinder it. But on power circuits, which supply induction motors, the case is very different. A 100-hp induction motor of the General Electric Company had a power factor varying from 0.43 at quarter load to 0.76 at full load, and though by use of a very small air gap the full load power factor may be increased to 0.9, yet a power factor of 0.7 is not too low an average to assume on a power circuit; the figures given above for the self-induction drop are then applicable, and show that both in overhead lines and cables the self-induction calls for some attention. Of course, on power circuits good regulation is not so important as on lighting circuits, but this fact is generally discounted by allowing a larger drop in the line. The article is to be concluded.—Lond. *Elec.*, July 18.

Protection of Machines.—CLARKE.—A brief article, illustrated by diagrams. While it is often said that every circuit should be protected by a fuse or automatic device, this rule does not apply where a three-wire system is balanced by means of a motor generator. The balancer is a very necessary machine, and is not in any case to be cut out of circuit while the generators are supplying current to the outers. When the balancer fails to perform its function, unless other means of balancing are available, the generating station should be shut down immediately. Consequently, no risk should be incurred by inserting fuses or cut-outs in circuit, but reliance should be placed on a good high-grade machine.—Lond. *Elec. Rev.*, July 11.

ELECTRO-PHYSICS AND MAGNETISM.

Radioactivity.—RUTHERFORD AND BROOKS.—A comparison of the radiations from radioactive substances. Both uranium and radium emit negatively charged particles with high velocities, similar in all respects to cathode rays. In addition, uranium, radium and thorium emit rays non-deviable by a magnetic field, which are readily absorbed by gases and thin layers of metal. These non-deflectable rays differ from one another in penetrating power, and cannot consequently be ascribed to any radioactive impurity common to all these substances. In addition, thorium and radium possess the remarkable property of continuously emitting radioactive emanations which behave in all respects like radioactive gases. The emanation from thorium and radium differ greatly in their rates of decay of radiating power. The presence of an emanation gives rise to the complicated phenomenon of "excited" radioactivity. The non-deviable "excited" radiations due to thorium and radium, although apparently of the same penetrating power, decay at very different rates. "Excited" radioactivity is not confined to radium and thorium, for Elster and Geitel have recently shown that a negatively charged wire, exposed in the open air, free from all possible contamination by radioactive substances in the laboratory, becomes strongly radioactive. This excited radioactivity decays at a different rate from that due to the emanations of thorium and radium, and is also of greater generating power.—*Phil. Mag.*, July.

Electric Resonance for Light Waves.—WOOD.—A brief abstract of a (Brit.) Phys. Soc'y paper, " on the electrical resonance of metal particles for light waves." In a previous paper he had shown that granular deposits of the alkali metals exhibit brilliant color by transmitted light; these colors were referred provisionally to the electric resonance of the minute particles for light waves. The present paper gives an account of experiments made with gold and silver films to determine whether the resonance is molecular, or whether it is an electrical vibration of metallic masses, smaller than the light waves, though of the same order of magnitude. Further investigations on the dispersion of the films and a more careful study with polarized light will doubtless throw light on the matter.—Lond. *Elec.*, July 11.

Discharge Between Flames.—SEMENOW.—An account of his continued researches on the discharge between and through flames. He compares a straight flame with a pointed conductor, whose density of charge is, of course, greatest at the point. In the case of a flame, the charge produces a diminution of pressure within the flame. When the distance between two flames is too great to allow of the passage of a spark, brushes appear at both flames, but in the case of the positive flame the brush is attached to it by means of a luminous thread 1 cm. in length. When the flames are brought closer together the brushes are converted into a spark, and he finds that the current of air accompanying the positive brush contracts and forms the spark. There is no sudden transition of one form of discharge into another; "*for* if a point wheel is substituted for the positive flame, its velocity of rotation diminishes steadily as the distance diminishes, and the brushes gives way to the spark." The spark, then, "consists of a positive air current and positive metallic ions." He further proves that the negative air current proceeds in the opposite direction, and surrounds the spark like a sheath.—*Comptes Rendus*,—June 16; abstracted in Lond. *Elec.*, July 4.

Ionized Vapors.—CAMPANILE AND DI CIOMMO.—An account of experiments, in which they found that ionized air, on being mixed with the vapor of a volatile liquid, undergoes a change of conductivity; in every case there is an increase of conductivity, which is somewhat in accordance with the volatility of the liquid.—*Phys. Zeit.*, June 1; abstracted in Lond. *Elec.*, June 4.

Period of Zodiacal Light.—DECOMBE.—A paper in which he advances a new hypothesis of the 11-year period of sun spots and of the zodiacal light. He considers that these periodic variations are of an electromagnetic character, and are propagated through what he regards as the residue of a flat solar nebula which extends far beyond the earth's orbit. The variations will die out in course of time, but will persist, and have persisted, very long on account of the very slight damping they undergo. If they obey the ordinary laws of the vibrations of free plates, the sun must be at a ventral segment, and the circumference may be regarded as a nodal line.—*Comptes Rendus*, June 9; abstracted in Lond. *Elec.*, July 4.

Zeeman Effect.—RUNGE.—An article on curious regular relations which he has found by studying the Zeeman effect. We know from the work of Paschen, Runge, Kayser and Rydberg that every spectrum may be split up into "series" of lines obeying certain laws. It is usual to distinguish a main series and two subsidiary series.

In addition, there are "doublet" series—*i. e.*, a series for each component of a set of doublets—and "triplet" series, resulting from the arrangement of all the first, second or third lines of a set of triplets in series. This series system has received a striking confirmation from the Zeeman effect. The author finds, first, that lines belonging to the same series are split up in an exactly similar manner, the difference of frequency produced being the same in each case; and he finds, secondly, that in different elements, lines of the "corresponding" series are split up in the same manner. Moreover there is a simple numerical connection between the differences of frequency produced in the components of triplets and doublets.—*Phys. Zeit.*, July 1; asbtracted in Lond. *Elec.*, July 18.

ELECTRO-CHEMISTRY AND BATTERIES.

Atomic Weights.—VINCENT.—A paper in which he brings forward a new numerical relation between the atomic weights of the elements. It states that the atomic weight is the 1.21st power of N, when N is the number of the element in an ascending series, and is always a whole number. Hydrogen is, of course, No. 1. There are, however, certain gaps in the series which the author allocates to elements yet to be discovered. The greatest deviation from the rule is shown by iodine, whose atomic weight comes out wrong by 3.9 units. But he shows that this may be due to a wrong serial number assigned to it. If it changed places with tellurium, not only would the error be much less, but the periodic law would be much better observed.—*Phil. Mag.*, July; abstracted in Lond. *Elec.*, July 11.

Gaseous Electrolytes.—HAGENBACH.—An account of experiments showing that gases are capable of dissolving and ionizing salts. He made up a cell of platinum and copper electrodes, with a solution of rubidium iodide in liquid sulphurous anhydride. *Rb I* was chosen on account of its great solubility and conductivity when dissolved. He measured the resistance and e. m. f. of the cell at temperatures ranging from 26° to 157° C. At the latter point, which lies above the critical temperature, the cell acquired a resistance of 500,000 ohms, but the e. m. f. was not sensibly affected, being about 0.1 volt, as against 0.07 volt at 26 degrees and 0.12 volt at 100 degrees. The copper electrode was oxidized and formed iodide of copper. The experiment shows that a gas is capable of ionizing a salt held in solution; at the same time, the chances of recombination are so much more numerous in a gas than in a liquid that the number of free ions is kept small. Hence the low conductivity of gaseous electrolytes.—*Ann. d. Phys.*, No. 7; abstracted in Lond. *Elec.*, July 4.

Gold Process.—HAMMOND.—An illustrated article, in which he discusses in general the conditions of gold mining in the Transvaal. Concerning the Siemens & Halske process, he says that its cost is slightly greater than that of zinc precipitation, and the percentage of extraction is about the same. But the Siemens & Halske process may be applied to any solution, weak or strong. The voltage used is 2 or 3; the current density about 0.06 ampere per square foot of cathode. Once a month the lead sheets are removed and replaced, and the gold-coated lead is melted and cupelled, yielding a bullion of 0.880 fine in gold, and 0.100 in silver.—*Cassier's Mag.*, July.

REFERENCES.

Laboratory Furnace.—An illustrated translation in abstract of Heraeus' article on a new form of laboratory resistance furnace with a spiral of platinum foil, as was recently noticed in the Digest. —Lond. *Elec.*, July 18.

Dry Cell.—An article giving rules for making a dry cell.—*English Mechanic; Sc. Am., Sup.*, July 5.

Dusseldorf Exposition.—An article on stationary and automobile storage batteries, exhibited by the Neumuehl Lead Works of Morian & Co.—*Centralblatt f. Accum.*, July 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Nomenclature.—STRECKER.—A paper read before the Berlin Electrical Society, in which he gives the report of a special committee on uniform nomenclature. The basis of the nomenclature proposed is the table recommended by the Chicago Electrical Congress in 1893 (see ELECTRICAL WORLD AND ENGINEER, Jan. 5, 1901, page 50), but while the latter contains only 37 quantities, the new table proposed contains 53. The magnetic quantities in the Chicago Congress table are designated by letters which are variously denoted as "French script" in this country, "German script" in France, and "round script" in Germany. In the present table the regular German capital letters are used in the place of these, and although they are considered to be the same by the author, there is, as a fact, considerable difference. It is proposed to represent not only the magnetic quantities by these letters, but also the heat quantities. The following symbols are new: number of turns N, frequency n, radius R, r, number of revolutions d, work A, efficiency h, specific gravity or density δ (Greek letter), temperature $\mathfrak{T}$, $\mathfrak{t}$ (German letters), heat quantity $\mathfrak{Q}$ (German letter), magnetic quantity $\mathfrak{m}$ (German letter), magnetic reluctance $\mathfrak{W}$ (German letter), coefficient of magnetic hysteresis η (Greek letter), electric resistance W, w, dielectric constant ϑ (Greek letter), electrochemical equivalent a (Greek letter), eddy current constant β (Greek letter). It is proposed to use L both for the coefficient of self-induction and for the coefficient of mutual induction, but to distinguish them by the indices s and m. Whenever in an article or paper this nomenclature is used, it is suggested to indicate this by a simple sign placed at the head of the article; for this it is proposed to use the sign ※. This system is offered as a suggestion, and the electrical engineers of all countries are invited to discuss it.—*Elek. Zeit.*, June 5.

Testing Meters.—DAWSON.—An article in which he discusses the "short-time' test for several meters; it consists in the passing of a steady current at the usual proportions of full load, noting the time taken to cause one revolution of the spindle, or *vice versa*, noting the revolutions of the spindle in a certain time, and from this ascertaining the actual constant K of the meter, then comparing with the testing or required K and deducing the percentage error. The testing K has a different meaning with different types of meters. In the Chamberlain & Hookham meter it is the time in seconds that 1 ampere will take to cause the armature spindle to make one complete revolution. In the Ferranti meter it is the number of revolutions of spindle per ampere per minute and depends upon the ratio wheels. In the Thomson watt-hour meter it is the number of watt-hours recorded by one revolution of the armature spindle. The rules and formulas for the tests in the case of these three meters are given.—Lond. *Elec. Rev.*, July 25.

Unifilar Magnetometer.—SCHULZE.—A paper in which he discusses the comparative value of the bifilar and unifilar suspension of a magnetometer needle, in view of the fact that the latter type is now the most popular in terrestrial magnetic observations. He shows that if, with a unifilar suspension, the needle is twisted out of the magnetic meridian into a new position of equilibrium, the oscillations about the new zero are unsymmetrical, the greater elongations being on the side towards which the twist has taken place. In ordinary operations the deflections are of greater importance than the oscillations, but the author shows that a similar lack of symmetry is shown in the deflections produced by equal couples. The errors thus introduced may easily be of practical importance, as is shown by a simple calculation. He gives an equation by means of which the true scale values may be calculated for positions near the zero, and also a method of correcting the readings for considerable deflections. These corrections have hitherto been neglected in magnetic observations.—*Ann. d. Phys.*, No. 7; abstracted in Lond. *Elec.*, July 18.

Induction Coil.—IVES.—The conclusion of his illustrated paper. He discusses the problem of how much capacity must be put around the break to stop the sparking at the break. He gives a formula for the "optimum" capacity, that is, that value of the capacity which gives the greatest difference of potential in the secondary. This formula shows that the optimum capacity is directly proportional to the steady current and inversely proportional to the velocity of breaking, and to the dielectric constant. This appears to indicate that for the same current and the same dielectric the optimum capacity depends only upon the rate of breaking of the primary circuit. The velocity which, according to his theory, is both necessary and sufficient, in order that there shall be no sparking, is called the safe velocity. According to his theory, when the speed of breaking is increased, without a change of the capacity, the secondary potential should increase up to a certain point and then remain constant. He has examined these theoretical results by experiment, but the results obtained were not very definite. They show a tendency towards a decrease in the secondary potential as the velocity of breaking is decreased, but do not, as a rule, show any well marked value of the velocity above which the potential remains constant. The experiments were made with three different kinds of

breaks, called by him the guillotine break, the free-fall break, and the rotating break.—*Phys. Rev.*, July.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—Gray.—A paper read before the Engineers' Club, of Philadelphia. He gives a brief historical review and a general statement of the chief methods used at present in wireless telegraphy. He refers briefly to the Fessenden system, as follows: "The sensitive part of his receiver is a continuous conductor and does not depend for its operation, like the coherer, on a vast number of loose contacts. Each time the electrical oscillation passes along the circuit in which the Fessenden receiver is placed, a change occurs in the electrical condition of the circuit. This change of condition manifests itself as a click in the telephone receiver. One click is produced each time a complete oscillation passes along the wire; or, in other words, each time the secondary spark occurs at the sending station. If these interruptions are slow, the clicks are difficult to interpret. As the number of interruptions increase, the individual clicks form themselves into more or less of a buzzing sound; and if the interruptions are made with a tuning fork, for instance, the telephone receiver will produce the same tone as the sending mechanism gives out. It will be seen that this arrangement lends itself, with slight modifications, to a telephone system." The chief advantages of the Fessenden system are said to be the simplicity of circuits and the fact that there are none of the fine adjustments necessary that are required in the coherer system. The Fessenden receiver is said to have between 20 and 25 times the sensibility of the former receivers. His system is also said to be admirably adapted to syntonic methods.—*Proc. Eng. Club, Phila.*, July. (Professor Fessenden has had a series of United States patents issued to him on his system, under date of August 12.—Eds. E. W. & E.)

Telephone Vibrations.—Kempf-Hartmann.—An account of the results of a long investigation of the vibration of telephone membranes. He recorded the vibrations of a telephone diaphragm by means of a mirror stuck onto it, and a device consisting of an arc light, a point diaphragm, a system of lenses and a revolving cylinder containing a sensitive film. The first point investigated was whether a note received by the diaphragm gives rise to a corresponding series of vibrations of the diaphragm at once, or whether the vibration only gradually fell in with that of the air. The photographic traces of a tuning fork note show that the reaction is practically instantaneous, the "period of latency" not exceeding 0.0005 second. The maximum amplitude is attained as soon as two full periods have passed through. After that the curve for a constant sound remains remarkably constant. When the note ceases, the proper vibration of the diaphragm persists long enough to be seen and even heard, but it is greatly damped by a rubber plug attached to the center of the diaphragm. It also appears that the overtones which produce the rattling and clattering noises in the telephone are the more prominent the greater the force with which the note is sounded. The records show a sound whenever a sound is heard, and *vice versa*. In traces of complete words, however, the records show a number of details which are quite beyond the perception of the ear. He gives some interesting curves representing vowels and consonants, which are reproduced in the finest details.—*Ann. d. Phys.*, No. 7; abstracted in Lond. *Elec.*, July 11.

Miscellaneous.

Electricity and Plant Growth.—Plowman.—An account of some experiments made at the Harvard Botanic Gardens. They have been of a widely varied nature, dealing with both static and kinetic charges, through a range of potential from 0.5 to 500 volts. Either platinum or high-grade carbon was used for the electrodes, and special care was taken to insure normal conditions of temperature, light and moisture. The results appear to show that vegetable protoplasm is paralyzed and quickly killed by the conditions existing about the anode, while within certain fairly broad limits it is stimulated by the conditions about the cathode. For instance, seeds placed near the anode are always killed by "current amounting to 0.003 ampere or more," if continued for 20 hours or longer, while seeds placed near the cathode have in most cases been but little affected, and under some conditions have been apparently stimulated by such currents. He tries to explain his observations by a provisional theory, in which he assumes "certain relations of plant growth to ionization of the soil." He thinks the effects are produced by the electrical charges of the ions, rather than by any mere chemical activity of the atoms. He makes some peculiar assumptions; for instance, he says that "since the movements of ions in solutions are relatively slow it is reasonable to suppose that in the region of the anodes there would be slight excess of positive ions, due to the rapid neutralization of the negative ions by the positively charged electrode" (This disagrees with modern views, according to which at any place inside of an electrolyte there are always the same number of positive and negative ions).—*Am. Jour. Sc.*, August.

References.

Lightning Flash.—A communication, with diagram, on "a remarkable lightning flash," which did damage to an electric line.—Lond. *Elec.*, July 11.

Dusseldorf Exposition.—The first part of a well-illustrated description of machines and apparatus exhibited by Lahmeyer & Co.—Lond. *Elec. Rev.*, July 11.

New Books.

Books Received.

Diagrams and Complete Information for Telegraph Engineers and Students. By Willis H. Jones. New York: *Telegraph Age*. 260 pages, 126 illustrations. Price, $1.50.

Self-Propelled Vehicles.—A Practical Treatise on the Theory. Construction, Operation, Care and Management of all Forms of Automobiles. By James E. Homans, A. M. New York: Theo. Audel & Company. 632 pages, 466 illustrations. Price, $5.00.

Position of Electrical Engineer.

The New York Municipal Civil Service Commission has issued notice that an examination for electrical engineer will be held on Friday, August 29, at 10 A. M. The data given is as follows: The receipt of applications for this examination will close on Monday, August 25, at 4 P. M. The scope of the examination will be as follows:

Subjects and Weights.—Technical knowledge, 6; experience, 2; handwriting, 1; arithmetic, 1.

Candidates who obtain a place upon the eligible list as a result of this examination will be certified to any department of the city employing persons requiring the experience and knowledge of an electrical engineer, at a salary of $3,000, or more, per annum (sixteenth grade).

There is at present a vacancy existing in the Fire Department under the title of "Superintendent of Telegraph." The compensation attached to this position is $3,000 per annum.

Applicants should possess the education of an electrical engineer, and should have had practical experience in the construction and management of fire-alarm telegraph or telephone circuits, including the construction of subways, character of cables and telegraphic lines, planning and making of circuits, and of the extension of lines and electrical connections incident thereto; making estimates, specifications and calculations of the cost of construction of subways, ducts, cables, etc., and should have had experience in handling men.

The Manufacture of an Incandescent Lamp.

The various processes involved in the manufacture of incandescent lamps have for the most part been heretofore regarded as more or less of trade secrets, but recently the Sawyer-Man Electric Company, in a pamphlet on the Sawyer-Man lamp, has given a brief account of the various steps in the making of its product. As the subject will, we believe, be one of interest to many of our readers, we present a condensation of that portion of the pamphlet treating of the details of a Sawyer-Man lamp. The accompanying illustrations will assist in following the description.

As a result of 20 years of careful investigating and experimenting, a filament is now being made which is so tough that it is not affected in any way by the rough usage to which it is subjected during the life of a lamp; so elastic that when forced out of its moulded curves it will spring instantly back like a steel wire, and so enduring that in the finished lamp it will glow with almost undiminished brilliancy for many hundred hours at a temperature of 1,500° to 1,600° C.

To form the filaments, a solution of cellulose is squirted through

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 4½ to 5 per cent. for 30 to 90 days, and 4¾ to 5 per cent. for four to six months. In the stock market there was some irregularity, although there was a strong tone. Favorable crop prospects kept up the bullish tone in connection with the granger stocks, and soft coal shares advanced materially. Manhattan was weak on reports of a possible strike of its engineers, and industrials were neglected. Brooklyn Rapid Transit was weak under poor July earnings statement and talk of the possible resignation of its president. The United States Steel stock were dull. In Boston, General Electric closed with a net loss of 10 points ,and American Telephone and Telegraph ⅝ of a point, the market being quiet. Tractions closed weak at New York, Met. St. Ry. at 148¾, a net loss of 1 point, and Brooklyn Rapid Transit at 68¾, a net loss of ½ point. General Electric made a net gain of ¼ point on sales of 1900 shares, the closing figure being 185½, which was only ½ point below the highest figure of the week. Am. Tel. & Tel. kept unchanged at 164, this quotation representing a net loss of 1 point. Western Union closed at 88¾, being a net gain of 1¼ point. Following are the closing quotations of August 12:

NEW YORK.

	Aug. 5.	Aug. 12.		Aug. 5.	Aug. 12.
American Tel. & Cable	93⅞	87	Hudson River Tel.	—	—
American Tel. & Tel.	164	163½	Metropolitan St. Ry.	149	148½
American Dist. Tel.	—	—	N. E. Elec. Veh. Trns.	10½	—
Brooklyn Rapid Transit	69¼	67⅝	N. Y. & N. J. Tel.	—	—
Commercial Cable	—	155	N. Y. E. V. T. Co.	—	11⅝
Electric Boat	25	23	Tel. & Tel. Co. Am.	—	—
Electric Boat pfd.	50*	40	Western Union Tel.	89	91¾
Electric Lead Reduc'n.	2½	2¼	West. E. & M. Co.	—	215
Electric Vehicle	7⅛	6½	West. E. M. Co. pfd.	—	—
Electric Vehicle pfd.	14½	14			
General Electric	185¼	185			

BOSTON.

	Aug. 5.	Aug. 12.		Aug. 5.	Aug. 12.
American Tel. & Tel.	163¾	162½	Western Tel. & Tel. pfd.	—	—
Cumberland Telephone.	—	—	Mexican Telephone	2¼	2¼
Edison Elec. Illum.	280	—	New Eng. Telephone	142	142¼
Erie Telephone	—	—	Westinghouse Elec.	—	106½
Western Tel. & Tel.	—	—	Westinghouse Elec. pfd.	—	106½

PHILADELPHIA.

	Aug. 5.	Aug. 12.		Aug. 5.	Aug. 12.
American Railways	47¾	50	Phila. Traction	99¾	99½
Elec. Storage Battery	—	88½*	Phila. Electric	5⅝	5⅝
Elec. Storage Bat'y pfd.	—	87	Pa. Elec. Vehicle	—	—
Elec. Co. of America	8⅞	8⅝	Pa. Elec. Vehicle pfd.	—	—

CHICAGO.

	Aug. 5.	Aug. 12.		Aug. 5.	Aug. 12.
Central Union Tel.	—	—	National Carbon pfd.	102½	100
Chicago Edison	—	—	Northwest Elev. com.	—	36½
Chicago City Ry.	210	220	Union Traction	—	15
Chicago Tel. Co.	—	—	Union Traction pfd.	47	—
National Carbon	30	31			

* Asked.

JERSEY TROLLEYS.—It is reported that the merger of the North Jersey Street Railway Company, of Jersey City and Newark; the Jersey City, Hoboken and Paterson Railway Company, and other trolley lines in Northern New Jersey had been effected, and that formal announcement of the consolidation will be made this week. It is said that Prudential Life Insurance Company interests are represented in the new combination, and that they sanctioned an offer of 38 for North Jersey Company stock, and 28 for the stock of the Jersey City, Hoboken and Paterson Company. North Jersey stock was quoted at 34⅞, and Jersey City, Hoboken and Paterson at 24⅝ last week. It is also said that the consolidation agreement has been signed by leading officials of the companies affected. Chandler Riker, of Newark, is the promoter of the new combination, which, it is said, includes all the street railway systems of Hudson, Essex, Union and Passaic counties and other portions of the State, the middle system, including Middlesex and Monmouth, and the seacoast system, all the principal lines in South Jersey and the lines in Staten Island. It is said to be the intention of the syndicate to make many changes and improvements, and to extend lines and construct a tunnel under the Kill von Kull from New Jersey to Staten Island. One of the advantages in merging the roads will be economy in maintenance and operation.

OTIS ELEVATOR.—A special meeting of the stockholders of the Otis Elevator Company has been called for Sept. 8, to take action on the question of the proposed amendment of the certificate of incorporation by the increase of the authorized capital stock of the company in the sum of $2,000,000, such increase to be preferred stock, to have the same privileges as the present preferred stock. This action is deemed necessary in view of the continuing increase and expansion of the company's business. Of the proposed increase, $1,000,000 will be offered to the stockholders, so that each stockholder, both common and preferred, will have the right to purchase at par such preferred stock to the amount of 10 per cent. of his holdings. The balance of the authorized preferred stock will remain in the treasury, to be issued only as the necessities of the company may require.

STATEN ISLAND PROPERTIES.—The properties of the Staten Island Electric Railroad Company and the New York and Staten Island Electric Company were sold by auction last week. The property of the company was bought in for $250,000 and that of the New York and Staten Island Company for $10,000. The purchaser in both cases was William L. Bull, chairman of the Reorganization Committee formed to control both properties. The two properties have been in the hands of Receiver John Greenough since March 1. According to the plan of the committee the two companies are to be incorporated on Sept. 1 as the Richmond Light and Railroad Company. The property of the New Jersey and Staten Island Ferry Company, which is connected with the other companies, was to have been sold also, but it was withdrawn.

INTERBOROUGH RAPID TRANSIT.—A special meeting of the stockholders of the Interborough Rapid Transit Company, of New York City, has been called for August 26, to consider an increase in the capital stock of the company from $25,000,000 to $35,000,000. The reason for the proposed increase is that the additional capital is required to meet the cost of the Brooklyn extension of the rapid transit subway. It is estimated that the extension will cost about $10,000,000, while the bid of the company was for $3,000,000. The call for the special meeting is signed by August Belmont, president, and Frederick Evans, secretary. The increase of capital will be effected by the issue of 100,000 new shares of the par value of $100 each.

INDEPENDENT TELEPHONE DEAL.—A dispatch from Richmond, Va., of August 11, says: The absorption of the Winchester Telephone Company by the United Telephone and Telegraph Company, of Philadelphia, was officially announced to-day. The new company controls 30,000 telephones, and will acquire 30,000 more. It is its intention to enter New York. The officers of the new company are: President, R. T. Barton, of Winchester; vice-president, W. D. Bernard, of Philadelphia; treasurer, S. R. Caldwell, of Philadelphia; local manager, S. L. Hoover; general manager, W. J. Latta, Philadelphia; Directors, T. J. O'Neill, Hanover; C. M. Clement, Sunbury, and S. H. Hansbrough and W. H. Baker, Winchester.

BOSTON ELEVATED STOCK.—The Railroad Commission held a hearing upon the petition of the Boston Elevated to issue $5,000,000 of new stock. Counsel Snow appeared for the company. He presented a table showing that the Elevated Company has expended $3,754,023 above the amounts estimated by the Railroad Commissioners as necessary to build the road when the $10,000,000 stock was authorized. The elevated people stated to the Railroad Commissioners that a price of $125 for the new stock would be satisfactory to them, and they did not think it should be above this figure, as the earnings of the road would not be increased through any of the money obtained by the new issue.

BOSTON EDISON.—The Boston Edison Company is gradually selling the several parcels of land secured through the purchase of the Boston Electric Light Company. The company's adjourned special meeting, to take final action upon new stock issue, will be held August 20. The gas commissioners recently authorized the company to issue 16,500 new shares at $200 a share, increasing the company's capital 20 per cent. It is understood that the stockholders will be asked, August 20, to vote an increase in the capital of but 10 per cent., the remainder of the authorized issue probably to issue next year. The earnings of the company are large and progressive.

SALE OF BELL STOCK.—At Boston last week R. L. Day & Co. sold at auction 881 shares of stock of the American Telephone and Telegraph Company, by order of the directors. After spirited bidding, the stock was sold as follows: 826 shares to Curtis & Sanger, at 163⅝; 50 to R. L. Day & Co., at 163¾; 5 to R. L. Day & Co., at 164. The larger lot will doubtless be split up for investors.

CAR LIGHTING DEAL OFF.—Dispatches from Albany, N. Y., state that negotiations for the consolidation of the Consolidated Car Heating Company, of that city, with the Safety Car Heating and Lighting Company, of New York, and the Gold Car Heating Company, of New York, have been entirely suspended.

DIVIDENDS.—The directors of the Kings County Electric Light and Power Company have declared the regular quarterly dividend of 1½ per cent., payable Sept. 2. The directors of the Niles-Bement-Pond Company have declared a semi-annual dividend of 4 per cent. on the common stock, one-half payable Sept. 15 and one-half payable Dec. 15. The directors of Pratt & Whitney Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable August 15. Metropolitan Elevated directors, of Chicago, have declared a semi-annual preferred dividend of 1½ per cent., payable August 30.

ST. LOUIS UNION BONDS.—The Union Electric Light and Power Company, of St. Louis, is to issue $10,000,000 five per cent. gold bonds.

Commercial Intelligence.

THE WEEK IN TRADE.—The midsummer quiet in distributive trade has disappeared, and, stimulated by brilliant crop prospects and good prices for farm products, Fall business has begun to expand, says *Bradstreet's*. Buyers are arriving in large numbers at all markets. The manufacturing industry continues well employed, and failures are few and liabilities small. July railway earnings returns so far reported show 7 per cent. gain over last year. The car famine trouble is a subject of complaint, and this promises to extend to other lines. The weight of imported iron is present on the domestic sentiment, though no perceptible effect is yet seen on prices for pig iron, which is still in active request for next year's delivery. Steel rails, bolts, bars and sheets are active at the West, but the edge of the demand for plates and sheets appears to have been taken off at Pittsburg. Structural material is active at Chicago and at Pittsburg, where sales have been very large. Shipbuilding interests have taken 40,000 tons of plates at Pittsburg. Western machinery manufacturers are crowded with orders. The copper market is very dull, and little metal has been offered for sale, changing hands at slightly lower prices. Following are the last quotations: Lake, 11¾ @ 11⅞c., electrolytic in cakes, wire bars and ingots, 11½ @ 11⅝c; cathodes, 11¼ @ 11⅜c., and casting stock, 11½c. The business failures for the week ending August 7, as reported by *Bradstreet's*, numbered 169, as against 168 the week previous and 185 the same week last year.

WESTINGHOUSE, CHURCH, KERR & CO. have under fulfilment a number of important contracts for railway, lighting and power properties. Metropolitan Street Railway—Third Avenue division: The designing of the entire Kingsbridge station and the installation of boiler, engine, condenser and generator equipments. This station contains one of the largest aggregations of power generating machinery in the country. Meriden Electric Light Company, Meriden, Conn.: The entire remodeling of the present lighting plant, rebuilding and extension of boiler and engine room, and the installation of an entire equipment of new machinery. Lackawanna & Wyoming Valley Railroad: The designing and construction of one of the most important high-speed interurban roads in the country. American Car and Foundry Company, Berwick, Pa.: The erection of an entire car manufacturing establishment, similar to that just completed for the same concern at Detroit, Mich. Rochester, Auburn & Syracuse Railway: Design and construction. This road is also an important interurban road, representing the most advanced engineering practice. Pittsburg & Lake Erie Railway: McKees Rocks, Pa.: Complete mechanical equipment for large railroad shops and terminal station now building at this point. Champion Coated Paper Company, Hamilton, Ohio, and American Smelting and Refining Company: Extensive high-pressure steam piping outfits. Nikola Tesla, Wardencliffe, L. I.; Electrical equipment, steam engines, auxiliary apparatus, steam piping, etc. Walter W. Law, Briarcliffe Manor, New York: Electrical heating and refrigerating outfits for suburban isolated plant and villa. The Phipps residence, New York: Complete mechanical, electrical, heating and refrigerating outfits for isolated plant.

FORT WAYNE ELECTRIC GATHERING.—During the week beginning July 28th the district managers and agents of the Fort Wayne Electric Works held a convention at the home office, which was very interesting because of its business features and the social enjoyment of the occasion. Representatives from all the large cities in which the company has sales offices were present. Mr. F. S. Hunting, general sales manager, made the evenings of the week especially interesting in a social way by a trolley and theatre party to Robinson Park, and the week was fittingly ended by a banquet tendered by the Fort Wayne Electric Works to the district managers and sales agents at the Wayne Club. There were present Lieut.-Governor Gilbert, H. C. Paul, president of the Fort Wayne Electric Works; Hon. R. S. Taylor, and several local directors. Judge Taylor gave a very interesting early history of the business and the early struggles of the founders of the Fort Wayne Electric Works, and related how he and R. T. McDonald, when working together to gather evidence to defend an infringement suit brought against the infant concern for manufacturing an arc lamp, "discovered Mr. J. J. Wood." The representatives present were: J. Allan Smith, Boston, Mass.; E. B. Goldsberry and C. A. Woolsey, Philadelphia, Pa.; A. E. Dresser, Syracuse, N. Y.; J. E. Hall, Pittsburg, Pa.; T. J. Ryan, Cincinnati, Ohio; T. W. Dixon, St. Louis, Mo.; A. H. Savage, St. Paul, Minn.; W. S. Goll, W. C. Knight, Frank McMaster, Chicago, Ill.; A. L. Searles, Grand Rapids, Mich.; J. C. Lott, New York, N. Y.; T. L. Sturgeon and Fred L. Reynolds, of the home office.

THE A. G. SCHOONMAKER COMPANY, of 126 Liberty Street, New York City, reports a very satisfactory state of trade. This Company is the representative of the Eager Electric Company, of Watertown, N. Y., builders of direct-current apparatus. Among the recent installations of the Eager apparatus may be mentioned: J. H. Lebkuecher, Newark, N. J., six 150-kw direct-connected generators; The Analomink Paper Company, Water Gap, Pa., one 30-kw direct-connected generator; The Black River Traction Company, Watertown, N. Y., two 200-hp engine-type, direct-connected, street-railway generators; one 50-kw booster set. The Schoonmaker Company carries in stock a full line of Ward Leonard starting boxes, in all sizes, and a full line of smaller new motors, at 220 and 500 volts. The shipment of rebuilt cars and motors is conducted from shops in Brooklyn. Among recent work may be mentioned: A large vestibuled motor car for the Moline, East Moline & Watertown Railway Company, Moline, Ill.; several open cars for the East Bangor, Portland & Delaware River Street Railway Company, Bangor, Pa. Several 150-ton hydraulic wheel presses have been shipped during the past month.

BELL TELEPHONE INSTRUMENTS.—The instrument statement of American Telephone and Telegraph for the month ended July 20, 1902, and the seven months since Dec. 20, 1901, follows. Month ended July 20:

	1902.	1901.	1900.
Gross output......	59,935	56,526	65,463
Returned	34,054	30,241	30,093
Net output......	25,881	26,285	35,370
Seven months from Dec. 20:			
Gross output......	649,044	526,449	411,609
Returned	260,321	224,810	162,753
Net output	388,723	301,639	248,856
Total outstanding.	2,914,735	2,254,455	1,839,361

THE KENTUCKY ELECTRICAL COMPANY, Owensboro, Ky., are moving into their new factory, a two-story brick building, their business having increased so rapidly in the past year that they have been compelled to increase their capacity. In their new quarters, the lamp department will be equipped with modern appliances and have an immediate daily capacity of 3,500 incandescent lamps, with ample room to increase this output to 5,000 per day. In the dynamo and motor department, all machine tools will be electrically driven and with facilities for building up to 50-kw. Their present line will be increased immediately to 30 kw. Their dynamos and motors have given excellent satisfaction, their present facilities having been taxed to their utmost for many months to supply the demand. Mr. A. W. Stuntz is secretary and electrical engineer.

THE NERNST LAMP COMPANY, of Pittsburg, Pa., reports having closed a contract with the Lunkenheimer Company, of Cincinnati, Ohio, for 238 lamps, and has just completed the installation of a large number of lamps in Messrs. Atha & Atha's store, Pittsburg. It has another large contract with the Commercial Electrical Company, of St. Louis, and contracts with various other concerns for 165 of its six-glower lamps, 250 three-glower, 115 two-glower and 871 one-glower. All of the above contracts were for lamps to be operated on alternating-current circuits.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY reports the sales of Westinghouse integrating wattmeters for the month of June to have been the largest in the history of the company. The sales of Westinghouse transformers have more than doubled in the past six months, and the transformer building capacity of the Westinghouse Company has been largely increased to meet the demand.

BALL ENGINE ORDERS.—The National Biscuit Company, of Baltimore, is installing an electric plant, consisting of two 300-hp cross-compound engines, direct connected to General Electric generators. A new addition to the power plant of the Lewis Institute, Chicago, will consist of a 150-hp engine, built by the Ball Company, direct connected to a 75-kw generator.

AMERICAN UNION ELECTRIC COMPANY.—With regard to our previous data on this new concern, Mr. S. Marsh Young, of the company, states that in addition to its purchase of the Union Railway Power and Electric Company, Morris Electric Company, The Falcon Electric Manufacturing Company, Electric Motor Specialty Company, Fountain Manufacturing Company, The Federal Manufacturing and Specialty Company, and Refrigerator Machine Company, it has added the Metropolitan Switchboard Company from Messrs. Chas. L. Eidlitz, T. J. Murphy and G. A. Annable. The American Union Electric Company intends to continue to operate the factory of the Metropolitan Switchboard Company at West Twenty-ninth Street, New York, as an auxiliary to its plant at Ampere, N. J., and in the Twenty-ninth Street factory will handle all switchboard and special panel-board work under the supervision of Mr. T. J. Murphy, former president of the Metropolitan Switchboard Company. The purchase of the Metropolitan Switchboard Company carries with it the ownership of the "Murphy" patents, which cover forms of installation of panel boards, as well as built-up panel board boxes and the divisible panel board. The American Union Company announces that it will probably turn in these patents to the general benefit of the panel board business, and will issue licenses to panel board manufacturers, its object being to strengthen the general situation and to enable the legitimate panel board manufacturers to receive a fair return on their investment. The new additions to the factory of the American Union Electric Company, at Ampere, N. J., covering about 23,000 square feet of floor space, are about completed, although plans are being prepared for the still further addition of a new brick building 300 x 50 feet for a general machine shop, as well as office building and warehouse.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended August 9: Argentine Republic—306 pkgs. material, $5,537. Almeria—1 pkg. material, $165. Antwerp—19 pkgs. material, $1,553; 7 pkgs. machinery, $1,120. Brazil—80 pkgs. material, $3,312; 7 pkgs. machinery, $224. Brussels—3 pkgs. material, $171. British West Indies—13 pkgs. material, $260. Berlin—1 pkg. machinery, $116. Barcelona—14 pkgs. material, $178. British East Indies—12 pkgs. material, $725. British Australia—72 pkgs. machinery, $3,379; 65 pkgs. material, $1,051. Cuba—28 pkgs. material, $794. Copenhagen—2 pkgs. material, $705. Chili—72 pkgs. material, $3,584. Central America—17 pkgs. material, 297. Dutch West Indies—2 pkgs. material, $18. Egypt—9 pkgs. material, $434. Glasgow—16 pkgs. machinery, $1,175; 4 pkgs. material, $165. Havre—9 pkgs. machinery, $587; 11 pkgs. material, $305. Hamburg—37 pkgs. material, $2,540. London—108 pkgs. machinery, $1,570; 157 pkgs. material, $7,642. Liverpool—207 pkgs. machinery, $12,220; 35 pkgs. material, $1,962. Mexico—93 pkgs. material, $3,318. Manchester—227 pkgs. machinery, $25,599; 1 pkg. material, $21. Nova Scotia—29 pkgs. material, $205. New Zealand—1 pkg. machinery, $58. Newfoundland—2 pkgs. machinery, $90. Odessa—8 pkgs. machinery, $315. Peru—10 pkgs. machinery, $116. Rotterdam—2 pkgs. machinery, $80. Southampton—83 pkgs. material, $1,026. Stockholm—5 pkgs. material, $130; 2 pkgs. machinery, $1,000. Strasburg—1 pkg. machinery, $120. Uruaguay—1 pkg. material, $40. U. S. Colombia—3 pkgs. machinery, $159. Venezuela—52 pkgs. material, $737.

STREET SIGN LIGHTING.—President Cantor, of New York, has awarded the contract for the placing of 6,000 dark-blue enameled street signs and 2,000 street sign boxes with reflectors, deflectors and radiators, to be attached to existing poles. When the bids were opened it was found that there were no bidders for the 1,200 street sign boxes of two different patterns, one for electric light and the other for gas light, to be erected on existing lamp-posts, fire-alarm and electric-light poles. President Cantor was surprised because no bid was received for this work. Two bids were received for the dark-blue enameled street signs. The first was that of Wilfred Buckley for the signs at 90 cents, and the other was from the Imperial Enamel Company at 98 cents. President Cantor referred the Buckley bid to Corporation Counsel Rives, as he claimed that it was informal, and later he awarded the contract to the Imperial Enamel Company at 98 cents. The bidder for Contract No. 3 was the Electric Reflector Company, which bid as follows: Common rectangular signs, $20 each; triangular signs, $18 each; rectangular signs with four-lettered signs, $12.50 each; rectangular signs lighted by Welsbach lights, $17.50. As this bid was the only one, the contract will have to be awarded to this firm. President Cantor ordered that Contract No. 2 be readvertised both with and without the maintenance clause, and with and without the lighting clause.

SOME GOUDEY-McLEAN EXPORT ORDERS.—The Goudey-McLean Company, of 88 Maiden Lane, New York, export sales managers for a number of American manufacturers of electrical machinery, etc., have just secured several fair-sized orders for motors, etc., to be shipped to the European markets. The Scottish Goudey-McLean Company, which was recently organized to look after interests in Scotland, has sent in orders within the last week or two for a number of motors, varying from 15-hp to 3½-hp. These motors are to be supplied by the Milwaukee Electric Company and the Browning Manufacturing Company, of Milwaukee, Wis. The American Electric Syndicate, of Vienna, which attends to the Goudey-McLean interests in Austria, has also requisitioned for several small motors of Browning build. Edge & Edge, of Sydney, New South Wales, have sent in a substantial order for lightning arresters, to be furnished by the Garton-Daniels Company, of Keokuk, Ia.

ROTARY TRANSFORMERS FOR SAN FRANCISCO.—The United Railroads of San Francisco has closed a contract with the General Electric Company for two 500-kw rotary transformers, which will be installed at the new San Bruno sub-station. They will be served from the three-phase plant which is being constructed by the company in the northern part of the city, and will be in operation next October. The rotaries will supply direct current at 600 volts, to operate electric cars between San Mateo and San Francisco. The electric power plant will have a capacity of 16,000 hp, and half of this capacity will be installed at once.

HYDRAULIC BIDS.—The Cloverdale Electric Light and Power Company is about to receive bids for its hydraulic work. A. E. Sharboro, of San Francisco, has been granted a right of way through condemnation proceedings for a pipe line and flume over the lands of the W. P. Ink estate. The plant will be located on Sulphur Creek, and electric lights will be supplied in Cloverdale and at Asti, where the winery of the Italian-Swiss colony is located. The transmission line will be extended to other points. The Engineering Offices, San Francisco, have charge of the work on this water power electric system.

ELECTRIC ELEVATORS.—The first Manhattan elevated station to have electric elevators will be the new one at West One Hundred and Tenth Street. The Otis Elevator Company have received an order from the Manhattan Railway Company for heavy electric passenger elevators to be installed in the new station, each to have a maximum lifting capacity of 3,300 pounds and a speed of 300 feet per minute. The travel of each car will be 60 feet. One week's orders showed 51 electric elevators and 15 hydraulic—possibly a good illustration of the trend of things.

NEW INSULATOR FACTORY.—Several independent telephone people contemplate the erection of a large glass factory at Toledo, Ohio, where will be manufactured glass insulators for telephone lines. The men interested are: E. L. Barber and James Brailey, of the Home Telephone Company; C. H. Roser, of Lima, Ohio; C. K. Duffy, of Lynn, Mass.; W. W. Townsend, of Chicago; Walter F. Ritchie, of Lima; James Brailey, Jr., of the Home Telephone Company; John A. Conway, of Detroit; C. N. Haskell, of Ottawa, Ohio.

ENGINES FOR COSTA RICA.—The United Fruit Company, of Boston, at 24 State Street, New York, has placed a contract through the American Supply and Construction Company, 120 Liberty Street, for three 150-hp belted engines, to be built by the Harrisburg Foundry and Machine Works. The engines will be utilized for operating an electric light and power plant on the Fruit Company's banana plantations in Costa Rica, Central America.

LIGHTING PLANT FOR JAPAN.—The Kyoto Electric Light Company's plant, Kyoto, Japan, is to be equipped with a 500-hp cross-compound condensing engine, to be built by the Buckeye Engine Company, of Salem, Ohio, for direct connection to a 350-kw generator of General Electric manufacture. The order was placed through the American engineering and contracting firm of Bagnall & Hilles, of Yokohama.

JAMES J. MURRAY & CO., of Philadelphia, Pa., whose plant was struck by lightning on July 25, report that it was but slightly damaged. They made temporary arrangements to fill all orders for their electric and other glassware, as their two furnaces were uninjured, and they were able to resume operations in full by August 1.

CAR FENDERS FOR SOUTH AFRICA.—The Consolidated Car Fender Company, of Providence, R. I., has secured a contract from the British electrical engineering and contracting firm of Macartney, McElroy & Company, 26 Cortlandt Street, for 60 equipments for the Durban, South Africa, electric traction system.

WIRELESS TELEGRAPH CONTRACTS.—The De Forest Wireless Telegraph Company has been informed by Col. H. E. C. Dunwoody, of the Signal Corps, Department of the East, United States Army, that its bid for the installation of wireless stations connecting Fort Wadsworth and Fort Hancock has been accepted.

NEW YORK CITY PLANT.—An ordinance has been approved by Mayor Low to provide $200,000 corporate stock for the construction and installation of a new heating and lighting plant in the American Museum of Natural History, near Central Park, New York.

MATERIAL FOR JAPAN.—General Electric Company has, it is said, chartered a steamer, which has been loaded at New York with a cargo of electrical appliances and machinery for Japan, to fill large contracts there.

General News.

THE TELEPHONE.

PHOENIX, ARIZ.—By the extension of the Sunset Telephone Company's Castle Creek line, Phoenix and Wickenburg, Ariz., are now connected.

PHOENIX, ARIZ.—The Lawson Telephone Company has been incorporated at Phoenix with a capital of $100,000, by J. Atkins, A. F. Lawson and W. A. Crawford, of Buffalo, N. Y.

AUGUSTA, GA.—The street committee has recommended the adoption of an ordinance, giving both the existing telephone companies the right to place their wires underground and not increase the cost of telephones.

NEX PERCE, IDA.—The Nez Perce Co-operative Telephone Company, recently organized, has now 50 subscribers and 45 miles of wire in operation. It will extend its lines to Lewiston and other points.

GILLESPIE, ILL.—The Gillespie Telephone Company, Gillespie, capital $5,000, has been incorporated by Jonah C. Steere, J. M. Rodiner and Henry R. Williams.

CHESTER, ILL.—The Gordon Telephone Company has received its cable to be placed under the river from Chester to Clearyville, and as soon as the cable is laid the line will be extended to Perryville, St. Mary's and other towns in Missouri.

CHICAGO, ILL.—The Chicago Telephone Company's business for July showed an increase of 1,000 instruments installed, but this is said to be 33 per cent. less than the average monthly increase this year. Officials of the company attributed the falling off to bad weather, which prevented outside work very materially.

GREENVILLE, ILL.—The Kinloch Telephone Company has announced the completion of its toll lines to this city, and that work of construction is being pushed steadily toward Terre Haute, Ind. The new telephone toll line follows the right of way of the St. Louis, Troy and Eastern railway to Troy, Ill., and there the country roads are followed in an easterly direction. New stations have been opened at Highland, Pierron, St. Jacob, Shiloh and Greenville, and others will be opened in a short time. The construction gang has progressed to Vandalia, and many towns along the line will be connected up this summer.

SOUTH BEND, IND.—The Mishawaka City council has granted a franchise to the South Bend Telephone Company.

BRIDGETON, IND.—The Bridgeton, Mansfield and Diamond Co-operative Telephone Company, capital stock $1,000, has been organized.

NEW CASTLE, IND.—The Mount Summit Rural Telephone Company has been incorporated, with a capital of $10,000, by R. R. Leath, F. Shiveley, P. Jeffries and others.

SPICELAND, IND.—The Spiceland Co-operative Telephone Company has been incorporated. Capital stock, $10,000. H. W. Jones, Sesson Hudson, J. A. Spencer, J. T. Unthank and Nathan Foster are the directors.

CHRISMAN, IND.—The Portage Home Telephone Company of Chrisman has been incorporated. Capital stock, $10,000. Directors: H. D. Schofield, Claus Brink, E. G. Miller, W. A. Briggs, F. A. Malmstone, C. E. Fifield, J. H. Lenburg, H. G. Rollins and James Lenburg.

PEKIN, IND.—The Indiana Telephone Company has been incorporated for the purpose of constructing an exchange here and a telephone system throughout Washington, Clark and Scott Counties. The capital stock is $15,600. The directors are C. L. and J. T. Graves and D. W. Bowman.

STOCKWELL, IND.—The People's Co-operative Telephone, of this place, has incorporated with a capital stock of $6,000. The company will erect an exchange here and operate a system in Tippecanoe and adjoining counties. W. O. Land, M. C. Cann, J. W. Skinner and E. N. Stout are directors.

HENRYVILLE, IND.—The Overland Telephone Company has been incorporated to construct and operate telephone lines in Clark County. Capital stock, $1,000. An exchange will be erected in this place and service first given to the citizens here and to Borden, a village a few miles distant. Directors: Ernest Schleicher, D. M. Gray, P. S. Spurgeon, W. H. Dietrich. John Coats and D. W. Martin.

KIRON, IA.—The Kiron Telephone Company has been organized here. Ed. Ekman is president; E. R. Wood, vice-president; P. G. Lundell, secretary. Capital, $8,000.

DES MOINES, IA.—West Morgan Telephone Company of Franklin County, capital, $5,000, has been incorporated. H. S. Mendell, C. H. Larson and Thomas Durrant, directors.

HUMBOLDT, IA.—The Northern Telephone Company of Fonda is to build a new line out of Fort Dodge, running north to Humboldt, thence to Gilmore City, Pocahontas and Storm Lake.

WELLSBURG, IA.—The farmers between Wellsburg and Cleves have organized to erect and put in operation a telephone line. D. De Neui is president; Joe De Neui, Sr., treasurer, and Dr. Heddens, secretary.

DES MOINES, IA.—The Mingo Farmers' Mutual Telephone Company, of Mingo, has been incorporated; capital, $5,000; M. F. Berkley, president; W. W. Goodrich, secretary; Cyrus Eatwell, vice-president; H. K. Poorbaugh, treasurer.

SIOUX CITY, IA.—The Illinois Central Railroad will, about October, connect Sioux City with its Chicago offices by long-distance telephone. The 514-mile wire from Sioux City to Chicago will cost the railroad about $45,000, and the entire telephone system about $150,000.

OBERLIN, KAN.—Kansas & Colorado Telephone Company, Oberlin has been incorporated; capital, $10,000.

LOUISVILLE, KY.—The Western Kentucky and Galloway County telephone system has been sold to the Cumberland Telephone and Telegraph Company.

LEXINGTON, KY.—The directors of the Fayette Telephone Company have transferred the franchise of the company in Bourbon County to the Bourbon Home Telephone Company, which will build an exchange.

HOPKINSVILLE, KY.—J. E. Mott, of Huntington, Ind., has purchased for $3 the telephone franchise ordered sold some time ago by the city. The Cumberland Company claims to have a priority of franchise and refused to bid.

ADRIAN, MICH.—The Gilliland Telephone & Supply Company has been incorporated, with a capital of $10,000.

WESTON, MICH.—Plans are under way for the construction of an independent telephone system in and around Weston.

PARK RAPIDS, MINN.—The Citizens' Telephone Company of Park Rapids has incorporated with $10,000 capital. L. H. Rice, L. W. Bills, T. C. Myers, F. C. Rice and P. D. Winship are the directors.

HANNIBAL, MO.—The Missouri and Kansas Telephone Company is making extensive improvements on the local exchange. Nine thousand feet of new cable, recently purchased, will be placed in position.

VANDALIA, MO.—The Lacrosse Lumber Company, of Louisiana, Mo., has bought the Vandalia telephone system, paying $3,000. It will be made a part of the Buffum system, which extends all over this part of the State.

SKIDMORE, MO.—The Nodaway Valley Telephone Company, of this city, has been incorporated with a capital stock of $3,000, all paid. The incorporators are: Benjamin Bassett, W. B. Ward, G. W. Stricker, W. M. Howden, W. W. Grigsby, C. W. Brown and others.

SPRINGFIELD, MO.—The Home Telephone Company of Springfield has been organized with a capital stock of $100,000. The incorporators are: H. B. McDaniel, B. W. Redfearn, C. O. Trask, F. C. Curren, A. J. Eisenmayer and W. D. Tatlow, of this city, and J. B. Wear, of Detroit, Mich.

ST. LOUIS, MO.—Mr. W. E. Goldsborough, Chief of the Department of Electrical Exhibits of the World's Fair, reports that during his visit to Chicago a strong sentiment was developed among the independent telephone manufacturing companies of that city in favor of making elaborate exhibits in the Electricity Building.

ST. LOUIS, MO.—Without waiting for the completion of one branch exchange, the building for which is now being rapidly erected, the Bell Telephone Company has found it necessary to build another branch to take care of the increasing business in St. Louis. The latest addition to the exchange system will be erected at No. 324 North Beaumont Avenue, near Locust Street. It will be three stories high and will cost about $40,000.

COZAD, NEB.—The Cozad Mutual Telephone Company has been incorporated, with a capital stock of $2,000.

BANCROFT, NEB.—Articles of incorporation of the Bancroft Independent Telephone Company have been filed. The incorporators are: W. H. Watson, E. T. Rice, W. F. Sinclair and E. H. Morgan. The authorized capital stock is $15,000.

ALAMO GORDO, NEW MEX.—The Alamo Telephone Company, with a capital stock of $5,000 and with principal offices at this place, has been incorporated by O. L. Pearson, J. D. Bennett, J. R. Gilbert, A. J. Buck, Alfred Hunter and H. W. Schofield, who will also constitute the first board of directors.

DEPEW, N. Y.—A franchise has been granted to the Haines Telephone Company to operate in this village.

DUNDEE, N. Y.—The Crosby and Barrington Telephone Company has been organized; capital, $5,000; directors: H. Fullager, S. T. Thayer, H. Orenshire and others.

BUFFALO, N. Y.—The Grand Island Telephone Company, of Buffalo, has been formed; capital, $10,000, and directors: Josiah Jewett, Jr., F. H. Williams and J. P. Williams, of Buffalo.

ALBANY, N. Y.—The New York State Independent Telephone Association has been incorporated. Among the directors are W. D. Barnard, of Philadelphia; E. B. Barbour, of Wauseon, Ohio; and J. J. Brailey, Jr., of Toledo, Ohio.

PORT JERVIS, N. Y.—The Monticello Telephone Company has purchased of H. S. Wells, of Ellenville, the telephone lines in the village of Monticello and the lines to Kiamesha Lake and South Fallsburgh, which were formerly owned and operated by the Delaware River Telephone and Telegraph Company.

NEW YORK CITY, N. Y.—Fire Commissioner Sturgis has decided to make a separate bureau out of the fire alarm telegraph system. This system was a separate bureau until 1898, when it was put in charge of the Chief of the Fire Department. It is understood about Fire Headquarters that J. Elliott Smith, who was the incumbent of the position at the time the bureau was abolished, will again be an applicant for the position.

COLUMBUS, N. C.—The Columbus Telephone Company has closed a contract with the Bell Company to bring its line to Wilmington, where it will connect with the Bell service. The line will be completed in thirty days.

CONNEAUT, OHIO.—The Albion Telephone Company will extend its lines to [illegible] and Cherry Hill.

URBANA, OHIO.—The Urbana Telephone Company has increased its capital stock from $[illegible] to $[illegible].

UNIONTOWN, OHIO.—The Flushing Telephone Company has several men at work putting up a line to Uniontown.

CLEVELAND, OHIO.—The village of Glenville has granted a franchise to the Cleveland Telephone Company to install its system in the town.

ROWENTON, OHIO.—A farmers' community company has been organized to build local lines throughout Rowenton, Sentinel, and Lenox Center.

COLUMBUS, OHIO.—The North Lewisburg Telephone Company, of Champaign County, was incorporated with $6,000 capital stock by W. H. Willis, L. E. Willis and others.

NORTH LEWISBURG, OHIO.—The North Lewisburg Telephone Company has been incorporated with $6,000 capital stock by W. H. Willis, L. E. Willis, N. S. Willis, M. S. Willis and L. L. Fisher.

MINISTER, OHIO.—The Minister Home Telephone Company, of Auglaize County, has been incorporated with $10,000 by L. L. Dine, F. L. Maisen, John Laupeiswiler, J. W. Eiting, M. Hosborn and others, to build a local system at Minister.

NORTH LIMA, OHIO.—Work on the lines of the Beaver Telephone Company in this section has been abandoned temporarily because of inability to secure workmen during harvests. The North Lima exchange will be built as soon as possible.

OAKWOOD, OHIO.—Citizens of Brown and Auglaize townships are planning to build a telephone line from Oakwood to Defiance by way of Schroeder, Arthur and Englewood. The exchange will be at Oakwood. Herman Schroeder and L. Reams, of Oakwood, are interested.

CINCINNATI, OHIO.—The W. F. Harrison Telephone Company of Cincinnati, which is constructing the exchange of the Texarkana Telephone Company in Texas and Arkansas, has closed contracts for the equipment. The company has subscriptions for 1,000 telephones in Texarkana alone.

LANCASTER, OHIO.—The McArthur Home Telephone Company will build a line from Bloomingville to Tarlton and New Plymouth, connecting with the long distance systems of other companies in that section. The gap between New Plymouth and Lancaster will be built in the near future.

YOUNGSTOWN, OHIO.—For some time various associations of merchants have been endeavoring to induce their members to patronize one telephone service to the exclusion of the other. The Retail Grocers' Association endorsed the Youngstown Telephone Company. Now the grocers outside of the association have notified the Central Union Company that they will use its telephone exclusively. It seems impossible for all the associations to settle on one service, hence the object of the crusade is likely to be defeated.

TUNKHANNOCK, PA.—The Tunkhannock and Wyoming Valley Telephone Company has been incorporated; capital, $2,000.

CHARLESTON, S. C.—The Bell Telephone Company has begun the work of putting its wires underground in Charleston.

WINNSBORO, S. C.—A commission has been issued to the St. Matthew's Telephone Exchange which proposes to run telephone lines in St. Matthew's and to connect with neighboring points. The corporators named are: L. M. Able, J. S. Wanamaker, H. A. Raysor, M. Jarecy and S. Pearline. The capital stock is $1,500.

AUSTIN, TEX.—The Farmers' Telephone Company of High, Lamar County has been incorporated; capital stock, $7,000. The incorporators are M. D. High, Fred Roach and D. W. Price.

DALLAS, TEX.—The Greenville Telephone Company, of Greenville, filed an amendment to its charter increasing its capital stock from $25,000 to $35,000

WHITEWRIGHT, TEX.—The Whitewright Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are: W. C. Fain, R. May and Lillie Selph.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company's Salt Lake City exchange has connection now with 478 nearby towns.

KENOSHA, WIS.—An independent telephone system has been established at Kenosha.

KAUKAUNA, WIS.—The Fox River Telephone Company will extend its lines to this place.

HARTFORD, WIS.—The Wisconsin Telephone Company is extending its line from Hartford to Mayville.

THIENSVILLE, WIS.—The Mequon Telephone Company of Thiensville has been incorporated, with a capital of $2,500.

BARABOO, WIS.—The Bell Telephone Manufacturing Company, Baraboo, capital stock $20,000, has been incorporated by W. J. Whistler and W. J. Bell.

Electric Light and Power.

LITTLE ROCK, ARK.—The Stuttgart Water and Electric Light and Power Company has filed an amendment to its articles of incorporation increasing the capital stock from $25,000 to $50,000.

SAN FRANCISCO, CALIF.—The Brandy Creek Water, Light and Power Company has been incorporated with a capital stock of $250,000. The directors are: W. A. Hall, J. M. Gardner, W. M. Sheldon, F. M. Archer and James H. Devereaux.

SAN FRANCISCO, CALIF.—The gold dredging mining plant which Dr. T. R. Heintz is constructing on Clear Creek, near Horsetown, will be lighted and operated by electricity furnished by the Northern California Power Company. The power will be tranmitted from the sub-station near Redding.

AUGUSTA, GA.—The Augusta Railway and Electric Company has signed a contract for lighting the city of Augusta for five years at the rate of $68 per light.

NEZ PERCE, IDA.—There is an opportunity to establish an electric light plant in this place.

BOISE, IDA.—The bid of the Capital City Electric Light, Motor & Gas Company to light the streets has been accepted. The company will furnish 54 450-watt arc lights at $6.50 each per month; 20 16-cp incandescent lamps at 75 cents each per month. All meter lights at 10 cents per kw.

PANA, ILL.—The lighting contract between the city and the Modern electric light plant having expired, the company has shut off the light. No new contract has been made.

CHICAGO, ILL.—The Pioneer Electric Light, Heating and Power Company has been incorporated at Marseilles; capital stock, $25,000. Incorporators: J. E. Bond, J. A. Kelso and R. F. Knott.

GRAYVILLE, ILL.—The water and light station, which was closed down some four weeks ago, has resumed operation, the company having accepted the city's offer to furnish light and water for the year.

VENICE, ILL.—The Venice Electric Light and Power Company has been transferred to George Banford, of New York. The company has been bonded for the sum of $250,000. The plant will be enlarged to three times the present capacity.

EDWARDSVILLE, ILL.—The new electric company which was recently granted a franchise to operate a power plant in Edwardsville has purchased an acre of ground and will locate its power plant on it. The company is composed of J. R. Bennett, August Loeffler and William Gaertner, of Wyandotte, Mich.

NICHOLASVILLE, KY.—The Beattie Electric Company, of Cincinnati is erecting a $11,000 electric lighting plant in Nicholasville, Ky.

BALTIMORE, MD.—The Baltimore and Ohio Railroad has been directed by the city council of Baltimore to use only electric motors in the tunnel that runs under this city.

DEXTER, MICH.—Proposals will be received until August 20 for the construction of an electric light and power plant for street and commercial lighting. Bids must be sent to A. Davis & Co., Dexter.

ST. CHARLES, MO.—The large cable of the St. Charles Light and Power Company has been laid in the river. It will carry power for the St. Charles. St. Louis and Western electric railway.

CARROLLTON, MO.—The Carrollton Water, Light and Power Company, of Carrollton, has been incorporated. The capital stock is $100,000, all paid. Incorporators: Herndon Ely, Pete L. Trotter, Lewis B. Ely, W. R. Painter and others.

ST, LOUIS, MO.—Immediately after the contract is let for the lighting of the public buildings for the year ending September, 1903, the board of public improvements will have bills prepared looking towards the installation of the city's own lighting plants in the public buildings. It is expected that during the coming year this work will progress so rapidly that all the public buildings will be lighted by the city's own plants after another contract for a year expires with private lighting companies. Then the board expects to take steps toward ultimate ownership by the city of lighting plants for the lighting of the streets.

ST. LOUIS, MO.—The Neighborhood Light, Power and Heating Company has been organized with a capital of $50,000 for the purpose of building a plant to furnish heat and electricity to buildings in the block bounded by Olive and Locust, Seventh and Eighth Streets. The new company is composed of Missouri Trust and Chemical Building stockholders. It was originally formed to supply the Union Trust and Chemical Buildings, but later arrangements were made to furnish light, power and heat to other buildings in the block. The power plant will be installed in the basement of the Union Trust Building. Contracts have been let for the boilers, and electrical machinery, and work will begin at once. President Schfley, of the Missouri Trust Company, owners of the Union Trust Building, says that all negotiations for the deal have been closed and only the signatures of the principals are needed before the incorporation papers are filed.

ST. LOUIS, MO.—An issue of $10,000,000 5 per cent. thirty-year gold bonds has been decided upon by the Union Electric Light and Power Company, recently organized for the consolidation of the Citizens' and the Imperial companies. Only $4,000,000 will be issued at once, however. This amount will be issued as soon as the details can be arranged, and all have been underwritten, one-half by St. Louisans and the other half in New York, the Mississippi Valley Trust Company, of this city, and the North American Company of New York acting as syndicate agents in the deal. The bond issue was authorized at a meeting held this week. The $4,000,000 will be used to retire the $1,552,000 underlying bonds of the Imperial company and the remainder to complete the immense plant started by the Citizens' company before the consolidation and in other improvements. The bonds have all been subscribed for, and a majority will be taken in St. Louis.

HAVRE, MONT.—An electric light franchise has been granted to eastern capitalists in Havre. A telephone franchise will be granted soon.

HELENA, MONT.—A company has been organized in Butte and Helena by Hogan Bros., called the Crooked River Electric Mining & Power Company. It intends erecting a 2000-hp electric plant on that stream as soon as the necessary machinery can be furnished. Power will be furnished the company's big quartz mine on the river as well as other mining properties in the vicinity.

HAWTHORNE, NEV.—The Consolidated Mines Company of Hawthorne will erect a large power plant using the waters of Twin River. Transmission lines will be built to the mines in the surrounding country. About $200,000 will be expended.

RALEIGH, N. C.—The city of Raleigh has contracted with the Raleigh Electric Railway Company for 155 arc lights at $55.75 each.

MANCHESTER, OHIO.—A committee of citizens is inspecting various lighting plants in this section with a view of planning a lighting plant for Manchester. S. S. Alexander, J. A. Murray and Peter Stark are interested.

CLEVELAND, OHIO.—The Cleveland Electric Illuminating Company has voluntarily returned the valuation of its personal property as $402,000. Last year the company paid taxes on a valuation of $250,000.

AKRON, OHIO.—The present lighting facilities of Barberton are inadequate and the council has accepted the invitation of the Northern Ohio Traction Company to inspect its power house with a view of arranging for a contract to illuminate the town.

DALLAS, TEX.—The plant and other property of the Dallas Electric Company was sold at United States Receivers' sale, Aug. 5, for $300,000, to representatives of the bond holders of the old Dallas Electric Light and Power Company. The purchasers are Boston capitalists, known locally as the "Bonta party." Mr. Bonta represents the Dallas electric street railway enterprises, the United Electric Securities Company of Boston, and it is understood he will direct the affairs of the Dallas Electric Company. The property is worth upwards of $1,000,000.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—It is reported that the Huntington-Hellman syndicate has decided to build an electric railway from Los Angeles to Santa Barbara, Calif. The large capacity of the new power house of the Huntington electric lines in Los Angeles would be an advantage in connection with a line to Santa Barbara. It is possible that the road will be built through Ventura.

WASHINGTON, D. C.—The Washington, Baltimore and Annapolis Electric Railway Company reports that it expects that cars will be in operation within one year. The line is now being graded between Washington and Baltimore. The company's power plant may be located at Hyattsville. This company will construct an interurban line between this city and Lima, O. Charles and Baltimore Railway, and if successful, will use the tracks of this company from Odenton to Annapolis.

MORRISTOWN, IND.—A fifty-years' franchise was granted by this city to Charles L. Henry and J. F. Wild for an electric railway to be constructed between Indianapolis and Rushville.

FT. WAYNE, IND.—The Ft. Wayne, VanWert and Lima Traction Company has filed articles of incorporation. The capital stock is $2,000,000. The company will construct an interurban line between this city and Lima, O. Charles Murdock heads the board of directors.

HUNTINGTON, IND.—The Ft. Wayne & Southwestern Traction Company, now operating a line between Andrews and Ft. Wayne, and almost ready to begin running on to Wabash, has doubled its capacity of its power-house in this city. It now has two 750-hp engines in service. The company has almost completed negotiations for a right-of-way to Warren, and from there the line will be built to Marion.

HARTFORD, KY.—The Hartford & Beaver Dam Electric Railway Company has changed its name to the Rough River Valley Railroad Company. It is expected that the road will be under construction by September 1.

AUGUSTA, ME.—The Maine and New Hampshire Railroad Company has filed articles of association here. This is to be the longest electric line in the State—ninety miles. The capitalization of the company is $400,000.

NEW YORK, N. Y.—Mayor Low has allowed to become law without his official sanction, a resolution requesting the Metropolitan Street Railway to change the motive power on First Avenue from horse to electricity.

ALBANY, N. Y.—The Richmond Street Railway Company has been incorporated with $190,000 capital. It takes the property of the Staten Island Electric Railroad. Directors: Waldo S. Reed, Englewood; William T. Newkirk, Paterson; Cornelius W. Van Voorhees, Mariners' Harbor; Frank B. Hammer, Brooklyn.

ALBANY, N. Y.—The Mineola, Roslyn and Port Washington Traction Company, of Roslyn, Nassau County, has been incorporated to build a street surface electric road ten miles long, from Mineola, in the town of North Hempstead, to Port Washington. The capital is $150,000, and the directors are Isaac H. Odell, Frederick H. Parker, Jacob Besant Gardner, P. Harrington and others of New York City.

ALBANY, N. Y.—The Vermont and Whitehall Railway Company, with principal office in New York City, has been incorporated with a capital stock of $500,000. The line lies in Washington County. The directors are: David A. Slattery, J. Osgood Nichols, K. C. Morehous, Paul M. Mowery, Leroy W. Baldwin, Harry M. Gough, Clinton E. Braine and Ronald K. Brown, of New York City, and Ezra A. Tuttle, of Brooklyn.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Railway Company will probably build a spur line from Prospect to Richwood.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Railway Company is planning to build spur lines from Oberlin to the villages of LaGrange and Kipton.

COLUMBUS, OHIO.—E. W. Matthews, formerly receiver for the Toledo & Ohio Central Railway, has taken up the long-talked-of project for an electric railway from Bryan to Columbus.

YOUNGSTOWN, OHIO.—The Mahoning Valley Western Railway Company has been incorporated with $1,000 capital stock, by J. E. McVey, A. L. Rowland, J. I. Harrington, Thomas L. Robinson and J. W. Blackburn.

XENIA, OHIO.—Surveys are being made for the new line of the Xenia-Wilmington Traction Company. Options on practically the whole of the right of way have been secured. Cleveland people are financing the road.

CINCINNATI, OHIO.—The Cincinnati & Northeastern Traction Company of Dayton has been incorporated with $15,000 capital stock by Dennis Dwyer, Albert Emanuel, Charles D. McCrea, Charles L. McCrea and B. M. Hopkins. It is proposed to construct an electric road between Cincinnati and Dayton.

YOUNGSTOWN, OHIO.—The Penhale-Devitt syndicate has incorporated the Sharon & West Middlesex Electric Company to build a line from Sharon, Pa., to West Middlesex, a distance of four miles. Capital stock, $50,000. Incorporators: M. A. Norris, R. Montgomery, A. N. Perkins, A. W. Williams and Wm. McIntyre, Jr.

CANTON, OHIO.—The Canton-New Philadelphia Railway Company has been incorporated, with $6,000 capital stock. The line will be the extension of the Canton-Akron Railway from Navarre to New Philadelphia, work on which has been started. The incorporators are Philip Saltonstall, L. E. Meyers and other officials of the Canton-Akron Company.

CLEVELAND, OHIO.—The Lake Shore Electric Railway has officially opened its through service from Cleveland to Toledo. The entire road has been in operation for several months, but no attempt has been made to work up the through business since the trip required changes at Lorain and Norwalk. The new schedule is six hours for the 118 miles, with change of cars at Norwalk. A number of cars are being equipped with high-speed motors, and as soon as these can be placed in operation, cars will run through without change and it is expected the running time will be reduced to about five hours. Already the through traffic is showing up surprisingly well.

NEW INDUSTRIAL COMPANIES.

THE TUGGLE ELECTRIC SUPPLY COMPANY, of Beaumont, Tex., has been chartered, with $25,000 capital, by G. W. Tuggle, E. L. Bacon and J. F. Keith.

THE F. B. LITTLE ELECTRIC COMPANY has been incorporated at St. Louis, with a capital stock of $3,000. The shareholders are: C. V. Wade, C. E. Campbell, F. B. Little, W. F. Little.

THE MICROPHONE TRANSMITTER COMPANY, Boston, Mass., has been organized under the laws of Maine to manufacture a telephone transmitter. The capital stock is $500,000.

THE CLIMAX ELECTRIC STORAGE BATTERY & VEHICLE COMPANY, of Portland, Me., has been incorporated; capital, $500,000; William Bowler and John Oldfield, incorporators.

THE BALL CHECK LIGHT COMPANY, of East Orange, N. J., has been incorporated to manufacture lighting devices; capital, $1,000,000. Incorporators: Edward T. Magoffin, Frank R. Searles and Walter H. Bond.

THE SUBWAY AND WESTCHESTER CONSTRUCTION COMPANY, of Mamaroneck, Westchester County, N. Y., has been incorporated at Albany with a capital of $400,000, to construct railways, etc. The directors are: George T. Foster, J. W. Edwards, Jersey City; Theodore M. Johnson, F. B. Hough, Albert Tusch, Jr., of New York City.

LEGAL.

MARCONI-DE FOREST LITIGATION.—The Marconi Wireless Telegraph Company of America, by its attorneys, Betts, Betts, Sheffield & Betts, has filed a bill of complaint in the United States Circuit Court for the Southern District of New York against the De Forest Wireless Telegraph Company for an alleged infringement of the Marconi basic patent by the De Forest system, and especially by the so-called "anti-coherer." An injunction is asked for to stop the use of the Marconi patent by the De Forest system. Also an accounting for the ascertainment and payment of damages. Knabe & Butler are counsel for the defendants.

WIRELESS TELEGRAPH LITIGATION.—Action has been begun by the De Forest Wireless Telegraph Company against the Marconi Wireless Telegraph Company and the firm of E. Rollins Morse & Brother, syndicate managers for the Marconi Company, for $1,000,000 damages for the publication of an article stating that action had been begun by the Marconi Company against the De Forest system for infringement of the Marconi patents. The attorneys for the Marconi Wireless Telegraph Company express the opinion that this suit was brought mainly for the purpose of an advertisement, as the papers were served upon the newspapers before they were made known to the defendants.

OBITUARY.

MR. W. A. SCOTT.—A special telegram from Chicago, of August 9, says: Walter A. Scott, the wealthy president of the Illinois Wire Company, was stabbed to death in his office to-day by Walter Stebbings, a well-known bridge engineer. The stabbing was witnessed only by Miss Myrtle Shumate, Scott's stenographer, who fled screaming from the Monadnock Building, in which Mr. Scott had his offices. Immediately afterward the slayer walked quietly across the hall to his own office, and was writing business letters when the police burst in on him. On being told that Scott was dead Stebbings reeled and would have fallen had he not been supported. "Dead!" he exclaimed. "I did not know I stabbed him. I thought I had merely knocked him down." The engineer was taken to jail almost in a state of collapse. Mr. Scott was reputed to be a millionaire. Until recently he was president and owner of the Marshfield and Southeastern Railroad and the Scott Lumber Company. He was heavily interested in real estate. Stebbings was favorably known among engineers as the designer of the High Bridge in Lincoln Park, and also of the Chicago, Milwaukee and St. Paul swing bridge over the river near Kinzie Street. Mr. Stebbings asserted that Scott owed him $3,000 for professional work, but payment had been refused. The engineer called at Scott's office again this morning in an effort to affect a settlement. Miss Shumate says that the two men soon quarreled violently, and a moment later were striking and kicking at each other. Then came the flash of steel, and Scott sank to the floor. She fled in panic, while Stebbings walked quietly away. It would appear that Mr. Stebbings had unconsciously picked up or used a Japanese envelope opener he had in his hand. Mr. Scott was forty-three years old. He lived at the Virginia House. A widow and one son survive him, the latter being twenty years old. The widow and son are at present out of the city on a vacation tour in the East.

PERSONAL.

PROF. F. B. CROCKER, of Columbia University, has left New York for a long holiday until the fall, in Colorado, etc.

MR. N. F. BRADY, first vice-president of the New York Edison Company, left last week on the "Celtic" for England, proposing to spend a month or two in European travel.

MR. THOMAS F. RYAN, the financier, sailed this week for Europe on board the steamship "Kaiser Wilhelm der Grosse," for a six-weeks' trip, entirely for purposes of recreation.

MR. J. K. ROBINSON, agent for the Westinghouse Electric Mfg. Company, at Iquique, Chili, has sailed this week for that city, from New York, so that all letters hereafter should be addressed to him there.

MR. E. LE C. HEGEMAN, a young New York electrical engineer, has sailed this week for Chili, to be associated with Mr. J. K. Robinson, who represents Westinghouse interests on the western coast of South America.

MR. W. E. DICKEY, past assistant engineer, U.S.N., is to represent in New York City the Goulds Mfg. Company, of Seneca Falls, and the West Point Boiler Works (R. Munroe & Sons), Pittsburg, Pa. His headquarters will be at 16 Murray Street.

MR. GEORGE W. HUTCHINS, the electrical contractor and engineer, of St. Louis, has left for East Las Vegas, New Mexico, where he is to build the Las Vegas & Hot Springs Railroad for the E. L. Epperson Construction Company of St. Louis.

MR. CHAS. F. SCOTT, chief electrician of the Westinghouse Electric & Manufacturing Company and president of the American Institute of Electrical Engineers, has just returned from England, where he has spent the last few months engaged on important professional work.

MR. GEORGE L. COLGATE, at one time well known in electrical enterprises in the South and in New York, has been spending the past few years in California for the benefit of his health. He has now returned to the East and with wonted energy is already engaged making business connections.

PROF. G. F. SEVER, of the electrical engineering department of Columbia University, has, we understand, been selected as consulting engineer for the Greater New York Department of Gas and Electricity. The position is said to carry with it a salary of $4,000 a year, and is one of the best appointments in the gift of Col. Monroe, the Commissioner.

MR. FRANK MILLER, formerly superintendent and purchasing agent of the Worcester & Webster St. Ry., Worcester, Mass., has accepted the position of salesman with the firm of C. J. Harrington, 15 Cortlandt Street, New York City, manufacturer of a full line of electric railroad and line material, and will cover for this firm the New England territory, where he has a wide and influential acquaintance.

MR. R. E. GALLAHER, the well-known general manager of the New York Insulated Wire Company, is now at the Thousand Islands, recuperating from a long and very severe attack of gastric fever. Mr. Gallaher's public spirited and intelligent work in behalf of the New York Electrical Trade Society and for the furtherance of commercial interests, has caused him to be missed throughout a wide circle of friends and admirers, all of whom will heartily welcome his return to business in the fall.

MR. T. A. EDISON.—The official organ of the Press Exhibition, which was opened at Copenhagen, Denmark, on June 14, prints a letter from Thomas A. Edison in reply to queries as to his opinions concerning motor traction, and aerial navigation. The letter is as follows: "I believe that within thirty years nearly all railways will discard steam locomotives and adopt electric motors, and that the electric automobile will displace the horse almost entirely. In the present state of science, there are no known facts by which one could predict any commercial future for aerial navigation."

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out booklets describing the push-button telephone, the latest thing in the telephone line. It looks like a push button, acts like one when desired and is a complete telephone as well.

ALTERNATING CURRENT BELL.—The Wotton Electric and Manufacturing Company, Atlanta, Ga., has just designed an alternating current bell which can be operated successfully on a 60-cycle circuit. The bell, which is similar to this company's telephone extension bell, is said to work very satisfactorily.

U. S. METAL POLISH.—Mr. George W. Hoffman, manufacturer of "U. S. Infallible Metal Polish Paste," reports that his business is steadily increasing, and that he is shipping "U. S. Metal Polish and Barkeepers' Friend" all over the world. This fact proves that the world appreciates a good thing when proper attention is directed to it.

INCANDESCENT ELECTRIC LIGHT.—The Sawyer-Man Electric Company, New York, has recently published a very interesting and artistically illustrated pamphlet under the title "Incandescent Electric Light." Its contents are classified under three general heads, viz.: Historical sketch; How the Sawyer-Man lamp is made, and suggestions for those who use incandescent lamps. The historical sketch briefly reviews the development of the electric lamp from Davy's time down to the present, and is very liberally illustrated. The description of the making of Sawyer-Man lamps is an interesting study, and the suggestions offered to users of incandescent lamps are calculated to enable the consumer to get the best results.

STATIONARY ENGINEERS.—The local associations at Chicago of the National Association of Stationary Engineers have made arrangements with the Dearborn Drug & Chemical Works to use their offices and laboratories, situated on the first floor of the Rialto Building, 145 Van Buren Street, as headquarters for the delegates and visitors going through Chicago on their way to the convention at Boston, on Saturday and Sunday, August 30 and 31. The offices will be open at 6 o'clock Sunday morning and remain open until train time. Refreshments will be served, and arrangements have been made to take care of the ladies, and they will be taken to the depot in carriages. Delegates and visitors will take their grips and baggage direct to these headquarters.

THE NERNST LAMP COMPANY has placed upon the market a special lamp designed particularly for the illumination of telephone switchboards. This lamp has already been adopted in several stations and is reported to give a much more satisfactory illumination on the switchboard and at the same time offers complete protection to the eyes of the attendant. One Nernst lamp does the duty formerly required of three incandescents. The Nernst lamp is found to be particularly well adapted for the illumination of boards using the lamp signal system on account of the soft white light emitted, enabling the operator to readily distinguish the switchboard lamps when lighted. Other forms of illumination for this purpose have not been found entirely satisfactory because of the yellow quality of the light.

LINK-BELT ENGINEERING COMPANY.—One of the handsomest trade catalogues which has recently fallen into our hands is that issued by the Link-Belt Engineering Company, of Nicetown, Philadelphia, Pa., on the subject of modern methods applied to elevating and conveying of materials and the transmission of power. This catalogue is issued in a standard size—6 ins. by 9 ins.—and is strongly bound in boards and green cloth. It contains no fewer than 320 pages and summarizes or epitomizes the art of which it treats. In addition to a large amount of engineering matter, various tables, compilations of data, etc., the catalogue includes a large number of cuts, many of which are full-page and illustrate practical installations of the various conveying systems with which the name of "Link-Belt" has been so long and so successfully connected. The ingenuity of the processes and the skilful manner in which human labor and manipulation has been eliminated from the transportation of even very heavy material, must win hearty admiration. The processes involved are essentially those which have ensured the universal adoption of American methods in the conveyance of material, loose or in packages, and the catalogue as it stands is virtually an exhaustive treatise on this branch of industrial art. The amount of work done with the Dodge coal storage system as here enumerated, is simply stupendous, but we imagine that if the figures were given of the different bulks of material also transported by the company's conveying systems in other lines of work, other and larger millions of tonnage would appear from the calculation. Aside from the conveying apparatus as such, a number of devices are included appropriate to power transmission, all marked by the same high standard of ingenuity and perfect application to the work in hand.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 5, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

706,011. ART OF CONTROLLING ELECTRICAL SWITCHES OPERATED BY ELECTRO-MAGNETS; F. Bourne, Mount Vernon, N. Y. App. filed Nov. 8, 1901. Consisting in controlling the movements of the circuit by two magnetic forces in such manner that when the circuit is first closed, they act conjointly and afterward oppose each other.

706,012. ELECTRO-MAGNETIC SWITCH; F. Bourne, Mount Vernon, N. Y. App. filed Nov. 8, 1901. Apparatus for carrying out the previously described method.

706,017. DYNAMO ELECTRIC MACHINE; J. Burke, Berlin, Germany. App. filed June 26, 1900. (See Current News and Notes.)

706,020. TRAIN CONTROL SYSTEM; F. E. Case, Schenectady, N. Y. App filed Jan. 7, 1901. Means for preventing the further operation of the master controller in case any of the sub-controllers fail to operate.

706,039. ELECTRIC REGULATOR; A. R. Everest, Lynn, Mass. App. filed Oct. 9, 1900. A potential regulator having a row of fixed contacts, a movable contact co-operating therewith and a change-over switch brought into operation as the movable contact passes from one fixed contact to another and co-operating with the movable contact to reverse the connection of the row of fixed contacts with respect to the circuit to be regulated.

706,053. MEANS AND APPLIANCES FOR THE MANUFACTURE OF COVERED STRIPS OF SOFT METAL FOR ELECTRICAL OR OTHER PURPOSES; I. W. Heysinger, Philadelphia, Pa. App. filed Dec. 4, 1901. Flat strips of soft metal are first covered with cement, then with a braided textile cover and then stitched through with rows of stitching so located that the strip can be cut up into narrow strips and used for conductors.

706,055. TIME LIMIT CIRCUIT-BREAKER; H. M. Hobart, Berlin, Germany, App. filed Jan. 5, 1901. (See Current News and Notes.)

706,062. MAGAZINE FUSE BOX; H. L. Hunt and W. E. Moon, Traverse City, Mich. App. filed Nov. 5, 1901. Details.

706,076. FLEXIBLE CONDUIT OR TUBE; G. A. Lutz, Brooklyn, N. Y. App. filed Nov. 20, 1901. The tube is formed by winding a continuous concave strip spirally and laying the spirals one over the other in such manner as to prevent the lengthening of the tube while permitting flexure.

706,082. AUTOMATIC POLE REVERSER; M. Moskowitz, Brooklyn, N. Y. App. filed Aug. 27, 1902. A pole changer controlled by the resulting motion due to the opposition of a spring and a centrifugal force.

706,083. AUTOMATIC SWITCH; M. Moskowitz, Brooklyn, N. Y. App. filed Sept. 28, 1901. Details.

706,084. AUTOMATIC SWITCH; M. Moskowitz, Brooklyn, N. Y. App. filed Sept. 28, 1901. A claim describes the invention as follows: In combination with an electrical switch and as a means for actuating the switch when the direction of rotation of a rotary body reverses, a rotary part suitably mounted and subject to such reversals of rotation, and a retractable engaging device movably mounted upon the said rotary part for engaging and actuating the switch in either direction, the said retractable-engaging device being provided with a weight for centrifugally retracting it.

706,085. ELECTRICAL SYSTEM FOR LIGHTING AND POWER; M. Moskowitz, Brooklyn, N. Y. App. filed Sept. 28, 1901. This invention contemplates the use of a motor-dynamo, the motor portion of which is driven from the main generator and the dynamo of which excites the field magnet of the generator when the proper conditions have been obtained.

706,092. TROLLEY POLE CATCH; J. A. Norton, Wilkesbarre, Pa. App. filed Nov. 19, 1901. A lock intended to catch the trolley pole when it is thrown violently downward.

706,099. ELECTRIC FURNACE; A. Parker, Chorley, Eng. App. filed May 8, 1901. (See page 258.)

706,106. ELECTRIC RAILWAY; W. B. Potter, Schenectady, N. Y. App. filed Nov. 18, 1896. A third rail system in which the continuity of the third rail is interrupted at stations or crossings and sectional conductors substituted therefor, which are normally disconnected from the source of supply.

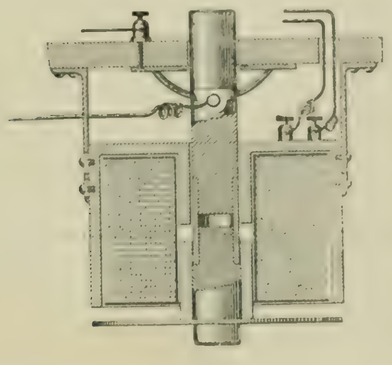
706,108. DYNAMO ELECTRIC MACHINE; H. G. Riest, Schenectady, N. Y. App. filed Nov. 13, 1900. (See Current News and Notes.)

706,123. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed June 30, 1900. In constant current arc lighting through rectifiers, makes use of one large source of current for all the rectifiers or at least any given group, and feeds each individual rectifier from the secondary of a transformer, the primary of which is in series with the primary windings of the companion transformers and in circuit with the source of constant current.

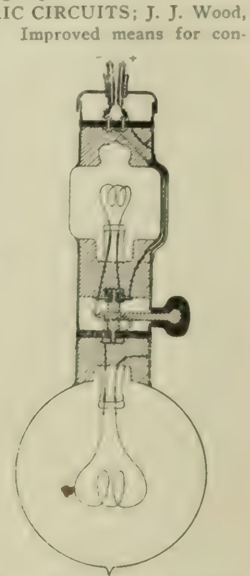
706,126. ELECTRIC CONTROLLING APPARATUS FOR ELEVATORS; A. Sundh, Yonkers, N. Y. App. filed Jan. 31, 1902. The controlling circuit is of lower potential than the main circuit, but is derived from a shunt to the main.

706,128. ELECTRIC FURNACE; E. R. Taylor, Penn Yan, N. Y. App. filed April 4, 1901. Renewed Jan. 2, 1902. (See page 258.)

706,143. MEANS FOR CONTROLLING ELECTRIC CIRCUITS; J. J. Wood, Fort Wayne, Ind. App. filed June 28, 1901. Improved means for controlling the several line circuits from a central power station, and restoring the current to several lines one by one in succession, and avoiding overload of generators due to the effort of motorman to start up all the cars again at once.



706,012. Electromagnetic Switch.



706,314. Compound Incandescent Electric Lamp.

706,146. MECHANISM FOR RECORDING OR REGISTERING THE MAXIMUM MOVEMENT OF ANY MECHANISM; L. B. Atkinson, London, Eng. App. filed May 12, 1902. A ball is caused to shift its position when the index reaches a position of maximum indication.

706,156. ELECTRIC RAILWAY; C. R. Campbell, New York, N. Y. App. filed Dec. 28, 1900. Details of a third-rail system.

706,165. SYSTEM OF ELECTRICAL DISTRIBUTION FOR CAR LIGHTING PURPOSES; J. L. Creveling, New York, N. Y. App. filed Dec. 7, 1900. The magnetization of the generator is controlled by two electromagnetic devices, one being in the work-circuit and adapted under predetermined conditions to act upon the other and thereby regulate the generator.

706,169. ANTISEPTIC TELEPHONE MOUTHPIECE; W. M. English and G. A. Burns, San Francisco, Calif. App. filed Oct. 28, 1901. (See page 256.)

706,177. MEANS FOR TESTING THERMOSTATS; T. M. Heaphy, London, Eng. App. filed Aug. 8, 1900. (See Current News and Notes.)

706,194. INSULATOR; L. McCarthy, Boston, Mass. App. filed May 26, 1902. Two terminal pieces linked together by a block of wood and the joint encased in a mass of insulating material.

706,211. TROLLEY WHEEL; R. H. Apelt, Boston, Mass. App. filed March 30, 1901. Details.

706,218. ELECTRIC SIGNALING SYSTEM AND APPARATUS USED THEREIN; R. G. Callum, Washington, D. C. App. filed Jan. 9, 1902. Consists in connecting the point to be signaled from, with the central station by a normally closed metallic circuit having a ground connection at the central station dividing the batteries so that a portion will be on each side of the connection; means are then provided for grounding the circuit at the signaling point and transmitting signals at both sides of the ground connection.

706,219. METHOD OF OPERATING ELECTRIC RAILWAYS; C. R. Campbell, New York, N. Y. App. filed May 6, 1902. A method of operating third-rail systems.

706,226. ELECTRIC TRAIN CONNECTOR; C. E. Felt and D. C. Kimbark, Chicago, Ill. App. filed Nov. 29, 1901. Details.

706,251. MECHANICAL TELEGRAPH TRANSMITTER; J. W. McDonald, Larimore, N. D. App. filed Jan. 27, 1902. Morse characters are indicated on the rims of wheels, any one of which can be rotated to send its character to line by depressing a key which mechanically connects the disk with a rotating shaft.

706,260. PRESSURE REGULATOR; J. L. Schureman, Chicago, Ill. App. filed May 31, 1902. An adjusting mechanism is interposed in the lever connection between a diaphragm and a circuit breaker for regulating the effect of the diaphragm's movements upon the circuit breaker.

706,281. MEANS FOR TRANSMITTING MOVEMENTS AND INDICATING POSITIONS ELECTRICALLY; W. A. Thiermann, Hanover, Germany. App. filed Nov. 12, 1901. The apparatus consists of a rotor and a stator. The rotors are bipolar and have no winding; the stators have a sectional winding, the sections of which are connected in parallel. The stators also have a second winding connected with a source of electricity which acts as the primary coil of a transformer, while the other winding acts as the secondary.

706,283. ELECTRIC GLASS FURNACE; A. Voelker, Cologne, Germany. App. filed April 25, 1901. (See page 258.)

706,286. BRUSH HOLDER; F. T. Weidaw, Syracuse, N. Y. App. filed Feb. 10, 1902. The brush clamp is secured to the central portion of a bow-spring whose opposite ends are secured to the brush holder support.

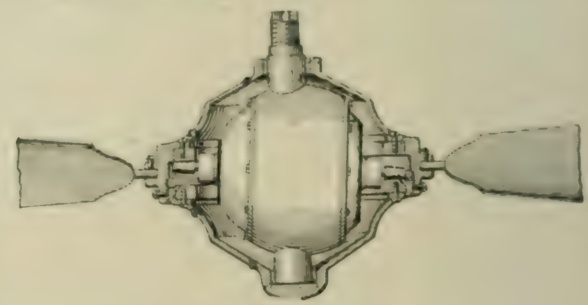
706,295. STARTING MECHANISM FOR TRAINS; J. B. Blood, Newburyport, Mass. App. filed Aug. 28, 1901. A train signaling device consisting of pressure controllers on each car and means whereby the starting signal is consequent upon the coincident condition of all of the pressure devices.

706,308. TELEPHONE CIRCUIT; I. H. Farnham, Dec'd, Wellesley, Mass. App. filed July 2, 1901. (See page 256.)

706,313. INCANDESCENT ELECTRIC LAMP; H. Gilmore, Boston, Mass. App. filed April 7, 1900. An improved connector between the filament and leading-in wire.

706,314. COMPOUND INCANDESCENT ELECTRIC LAMP; H. Gilmore, Boston, Mass. App. filed Feb. 7, 1901. Two incandescent lamps, one with a fine filament and the other with a coarser filament and means for passing the current through the lamp with the coarser filament to bring that lamp alone to full glow, and means for passing the current through both lamps in series to so reduce the amperage that only the lamp with the fine filament will be brought to full glow.

706,317. ELECTRIC MOTOR; A. B. Holson, Chicago, Ill. App. filed Nov. 4, 1901. A ceiling fan-motor in which a pinion on each end of the armature shaft engages with facing annular gears, respectively connected to a rotating frame carrying the blades.



706,317.—Electric Motor.

706,318. COMPOSITE ELECTRIC CIRCUIT; M. H. Howell, Melrose, Mass. App. filed June 24, 1901. (See page 256.)

706,319. TELEPHONE CIRCUIT; M. H. Howell, Melrose, Mass. App. filed June 19, 1901. (See page 256.)

706,338. TROLLEY WIRE FINDER; L. C. Nolan, St. Paul, Minn. App. filed April 11, 1902. A pivoted fork arranged to be thrown above the wheel.

706,340. BATTERY; W. L. Panikoff, New Haven, Conn. App. filed March 18, 1902. A medical battery outfit wherein the battery jars are lifted to carry the elements thereinto.

706,361. INSTRUMENT FOR MEASURING ELECTRIC CURRENTS; W. Thomson, Glasgow, Scotland. App. filed Dec. 30, 1897. Improvement in measuring instruments, in which a soft iron rod or wire is drawn into a solenoid carrying the current; the plunger being hung by a ligament from a segment or circular arc fixed to the beam of a balance in such a way that said ligament passes tangentially downward and plunger moves in a straight line of its own length.

706,384. FIRE ALARM TELEGRAPH SYSTEM; R. G. Callum, Washington, D. C. App. filed Oct. 5, 1899. Renewed Jan. 11, 1902. Improvements in thermostat alarm systems, so that a renewed and more than one alarm can be sent in from the danger point; one circuit being normally open, and one closed.

706,406. CURRENT METER; G. L. Gowland, Peterboro, Can. App. filed March 22, 1902.

706,435. CIRCUIT CLOSER; D. F. Mulkey, Soddy, Tenn. App. filed Dec. 31, 1901. Details.

706,436. APPARATUS FOR THE ELECTROLYTICAL TREATMENT OF ORES OR SLIMES; F. T. Mumford, Kalgoorlie, Western Australia, Australia. App. filed Sept. 30, 1901. (See page 258.)

706,444. COMPOSITION FOR USE IN SECONDARY BATTERIES; C. T. J. Oppermann, London, Eng. App. filed Jan. 11, 1902. Active material consisting of lead oxid in a solution containing bitumen intended to render the active material harder and more coherent.

706,478. FLUID PRESSURE ELECTRIC SWITCH CONTROLLING APPARATUS; A. Sundh, Yonkers, N. Y. App. filed Dec. 16, 1901. A quick acting power switch.

706,500. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed Oct. 25, 1901. Employs a receiver built up of a plurality of plates in inductive relation; means for permanently charging the plates, and a local circuit controlled by said plates.

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NEW YORK, SATURDAY, AUGUST 23, 1902.

CONTENTS.

SPECTACULAR ELECTRICITY.

The dispatches from London describing the ceremonial of the coronation of King Edward mention the interesting fact that at the moment when he assumed the crown all the electric lights in Westminster Abbey flashed out in their full brilliancy, with great effect. The idea was an admirable one, and it is to be inferred from the reports that it was carried out with all the smoothness and precision that characterized the other proceedings of that great event. We can imagine that in some quarters the effect may be criticized as theatrical, but looked at fairly and squarely, the coronation was as truly a theatrical performance as any that could well be attempted on histrionic boards. It is the fact that a coronation is a religious ceremony, but lots of kings and queens get along very nicely without it, and are just as effective in their various functions as rulers. Considering the joyousness and gladness of such an occasion as that which has just taken place in the old Abbey, we are glad to see the electric light used to illuminate its dusty splendor, and add eclat to the celebration. This use of electricity at the antique rite was fully as appropriate, and quite as essentially modern, as the use of electric fans in the King's bedroom to mitigate the heat as he lay suffering so patiently and bravely in the dense heat of midsummer. While there are kings and queens, the world will largely look to them for guidance and leadership in setting the fashions, and we feel, personally, very much obliged to King Edward for his willingness to use electric lights and electric fans, and to have electric elevators installed in his palaces for the sake of comfort and convenience.

THE ELECTRICAL EXPORT TRADE.

The June summary of the commerce and finance of the United States, issued by the Bureau of Statistics, of the Treasury Department, gives the complete export figures for the year. The general totals have already been noted, showing a lower volume of exports and a slight increase in imports, but leaving still a substantial balance of $478,392,330 of goods exported; while of the imports a growing quantity consists of raw material to be worked up in manufactures. In view of the failure of the corn crop last year, and the great domestic demand for manufactured products, the results are very satisfactory. This year there are bumper harvests, with an increase in the quantities of agricultural produce available for export; but probably the briskness of home consumption will act as a check on the export of surplus manufactured goods.

In the branch of electrical exports the figures are good, but exhibit the effect of the establishment abroad of large plants to make American apparatus. It was hardly to be expected that exportations could long continue on the scale of a few years ago, in certain heavy lines, for it was inevitable not only that foreign manufacturers would give closer attention to newer demands but that foreign capital would invite Americans to establish plants. Hence, some of the largest factories in England and on the Continent to-day are largely American in origin, methods, personnel and product; and this being so, the export of the classes of apparatus affected must necessarily sustain some check. Turning to the figures themselves we find the export of electrical machinery for the year ending June 30, given at $5,379,746, as compared with $5,812,715 in 1901, while it is just about one million dollars more than in 1900. Of the product for 1901-2,

the United Kingdom took nearly one-half, and British North America nearly another quarter, and British Australasia one-ninth. Not to mention other parts of the British Empire, these figures show what excellent customers our English cousins are.

As to electrical instruments, including telegraph and telephone apparatus, the figures are not so clearly arrived at. Up to the present year all such apparatus was grouped indiscriminately with scientific apparatus. It is now being separated, and it appears that of a total $5,389,476 under the general heading, not less than $3,631,759 was the value of electrical appliances. This is not subdivided so as to show the countries buying, as in the former case; but of the total it again appears England and her colonies took about one-half. There is a wide range of apparatus included in this group whose details would be interesting, but it is at least something to have the electrical figures now taken separately on account of their growth and importance. From the above it will be seen that this country is doing an annual export electrical trade of at least $9,000,000 a year, a figure, we believe, to be susceptible of marked increase on account of the scale on which electrical apparatus is produced in this country, and its universal applicability without change of make or style.

Engineering Education.

It is a long-established truism that education cannot create, but that it can foster. *Poeta nascitur non fit* was the verdict rendered by public sentiment upon this question in the days of ancient Rome, and what is true concerning poets is more or less true concerning engineers. Engineers are born, just as poets, artists, musicians, and salesmen are born, and no amount of education can be expected to make a great salesman out of a born engineer, or *vice versa.* But education itself seeks not to determine congenital ability or natural talent. It appeals to the intelligence of the student regardless of capability. The average man of a given community has a perfectly definite statistical existence. He has a certain height, weight and girth in physical assessment, and a certain intelligence and capacity for acquisition in mental assessment. Education of a certain definite character is theoretically capable of bringing about a certain definite result in this average student, when the study is carried on for a certain specified time. In fact, the whole system of national education, considered on a large scale, is a purely mechanical and statistical process from this point of view.

As soon, however, as averages are departed from and picked students are selected, the entire problem is modified. A new set of statistical conditions applies to the new average formed by the selected students. These call for a different class of education and for a different period of its application. The results attained in the education of picked students are hopelessly incapable of parallel comparison with the results attained in the education of unselected students.

It is for this reason in particular that the curriculum of study in night schools is necessarily and essentially different from the curriculum of post-graduate students. The former tend to represent more nearly the average capabilities of the community at large. The latter tend to represent selected individuals culled from the ranks of successful students, who were again culled from classes that tended to attract men of special ability in that line of industry. If the class of students who attended night schools were statistically the same as the class of students that attend college—and particularly post-graduate courses—then the results achieved in night schools might approach those achieved in post-graduate education In the night schools there are individuals of abilities as marked as any in college courses, but the average is necessarily different

These views seem to be in accordance with Mr. Hines's article in this issue. That article points to the desirability of having suitable courses of education open to the great mass of the workers in electrotechnics. This is, undoubtedly, sound principle. Education is unquestionably the need and the spirit of the age. There is no class of workers in the whole world that cannot be benefited by it. The difficulty is to ascertain the statistical condition of each class and to determine the particular kind of education adapted thereto. To the great majority, correspondence schools, night schools and manual-training schools are best adapted. By continually lessening numbers, in any country at any one time, higher educations, with the corresponding tax upon time and subsistence, are demanded for producing the best results.

Block Signals on American Railroads.

Although the automatic block signal systems which have been developed for use on American steam railroads have depended so much upon electricity for their operation, block signal engineering has from its nature been so apart from other lines of electrical engineering that the average electrical engineer probably knows less of automatic electric block signal practice than of any other branch of electrical development. An article on the subject, by Mr. E. F. Bliss, which is given in this issue, cannot by any means be considered a complete review of automatic block signal practice, but it will serve to give a clear outline of some of the more important features of present automatic block signal practice to those not conversant with this increasingly important branch of electrical work. The automatic electrical block signals coming into such extensive use in America may be considered as somewhat in a line with other American automatic labor-saving appliances. American railroad engineers have not been content to confine themselves to the expensively-maintained manual block system, requiring operators for each block station, and the automatic block system, which has in consequence been developed, has resulted not only in a saving of operating expenses on lines which would otherwise require a manual block system, but has also made it possible, financially, to put block signals on many more miles of road than could otherwise have been protected.

Automatic block signal work in America dates back to the experiments of Thomas S. Hall, in 1866. The progress of the first 20 years was exceedingly slow. Until 12 years ago the use of the track circuit, now so universally used for the operation of signals, was limited, and generally considered as an uncertain experiment when tried. As the requirements of track circuits became better understood, the difficulties before experienced were reduced to such a point that the track circuit now has the field almost to itself. Indeed, it is upon the track circuit that much of the reliability and simplicity of our present block signal systems depends, and it is to be regretted that owing to the use of the track as a return circuit, electric railways operating on the surface are prohibited by practical considertions for using track circuits for automatic block signaling. At the present time railroad practice has virtually settled down to two accepted forms of signals—the semaphore and the enclosed disc. The semaphore has the advantage of giving more unmistakable indications by day, while the enclosed disc, owing to the small amount of electrical energy taken to operate it, has the advantage of economy of operation and maintenance. For a number of years the only automatic semaphore available was the electro-pneumatic type, which required compressed air for its operation, and the expense of which was prohibitive for many miles of road which could, however, afford the less expensive enclosed disc. Within the past five years the semaphore operated by an electric motor has been developed, and

railroads now have the choice between the electrically-operated enclosed banjo or disc and the electrically-operated semaphore signal, at a slight increase in cost over the disc.

The evolution of a thoroughly reliable electric semaphore motor mechanism has taken some time because the problem is, by no means, a simple one, and even the apparatus of to-day is somewhat complicated. The question has been, not how to devise a motor mechanism that will operate a semaphore signal, but to secure such economy in the apparatus as to enable it to be operated from primary batteries located at each signal, and at the same time be absolutely certain that signals will never stick in the clear position. The counterweight on a semaphore, which acts to return the signal to danger position, may be considered as one of the factors of safety of the signal. Reduction in this factor of safety means reduction in the amount of electrical energy required to force it to the clear position. All of the inventive efforts, therefore, have been directed towards means for reducing the counterweight the signal must carry by reducing the various elements of friction which necessitated heavy counterweighting. It is on this point that the greater part of the skill and design and workmanship has been expended. The prosperous times of the past few years have stimulated immensely the work of equipping railroad lines with automatic signals, which previously were unable to earn a surplus sufficient to make improvements of this kind; and these roads are now taking advantage of increased earnings to equip with block signals. Every improvement in the block signal field which tends to put automatic block signals within the reach of more railroads, so that a greater mileage can be equipped, is most beneficial in its results, adding as it does to the safety of the thousands who travel, by removing the uncertainties which accompany the train dispatching system.

STEAM VS. ELECTRIC LOCOMOTIVES.

We are glad to note that the cause above mentioned, which has been argued with all the fervor of an impending prize fight, is, according to recent reports from Berlin, about to come to trial again on the now famous Berlin-Zossen line. When the electric trials came to a close for the time being by reason of the failure of the track, a prize contest was inaugurated by the German Society of Mechanical Engineers, looking to the confusion of the electrical contingent. The specification calls for an engine and train having a capacityy for 100 passengers, to be capable of a speed of 75 miles per hour for three consecutive hours without stops for fuel or water. This of itself would appear to be a most insignificant feat from the standpoint of the American engineer, for with a train of so small capacity as that demanded, almost any first-class express locomotive from one of our big trunk lines would make light of the task. But in the German test, economy of fuel is to be an important feature, and the trials are to be upon the same track which failed at the high speeds reached by the experimental electric cars. A recent publication in the U. S. Consular Reports gives some details of the plans which are of considerable interest. In view of the air resistance found by the electric tests it is proposed to box in the entire train so as to form a species of flexibly-jointed sheet-steel projectile, with sharp point and smooth sides. This is the familiar shape affected by the high-speed promoter for some years past, and we shall be glad to see the old friend really materialized and in operation. It is commendable on general principles for either steam or electric service.

The design of the projected locomotive is evidently intended to get there. In addition to providing a heating surface double that of the standard German locomotive, the locomotive is to be three-cylinder compound with external low-pressure cylinders and a central high-pressure cylinder. The attempt is to secure very great steaming capacity with usual economy of fuel, so as to obtain the requisite speed with the smallest possible weight and resultant strain on the track. The weight is to be spring supported in the softest possible manner to reduce the strains on the track. The projectors of the outfit seem to have a fixed delusion that the high electric speeds failed on account of lack of flexible supports for the weights; and they do not propose to be caught in the same way if they can possibly escape. They have not yet devised any method, so far as we are informed, of abolishing the hammering of the reciprocating parts, which is the feature of steam locomotives; but, perhaps, they hope to reduce it by careful balancing for the proposed rotative speed. It strikes us that they need not worry much about attaining the required speed, but unless we mistake, they will have plenty of fun with the track unless it is greatly improved over its condition during the electric trials. Of course, the comparatively light engine will help matters materially, but it is no joke to run over a light track at double the usual speeds for which the track was to be used.

And supposing the feat were accomplished successfully, what of it? To our minds the steam experiments are putting the cart before the horse. They are deliberately designing a light locomotive to run on a bad track at a speed which otherwise would not be safe, instead of building as good a track as possible and trying for speeds high enough to be worth the while. Seventy-five miles per hour for three hours is an easy mark on any good American line with a reasonably straight and level track. With a locomotive and train especially planned for the purpose, the problem involves no material difficulties whatever. And supposing the new experiment is capable of operating even on the Berlin-Zossen line where the electric cars were run, what of it? Unless a speed much greater than 75 miles per hour is reached, the conditions of the test will not be comparable with the results obtained from the electric trains. It is, of course, a desirable thing deliberately to build a high-speed train for the purpose of finding out what can be done by refinements of design, but to be of practical value the speed aimed at should not be less than 100 miles per hour. Seventy-five miles per hour is not enough higher than present speeds to be of any great importance. As we have many times pointed out, the value of really fast running lies in covering long distances at very great speed, so as to effect a valuable saving of time. For example, we do not think that a 20-hour train between New York and Chicago is materially better than a 24-hour train, save as it may gratify a very human taste for a hot pace. In either case practically a day and a night are required to complete the journey. Reduce the running time to ten or twelve hours, however—a mere night's run—and an entire business day will have been saved; so that the gain involved is important. In the same way, a shortening of running time sufficient to convert a half day's trip into a couple of hours is most useful.

We are glad to have a really serious effort at the development of a steam locomotive for great speeds, but the present attempt does not go far enough. However successful, it proves nothing for or against the electric method of propulsion. The Berlin-Zossen trials were made with a very heavy and powerful equipment, so powerful that at the highest speed that the track allowed, the motors were barely half loaded. If the motors had been built for 75 miles per hour instead of 125, and the whole equipment had been correspondingly light, there would have been a different story to tell. The electric trains got into track trouble at just about the speed for which the steam locomotives are planned, so that if the latter succeed, their victory will be a most unsubstantial one. And if they do not make the speed, we shall be ashamed of German engineering, for which we usually entertain most sincere respect.

Juries and Awards for the St. Louis Exposition.

The special rules and regulations providing for an International Jury and governing the system of making awards at the Louisiana Purchase Exposition, at St. Louis, were promulgated last week by President Francis. They represent a great deal of careful research and much correspondence, many persons in other cities having been consulted. It was the desire of the Exposition authorities to secure the best outside advice obtainable as to a number of the matters under consideration, and the completion of the work was delayed somewhat in consequence.

The total number of jurors in the International Jury of Awards will be approximately two per cent. of the total number of exhibitors, but not in excess of that number, and each nation having 50 exhibitors or more will be entitled to representation on the jury. The number of jurors for each art or industry and for each nationality represented, will as far as practicable, be proportional to the number of exhibitors and the importance of the exhibits. Each group jury will be composed of jurors and alternates. The number of alternates will in no case exceed one-fourth of the number of jurors, and they will have a deliberative voice and vote only when occupying the places of absent jurors. The United States jurors and alternates of the group juries will be nominated by the chiefs of departments to which the respective groups belong. The jurors and alternates of the group juries representing foreign countries and the United States insular possessions will be nominated by the commissioners of such countries.

There will be department juries, to consider carefully and review the reports of the group juries, to harmonize any differences that may exist between the recommendations of the several group juries as to awards, and to adjust all awards recommended so that they will be consistent with the rules and regulations. Twenty days may be devoted to this work, and when the awards recommended by the group juries have been adjusted, the department juries will, through the chiefs of their respective departments, sumbit their findings to the Director of Exhibits, who shall, within ten days after the receipt thereof, certify the same to the superior jury, including such work as may have been left incomplete by the department jury.

The officers and members of the superior jury will be as follows: President, the President of the Louisiana Purchase Exposition Company; 1st vice-president, the Director of Exhibits; 2d vice-president, a citizen of the United States, to be named by the National Commission; 3rd and 4th vice-presidents, the Commissioners-General of the two foreign countries having the largest number of exhibitors. The members of the jury will further consist of the chairman and the 1st vice-chairman of the department juries, the chiefs of the exhibit departments, and one person appointed by the Board of Lady Managers.

A special award, consisting of a gold medal in each department, may be recommended by the department jury, for the best, most complete and most attractive installation.

The following scale of markings will be used in determining the final merits of an exhibit and fixing the award that should be made, 100 being used as indicating perfection: Exhibits receiving markings ranging from 60 to 74, inclusive, bronze medal; exhibits receiving markings ranging from 75 to 84, inclusive, silver medal; exhibits receiving markings ranging from 85 to 94, inclusive, gold medal; exhibits receiving markings ranging from 95 to 100, inclusive, grand prize.

The diplomas or certificates of award for exhibitors are to be signed by the President of the Louisiana Purchase Exposition Company, the President of the Louisiana Purchase Exposition Commission, the Secretary of the Louisiana Purchase Exposition Company, the Direcor of Exhibits and the chief of the department to which the exhibit pertains.

Special commemorative medals and diplomas may be issued to the officers of the Exposition, to the United States, State and Foreign Commissioners, to the members of the International Jury of Awards, and to such other persons as may be deemed worthy of special recognition.

The superior jury will determine finally and fully the awards to be made to exhibitors and collaborators in all cases that are formally presented for its consideration. Formal notification of the awards will, in each case, be sent by the president of the jury to the exhibitors to their respective exhibits.

If, for any reason, an award is not satisfactory to an exhibitor, he may file written notice to that effect with the president of the jury within three days after the official notification of the award; and this notice must be followed, within seven days after the date of the official notification, with a written statement setting forth at length his views as to wherein the award is inconsistent or unjust.

Pacific Cable Conditions.

We printed last week the conditions proposed by President Roosevelt for the privilege of landing the Pacific commercial cable on American shores. The reply of the Commercial Cable Company will not be made for a month or more. Mr. George G. Ward, the manager of the Pacific Cable Company, and the person best acquainted with the situation, is in London, and will not return until the middle of September. Mr. Clarence H. Mackay is also abroad.

According to Mr. George Clapperton, the traffic manager of the Commercial Cable Company, the only stipulation which is really irksome and capable of affording a source of serious disagreement, is the condition that an additional cable be laid between the Philippine Islands and China. This extension of the line demanded by President Roosevelt is particularly objectionable because the company already has entered into an agreement with the persons controlling the existing line between Manila and China; this arrangement was intended to give the Pacific Cable Company an outlying spur without the necessity of laying another cable. "This condition," Mr. Clapperton states, "if complied with, would entail a large extra expenditure on which we had not reckoned. The others are either insignificant or can be easily adjusted. The term providing that only American citizens shall be employed in the operation of the cable meets with our approval, but practical obstacles stand in the way of our immediate compliance with it. There are very few Americans who are prepared to serve as operators, and at the start foreign recruiting will be necessary. Even if we should establish a school to train operators, the benefit would be slow and small. The work requires unusual skill and intelligence, and I should venture to state that out of a school of 100 about 5 per cent., and no more, would be competent to enter the service."

Automobile Guarantees.

Motor vehicle makers of this country have adopted a standard form of guarantee. It has been under discussion by the members of the National Association of Automobile Manufacturers for several months.

The guarantee, as finally promulgated by the association's executive committee, is as follows:

We warrant all goods furnished by us for 60 days following the date of their shipment, based upon the date of invoice covering the goods; this warranty being limited to the replacement in our factory of all parts giving out under normal service in consequence of defect of material or workmanship.

If the circumstances do not permit that the work shall be executed in our factory this guarantee is limited to the shipment, without charge, of the parts intended to replace those acknowledged to be defective.

It is, however, understood that we make no warranty whatever regarding pneumatic tires or the batteries.

We cannot accept any responsibility in connection with any of our motor cars when they have been altered or repaired outside of our factory.

We are not responsible to the purchaser of our goods for any undertakings and warranties made by our agents beyond those expressed above.

We wish it distinctly understood that we make no warranty of our goods except as stated above, but desire and expect that customers shall make a thorough examination of our goods before purchasing.

The N. A. A. M. executive committee also announces that it has completed negotiations with the management of the next British show in London for an American exhibit, under the auspices of the association, whereby members can show sample vehicles at a very moderate total expense, including transportation.

Modern Electric Block Signaling.

BY E. F. BLISS.

As traffic becomes heavy on double-track lines so that trains are run closely together some device must be used to keep them a safe distance apart. The device commonly used is the block signal, so called because it is placed at the entrance of a block; a block being simply a portion of the track varying in length according to the physical conditions of the country and the number of trains to be handled. The length is usually from ½ to 2 miles.

There are two patterns of block signals in common use to-day, the semaphore blade and the disc. A semaphore blade is about 4½ feet long and 7 inches wide, placed at the top of a mast about 25 feet high which stands near the track. (Fig. 1.) The blade always extends to the right of the mast as seen from an approaching train. When the blade is in the horizontal position it indicates "stop," or "danger." When inclined at an angle of about 45° it indicates (according to the rules of most roads) "clear" or "safety." At night the two positions are usually indicated by red (danger) and white (safety) lights respectively. A second blade on the mast about six feet below the first one is frequently employed as a "caution" or "distant signal." When this blade is in the horizontal position it indicates that the top blade or "home signal" at the next signal post in advance is in the "stop" position, and that the engineer must be prepared to stop his train before reaching the next signal. When the lower or distant signal blade is inclined it indicates that the top or "home" blade on the signal ahead is also clear. At night the two positions of the distant signal are shown by green and white lights respectively. The end of the stop blade is usually square, while that of the caution blade is forked.

On some roads instead of a semaphore post with two blades there is one "three-positon" blade in which the horizontal position indicates stop, an angle of 45° caution, and a vertical position clear. The Pennsylvania Company was the first to adopt the three-position semaphore. In the three-position semaphore, the cost and mainte-

FIG. 1.—UNION ELECTRIC SEMAPHORES.—HOME AND DISTANT SIGNALS ON SAME POST.

nance of one blade, lamp and working apparatus is saved. The cost of oil and care for the semaphore lamp is about $12 a year. All semaphore blades are counter-weighted so that in case any part of the apparatus breaks, the blade will go at once to the horizontal position.

THE HALL DISC SIGNAL.

One of the cheapest, simplest and most reliable electric signals is

FIG. 2.—HALL DISC SIGNAL.—HOME AND DISTANT SIGNALS ON SAME POST.

the Hall disc signal, (Figs. 2 and 3.) which is used by a large number of railroads. In this signal the indication is given by a colored disc instead of a semaphore blade. The disc, which is about

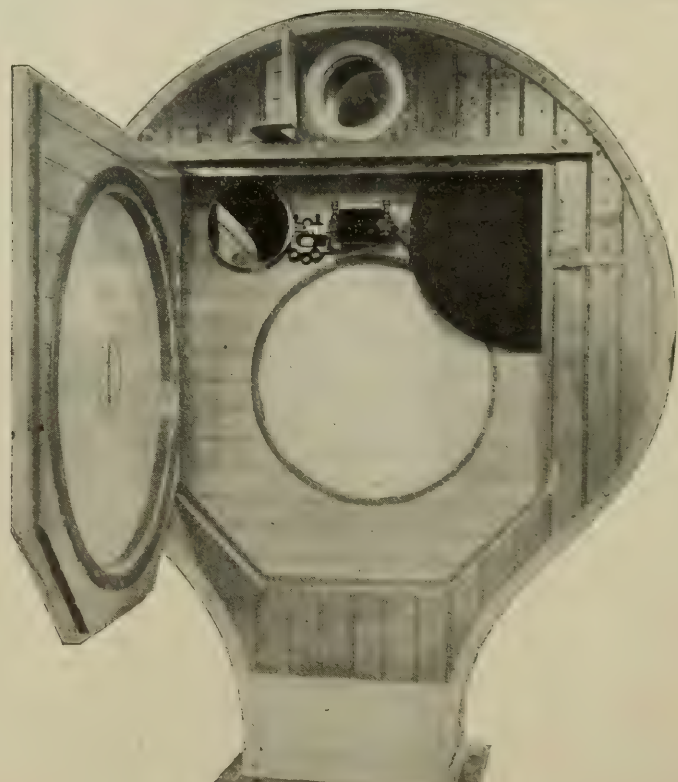


FIG. 3.—HALL DISC SIGNAL.—INTERIOR.

a foot in diameter, is made by stretching colored silk over an aluminum wire frame; lightness of moving parts being of prime importance in this design. This disc is placed on one end of a lever,

while the other end carries a small disc of colored glass. The lever is mounted near its center of gravity upon the armature of an electromagnet of about 35 ohms resistance. The whole apparatus is enclosed in a large weatherproof case.

When the magnet is deenergized the silk disc hangs behind a round glass window in the case, while at the same time the colored glass covers a small window just above the first one and in front of the lamp which gives the night indication. When the magnet is energized the lever turns upon its axis until the silk disc is raised away from the window and the colored glass moved away from the lamp. This is the clear position and shows a white background behind the window in the place of the colored silk. When the lever reaches the clear position the 35-ohm magnet is cut out of the circuit and one of 500 ohms is cut in. This high resistance magnet is sufficient to hold the signal in the clear position. These signals are mounted on iron or wood masts, and the red above the green, as in Fig. 2, if home and distant are on the same pole.

CIRCUITS FOR HOME AND DISTANT, NORMALLY CLEAR SIGNALS.

One form of track circuit used with a system of home and distant Hall disc signals is shown in Fig. 4. In this, *A*, *B* and *C* represent three block stations. The rails of the track are all bonded at the joints save at each block signal station, where one joint in each rail is insulated. A small battery *D*, called the track battery (consisting usually of two gravity cells in multiple) is connected between the rails at the forward end of each block. At the beginning of the block a track relay *T* is connected to the rails in a similar manner. When there is no train in the block, the current from the track battery circulates down one rail, through the coils of the track relay and back through the other rail. The armature of the track relay, the magnet of the red home signal *R*, and the signal battery *S*, form a second circuit by which the signal is held at clear when the track circuit is closed.

The direction of train travel is from the bottom to the top of the diagram, as indicated by the arrow. Now, when a train or even a single pair of wheels passes *A*, the current from the track battery at the end of the block *A*, *B*, will be short-circuited, flowing through the wheels and axles instead of through the track relay. The armature of the track relay immediately falls, which breaks the circuit of the signal battery, and the signal goes to the "stop" position by the force of gravity. As soon as the last pair of wheels has passed *B*, the circuit is restored through the track relay at *A*, the armature of which closes the signal circuit and causes the disc to go to the clear position. After the train has passed *C* the track relay at *B* closes the circuit of its own red signal and also a circuit which runs back over the telegraph poles to the caution signal at *A*, bringing it to the clear position.

If an engineer approaches a block station and sees both signals clear he knows there are at least two unoccupied blocks ahead of him. If the red or home signal is at clear, but the green one is not, he knows there is a train in the second block ahead. If the home or red signal is at danger he knows there is a train in the next block ahead. In Fig. 4, a train is in the block beginning at *C*, as is shown by the position of relay and signals. It is often preferred to have the distant or green signal indicate caution when the red signal on the same mast indicates stop. This is easily arranged by having the circuit of the green disc run through a pair of contact points opened and closed by the lever of the home signal.

CIRCUITS FOR THE OVERLAP BLOCK.

Fig. 5 shows an arrangement which is sometimes used in the place of a distant signal or caution blade of the semaphore. The signal at station *A* does not go to the clear position when the train passes station *C*, but only after it has passed *D*. The distance between *C* and *D* is sufficient for a train to stop when running full speed. An engineer finding the signal at *A* in the danger position, knows that there is a train somewhere between *B* and *D*. This overlap block is especially useful in single-track blocking, as will be seen.

CIRCUITS FOR SINGLE-TRACK BLOCKING.

Fig. 6 shows an arrangement of circuit for single track blocking. Each block is divided near the middle and a track battery connected to each part, as shown. When a train passes into block *A*, *B*, the track relay *F* opens the circuit controlling the signal at *E*, which allows it to go to the stop position and warn any train that may be approaching from the opposite direction. When the train passes *B*, relay *G* opens and the signal at *B* goes to the stop position, opening a switch, *S*, on the signal rod which holds the circuit to *E* open through *F* to be closed. In this way the circuit to *E* will be open until the signal at *B* goes to the clear position, which, with this overlap block arrangement will not be until the train has passed *E*. It will be seen that on the track just passed over by a train the signals in the rear work exactly as in Fig. 5, and at the same time the train keeps the first two signals ahead of it which govern the opposing train, in the stop position at all times. A train running from *E* to *A* will control the signals at *B* and *D* in precisely the same manner.

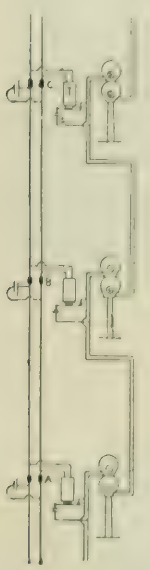


FIG. 4.—CIRCUITS FOR HOME AND DISTANT NORMALLY CLEAR SIGNALS.

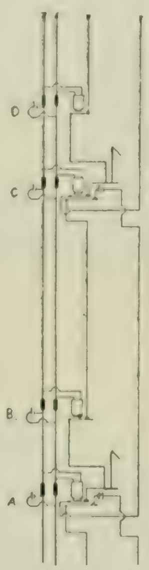


FIG. 5.—A CIRCUIT FOR THE OVERLAP BLOCK.

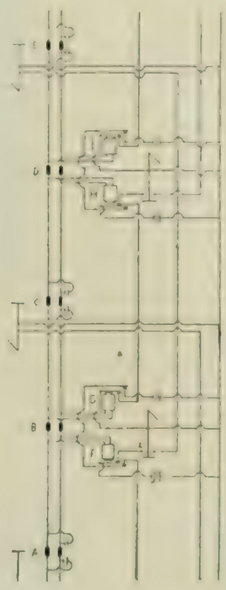


FIG. 6.—CIRCUITS FOR SINGLE-TRACK BLOCK SIGNALS.

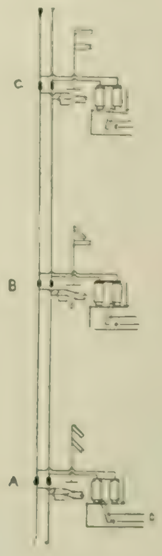


FIG. 7.—CIRCUITS FOR UNION WIRELESS DISTANT SIGNALS.

FIG. 8.—ONE OF THE CIRCUITS FOR NORMAL DANGER SIGNALS.

CIRCUITS OF UNION "WIRELESS" SYSTEM.

The Union Switch & Signal Company works its caution or distant signal through the track circuit, which does away with all line wires. The track relay has, besides the ordinary neutral armature, a polarized armature which closes the circuit for the caution signal. When the top blade at *B*, Fig. 7, goes to the clear position, the signal rod throws a pole changing switch *S*, which reverses the direction of the current in the track running back to *A*. This reversal of currents through the relay at *A* causes the polarized armature to close the circuit *D*, which extends through a battery and to the mechanism of the caution blade at that station, bringing it to a clear position.

NORMAL DANGER SIGNAL CIRCUITS.

All of the circuits shown thus far are for signals operated on what is known as the "normal clear" plan. That is, the signals always stand in the clear position except when there is a train actually in the block. There is another system called the "normal danger" in which the signal always stands in the stop position until a train comes in sight of it, when, if the block ahead is clear the signal will go to the clear position and stand there until the engine is past. Fig. 8 shows one arrangement of circuits for working "normal danger" signals. The signal circuit at *B* passes through the armature of the track relay *T* and the battery *S* in the regular manner, and also through the armature of relay *C*, called the clearing relay. This clearing relay is controlled by a battery, *E*, the circuit of which is short-circuited when there is a train between *D* and *B*.

When a train passes *D*, the signal circuit of *B* is closed by the armature of *C*, when, if the block ahead is clear, the armature of *T* will be closed, making a complete circuit through the signal at *B*, which will go to the clear position. As the train passes *D* the signal at *A* is still held in the stop position by the armature of *C*, which holds the battery at *D* open until the train has passed entirely out of the block at *B*. Line wires *F* and *H* pass through the battery *S*, armature of *T* and back to *A*, where circuit is completed through

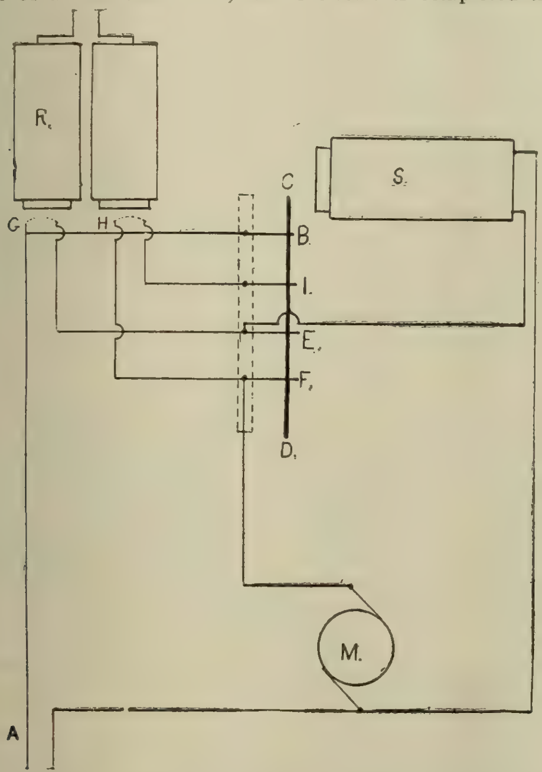


FIG. 9.—CIRCUITS OF THE GRAY ELECTRIC SEMAPHORE MECHANISM.

the mechanism of the caution or distant signal and the armature of the clearing relay *I*. In this manner the distant signal at *A* will clear when a train approaches it if the block ahead of *B* is clear.

There has been considerable discussion of the relative merits of the two systems of signaling. Advocates of the "normal danger" plan claim a great saving in cost of battery material to hold the signals at clear and freedom from the liability of the signal sticking or freezing in the clear position. Advocates of the "normally clear" plan claim greater simplicity, ease of inspection and a better chance to quickly locate and remove trouble when it occurs. As far as cost is concerned, it would seem that careful railroad managers do not consider the moderately higher cost of any equipment when once convinced that it is really better than something that can be had for less money. This is well illustrated by the way electric semaphores are being installed where the much cheaper disc signals could be used.

ELECTRIC SEMAPHORE SIGNALS.

The one great drawback to the disc signal is that it is purely a color signal. The engineer has to depend for his indication entirely on the color that is seen in the little window of the signal case. In hazy weather or smoky places or when the face of a signal does not reflect the light quite right it is very difficult to see the indications, especially when at some distance. The position of a semaphore blade can be seen as far as it is visible. This fact has led inventors to get out electric semaphores of several types.*

In the Gray signal, used on the Pennsylvania lines west of Pittsburg, a small electric motor of about 1-10-h.p. moves the three-position semaphore blade to the caution and clear positions. The mechanical and electrical parts are enclosed in a waterproof iron box which rests on the ground or on a bridge and supports the mast of the signal, which is a steel tube within which the up and down rod of the signal moves. The Gray signal uses the same kind of track circuit as was shown in Fig. 4. The electric circuits in the mechanism box at the base of the Gray signal are shown in Fig. 9. The wires at *A* are from the track relay and signal battery. When the track relay closes, the current from the signal battery flows from *A* to the contact maker *B*. This contact maker is a spring which presses against a metallic slider *C, D*. Part of the current passes through the spring *E*, around through the magnet *S* and thence back to the battery. Another part of it goes through the spring *F* and starts the motor *M*. The slider, *C, D*, and the magnet *S* (which has flexible connections) are fastened permanently to the lower end of the signal rod, which is hollow and and fits like a sleeve over a short lifting rod. The lower end of this lifting rod is a rack operated by a pinion from the motor through a train of gear wheels.

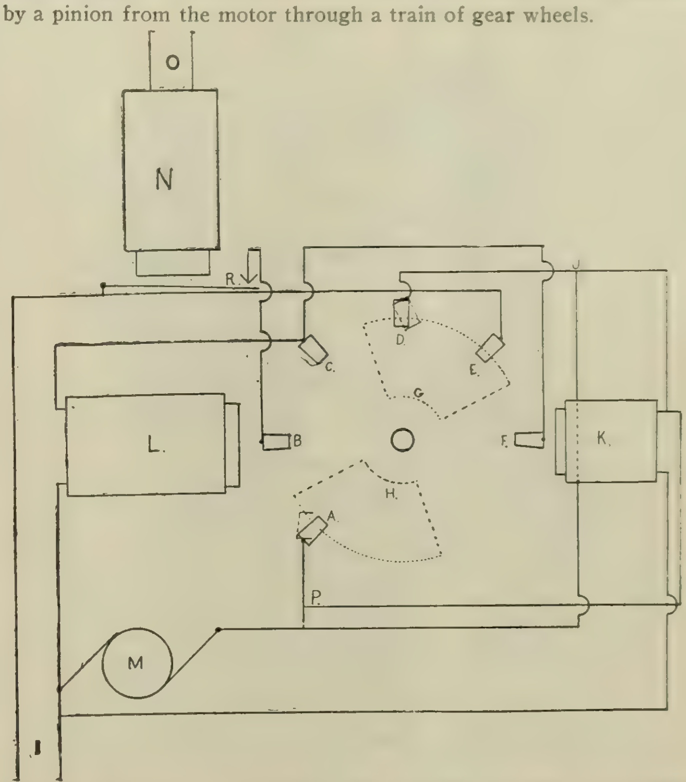


FIG. 10.—CIRCUITS OF PENNSYLVANIA IMPROVED ELECTRIC SEMAPHORE MECHANISM.

When the magnet *S* is energized it locks the signal rod to the rack and lifting rod and thus connects the signal rod to the motor through the rack, pinion and gearing. The motor raises the signal rod (which lowers the blade) until the bottom end of the slider passes *F* and breaks the circuit at that point. This opens the motor circuit, leaving the signal blade at the caution position, where it is held by a pawl and ratchet on one of the cog wheels. As soon as the track relay at the first station ahead is closed, the current comes back over the line wires and energizes the relay *R*, which closes the points *G* and *H*, as shown by the dotted arcs. The current now reaches the motor through the spring *I* and turns it until the end of the slider passes *I* and breaks the circuit as before. There is still contact at *G* which keeps the magnet *S* energized. The signal is now at the clear position.

When the circuit at *A* is broken by the opening of the track relay, the magnet S lets go of the catch which holds the signal rod to the rack and lifting rod. The signal rod, magnetic catch, and magnets fastened to it then fall and the semaphore blade goes to horizontal or danger position. An air dash pot is used to break the fall. To allow the rack and lifting rod to fall back to a position where they can again lift the signal rod to clear the signal, the pinion which

*For a detailed description of the Hall electric semaphore, see the ELECTRICAL WORLD AND ENGINEER of September 28, 1901.—ED.

meshes in the rack is of such size that it will lift the signal rod to full clear position on slightly less than ¾ of a revolution. One-fourth of the circumference of this pinion has the teeth cut out. When the motor starts with the rack elevated this blank quadrant on the pinion soon reaches the rack, which allows the lifting rod to drop down to its first position, where it is ready to lift the blade as before.

During the summer of 1901, the Pennsylvania Company brought out a new signal, very similar to the Gray, but greatly improved. The lower end of the signal rod is attached to a disc which is revolved by a motor through an angle of 90°, thus turning the semaphore blade through the same angle or from the stop to the clear position. Fig. 10 shows the electrical connections of this signal. The circuits are closed through the pieces *A*, *B*, *C*, *D*, *E*, and *F*, and the two quadrants *G* and *H*. These pieces fit snugly on both sides of the quadrant like a spring clothes-pin. When the track relay closes, the current enters the signal box at *I*, passes around to *E*, through the quadrant *G*, out at *D* to *J*, where it divides, part going to the motor *M*, and part to energize the clutch magnet *K*, which locks the disc mentioned above to the train of wheels from the motor. The magnet *K* has flexible connections and moves with the

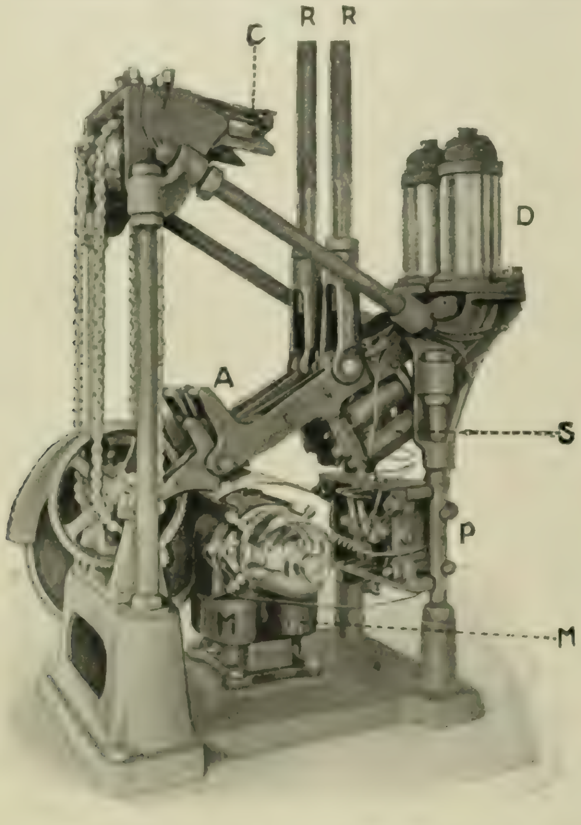


FIG. 11.—UNION ELECTRIC SEMAPHORE MECHANISM.

disc. The quadrants *G* and *H* are insulated from each other and are attached to the same shaft as the disc.

As the shaft revolves 45° clockwise the quadrant *G* makes contact at *F* and breaks it at *D*. Current now goes around through *C* to slot magnet *L*, which locks the disc and holds the blade in the caution position. At the same time quadrant *H* makes a contact at *B*. When the current at *O* energizes the magnet *N*, the current from *I* will flow through *R*, *B*, *H*, *A*, to *P*, where it divides between the motor *M* and magnet *K* as before. The quadrant and disc now revolve 45° further when contact is made at *C* and broken at *A* and *E*. Current through *R*, *B*, *H* and *C* now energizes magnet *L*, while all other circuits are open and the signal stands in the clear position. The two most important contacts, *A* and *D*, swing on pivots as the quadrant passes through them into the position shown by the dotted lines. When the quadrants finally leave them they spring back to the normal position, preventing sparking by giving a quicker and much wider break than would occur otherwise. This signal is especially economical in yards where there is much switching, since, if a switch be opened in the second block ahead, the blade will go at once to the caution position and be caught there. In the Gray signal it would first go to the stop position, when the motor would start and move it to the caution position. This new signal has a liquid dash pot which makes it work very smoothly.

THE UNION ELECTRIC SEMAPHORE.

The mechanism and motor of the electrically operated semaphore with home and distant blades (Fig. 1), made by the Union Switch & Signal Company is shown in Figs. 11 and 12. In Fig. 11, *M* is the motor, *R*, the signal rods, *P*, the pole-changing switch, *D*, the dash pots, *A*, the slot arm, *S*, the slot magnets, and *C*, the electric contacts. Fig. 13 shows the circuits of the Union electric semaphore as used with the Union "wireless" distant signal circuits described before and shown in Fig. 7. The signal, of course, can be operated on other than the wireless system, in which the pole changing switch is left off the signal.

Referring to Fig. 13, when the neutral armature of the track relay closes at *A*, current from the battery *B*, energizes what is known as the slow-acting relay, *R*, which, in turn, closes two circuits in parallel, one being formed by the part of the slot or catch magnet, *L*, and the other by the part, *Q*, and the motor *O*. Both parts of the slot magnet are wound upon the same cores. Most of the current goes through the motor circuit, since *L* is of 1000 ohms resistance. The magnet causes the slot arm by the series of levers and catch shown in Figs. 11 and 12, to engage with lugs on the sprocket chain, which chain is geared to the electric motor, and as the motor revolves the arm is raised and the signal cleared. When it arrives at clear position the point *C*, Fig. 13, is opened, by the movement of the signal, breaking the circuit through the motor but leaving *L* in circuit to hold the signal clear. At the same time the point *D* is closed, which leaves the motor and magnet *N*, ready for current as soon as the polarized armature of the track relay closes the point at *E*. When *E* closes, the caution blade is brought to the clear position by the motor *O*. Point *F* now closes and holds the blade clear while *H* opens the circuit through the motor and *N*. The slow-releasing relay *R* is wound with a regular coil of 1000-ohms resistance. Upon the same cores is also wound a closed coil of 2000-ohms. The effect of the inductance of this closed coil is sufficient to hold the points *K* closed during the very brief interval in which the circuit through the rails is changing direction.

THE MILLER SIGNAL.

During 1901, a few miles of the Chicago & Eastern Illinois Railroad out of Chicago were equipped with the Miller signal system, which is dfferent from anything else now in use. The indications of the Miller signal are given, not by a signal on a post beside the track, but by a lamp carried in the cab of the locomotive. Two small incandescent lamps, one white and the other red are placed side by side in the cab. Only one of them can burn at a time. As long as the white one is burning the engineer knows that the track is clear for at least two blocks ahead. If the red one lights up and the white one goes out, he knows that there is a train in the second block ahead. Fig. 14 illustrates the principle of this system.

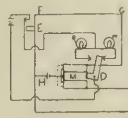
The track is divided into insulated blocks with track batteries and track relays, such as have been described, the only difference being that a short block is left between the regular blocks at each block station. The block station equipment consists of this short block, the station relay and the station battery, no semaphore or disc signals being used. In Fig. 14 the lines at the left of the track represent the apparatus which is carried on the engine. The terminal *P* is connected to the locomotive wheels while the terminal *N* is connected to one of the tender trucks, which is insulated from the rest of the train. These two terminals, therefore, rest on the track, in the relative positions shown in the diagram.

Suppose first that there is no train between stations *A* and *B*. The track relay *T* at *A* will be closed and the current will circulate as follows: From the station battery *S* at *B* through the top armature of the station relay *R* to *C*, through the rail to station *A*, through the relay *R* at that station and the top armature of relay *T*; forward through the line wire *L* to station *B*, through the lower armature of relay *T* at *B* and through the lower armature of relay *R* to *S*. In case there is a train in the block, as shown in the figure, the track relay *T* at *A* will open the circuit through relay *R* at that station. The engine approaches *B*, and as soon as the locomotive *P* passes the first insulated joint near *C*, the circuit through the engine forms a bridge over that joint. The result is that the current from *S* circulates through the circuit of the engine and back to the other pole of *S* instead of through the track and line wire. If the relay *R* be energized as shown at *B*, the current from *S* will flow in the direction to throw the polarized armature *D* of the magnet *M* in the

position to close the circuit through the white light in the engineer's cab. If the relay R is de-energized as shown at A, the circuit from S will pass through the magnet M in the opposite direction and close the circuit through the red lamp.

The indication thus received, when passing a station, will be carried to the next block station; thus, if the signals are thrown to danger upon passing the block station at A, the red light will continue until the station B is reached, where it will remain at danger or go to safety according to the conditions ahead. In case no indication either by red or white light is received in the engineer's cab, it is, of course, taken for granted that there is a danger signal and the engineer proceeds just as if a positive red-light danger signal had been received.

The object of the battery H is to guard against a break in the locomotive circuit. Under normal conditions the circuit from this battery divides, part going around by F and G and part by way of N, the rail and P. These two circuits neutralize each other in the magnet M, so that the polarized armature remains wherever it was placed at the last station passed. In case the circuit down through the track is broken, the current from H all goes through the top half of the magnet M, which is so wound that the armature closes the circuit through the red lamp. If the circuit through F and G is broken, the little relay E allows the lamp circuit to open and neither lamp burns. While the circuit from the battery S must go through the one cell at H, this cell does not interfere with the signal battery, merely working with it in one case and neutralizing a part of it in the other. It will be noticed that a train in any block reverses not only the battery of the first block station in its rear, but also that of the second station in the rear through the line wire. This gives an engineer a whole block in which to stop after he gets a red lamp, so that no other caution signal is required. The battery employed is of the Edison-Lalande type, two cells being used for a station battery and six for the lamp battery on the engine. The insulated joints at the front end of the short block are some feet apart, so that an unbroken circuit is maintained by one rail or the



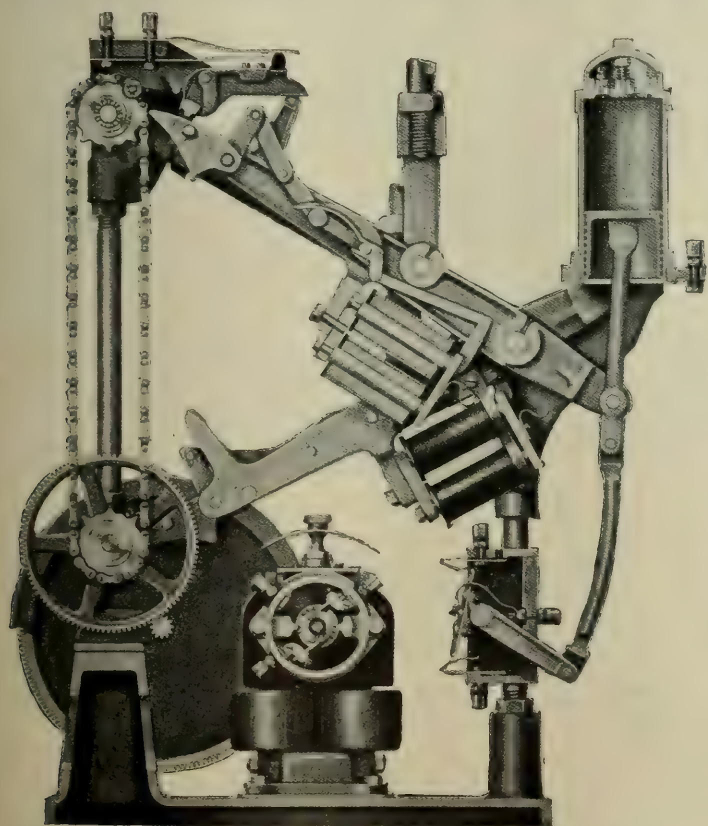


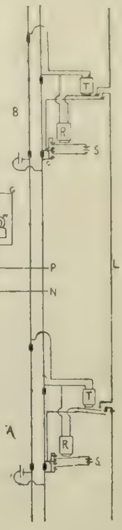
FIG. 12.—UNION ELECTRIC SEMAPHORE MECHANISM, SECTION.

other between P and N after both trucks have passed the first insulated joints of the short block.

TRACK CIRCUITS.

There are some special advantages in using the track circuits for signaling purposes. In case a rail breaks, the track circuit is broken and the signal at the entrance to that block goes to the stop position at once. All switches are wired so that when one is opened the track battery is short-circuited or opened at that point, which causes the signals to assume the stop position. As open switches and broken rails are the cause of many very bad accidents, these two features will be readily appreciated.

Track circuits work best when coarse gravel or broken stone is used as ballast and filled in no higher than one inch below the top of the ties. Rail bonds are usually made of common No. 8 galvanized telegraph wire. One way of fastening them is to wrap the ends around iron rivets and solder fast by dipping. The rivets are then



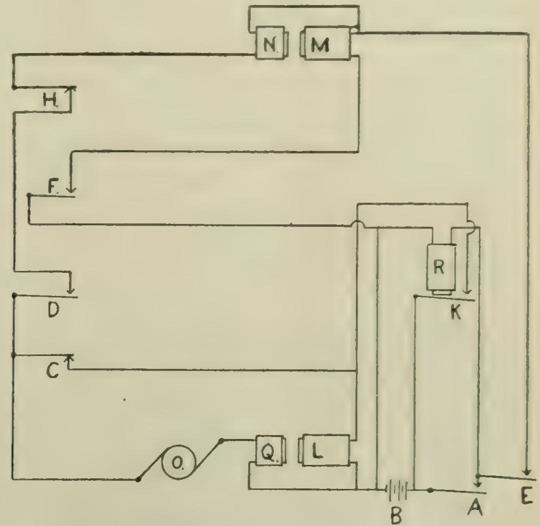


FIG. 14.—CIRCUITS OF MILLER SIGNAL SYSTEM.

FIG. 13.—CIRCUITS OF UNION ELECTRIC SEMAPHORE MECHANISM.

driven tightly into quarter-inch holes drilled in the flange or web of the rails. Another way is to simply wedge the end of the wire into the hole with a channel pin. The bond wires are double, sometimes under the fish-plates and sometimes outside of them; sometimes on both sides of the rail and sometimes both on the inside, which is much better for inspection.

The insulated joints are made by putting a piece of fibre about 3-8-inch thick and the shape of the cross-section of the rail between the ends of the rails. The fish-plates at these joints are made of wood, bound with iron, and the bolts insulated with fibre in such a way that no current can leak across.

COLOR OF LIGHTS.

In all semaphores and the disc signals described thus far, the night indications for "stop," "caution," and "clear," have been given by red, green and white lights respectively. Of late years many roads are doing away with white lights for such signals. If the signal lamp goes out, a false indication may be taken from a white light on the right of way in line with the signal mast. A broken semaphore glass can easily cause a white light to show when it should be red or green. A broken semaphore casting may do the same thing. A large number of roads are using green for clear, which leaves no color for caution or distant signals that is generally acceptable. Some roads are using yellow for caution and are satisfied with it, while others claim the yellow light is too much like the natural color of the kerosene flame, or when seen through smoke is too apt to be taken for a red light. The Chicago & Northwestern Railway system has used a combination of red and green for caution for 10 years with good satisfaction.

The Union Pacific Railroad adopted this combination in the fall of 1901, as well as green for clear in switch lamps, semaphores and all other places where white had been used for clear. The combination of red and green lights is given by a single lamp. The front of the lamp shows red in the usual manner. At one side of the flame is a plain reflector placed at an angle of 45° with a red glass. In front of this reflector and in line with the red glass is a green glass. In this manner the one flame gives the appearance of a red and green light side by side, which indicates caution. An opaque disc is moved before the red glass to give a clear (green) indication.

BATTERIES.

The battery used on track circuits is usually the common gravity battery such as is used in telegraphy. The battery for each block

is usually 2 or 3 cells in parallel, located in a well deep enough to be away from frost. For signal batteries, the Pennsylvania Company uses two sets of lead storage cells charged by a 500-volt generator in a shop about 20 miles from the farthest battery. There are six cells in each set giving about 12 volts. They are changed every day, one set being charged while the other is in use. These batteries are kept in wells made of boiler iron lined with wood. They are about 7 feet deep and are sunk in the ground nearly to the top. A double cover keeps out the frost. The track battery is also kept in these wells. On the Pan-Handle, this same type of signal battery is charged from 18 cells of gravity battery. The Union Pacific Railroad uses 10 cells of gravity battery on its normal danger enclosed disc signals. The Union Switch & Signal Company for operating its electric semaphores uses 16 cells of Edison-Lalande battery giving about 12 volts. This battery has the great advantage that no well is needed. It is placed in the base in the semaphore post just below the mechanism and will work well at a temperature of 20° below zero.

TRACK RELAYS.

The principle of the track relay is very simple, yet this instrument is the most vital part of the signal apparatus. So delicate is the adjustment required that it is deemed advisable to have none but authorized skilled hands attempt it. One company seals up its relay case so that it cannot be opened to change the adjustment without detection. Fig. 15 shows a sectional view of such a relay made by

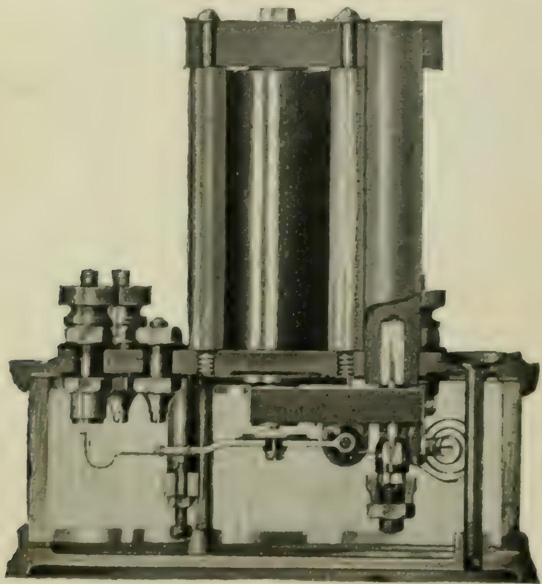


FIG. 15—UNION TRACK RELAY.

the Union Switch & Signal Company, with a glass case protecting the armature and the contact points. The coils are wound to about 4 ohms resistance. The contact points are usually double, so that two independent circuits may be controlled by them.

There are approximately 27,000 miles of track or a little over ¼ of the total mileage of this country protected by block signals. Only about 10 per cent. of this mileage, however, has automatic signals.

The above is an abstract of a thesis presented by the writer for graduation at the University of Nebraska, June, 1902.

Geissler Tube and Condenser Effects.

By Alfred G. Dell.

In the following I will give some of the causes of the effects, as they appear to me, described in communications of mine to Electrical World and Engineer of Jan. 25 and March 20, 1902. In the first place I will note that the Geissler tube is one of the most sensitive things used in experimenting. When the Geissler tube is connected in the secondary of an induction coil, the anode and cathode discharges through it are plainly shown. There are no reversals, whether there is a condenser across the break of the primary or not, and, as published some years ago, it is impossible to tell from the tube when the condenser across the break of the primary is connected or disconnected, the light appearing with equal intensity. The tube allows an easy discharge through it, and does not offer much resistance. It is nearly independent of the spark length obtained by the condenser across the break, a long spark not being required to discharge through it. Hence, the energy between a break and the next make of the battery is the same whether the condenser or not is used, which has a considerable bearing on the action of a coil. Some may say a Geissler tube in series with a Crookes tube shows both bulbs filled with light, and would indicate reversals. This is not so, however. When the impulse on the side of the Crookes tube containing the Geissler rushes through the Geissler, it meets immediately the resistance of the high vacuum of the Crookes, and not being able at once to discharge through the tube rushes back into the Geissler, and is held on the electrode in the Crookes, and also in the Geissler vacuum for a brief moment. Of course, all occurs in an incredibly short time, and the eyes see the effects all together.

Those persons who think there are reversals in the primary of an induction coil from the condenser across break of primary will certainly be brought to a halt by the Geissler tube, for if there were any reversals in the primary there would also naturally be reversals in the secondary of the coil, and the tube would to a certainty show them, although they might be the lightest superimposed impulses imaginable—of course, providing the tube is a sensitive one.

In the experiment of Jan. 25, 1902, I stated that when I placed a small piece of mica, with tin-foil glued on both sides and covered with wax, one side of which was earthed and the other connected to the one side of a spark-gap in the secondary of an induction coil (there being, of course, a condenser across the break of the primary of the coil, so I would have a good spark in the secondary), there were superinduced high-potential discharges from the secondary into the primary, which were shown by a Geissler tube placed across the battery poles or elsewhere. The cause of such an action is very plain to my mind. When the one side discharge rushes into the condenser before the spark is made, it rushes out again, but all does not go to the spark-gap; some little rushes around the secondary of the coil, and thus produces the induction into the primary, the spark-gap in air offering a high resistance.

In the experiment described March 29, 1902, where a rotating disk is used and the condenser is shifted from one side of the spark-gap to the other, the explanation is not so easy; in fact, I have failed to explain it fully. It would appear that an explanation would require a thorough knowledge of the difference between + and — discharges of the secondary of a coil, and if that was understood the knowledge of any electric current would be plain and not a matter of guess work. I will attempt to give one of my explanations and also state where it fails. When the condenser is on the — side, the direction of starting rotation is not changed, the disk still starts from + to — from rest, and will rotate from — to + when started in that direction. Both velocities are very much increased over the ones obtained without the condenser. When the + electrode is touched, the disk only rotates one way, from — to +, with a slow constant velocity and a stiff resistance to any change. If it is rotating rapidly from + to — and the + side is touched, it gradually slows up, reverses and rotates until, as stated, it reaches the slow velocity.

Now, if the condenser is on the — side, that part first rushes into the condenser, and out again to meet the discharge from the opposite side, a small part going back through the secondary of the coil. The side containing the condenser, that is the — side, presents that part of the impulse shortened through condensation, and to meet the — discharge the + is lengthened. Both sides make their discharges in shorter times than otherwise, on account of the delay; hence there would be an increase of velocity, but the disk would still rotate both ways. Up to this point the theory seems all right.

When the condenser is touched to the + electrode, that part of the discharge would be shortened, and the same thing as the above should occur. The + side being the stronger, it would more nearly equalize the two forces, at least reduce the +; but the disk rotates only from — to +, where it should also rotate from + to —, if started in that direction, if it did not rotate from rest from + to —. Hence, you can see that it is entirely in the difference of the two forces. What that difference is I do not know, and the person who can tell will surely know more about electricity than is known, and should understand the very life of it. As explained in the experiments published, a ground acts like a condenser. When the condenser or ground is used, as described above, the spark in the

secondary of the coil is slightly harder to maintain than when not used.

When the ground connection is used instead of the condenser, it acts as a condenser; the reason appears to be that the spark is made too quick for the charge to be dissipated through the ground; it rushes back to the spark-gap before it can be scattered in the earth, although I think there is some little more dissipation with the earthed connection than with the condenser. The ground connection to the one side of the condenser dissipates that induced charge entirely; it does not return, as there is no inducement for it to do so.

Electrical Mining Equipment on the Comstock Lode.

BY LEON M. HALL.

WHEN the mining properties on the Comstock Lode were developed, operations were carried on by means of steam power, wood being used as the fuel. This was very costly on account of the scarcity of wood. The milling was, until quite recently, done at a distance of some 15 miles from the mine, at a point on the Carson River, where cheap water power could be obtained. About two years ago the question of electrical transmission for the purpose of supplying power for deep mining operations on the Comstock Lode was taken up, and since then extensive hydraulic developments have been carried out at Floriston, Cal., on the Truckee River. Power is now transmitted 35 miles to the mines in Stotey County, and a dozen or more of the properties have been equipped with electrical machinery. Among these is the C. & C. shaft, of the Consolidated California and Virginia Mining Company, which has a world-wide reputation as a bullion producer.

The power plant on the Truckee River is about two miles east of Floriston. The river is dammed just below the Floriston Pulp and Paper Mill, and the water is conveyed about 600 feet through a canal, and then 8,600 feet through a wooden flume 6 feet 8 inches high and 10 feet wide, to a point directly above the generating station. It is then conducted through two wooden stave pipes, 160 feet long and 6 feet in diameter, to the wheels, upon which there is a head of 84½ feet. There are two pairs of 27-inch horizontal McCormick turbines, direct connected to Westinghouse, three-phase, 60-cycle generators of the revolving armature type. These generators are separately excited by two 22½-kw direct-current machines. (Fig. 1.) The wheels will each develop 1,400 hp at 400 r. p. m., with the above head of water. They are regulated by two Lombard governors. Current is generated at 500 volts, and is raised to 24,000 volts by means of six 300-kw Westinghouse, oil-insulated transformers, at which potential it is transmitted 33 miles over a double circuit of No. 4 hard-drawn copper wire, to the sub-station at Virginia City. The line is composed of square redwood poles, 30 feet in length, with pine cross-arms and locust pins, upon which are mounted 7½-inch Locke insulators. The telephone circuit is carried on the same poles by oak brackets with pony insulators. At the sub-station at Virginia City (Fig. 2) the potential is lowered to 2,300 volts by means of six 450-kw Westinghouse, oil-insulated transformers, and at this potential current is distributed to the various mining companies. The distribution circuits are composed of weather-proof wire, and are designed for 4 per cent. drop under full load. The generating station at Floriston is constructed of brick with a galvanized iron roof, and the sub-station at Virginia City is entirely covered with corrugated galvanized iron.

The plant has been in continuous operation since Oct. 20, 1900. The Truckee River General Electric Company sells power to the various mining companies at $7 per horse-power per month, the amount used being based on a maximum peak load of two minutes duration. This, with other conditions, has made necessary the installation of machinery of the most durable character and the introduction of some features which are rather unique in character. In the C. & C. Shaft at Virginia City every precaution has been taken to secure thorough reliability and the highest efficiency. The electrical machinery in operation on the surface consists as follows, all being Westinghouse: A 200-hp, 2,200-volt, variable-speed, three-phase, induction motor, geared to balanced electric hoist; a 100-hp, 2,200-volt, induction motor, belted to a 16½-inch x 30 inch single-stage air compressor; a 30-hp, 440-volt induction motor, operating circular saws; a 15-hp motor, driving tools in the machine shop; a 10-hp motor, operating a Blake rock breaker at the ore bin; three 15-kw indoor transformers, transforming from 2,200 volts to 440 volts; one 5-kw lighting transformer, transforming from 2,200 volts to 110 volts; two Manhattan arc lamps; fifty incandescent lamps, together with necessary lightning arresters, fuse blocks, cut-outs and switches. The apparatus underground consists of the following: A 15-hp induction motor, operating at 440 volts, and driving a fan on the 250-foot level; two 10-hp motors, driving fans on the

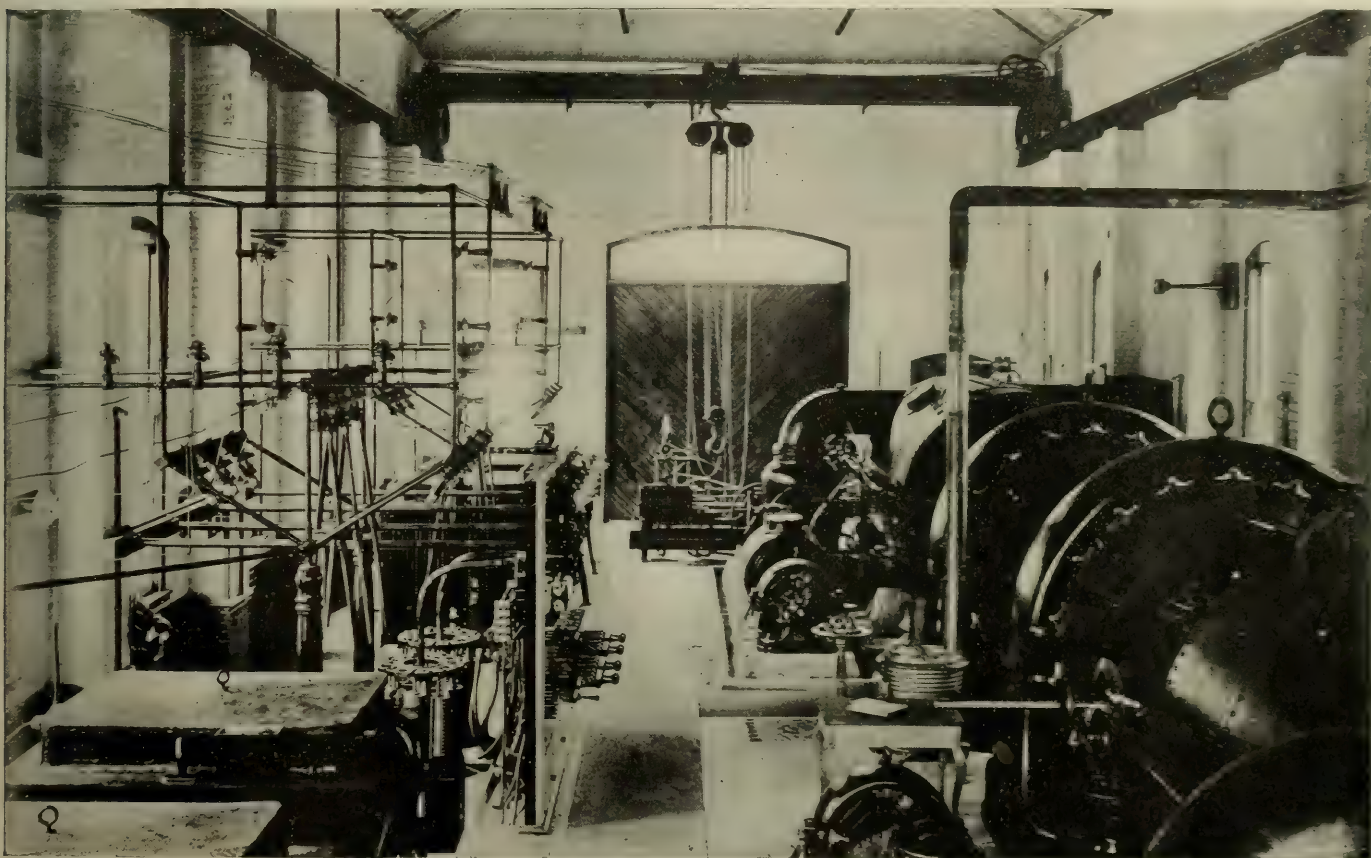


FIG. 1.—GENERATING PLANT, FLORISTON.

1,750-foot and 2,150-foot levels (Figs. 8, 9 and 10); three 225-hp motors, operating at 2,200 volts, and geared to three duplex double-acting Riedler pumps located on the 2,150-foot level; three 10-kw transformers, transforming from 2,200 to 440 volts, located on the 1,750-foot level; a 3-kw lighting transformer, transforming from 2,200 volts to 110 volts, on the same level; three 15-kw transformers, transforming to 440 volts on the 1,950-foot level; two 5-kw lighting transformers, transforming from 2,200 volts to 110 volts, on the same level; three 10-kw transformers, transforming to 440 volts, on the same level; a 5-kw lighting transformer, transforming to 110 volts, on the same level. These are all Westinghouse transformers, and supply the motor and lighting circuits within the mine.

There are 250 16-cp incandescent lamps scattered through the workings underground. A No. 6 B. & S. three-conductor, lead-covered cable, armored with iron wire, extends from the surface to the 2,150-foot level, and a No. 3, three-conductor cable to the pumps on the same level. The weight of the No. 6 cable is 6 tons, and of the No. 0 cable 10 tons. The cables were lowered down the wall by means of the hoisting rope, and then securely clamped to the wall plates. At each station a water-tight junction box is used, and the lead covering sweated into a tight-fitting sleeve located in the side of the box.

The power is brought into the works over two separate circuits, each of which is provided with a single-pole switch at the entrance of the building, and also an integrating wattmeter with its transformer. The pump circuit is further equipped with an ammeter, a frequency indicator, a power-factor indicator and a static ground detector. Oil-break switches are used on the cable circuits and upon all of the 2,200-volt motors. The smaller motors, both on the surface and underground, are equipped with auto-starters, quick-break switches and slate-base fuse blocks. Some of these machines are located in warm places and operate under severe conditions.

The entire installation is wired with lead-covered cables or with rubber-covered copper wire, mounted on glass insulators or porcelain knobs. The greatest care is used in installing the wiring, with the result that it is safe and gives absolutely no trouble. Candles have been entirely discarded, incandescent circuits having been carried directly to the working faces and into the slopes. The current is taken into the mine at a potential of 2,200 volts, through the cables above mentioned, and the potential is lowered in the mine by transformers, which are located as near as possible to the point of consumption.

The compressed air plant, supplying air for drilling, a number of underground hoists and the hydraulic pump, consists of a 16½-inch x 30-inch Rand & Waring single-stage air compressor, driven at 73 r. p. m. by a 100-hp motor. The motor speed is 580 r. p. m., which is reduced by a countershaft with wooden rim pulleys and rubber belting. No automatic regulator is used at the present time, as the compressor is working to its full capacity, and the motor is developing 96 hp.

The electric hoist (Figs. 5, 6 and 7) is a decided departure from usual practice in deep mine hoisting plants, and embodies what is commonly known as the balanced, continuous or tail-rope system. This was adopted in order to reduce the cost of operation, and also

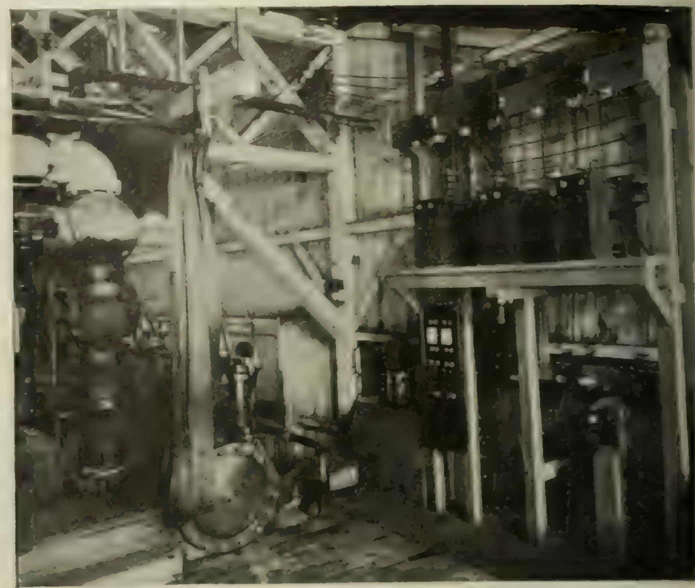


FIG. 3.—THE 2,150-FOOT LEVEL STATION.

the size of the motor to the lowest size compatible with the duty required—viz.: to hoist 500 tons daily from the 2,500-foot level by means of double-deck cages carrying 3,600 pounds of rock. The hoist consists essentially of a main driving drum and an idler, around which is wrapped a 1⅛-inch plow-steel wire rope. The rope passes down one compartment, around a movable tail sheave and up the other. One cage is inserted between the ends of the rope and the other fastened to it by means of heavy iron clamps. The main driving drum is geared to a 200-hp variable-speed, three-phase induction motor, which operates at a maximum speed of 580 r. p. m., moving the cages through the shaft at 1,250 feet per minute. The speed of the motor is readily controlled by means of variable resistances inserted in the secondary winding, but external to the motor itself. The variation of the resistance is accomplished by the use of a special controller resembling an ordinary street car con-

FIG. 2.—TRUCKEE RIVER SUB-STATION.

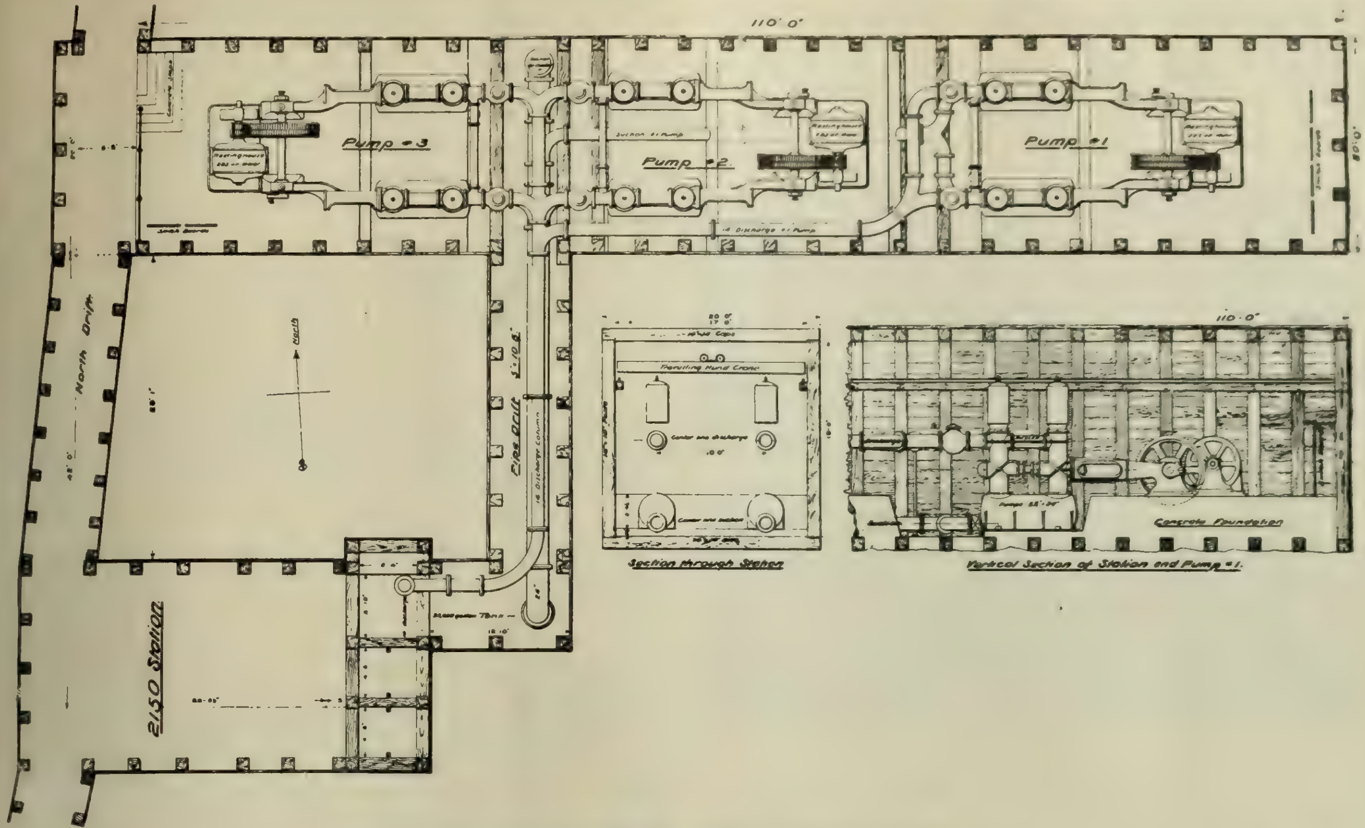


Fig. 4.—Plan 2,150-foot Level Pumping Station.

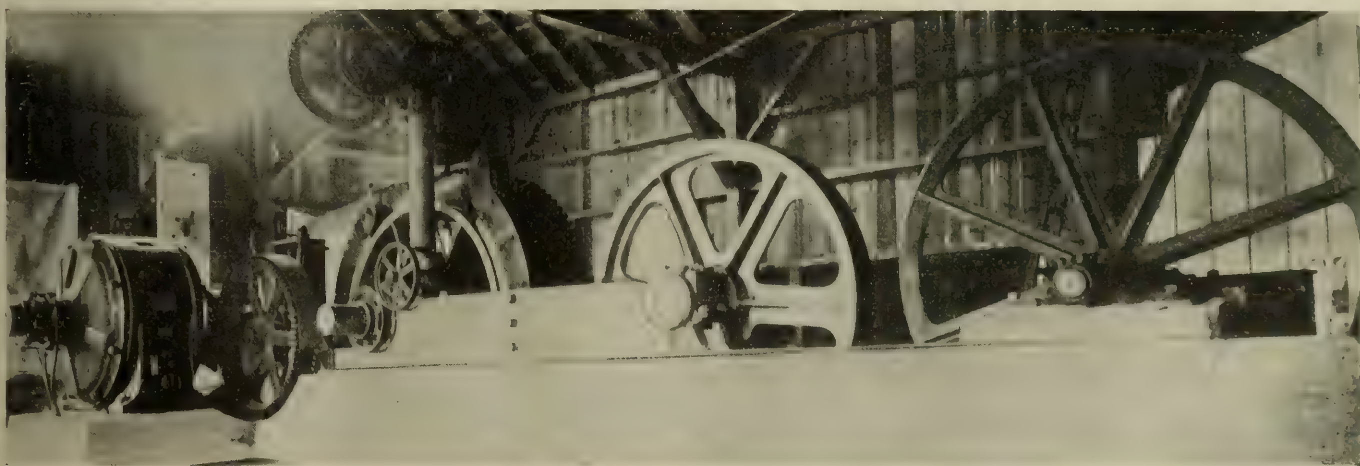


Fig. 5.—200-hp Motor and Continuous Rope Hoist.

Fig. 6.—Controller Side of Rope Hoist.

Fig. 7.—Hoist Driven by 200-hp Motor.

ELECTRICAL MINING EQUIPMENT ON THE COMSTOCK LODE.

troller; the primary circuit is controlled by means of an oil-break switch. The hoist is equipped with heavy post brakes, hydraulically operated, and the machine is handled with remarkable ease. In tests that have been made these hoists show a net efficiency of about 75 per cent., counting all electrical and frictional losses.

The pumping plant (Fig. 11) consists of three duplex, double-

FIG. 8.—MOTOR DRIVING BLOWER AT 1,750 FOOT LEVEL.

acting 6 11-16 x 24-inch Riedler pumping engines, located on the 2,150-foot level (Fig. 3). These pumps take their water supply from a tank on the east side of the shaft just below the 2,150-foot station. Each pump is separately driven by a 220-hp, 2,200-volt Westinghouse induction motor, and has a capacity, at 110 r. p. m.,

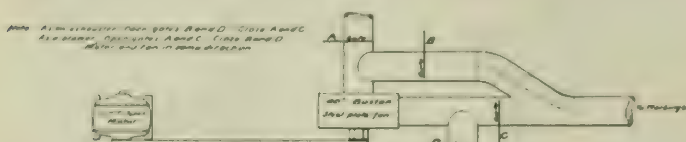


FIG. 10.—DIAGRAM OF 40-INCH REVERSIBLE FAN.

of 1,500 gallons per minute to the height of 450 feet, or to the Sutro Tunnel level. The motors run at a speed of 495 r. p. m., the necessary reduction being obtained by the use of cut gearing with stepped teeth. The total capacity is 4,500 gallons per minute, and is intended

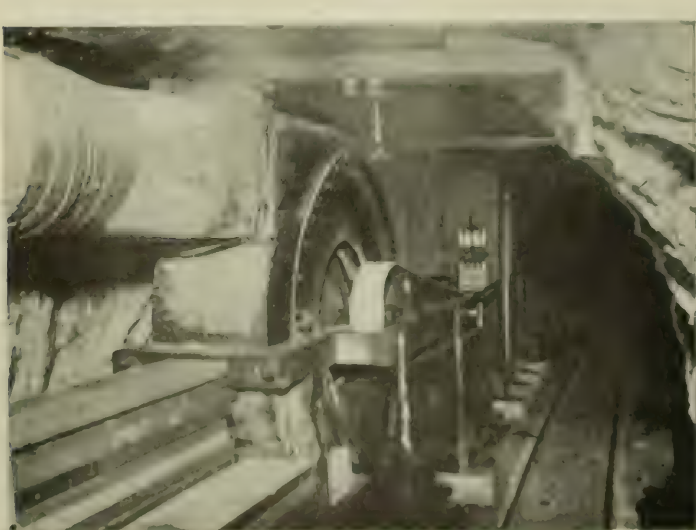


FIG. 9.—MOTOR DRIVING BLOWER AT 2,150 FOOT LEVEL.

to take the water from the hydraulic elevator as long as it is used as a sinking pump.

The pumps are located in a station 30 feet north of the shaft. This station is cut from the solid rock and is 18 feet x 17 feet 8 inches in section and 110 feet long. It is timbered with 14-inch x 14-inch pine timbers, with 3-inch planking. A drift, 5 feet x 10 feet 6 inches in section, connects it with the shaft, and ventilation is obtained by means of a small electrically-driven blower. The motors are all wired with lead-covered cable, and the station is lighted with incandescent lamps. A 10-ton hand crane travels the entire length of the station, so that the labor of handling and installing machinery has been reduced to a minimum.

This plant is undoubtedly one of the best and most complete mining installations in the world, and its operation has been entirely

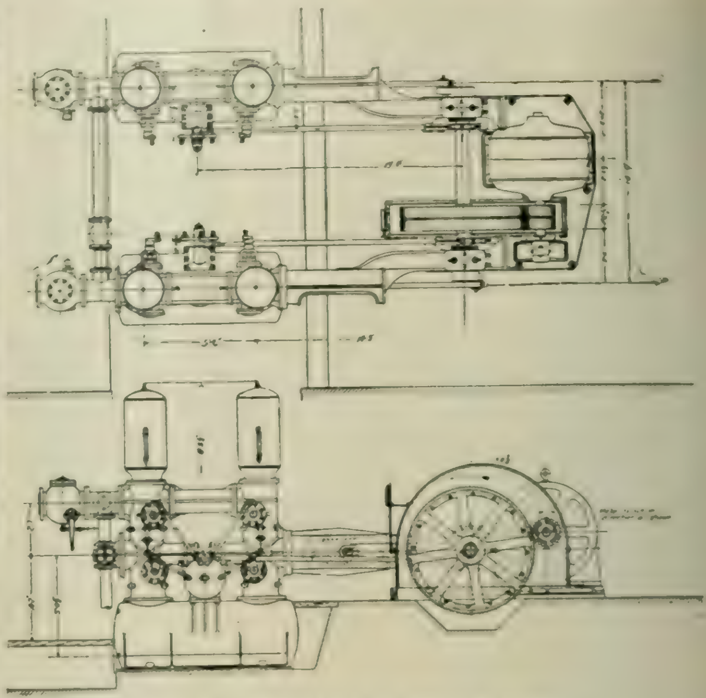


FIG. 11.—DIAGRAM OF PUMPING ENGINE.

satisfactory, both in regard to economy and to reliability. Up to the time when electrically transmitted power was adopted, the cost of motive power was never less than $20 per horse-power per month, while under existing conditions, it is reduced to $7. For example, the cost of operating the 100-hp air compressor usually averaged about $1,800 per month, while to-day it is only $672. The entire plant was installed according to my plans and specifications, and under the able direction of Supt. Jos. R. Ryan. It has proved an unqualified success from the very beginning.

Expenditure on Tramways in London.

After a prolonged discussion the London County Council passed, on July 29, all but one of the comprehensive schemes for the extension of the municipal tramways. The total length of the new tramways proposed was 26¼ miles at an estimated cost of £1,180,750. There will be an additional charge to the tramways account of £127,165 in respect of the street widenings, and one-third will be charged to the local authorities. The new lines range all over London, being extensions and linkings-up of existing systems. The opposition to the proposals was led by Mr. Beachcroft, who estimated the total cost of all the tramway undertakings at £12,000,000. They ought to satisfy themselves that they were entering upon a profitable undertaking. The conduit system which was proposed would cost from £8,000 to £10,000 a mile more than the overhead.

Mr. Benn and Mr. Allen Baker replied, the latter arguing that the new lines would earn £146,000 and leave a profit of 8 or 10 per cent.

The London County Council experimental conduit tramway from Westminster to Tooting is steadily, as it progresses, bearing out the forecasts made about its high cost. In February, 1901, the council gave its sanction to estimates amounting to the total of £623,500 for the conversion of this line to electricity, and the provision of machinery, rolling-stock and generating plant. This was very much in excess of the highest amount that an overhead system would have cost, but the council was prepared to spend more to avoid street wires.

This expenditure of £623,500 has been raised till it now amounts to no less than £981,497. The road work is to cost £12,000 more than was estimated; the power station, estimated at £100,000, is to cost £230,000; extra concrete on the roadways comes to £10,021 more; besides the extra on the power station there is a further addition of £64,600 for plant and sub-stations not at first provided for; and a car shed will be wanted at Clapham, at a cost of £85,000.

The Fessenden Wireless Telegraph Patents.

By A. FREDERICK COLLINS.

IN this day of "wireless," when a new coherer or a modified form of induction coil constitutes a "system," it is refreshing to note and review the work of Prof. Reginald A. Fessenden, who, in a most exhaustive and classical series of patents, describes in lucid and simple language, the comprehensive work he has done.

In this magnificent collection of data, dealing sometimes in broad generalizations, sometimes in minute detail, as the requirements of the case may be, Prof. Fessenden has shown himself a pastmaster in the theoretical and practical science of wireless telegraphy, and has not only evolved apparatus entirely different from that of his contemporaneous workers abroad, but has discovered new phenomena separate and distinct from those of Hertz, who gave to the world a physical demonstration of electromagnetic waves. The waves of Fessenden differ from those of Hertz "in that they are not complete waves, but only half-waves, and in that they travel over the surface of a conductor, and, hence, *unlike* Hertz waves, can be deflected from a straight line."

These Fessenden waves are described as "semi-free ether waves," and are yet different from those investigated by Lodge in metal conductors, in that they are not current waves. The portion of the Fessenden specification embodied in Patent No. 706,746, relating to electromagnetic waves, is of such notable interest, I take the liberty to reproduce a portion of it intact, as follows: "In the Lodge waves the electric energy is maximum when the magnetic energy is minimum, and all energy not absorbed by resistance losses is recoverable, while with the form investigated by me (Fessenden) the electric energy is a maximum at the same time as the magnetic, and none of the energy radiated is recoverable except by deflection. I have found that it is essential for the proper sending and receipt of these waves that the surface over which they are to travel should be highly conducting, more especially in the neighborhood of the point where the waves are generated. I have found that this highly-conducting portion of the surface should extend to at least a distance from the origin equal to $\frac{\lambda}{4}$ of the wave in air, and in the direction toward the station to which it is desired to send the waves."

The arrangement shown in Fig. 1 is the physical method by which this is accomplished, and is, in Fessenden's terminology, a *wave-chute*.

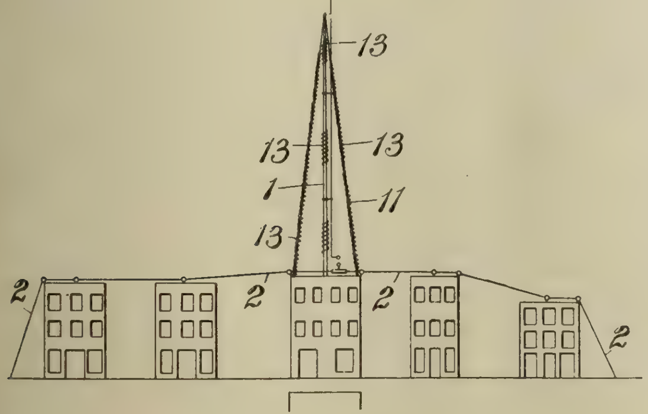


FIG. 1.—"WAVE-CHUTE."

Briefly, 1 is the antenna or sending conductor, and 2 2′ 2″ is the grounded conductor leading across buildings and other obstacles to a $\frac{\lambda}{4}$ or more, beyond the limits of obstructions, when the terminals are earthed, as shown. The coils, 3 and 4, forming guys from the mast, have a natural period of oscillation, different from that of the sending conductor, and this, with the grounded conductor or wave-chute, eliminates outside interference of wave lengths not in tune, and dissipates atmospheric potentials which ordinarily produce untoward effects in the reception of wireless messages.

Another novel feature of the antenna and oscillator system is due to the discovery of Fessenden—that if electromagnetic waves were produced in a medium having a specific inductive capacity and permeability to electromagnetic waves greater than air, the height of the antenna may be considerably reduced, since "the periodicity of oscillation is decreased compared with that of the same antenna in air; and the radiation is, therefore, increased, giving the effect of a long conductor." The arrangement to accomplish this is quite simple. The antenna or conductor with the oscillator is placed within a second and tubular conductor, and this, in turn, is immersed in water or other liquid having an electric constant greater than that of air, and on which the emitted wave length depends.

In practice, Fessenden employs at the sending station a vertical wire, having a large capacity and low induction. The former can

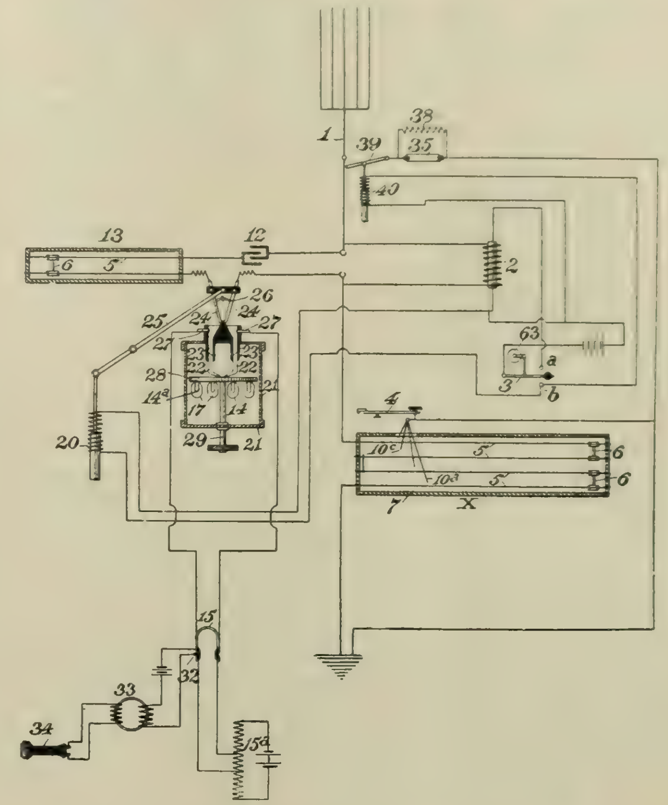


FIG. 2.—DIAGRAM OF SENDING AND RECEIVING APPARATUS.

be regulated by increasing the area of the antenna, and the latter by adding to the number of turns of wire connecting the vertical wire with the source of electromagnetic force.

One of the strongest points in Fessenden's apparatus is that by which he is enabled to send messages at an exceedingly high rate of speed—much higher than in the ordinary method of making and breaking the primary circuit; he has also found it possible to send signals over a much greater distance with a smaller expenditure of power than in any of the present systems. Again, a third factor is the absolute accuracy and certainty with which the receiver operates, enabling the code-messages and other difficult matter to be transmitted by wireless equally as well as by wire, and without fear of error.

The complete sending and receiving apparatus for accomplishing these extraordinary results is shown in Fig. 2. In the specification of his patent No. 706,742, Fessenden says: "In the practice of my invention I employ at each station a conductor, 1, connected to one of the terminals of the induction coil, 2, the other terminal being grounded. A switch, 3, is arranged in the controlling-circuit of the generator (induction coil) so as to permit of the generator being rendered inoperative when the apparatus is employed as a receiver. When sending, it is preferred that the generator should be kept continuously in action. When the generator is in continuous operation a key, 4, is employed by throwing the antenna out of tune with the station to which signals are being sent. This is effected, not by making and breaking, but by short-circuiting, more or less, the tuning device, which is arranged in series with the conductor, 1, and preferably between the generator and the ground."

The tuning is accomplished by means of one or more pairs of parallel wires or strips, 5, forming a tuning grid, and one or more movable contacts, 6, forming an electrical connection with the wires of each pair. These wires are arranged in a box, 7, containing sufficient oil to cover the wires to a depth of an inch or so. This construction permits of proportioning the capacity and inductance so as to obtain a pure sine wave in order to give good resonance. To obtain

pure sine waves the ratio of capacity to inductance per unit length should be the same as nearly as possible for all portions of the conductor. In this respect Fessenden's system differs sharply from those involving the use of coils suited to attain the greatest inductance with a given amount of resistance.

In Fig. 2, the key represents an ordinary make and break device, but Fessenden prefers to operate the induction coil continuously, and

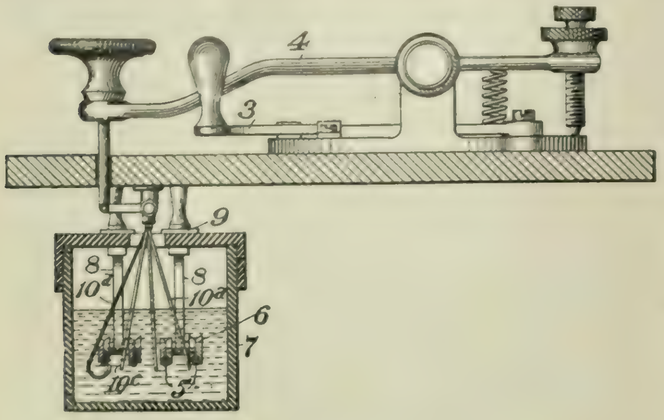


FIG. 3.—TRANSMITTING KEY.

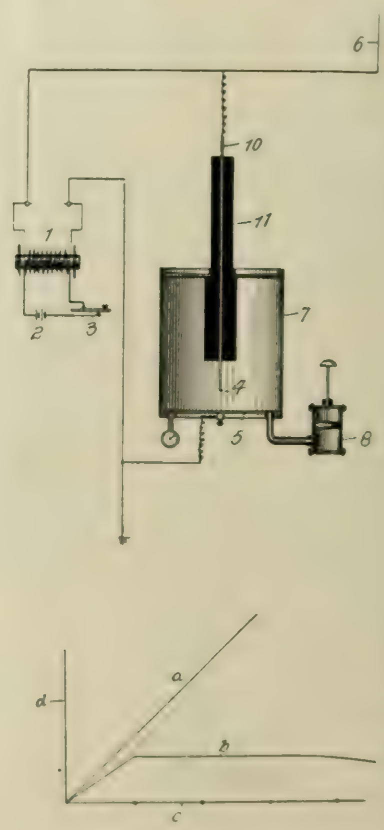
by throwing the sending circuit out of tune, waves of a desired length only will be emitted. This is done by means of the key 4, shown in detail in Fig. 3; it is provided with a finger, 10, arranged to be pressed into contact with one of the wires, 5, by a movement of the key 4, which is connected with the ground, so that when the finger is in contact with one of the wires a shunt circuit is joined around a portion of the tuning-gird.

The receiving circuit consists essentially of the conductor 1 (Fig. 2), condenser, 12, a combined capacity and inductance forming a tuning-gird, 13; these are connected in series, but the condenser, 12, and the combined inductances and capacity, 13, are in shunt to the spark-gap, thus bringing them in parallel with the sending conductor.

In order to obtain speed, Fessenden has eliminated the cumbersome Morse registering device, and substituted the telephone receiver.

This device is based somewhat on the principle of a bolometer, but instead of having a large radiating or absorbing surface in proportion to its mass, the Fessenden detector is just the reverse; so that the conductor losses will exceed the radiation losses; the heat capacity is exceedingly small, so that an infinitesimal amount of energy is required to heat it. To obtain these effects in practice, a short loop of silver wire, 14, having a diameter of .002 inch, and having a platinum core .00006 inch in diameter is fastened to the leading-in wires, 16, which are sealed in the glass bulb, 17. The tip of the loop is immersed in nitric acid and the silver dissolved away, leaving the platinum exposed. To further decrease the loss of radiation by heat, the loop is enclosed in a silver shell, 18, as shown. The bulb may be exhausted to further increase the sensitiveness of the detector.

The device numbered 21 to 29, and shown in detail in Fig. 5, is a holder, arranged to contain a number of wave detectors just described. It consists of a movable disc, 28, of hard rubber, upon which a number of the detectors are arranged, and any one of which may be brought into contact with the rods or leads, 23 and 24, and in case any one of the detectors becomes inoperative a fresh detector may be instantly substituted. The disc, 28, is supported by the rod 27;



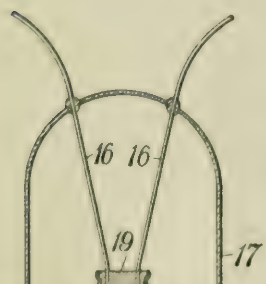
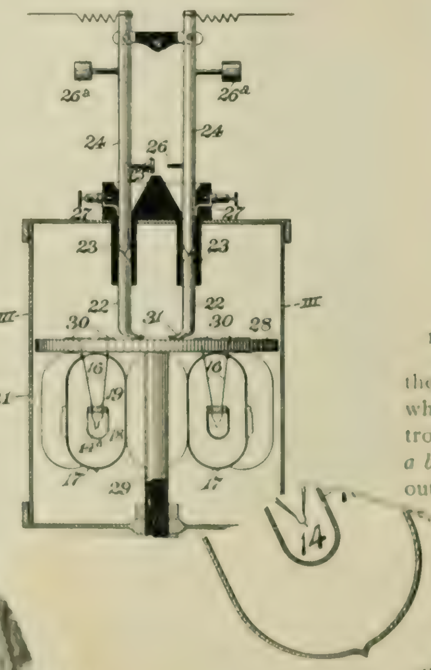
FIGS. 6 AND 7.—FESSENDEN APPARATUS AND DISCHARGE CURVES.

the whole receiving mechanism is then placed in the metal case, 21, which offers additional protection to it. 20 and 25 represent an electromagnetic cut-out, which becomes operative through the switch a b 3 (Fig. 2), the lever, 25, drawing the leading-in wires, 24, in or out of contact as the case may be. A double receiver-head telephone, .. is connected in series with a pair of cables, 15a, having a slightly ... m f.

...ceiving apparatus is shown in 32, 33 and 34 (Fig. 2), ...oherer, 33 a transformer, and 34 a telephone bell or ...ating mechanism. To protect the apparatus from ... of atmospheric electricity, a coherer, 35, connects ... round.

...etector shown, an earlier form employed by ...his leaving Allegheny, may be substituted ...silver ring resting on two knife edges of ...bon. This forms a microphonic contact, ...omagnetic waves into readable Morse. ...patent.

...ated in Fig. 6, the object of which is ...ion between the inductance, capacity ...otential employed. The disruptive ... pressure, the spark-gap being

FIGS. 4 AND 5.—W...

This necessitates some form of a w... than the process of cohesion and dec... detector is far more rapid in operation and has the added advantage of utilizi... whereas in ordinary coherers only that ... sary to bring the potential to a certain ... takes place.

The Fessenden detector is shown in d... to the receiving circuits in Fig. 2.

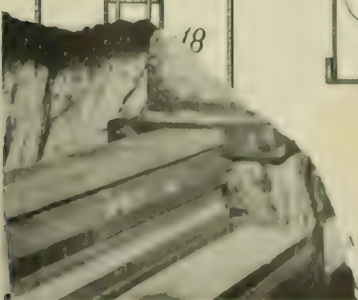


FIG. 9.—MOTOR DRIVING BLOW...

...ave d ...hesion than ... ...g all t... ...portion i... critical ... ...tail in Fig.

to take the water from the hydraulic ... as a sinking pump.

The pumps are located in a stati... This station is cut from the solid r... inches in section and 110 feet long. 14 inch pine timbers, with 3 inch plank ... 0 inches in section, connects it with th...

formed between the part 4 and the plate 5. "In using this apparatus, the terminals are adjusted to about one-quarter of an inch apart when using a 12-inch coil. By increasing the pressure the dielectric strength of the medium is increased, and the spark-potential can be raised to almost any amount without any material loss in oscillatory power, as indicated by the line *a*, (Fig. 7), whereas in air under ordinary pressure it is found that no matter how high the potential is raised, practically no increase in efficiency is obtained higher than given with a spark length, as indicated by the line *G*. The horizontal line *c* indicates spark potential in inches, and the vertical line, *d*, represents the radiation."

In all, there are 13 patents in the recent issue to Prof. Fessenden, containing 20 pages of drawings, 53 diagrammatic views, and 220 claims; the whole forming a most instructive and interesting memoir of the very latest advance in the art of wireless telegraphy.

Engineering Education.

By CHAS. H. HINES.

THE papers presented on this subject at the convention of the Institute at Great Barrington were excellent as bearing on the proper training of the college graduate and his future career, yet it seems to be taken for granted that the only method in which the profession of electrical engineering may be recruited is from the products of the various institutions of technical training in that particular line, and the writer regrets that not a word of encouragement was spoken in behalf of the many men who are earnestly striving to achieve success in this line, without either the time or money necessary to enable them to attend a college, or even a technical school, and it is with the purpose of offering some words of hope to such as these that this article is written.

To a certain extent the successful engineer, like the genius, is born, and not made; yet this fact is rarely recognized in choosing a life's career, and to many young men the idea comes like the man in Dickens' story who says, "Hallo, here's a church, let's get married!" and the young man in a similar manner says, "Hallo, here's a profession, let's enter it," entirely regardless of whether he has a natural fitness for the same or not. In another instance the fond parents having observed in their son a taste for playing with some electrical toy, or from the fact of his having successfully installed the intricate mechanism of a front door bell, immediately discern in him a budding Edison or a Tesla, and as soon as possible enter him as a candidate for engineering honors, with the usual result of spoiling what might have been a good man in some other field, and adding another to the list of failures to the electrical profession.

The degree of E. E. can no more make a successful engineer of one not having natural aptitude for the calling than can the hall-mark West Point or Annapolis make an "officer and gentleman" of one who is not so by breeding or instinct; yet there appears to be a growing sentiment to-day that unless a man has graduated from one of the many technical schools or colleges that for him there is no future, no opening in the profession.

Such feeling prevails in the army, where the "West Pointer" looks down upon the volunteer no matter how great his ability, and still more so in the navy, where there is absolutely no hope for the man who is not a graduate of the Naval Academy; and I regret to-day to see that forgetful of the splendid results attained in the past by men whose names are household words, and whose standing in the profession is of the highest, the same feeling is beginning to pervade the electrical field.

I do not for an instant hold, that with the broadened field that now prevails, and the vast strides that have been made during the past decade, that a sound theoretical knowledge is not necessary, but neither do I believe it impossible for the intelligent practical worker to raise himself from the level of a "hewer of wood and drawer of water" if he has the natural aptitude.

Every employer or director of labor in the electrical field, if he is observant of the progress and methods of his men, will notice among them some few whose natural mechanical ability, intuitive grasp of principles, coolness in emergencies and ability in handling men stamp them at once as naturally fitted for the profession in which they are engaged; but usually owing to a deficient early education, or the necessity of having to enter upon the struggle for a livelihood at an age when others who are more fortunate are pursuing their studies, they are handicapped in life's race, and here, it seems to me, that the helping hand may be extended and the rough material fashioned into the perfect work. How, it will be my aim to show later on; in the meanwhile let us compare the two: the theorist, fresh from his "Alma Mater," and the untaught, yet apt toiler.

The young man fresh from his college steps forth into the world as Mr. Venus says, "In the wicious ignorance of youth," expecting that there will be an immediate rush for his services; then finds that he will either have to accept a subordinate position in the works of some large company or else a minor place on the staff of some well established consulting engineer. In the first case, in nine cases out of ten, he feels how superior he is to the work that he is asked to do, does that work in a half-hearted manner, and accepts the first outside position offering him more money, whether capable of handling it or not; and in many cases, proving unsatisfactory, drops out of sight and ken, or joining the staff of some well-known expert who has devoted weary years to the study and practice of his profession, yet who may not be the possessor of a degree, the young man begins by pitying the ignorance of his employer, and hoping in time to impart to him a portion of the knowledge with which his brain is filled, and so, lacking in the practical knowledge of men and things, with a narrowed and unreceptive mind, he rushes boldly in where "angels fear to tread," and in a brief time demonstrates how utterly unfitted he is to deal with the practical side of the profession, until at length his long suffering employer is obliged to more or less gracefully dispense with his valuable (sic) services These are the worst cases, but even with the best ones much valuable time must be wasted in teaching that on leaving college, the education of an electrical engineer has but begun, and that tact, judgment and experience in handling men and materials have all yet to be learned, and this teaching is exasperating and many times costly to the employer, and usually entirely unappreciated by the subject.

On the other hand, we will now take the practical worker who has worked at the different details of the profession, but whose knowledge of the principles involved may, and in most cases does amount to nothing, yet who is most eager to learn, and grasps any crumbs of instruction that may be thrown him with an avidity that is at times almost pathetic; *he realizes* his deficiency, and is willing to do anything that may tend to better his condition and enable him to attain knowledge.

To him there are the correspondence schools, which are excellent in their way, but limited in scope, and to a beginner even they present obstacles which are apt to discourage him, and after spending more or less time striving to untangle some knotty point, he becomes discouraged and is apt to drop out and give up the struggle, and it is here that there is a chance for those employers and directors who possess knowledge to assist those in their employ who have shown the aptitude and desire to learn, of which I have spoken.

This may be done by devoting an evening or two a week in classes formed from among their men, either in conjunction with the correspondence school or text-books, leading them gradually over the first hard places, and demonstrating by interesting talks with simple apparatus and sketches the first principles, thus encouraging them and leading on to the higher steps.

This not only results in benefiting the men, but the employer as well, for as they become more efficient his own labors are lightened, and the work under his charge is done with more intelligent effort on the part of the men so instructed, and the little time given by him is repaid a hundred fold, as I have found by actual trial; the results are really amazing.

I have carried on such classes at different times, and I have never found the interest lag or the attendance diminish, and the results shown in examinations held from time to time were surprising, showing as they did the earnest and thoughtful effort on the part of those who attended; while the results in their work were at once apparent.

Such classes, beginning with simple mathematics, mechanical drawing and the principles of electricity and magnetism at the first, then going on to the higher grades, working in conjunction with a correspondence school or from text-books, are feasible, practical and not only a benefit to the men but to the instructor as well, and result in many cases in starting men on the high road to success in the profession.

In conclusion, I may say that there is also a broad field for the

philanthropist who desires to help those who are deserving of it, by endowing night schools, fashioned after the principles of the Pratt Institute of Brooklyn, N. Y., in all the large cities where the eager seeker after knowledge could carry still further his desire for learning, and many a naturally bright intellect which is now hampered by lack of early training might repay to the world at large by his achievements in the future the money thus expended in his behalf.

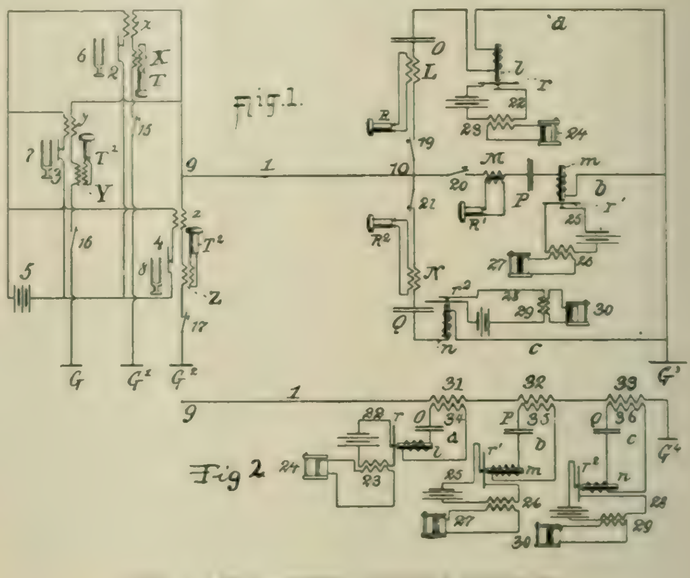
Let us continue to plan and do all we can for the young man who is fortunate enough to be able to afford a college training, but at the same time let us not altogether forget the great army of practical toilers whose patient and unnoticed efforts have made possible the development of the profession to the point at which it stands today, and when we find one among them who is worthy of the chance, give him an opportunity to develop the genius that he may possess.

Multiple Telegraphy by Resonance.

Professor Pupin, who has made the subject of the propagation of electric waves along conductors a subject peculiarly his own, has recently obtained two patents (Nos. 707,007 and 709,008) on a system of multiple telegraphy based on resonance. The object of the invention is to send a number of messages simultaneously over a single conductor by means of periodic currents of different periodicities. When a periodic electromotive force acts upon a conductor of adjustable electromagnetic constants—that is, of adjustable capacity, self-induction and resistance—then by varying the capacity or self-induction, or both, these electromagnetic constants can be proportioned with respect to each other in such a way as to make the natural period of the conductor equal to the period of the impressed electromotive force. The conductor and the electromotive force are then in electrical resonance. The process of adjusting the natural period of the conductor so as to render it resonant is called "electrical tuning." The laws which underlie electrical tuning and electrical resonance are analogous to those of acoustical tuning and resonance, as Dr. Pupin has pointed out in his various original papers on the subject (*Vide Transactions,* A. I. E. E., May 17, 1893).

A resonant conductor offers under all conditions a smaller impedance to the electromotive force with which it is in resonance than to any other electromotive force. Hence, a resonant conductor can act as a current-selector; that is, if it forms part of a system on which a number of electromotive forces of various periodicities are impressed, then its impedance will be smaller to that one of those electromotive forces with which it is in resonance than to any other. Thus, in a system of conductors having adjustable self-induction coils and condensers the coils and condensers can be adjusted in such a way that each conductor will have a different predetermined natural period, and, therefore, each part will resonate to a periodic electromotive force of its own pitch independently of the presence of other electromotive forces. Such a system of interrelated tuned conductors of different periodicities acts, therefore, in consequence of its resonating properties, as a set of current selectors. This forms the essential feature of the invention and its applicability to multiple telegraphy is evident. Dr. Pupin claims the broad method disclosed, of distributing electrical energy, no matter for what purpose it may be used, of throwing upon a common conductor a number of alternate currents of different frequencies, and distributing the several energies of these currents, each selectively to a separate electrical translating device, and he also claims the method disclosed of tuning the various selective parts to different periodicities. These methods can be effected by many different forms of apparatus.

Referring to the drawings in Fig. 1, 1 is the common conductor to which are connected three telephone transmitters, 2, 2 and 4, in circuit with the battery, 5. The secondaries of the transformers, x y z of 2, 3 and 4, are connected in parallel to wire 1 at g, and to ground at G G^1 G^2. In front of each transmitter is a tuning fork, 6 7 8, each tuned to a different note, so that three periodic e. m. fs., each of a different periodicity, will be impressed on wire 1. At the receiving end are three branch circuits, a b c, having coils, L M N, for furnishing the auxiliary self-induction, and condensers, O P Q, for furnishing the auxiliary capacity, by the proportioning of which self-induction and capacity the auxiliary conductors are tuned. The three branch circuits are grounded at G^3. The auxiliary parts of the branch circuits are the telephones R R^1 R^2, placed in inductive relation with the coils L M N and the small coils surrounding magnet or soft iron cores l m n, and also three keys, 19 20 21. Suppose it is required to send a message from transmitter 4 to branch a. Coil L has a predetermined self-induction, and condenser O a predetermined capacity, their values being such as to render branch a resonant to, say, a frequency, C, the note of fork 8. The telephone T^2 is acted upon inductively by coil Z. The sound of the telephone, R, calls the attention of the operator in circuit a. He answers by tapping key 19, the breaks being heard in T^2. He then closes the battery circuit, which works the receiving transmitter, r, and the receiving instrument, 24, is then ready to receive the electrical impulses from the line. These impulses are given in the following way:



FIGS. 1 AND 2.—PUPIN MULTIPLE TELEGRAPH.

When operator at 4 closes key 17, an alternating current of frequency, C, passed to branch a, and acting on l sets diaphragm of r in vibration, producing an induced current of the same frequency in secondary of 23, which current passing through coil of sounder 24 repeats the signals sent by 17. This set of signals will in no way be interfered with by the simultaneous transmission of signals between branch circuits b and c and transmitters 2 and 3 as long as different frequencies are used. An adjustable condenser may be used in series with each receiving instrument to reduce its electromagnetic impedance to a minimum for the frequency to be used in that branch. There may be any number of branch circuits at each end of the line, and each branch can operate simultaneously as transmitter and receiver. In the diagram only the transmitting apparatus is shown at

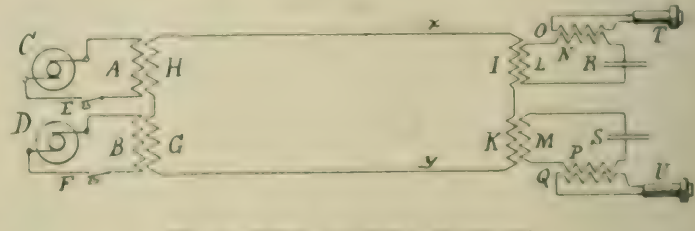


FIG. 3.—PUPIN MULTIPLE TELEGRAPH.

one end and the receiving apparatus at the other; but in practice each would have both, and any number of sets might be connected in the one branch, all to work with the same frequency. In Fig. 2 the branch circuits are shown inductively connected with the main line, the primaries of the transformers 31 32 33 being in series. They may also be in multiple.

In the second patent, Dr. Pupin shows, in Fig. 3, a system which is substantially like that of Fig. 2, but at the transmitting end is preferable to that of Fig. 1. A number of generators, as C and D, suitably constructed and operated to generate currents of desired periodicities, are inductively connected to the line x y through transformers AH BG with keys E and F in the primary circuits. At the receiving end are the branch selective circuits connected by coils IL, KM. Adjustable condensers, RS, and adjustable self-induction coils, NP, telephones, T, U, constructed with secondary coils O and Q, complete the branch circuits, one of which is tuned to respond to the current of C, and the other to that of D.

Dr. Pupin says it is not possible to calculate mathematically the values of the self-induction and capacity required for a complex system, though the mathematical theory suggests in a general way how the tuning should be done. The use of iron in the coils should be avoided; the ohmic resistance of the secondary circuits should be as small as possible. The adjustable coils should have as large self-induction as possible, and the condensers should be adjustable in small steps. With these general cautions, each branch should be tuned to one of the periodic currents by varying one or both of the electromagnetic constants until the maximum effect is obtained. It is usually necessary in a complicated system to make a preliminary tuning of all the branches and then make a final and more accurate tuning. When the branches are once tuned to the appropriate frequencies they are left unchanged. The final tuning is done by adjusting the frequency to suit the electromagnetic constants of the circuits, for it is impossible to reach in each branch the point of true maximum selectivity by varying only the constants. Having, therefore, adjusted approximately the circuits to respond to the periodicities previously selected, the final step to be made is then to vary the frequencies. This is easily done where electromagnetic oscillators are employed.

The system described by Dr. Pupin has no moving synchronous parts. It is applicable either to selective signaling or to multiplex telegraphy, and whether it finds practical application or not, it is a highly interesting and original contribution to the telegraphic art. It serves as one more illustration of the valuable results that applied scientific investigation and mathematical reasoning frequently have to offer to the practical industries.

Improvement of Motor Meters.

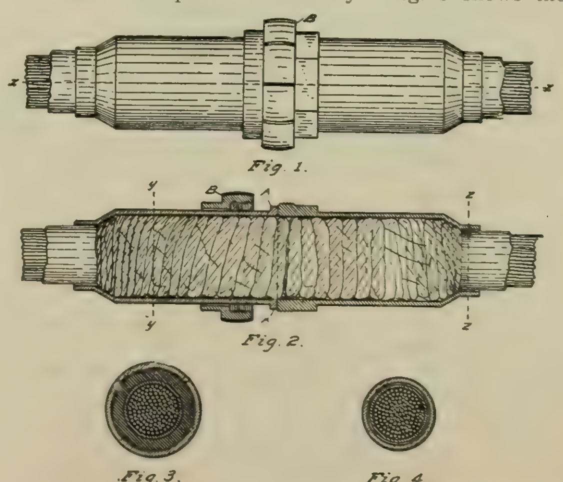
An interesting patent on improvements in motor meters was issued to Prof. Elihu Thomson last week, on an application filed in January, 1900, his object being to simplify and cheapen the construction, and render the operation of the meter uniform over all ranges of load. It is especially applicable to meters operating under direct current. A register is provided, driven by a meter-motor at a speed varying with the load on the consumer's circuit, in which the meter is installed in a manner usual with electric meters, and a motor comprising an armature or torque-producing element formed of a plurality or flat or "pancake" coils moving in a magnetic field of constant strength. The field for the sake of cheapness and convenience is excited by one or more permanent magnets, between the poles of which the pancake-coils are mounted for rotation. As many such coils as desired may be employed and symmetrically disposed about the axis of rotation and supported in a common plane, to which the load-current of the consumer's translating devices is led through a suitable commutator, formed of three segments, and a corresponding number or multiple thereof of armature coils. The small number of segments also permits the commutator to be made of small diameter, thus rendering brush-friction low. A type of commutator suitable for the purpose is that employed in the Thomson-Houston three-coil arc lighter. In shunt to the armature is a resistance of such value as to take the maximum portion of the current flowing through the meter.

With an organization of the kind just outlined, the effect of the friction of the moving parts is such that it is impossible to so adjust the meter that it will register the energy consumed with substantial accuracy both at low and at high loads. If the meter is so adjusted that its registration is accurate at the normal load for which the meter is constructed, there will be a considerable inaccuracy in the registration at very low loads, due to the fact that the friction of the moving parts, which is substantially constant at all speeds, becomes a greater proportional part of the load as the load on the meter decreases. The load due to the friction of the moving parts is, however, small in comparison with the load on the meter when full-load current is flowing in its actuating windings. It is, therefore, possible to materially increase the accuracy of registration at low loads without decreasing by so great an amount the accuracy at full load by so adjusting the meter that its registration will be correct at some point intermediate between zero and full load, the particular point being determined in accordance with the range of load to which the meter is likely to be subjected. The meter when thus adjusted will, of course, register too low at low loads and too high at full loads; but its accuracy will on the whole have been substantially increased. It is not, however, possible by such an adjustment to make the registration accurate at all loads up to the full-load limit for which the meter has been designed.

Prof. Thomson states that it is possible to so modify the organization above specified that the registration of the meter may be made substantially accurate both at light loads and up to the maximum load for which the meter is designed, and one of the features is a corrective which will obviate the inaccuracies above referred to and will render the registration of the meter truly proportionate to the load on the circuit. A retarding-magnet system comprises, in addition to the damper which slows down the speed of the meter motor at all times, an auxiliary damper, consisting of an electromagnet carrying a current varying with the load in the consumer-circuit, and provided with an iron core so proportioned that its magnetization will be raised to or near the point of saturation as the meter load approaches a maximum. The magnetization of this auxiliary damper is, of course, nil at zero load; but as the load comes on its damping tendency rapidly increases until when the load appraches a certain value, where the core of the electromagnet approaches saturation, the curve representing the retardation due to the auxiliary damper becomes flattened, and the effect of the said damper thereafter substantially the same as that of a permanent magnet. With such a construction the meter is so adjusted that it registers with substantial accuracy at full load when the core of the auxiliary damper is saturated. As the load falls off, that part of the retardation which is due to the auxiliary damper falls off at first slowly, and later at an increasing rate as the magnetization falls below the bend in the "curve of magnetization," until finally when the load reaches its minimum value it becomes practically nil. By properly designing the electromagnet constituting the auxiliary damper its effect may be made to exactly compensate for the frictional resistance of the moving parts of the meter, so that the curve of registration will be substantially a straight line up to the maximum load for which the meter is designed, it being understood that beyond this load the curve of registration is likely to fall off somewhat, probably by reason of the disproportionate counterbalancing effect of the counter electromotive force generated in the meter-armature at such loads.

New Telephone Patents.

The issue of the Patent Office for August 12 contributes to telephony four patents, all relating to auxiliary apparatus, three covering protector devices and one a screw connection for cable splices. The inventor of the latter device is Mr. Thomas P. Jones, of Olyphant, Pa. The device is simplicity itself, consisting of two tubes, which are slipped over the cable sheath (and presumably soldered to it, though the specification does not say so), and joined together by means of a nut on one sleeve which screws over a threaded collar on the other. The drawings illustrate the device sufficiently clearly to make further description unnecessary. Fig. 1 shows the com-

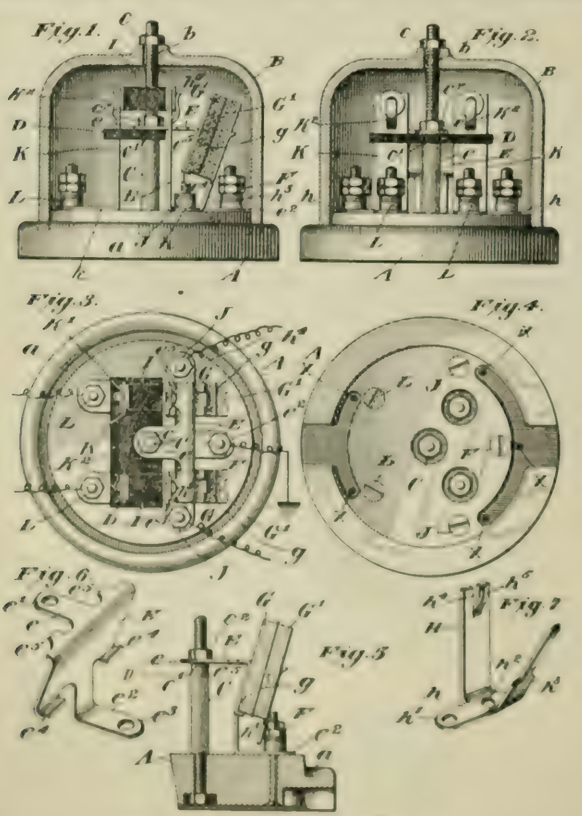


FIGS. 1 TO 4.—JONES TELEPHONE CABLE CONNECTION.

pleted joint, Fig. 2 a section with the nut B not screwed home. Fig. 3 is a section on line y y, and Fig. 4 a section on line Z Z of Fig. 2. When the two sleeves of the union have been slipped on the cable, and the wires spliced in the usual manner, the cable is wrapped with waterproof paper or other covering of sufficient quantity to fill completely the space within the body part of the union, when the nut

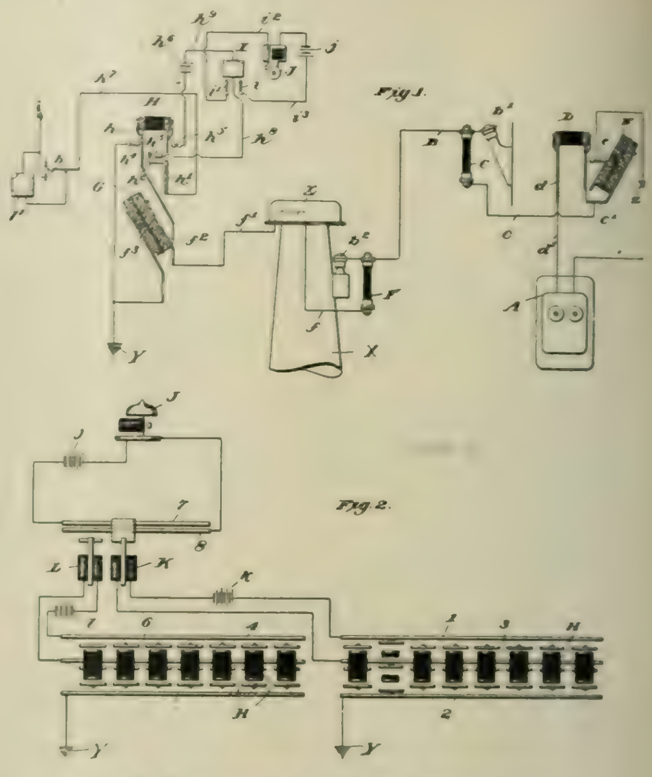
B is screwed home, compressing the covering or wrapping, making a solid air-tight joint. Mr. Jones claims that his device supplies a rapid method for connecting telephone cables, affords facilities for repairing wires where connected when necessary, makes a more rigid and durable connection than the method commonly used, and provides for disconnecting the cable when desired. The weak points, however, are that the sleeves must be soldered to the cable sheath to make a moisture-proof joint, and the splice in a paper-covered cable must be "boiled out" before the union is closed, so that a screw-joint is neither more rapid nor more accessible than one made by the method commonly used.

Mr. Frank B. Cook, of Chicago, as is well known, makes a specialty of protectors. In the ELECTRICAL WORLD AND ENGINEER for July 19, 1902 (Vol. XL, No. 3, p. 97) was described a heat coil device due to Mr. Cook, and this he now follows up with three patents on protectors and various arrangements thereof, having a fourth withheld by the Patent Office in order to determine the question of interference. The original application for the present patents and the one in interference was filed July 29, 1896, and divisional applications were filed May 21, 1902, so that Mr. Cook's protectors have occupied the attention of the Patent Office for quite a considerable period. One patent relates to a protector set to be used at the subscriber's station one to a system of strong current protection, embodying all the required protective elements and a signal system to indicate the position of a protector, which has operated, and a terminal box equipped with protectors. For his protector set, Mr. Cook claims "a simple and compartively inexpensive construction, whereby a plurality of electrical protectors may be combined and efficiently employed in a compact and easily accessible structure." Further, the protectors are so mounted as to be easily connected with the circuit wires, and there are details and features of improvement making for general efficiency and serviceability. Referring to the drawings, as shown in Figs. 1 and 2, the protectors are mounted on a porcelain base, *A*, and covered by a glass dome, *B*, secured by a nut, *c*, on the central post, *C*. The heat coil used is that described in Mr. Cook's patent above referred to, which has a metal cap or plug that pulls out when the coil operates, allowing the



FIGS. 1 TO 7.—COOK PROTECTOR SET.

supporting spring to bend outward. The coil, *I*, is held between the stationary spring, *K*, and the moving spring, *H*, the peculiar form of which is shown in Fig. 7. The plate *E* (Fig. 6) is held on the insulating plate, *D*, resting on a shoulder, C^1 on post *C* by nut C^2, on the shoulders c^4 it supports one plate of each of the arresters, *G* G^1, and the shoulders c^5 are adapted to make contact with *H* when *H* is released by the action of the heat coil. It will be seen that the upright spring of *H* passes behind *E*, and its inclined spring h^3 holds the plate G^1 against the plate *G* supported on the shoulder c^4 of *E*. The plate *E* is connected to ground at *F*, and each *H* plate is connected to a line wire. The two plates, *G* G^1, are separated by a strip of silk, *g*, which will be burned out by a heavy stroke, allowing the carbons to come together. The *L* binding posts are connected to the sub-



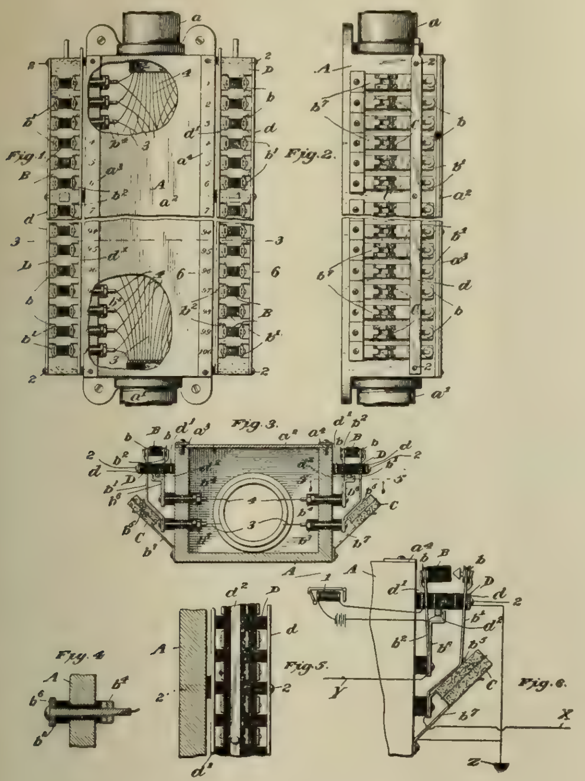
FIGS. 1 AND 2.—COOK SYSTEM OF PROTECTION.

scriber's instrument, and the *F* posts, carrying the *H* plates are connected to line. Thus it will be seen that the operation of either coil will ground the line by allowing an *H* spring to come in contact with *E*, and similarly the burning out of the silk, *g*, of either arrester will cause the same result. Mr. Cook seems to have produced a neat and compact protector set.

The second patent aims at a general comprehensive system, including fuse-protectors, heat-coils and carbon lightning-arresters, an arrangement whereby any heat-coil will signal its operation, and an arrangement of the protectors in banks, and so equipped with signals that a general alarm will be given when any protector operates, and also a signal set indicating the bank containing the operated protector. The line fuse protector shown by Mr. Cook is the portion of his protector inventions which finds itself in interference. Referring to the diagram, Fig. 1, *C* is the line fuse protector in dispute attached to the suspended line wire outside the subscriber's premises and *F* is its mate at the central office end of the line, attached in the same way; a cable box or pole terminal connection being indicated at *X*. The heat-coil and arrester devices are those described in the previous patents, as clearly indicated. At the central office the spring, h^1, which is released outwardly by the operation of the heat-coil, has a bent portion, h^2, adapted to make contact with the plate h^8, and contact being also made with stop h^7 the releasing of the spring closes the circuit of relay, *I*, which indicates the protector operated, and also closes the local circuit containing alarm bell *J*. Fig. 2 illustrates the arrangement of the heat-coils in banks or sections, arranged according to the method just described so that a general alarm will be sounded when a coil has operated, and a special signal will be set indicating the bank in which the operated coil is situated.

The third patent covers a terminal box equipped with protectors and including the signaling circuit for announcing the operation of a protector and indicating its position. The terminal box, as shown by the drawings, is the standard form of cable head, and the protectors of the form already described are mounted on the sides in the usual manner. Numbering strips, a^3 a^4, are attached to the edge of the cover a^2. The springs of the heat-coil, *B*, pass through a slotted bar of insulating material carrying metal strips, *d*, on its outer edge, with which spring b^1 makes contact when a coil operates,

d^1, on its inner edge to receive b^2 and d^2 below to receive the bent contact spring, b^6. The strips d^1 and d^2 form the contacts for closing the signaling circuit or relay I, as shown in the diagram, Fig.



FIGS. 1 TO 6.—COOK TERMINAL BOX.

6. The details of the terminal and arrangement of the protectors are so clearly illustrated by the drawings as not to need further description.

CURRENT NEWS AND NOTES.

LINEMAN WITH SIX LIVES.—A lineman was fatally shocked while handling an electric light wire in Mount Vernon, N. Y., recently. The coroner's verdict was that the victim met his death by being "electrocuted six times by an electric light wire containing 1,500 volts."

NAVY WIRELESS TELEGRAPHY.—Communication between Washington and Annapolis was established last week by wireless telegraphy under the auspices of the Navy Department. The distance is about 35 miles, which in view of other achievements the officials have decided not to treat as sensational.

THE JUNEAU-SKAGWAY SUBMARINE CABLE line is again out of commission. After a recent windstorm in Alaska, the cable was found to be damaged. It is supposed that the heavy seas caused the armor to be worn off by chafing on the rocks. The Signal Service Bureau will make repairs as soon as possible.

A LONG FREE TELEGRAM.—The Pope celebrated his name-day on August 17. Among the telegrams of congratulation was one of 20,000 words from the Catholics of Catania, Sicily. The receipt of this long message caused no little amusement at Rome in ecclesiastical and other circles, as, under the agreement or settlement with the Italian government, all telegrams for the Vatican are accepted and delivered free of charge.

MARCONI IN LONDON.—A special cablegram to the New York *Sun* says that Mr. Marconi arrived in London August 13. He declared that he was satisfied with his recent experiment of wireless telegraphy on board the Italian flagship "Carlo Alberto," by which messages were received at Cape Skagen from Poldhu, Cornwall, and signals at Cronstadt from the same place, distances, respectively, of 850 and 1,400 miles. He says these experiments prove that transatlantic wireless telegraphy will be successful in the future.

CHILIAN TELEGRAPHS.—The Director-General of Telegraph, in his report to the Chilian Government covering the year 1901, states that expenditures in the course of the year for telegraphic installations amounted to $29,881, and for telegraph wires, $76,329.51. The total length of new wires put in place was 169 kilometers. The number of telegrams dispatched in 1901 is detailed as follows: Private telegrams, 1,231,000; words, 16,974,413; value, $581,004.12; official telegrams, 140,146; words, 4,681,633; value, $148,009.57. The cost to the State of the telegraph line to the Argentine Republic is given as $126,332.

AERONAUTICS FOR ST. LOUIS FAIR.—We have received from Prof. W. E. Goldsborough, of the Department of Electricity, of the St. Louis, 1904, Exposition, a copy of the rules and regulations relating to the aeronautic competition, for which $200,000 has been appropriated, half of which goes in a grand prize. One prize of $3,000 is offered for "a successful attempt to drive an air-ship motor by energy transmitted through space, either in the form of electric radiation or in some other form of electrical energy, to an actual amount of one-tenth of a horse-power at the point of reception, and at a distance of at least 1,000 feet." The test must be made on the Exposition grounds by the experts of the jury.

BOSTON AUTOMOBILE MEET.—It is stated from Boston that under the auspices of the Boston Automobile Club, the Boston Gentlemen's Driving Club is making arrangements for what is to prove the greatest automobile race meet ever held in this country, at Readville, in October. There is already a promising list of entries, prominent amateurs, including Mr. Vanderbilt, have been invited to participate, while negotiations are being made with professionals for what are expected to prove popular features. It is expected that about 185 carriages, representing the Automobile Club of America, will be at the club after the endurance run from New York, and it is expected that a number of New Yorkers will send over their fine racing vehicles to compete. The home club probably will entertain the visitors, after which all will join in a run to Readville. It is believed the Readville track is well adapted for auto racing.

THE MACKAY WILL.—Mrs. John W. Mackay and her son, Clarence W. Mackay, filed the will of John W. Mackay at Virginia City, Nev., last week. The will bears date of July 14, 1898, and was made in this city. Declaration is made in the first paragraph of the will that all the estates of the testator are the common property of his wife and himself. The will bequeathes all of his estates subject at the time of his death to Mr. Mackay's testamentary disposition to his son, Clarence Hungerford Mackay. The wife and son are named as executors without bond, and are given power to sell or dispose of the estate in any way they see fit. The principal property of which Mr. Mackay died possessed consists in stock of the Commercial Cable and Postal Telegraph companies, bonds of the Southern Pacific and Canadian Pacific Railroads, and real estate and mining property in Texas, California and Arizona. The value of the estate is estimated at between $50,000,000 and $75,000,000. The witnesses to the will are Messrs. A. B. Chandler, E. C. Bradley and W. H. Baker.

OLD MENLO PARK.—The New York *Times* has a pathetic note about the decay of Menlo Park, New Jersey, where Edison did so much of his famous early work. "Edison made Menlo Park famous all over the world and in the old days there were many visitors to the little place. Even to-day many persons suppose the main laboratory of Edison is still at Menlo Park, and scarcely a day passes that the postmaster does not receive some letter addressed to Edison. Those were boom days for Menlo Park. Besides the Edison plant two other factories were built, and it looked as if the place had a bright future. Then Edison removed his plant, and the prosperity of the village came to a sudden stop. Little by little Menlo Park sank back to the condition of a country village. The railroad steadily decreased the number of trains stopping there. To-day an air of almost melancholy quiet broods over the place. Although the plant has fallen into decay Edison still owns it. His family have large interests in Menlo Park. A short distance east of the former laboratory stands the old Edison homestead, which is the property of Mr. Edison's daughter. In its time it was an imposing structure. Tenants were hard to find, the buildings fell into decay, and finally an Italian family were allowed to live in it rent free."

LARGE TRANSFORMERS.—What are said to be the largest electric transformers ever manufactured have been put in operation at Chambly and Montreal. These transformers are 20 in number and have a total capacity of 750,000 lights. By their use the current at Chambly is raised to a voltage of 25,000, and transmitted at that pressure to Montreal, where it is lowered to 2,000 volts.

MARCONI STATIONS THROUGHOUT THE WORLD.—It is announced that Mr. Vyvyan, engineer in charge of the erection of the Marconi wireless telegraph station at Table Head, will leave shortly for South Africa, where he will superintend the erection of a similar station at Cape Town. It is likely that he will first put the Cape Breton station in operation before leaving. The plan of the Marconi Company is to establish, as soon as possible, a chain of long-distance wireless stations in different parts of the world. Within a year, it is expected, there will be one station in Canada, two in the United States, one in Central America or the West Indies, one in South Africa, and one on the continent of Europe.

A MULTIRATE METER has been patented to Mr. A. D. Lunt, and involves details controllable from a central station or other suitable point for altering at will the rate of registration of energy consumption on a distribution system or portion of a system fed from said station, the operation being effected without the employment of any additional conductors between the meter and the central station, and without the utilization of a ground on the system, as has heretofore been proposed. This result is accomplished by the employment of an actuating device located in the vicinity of the meter, arranged so as to respond to alternating currents of suitable selected frequencies sent over the distribution system from the central station. A current of one selected frequency, for example, will serve to move the actuating device in one direction, while a current of some other selected frequency causes an opposite movement. The movements thus produced may be utilized to change the rate of the meter in any usual or ordinary manner—as, for example, by cutting in or out resistance in the armature circuit of the meter or by shifting the registration from one recording device to another.

NIAGARA POWER IN CANADA.—The Ontario government has so modified the regulations governing the grant of additional water privileges at Niagara Falls to the Ontario Power Company that no further opposition is anticipated from the Canadian Power Company, the original lessees of the Falls power. Both companies will proceed now on a basis of 50,000-hp development each, and it is understood that the bulk of the power has already been arranged for. The Toronto-Niagara Power Company, which will bring the Canadian Company's power to the city of Toronto, expects to use about 20,000 horse-power in the city and the immediate vicinity. This will displace something like 200,000 tons of soft coal per annum, now imported from the United States. At the recent meeting of the Niagara Falls park commission, the application of the Ontario Power Company for permission to take water from Niagara River as well as from the Welland River, was argued with the result that the commissioners will recommend to the Ontario government that the application be granted, subject to the condition that the company must submit detailed plans of the proposed works to the Commissioner of Public Works for Ontario. An opportunity then will be afforded to the Canadian Power Company to state any objections which that company may have to the proposed plans.

HANGER FOR TRANSFORMERS.—Mr. J. J. Wood, the well-known electrical engineer of Fort Wayne, Ind., has taken out a patent on an improved hanger for transformers, etc. It is customary to suspend transformers from the cross-arms of poles by means of a supporting member having its upper end bent to fit over one of the cross-arms, and which is generally called a "hook." The casing of the transformer is usually attached to the hook by means of bolts passing through the hook and carrying nuts at their ends at the back face of the hook. These nuts often coincide in position with a lower cross-arm, so as not to interfere with the proper setting of the hook. When it is desired to remove the transformer, the nuts have to be loosened, and as they have usually rusted fast by exposure to the weather, and as the operator is in a very difficult position for working a wrench, the releasing of the transformer from the hook is a matter of considerable difficulty. When the nut is finally withdrawn it is often lost, as well as the bolt. Mr. Wood avoids these disadvantages by the provision of a supporting member (which may be in the shape of the usual hook) which has an uninterrupted flat rear face, so that it may lie evenly against the cross-arm, no matter at what position the latter occurs. Complementary engaging parts on the supporting member and the casing are provided for clamping the supporting member with the casing, comprising a lug stud, corresponding members on the front engaging the lug and locking securely. The annoyance of losing small parts, such as bolts or nuts, is avoided by permanently connecting the attaching means to the supporting member. The difficulty occasioned by the necessity of using a wrench upon a rusted nut from a seat on the cross-arm of a pole is avoided by the provision of a wedge which holds the parts fast together, but which may be released by a blow in the proper direction from a hammer or other tool.

OBVIATING TROLLEY ELECTROLYSIS is the purpose of a patent granted to Mr. H. F. Parshall, the American electrical engineer now practicing in London. He establishes in the various railway sections, corresponding to the several feeders of the system, an assisting electromotive force tending to prevent the dispersion of the currents through the earth by establishing what might be regarded as a negative potential at the rails in the several track sections, thereby establishing a condition which might be loosely described as an "electric suction" in the metallic path leading to the distributing station. At the distributing station are installed electromotive devices, corresponding in number to the number of feeder sections in the system, and connected by independent conductors with the rails or return circuit at points of the track varying in distance from the distributing center. For such purpose he uses a motor generator having two independent armature and field-magnet windings, one pair acting as a motor and the other as a generator or booster. One set of these armature windings in the several electromotive devices has one terminal connected to the several trolley-supply sections, and the other to a generator lead close to the station. The other set of armature windings has each one terminal connected with earth at the distributing-station, the other with the rails or return conductor at points varying in distance from the station. Thus the electromotive devices have their driving members operated under a voltage varying with the distance of the point protected and their driven members supplied with an assisting electromotive force varying in a corresponding way. The range of potential of the return circuit above or below that of the earth connection at the station existing at different points of the system is in many places regulated by rules established by boards of trade or other authorities. This voltage is always low, amounting to only a few volts. It is evident that with such low pressure in view of the excellent conductivity of the metallic return circuit provided, but a small proportion of the current will leak to earth and be a possible source of damage to intervening pipes or metallic structures. The invention comprises one or more motor generators located at the distributing station, each motor operating under a constant field and having its armature operated at a voltage proportionate to the distance from the station of the point to be protected, and having its generating boosting winding connected with the return circuit at such point as to divert the earth currents and to assist their flow back to the station through a metallic path.

LETTER TO THE EDITORS.

The Effect of Electric Waves on the Human Brain.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of June 21st there appears a criticism by Mr. Collins of methods described by us in an article on "The Effect of Electric Waves on the Human Brain," which was published in your issue of May 31st, and while disclaiming any wish on our part to enter into a controversy with Mr. Collins, we beg to indicate a few points which are apparently not well understood.

The three coherers, as well as the whole apparatus, were those used repeatedly by Professor Rutherford in class and public lectures on "Wireless Telegraphy." While we have Mr. Collins' assurance that a description of these instruments would form an unique chapter in the history of Wireless Telegraphy, yet this, with many others of his statements, we beg to doubt.

Again, while Mr. Collins finds accumulators only of service for "operating an automobile" and not for "delicate tests," we can at present think of few cases where dry cells are to be preferred. And why an accumulator with an e. m. f. of 2.2 volts and an internal resistance of (say) 0.02 ohms, is not as serviceable and as suitable for delicate tests as two dry cells of e. m. f. of 2.5-3.0 volts and internal resistance of (say) 0.2 ohms, on a circuit having a resistance of 1000-5000 ohms—our non-cohering minds fail to grasp. We may say that we also used the current from the 110-volt circuit, cutting it down by means of a resistance frame, and using potential differences between 0. and 23 volts. That a "fresh" brain—or a brain of a living animal—conducts electrolytically, we may fairly regard as proven: to the electro-chemist the tests of an electrolyte is whether—or not—the substance gives a polarization current. On passing the current through a fresh brain, oxygen and hydrogen are liberated at the poles; on stopping the current and measuring the polarization e. m. f. it is invariably found to be 1.7 volts—the decomposing voltage for sodium chlorides—the obvious deduction is surely logical.

We made no statement that the brain matter was analogous to alkaline solutions, and what deduction Mr. Collins wishes us to draw from his illustration of the effect of heat on sodium chloride and brain matter, we fail to understand. He is doubtless aware that the brain substance is a complex compound—or combination of compounds—of carbon, with oxygen, hydrogen, nitrogen, phosphorus and other elements. On applying heat the water is first driven off; dry cerebral substances, in the one case, and the dry sodium chloride, in the other, are left. On further heating, the former is decomposed, leaving some carbon, the chlorides of potassium, sodium (magnesium and calcium), ferrous phosphate, etc.—the total ash amounting to 2.9-7.1 pts. per 1,000.

Similarly, sodium chloride heated to a high temperature under pressure, would be decomposed into chlorine and sodium; the sodium could then be condensed and a "conductor" thus obtained. But how would this result enhance the value of Mr. Collins' argument? Does he mean to imply that the brain matter is actually decomposed into carbon by the passage of electric waves? Of course there is no experimental proof at present, pro or con, for such a supposition; but if so, reasoning by analogy, truly an ordinary thunder storm would be direly pathogenic in its effects. While we have condemned Mr. Collins' telephone method as defective—since auditory judgments are always more liable to be erroneous than are visual; the ear, no matter how unprejudiced the observer may be, often hears at the telephone what it desires to hear;—yet we have "in an unobstrusive little foot-note" (and in two other places in the course of our article) spoken of Kohlrausch's method of measuring resistances. As Mr. Collins is doubtless aware, this is effected by means of a telephone and an alternating current, with freshly platinized electrodes. This method gives an accuracy of .1%.

Mr. Collins defends his method by referring to the fact that Signor Marconi used the telephone receiver in his most crucial test; we are fully aware of the fact, but would beg to remind Mr. Collins that just as his experiments were "qualitative and not quantitative," so the difference between his "brain-coherers" and those of Signor Marconi, was qualitative rather than quantitative. We are prefecly willing to admit the delicacy of the telephone receiver, when carefully manipulated, but we most emphatically do not admit that it is as decisive and as impossible of an erroneous interpretation as is the milliammeter, an instrument which leaves nothing to the individuality of the observer. Not only, however, did we fail to detect any change of resistance in the brain with a milliammeter, but an attempt to do it with Kohlrausch's apparatus, was equally unsuccessful. That is to say, with our apparatus the coherer effect in the brain did not amount to 1-10th of 1 per cent.; to measure closer we thought useless, since a change in temperature of 1-20° C. would mean a change in resistance of 1-10th of 1 per cent.—(Textbooks of Physiology—Schaffer, Kirke, Mills, etc.)—this, be it remarked, in spite of the fact that the resistance in the control coherers dropped from 35,000 to 4 ohms when the waves were passed from the same distance.

We are still inclined to doubt that this can be satisfactorily explained on the basis of electrostatic stresses in the intervening dielectric as proposed by Mr. Collins. Moreover, since no difference could be detected in the coherer action when placed at distances of 4, 10, and 25 feet from the coil, all influence from "disrupted discharge through the field of force" etc., must have been entirely negligible.

Mr. Collins regards the fact that our transmitter was capable of sending waves 500 miles as an objection to our having placed the coherer 4, 10 and 25 feet away. His next sentence: "At that distance a coil giving a maximum spark of 2 cm. will act upon a properly constructed coherer without any disrupted discharge through the field of force set up by the surging of the low-frequency, high-potential currents alone"—is evidently intended to give the clue to his line of reasoning; in which case we must confess that we are utterly at a loss to see the connection.

To pass from the physical to the physiological aspect of the phenomena attributed by Mr. Collins to the Hertzian waves, we beg to draw his attention to the fact that "hypnotic suggestion" had absolutely nothing to do with our explanation of the accident quoted—the phrase is Mr. Collins' entirely. A great majority of people have either seen a person faint or have themselves "felt their heart stop," in the popular phrase, for an instant, when under the stress of some violent emotion: death from shock is simply a similar condition carried to a further stage. As Mr. Collins accuses us of believing in action at a distance, without being able to trace either the nature or the paths of the agency at work, we may, perhaps, be pardoned if we trace somewhat fully the actual course of events.

As a result of something taking place in the external world, waves of light or sound reach the special senses, and are conveyed to the centers in the brain as nerve impulses which they affect so as to cause sensations of sight and hearing. When these afferent impulses are sufficiently powerful, disagreeable, or painful, they cause a lesser or greater degree of paralysis of those centers governing the functions most necessary to life, such as respiration and circulation.

The result is an immediate and pronounced lowering of the blood pressure, with consequent cerebral and medullary anaemia, causing, first, loss of consciousness, and later, arrest of the cardiac and respiratory functions. At the same time the blood pressure may fall so low that the coronary circulation is impoverished and the heart itself dies from lack of oxygen.

But as a discussion of this subject would belong more to the province of medicine than electricity, we beg to refer Mr. Collins to the authorities quoted: we may, perhaps, be permitted quotations from such recognized authorities as Dr. Osler and Dr. Lauder Brunton.

"Bodily shock or concussion is not necessary. The affection may follow a profound mental impression; thus, an engine-driver ran over a child and received thereby a very severe shock, subsequent to which the most pronounced symptoms of neurasthenia developed.[1]" Dr. Osler then goes on to cite cases in which fatal organic changes in the brain and cord have supervened.

"Convulsive movements and fibrillary twitches of the muscles, and especially of those in the face, are observable."[2] (Cf. twitching of cephalic muscles in case of rabbits.)

"Nor must the effect of mental emotion be left out of account, as this is sometimes sufficient of itself to cause death without any injury to the body whatever."[2] The author then cites the case of an absolutely healthy man who was blind-folded and "beheaded" by means of a blow with a wet towel on the nape of the neck; death was instantaneous.

Under the predisposing causes of shock, Dr. Dawbarn mentions fear as a very considerable factor; he narrates the death of a man, "apparently of sheer cowardice, some hours before the time set for operating upon piles."[3]

Does Mr. Collins imagine that we regard "hypnotic suggestions" as the cause of death in these and similar cases? Most assuredly we do not: but as he has not apparently a very clear idea of what he means by that term, we beg to refer him to Professor James, of Harvard, in whose work he will find a very lucid resumé of the three main theories of hypnotism.

The lessened surgical mortality under anæsthetics is due to the fact that these deleterious afferent impulses are prevented from reaching, or at least being "apperceived" in the nerve centers, and are thus unable to cause reflex medullary paresis. Mr. Collins was able to obtain a cohering action in an anæsthetized brain, and consequently, unless he is able to give a totally different reason for all the cases of death mentioned in the references, we shall maintain that not only are his experimental methods defective, but that his reasoning is also inconsistent.

Again, if Mr. Collins were able to obtain a cohering action in a brain under the much deeper narcosis of ether, how does he reconcile that result with the fact that a child may sleep—if kept quiet

and very tired—through a thunderstorm which would cause it the most acute terror when awake? According to his theory, the child, too, should have a much more powerfully cohering brain—his theory assumes that all such phenomena of terror, etc., are due to a cohering action of the brain.

To conclude: Mr. Collins, after some experiments tending to prove that the brain is a coherer when a coil giving a 2-cm. spark is used, deduces an explanation of death "from shock" during an electrical storm. This theory we have attacked, and until Mr. Collins supplies evidence to the contrary, we shall continue to think that waves from an apparatus with a 5 or 50-centimeter spark-gap are as much like those propagated during an atmospheric electrical storm as are waves from his apparatus.

Our thanks are due to Drs. Barnes and Morrow for their valuable criticism and advice.

1. OSLER:. Practice of Medicine, pp. 1132-1135.
2. LAUDER BRUNTON:. Practitioner, XI., p. 241-258.
3. DAWBARN:. Shock. New York Medical News, 1899, LXXIV., 299-234.
4. CROMPTON: Guy's Hosp. Reports, 1887, 3s. XXIX., 150.
5. REEVE: Medical News. Philadelphia, 1887. L 6,—Death from Introduction of an Aspirator.
6. THOMAS: Lancet, 1898, ii., 1390.
7. BARROW: Lancet, 1898, ii., 323.
8. JAMES: The Principles of Psychology, Vol. ii., 593-616.

It may be noted that only a few of the more easily accessible instances among a mass of such literature have been chosen.

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DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Compound Non-Synchronous Motor.—LATOUR.—A communication in which he replies to the communications of Feldman and Heyland. He has built a machine of 27-hp, in which the commutation is perfect. With twice the normal current there is no sparking whatever. As motor, this machine operates with a power factor equal to unity at any load; it runs above synchronism at no load and synchronous at full load. But he could also operate it like Heyland, synchronous at no load and below synchronism when loaded; he, however, prefers synchronism at full load. No shifting of the brushes is required in practice, the slip causing only very slight disturbances in the commutation. As a generator, his machine retains enough permanent magnetism and becomes at once self-exciting, like a direct-current shunt dynamo. Without a shifting of the brushes, and when the constancy of the frequency is of no importance, he generally operates it below synchronism at no load and synchronous at full load; but, like Heyland, he could run it synchronously at no load and above synchronism when loaded. He concludes with the following sentence in italics: "If my generator is compounded, it remains theoretically synchronous at any load."—*Elek. Zeit.*, July 3.

Induction Motor.—LINDSTROEM.—An article on the calculation of the characteristic curves of the induction motor. There exist two such methods: the one graphical, by Heyland, which in its simple form enables one to find very quickly the approximate properties of the motor; the other analytical, by Steinmetz, distinguished especially by the fact that it gives exact results. The present author describes another method for determining the characteristic curves of the induction motor; he starts from a diagram and then applies only simple trigonometry; the method is based upon Kapp's transformer diagram, but Steinmetz's terms are used; the result of his method is identical with that of Steinmetz, and the calculation requires about the same amount of work. The method can be used for single-phase motors and motors connected in cascade.—*Elek. Zeit.*, June 17.

REFERENCES.

Direct-Current Machines.—TRYLSKI.—A communication referring to a recent paper of Niethammer, in which he had discussed the conditions of sparkless running of direct-current machines and the influence which the type of winding has upon it. The present author describes some experiments which show this influence.—*Elek. Zeit.*, June 12.

Shunt Regulator.—KRAUSE, FRISCHER, HANKE.—Two illustrated communications dealing with methods for determining the number and values of the steps of the regulator of a shunt generator with self-excitation.—*Elek. Zeit.*, June 19, July 3, 24.

LIGHTS AND LIGHTING.

Experiments with Very Large Electric Arcs.—REY.—An abstract of a paper read before the International Society of Electricians, in Paris, in which he described his experiments with electric arcs in conjunction with Blondel's work on projectors in 1892 to '94, 1899, 1901, and quite recently with Jigouzo. Among the foremost general conditions to be fulfilled for good regulation, are the use of a compound machine, good carbons and a large steadying resistance. A 250-ampere arc implies the use of a steadying resistance, absorbing as much as 62 volts; this figure applies to the best quality of carbons. The quality of samples obtained from the best firms is still unreliable, but the (French) author states that French carbons are the least unreliable in average quality. From careful measurements made by different methods he concludes that the intrinsic illumination of the crater increases with the current. Photometric measurements show a continuous variation of photometric intensity without any noticeable variation of current. It is quite useless to attempt to follow these changes, and the only resonable method consists in taking average values of numerous series of readings. Referring to researches made with Blondel, he states that a given current sent through carbons of different diameters gives different illuminations, due to the different conditions of cooling. Curves have been plotted by the author with current densities as abscessas and photometric intensities as ordinates, for different carbons, and for two different methods, both of which check quite well, *i. e.*, within 15 to 20 per cent. The equation of this parabolic curve states that the illumination multiplied by the product of illumination and a constant, 200, equals 10,000 times the current density (the units of illumination and current density being not given in the abstract). The law of variation of current density for a given illumination, with the diameter, is as follows: the square of the current is proportional to the cube of the diameter of the carbon, or the current density is inversely proportional to the square root of the diameter of the carbon. Violle has investigated the variations of the illumination by photographic methods, but the present author claims that the interpretation of the photographic proofs is liable to great errors, due to the complex laws of variation of the darkness of the proof with the time of exposure. He claims that no credit can be given to this method, which is said to be worse than the photometric methods of investigation. He states that the actual flux of the arc, due to "occultations" of the negative carbons, reaches only 84 per cent. of the theoretical flux.—*L'Eclairage Elec.*, July 10; *L'Ind. Elec.*, July 25; Lond. *Elec.*, August 1.

TRACTION.

Third Rail.—POTTER.—An illustrated description of a form of construction which is intended to afford protection from ice and sleet for the third rail, and prevent short-circuits caused by careless handling of track tools. The protection consists of a channel iron or plank supported by brackets directly over and about 2½ inches above the third rail. The center of the third rail is 28 inches from the gage line in the construction advocated, and the top 3 inches above the top of the running rail. It is not advisable to locate the third rail lower than 3 inches above the top of the track, for in such cases the contact-shoe, which ordinarily drops 1 inch lower than the third rail, would be in danger of touching the track rails, large frogs and switches, causing a short-circuit. A rectangular section

of rounded top is recommended. The following composition for a third rail is suggested, as not being difficult to obtain commercially while providing a reasonably high conductivity: carbon, not to exceed 12 per cent.; manganese, 15 per cent.; phosphorus, 10 per cent.; sulphur, 5 per cent. The electrical conductivity of a third rail of this composition will be about 60 per cent. higher than that of an ordinary running rail of the same cross-section. Another feature of this construction is a third rail insulator, which consists of a block of wood or vitreous material, with a slot in the top, into which the third rail is laid. The shoe used has a plate of cast-iron, hinged at the point of support and carried by brackets adjustable for height to allow for the wear of the wheels. In specially complicated slip switches, it is pointed out that some difficulty may be experienced in locating the third rail so that the gap may be spanned by the shoe, and in such cases a short length of rail or wire may be placed overhead for a distance of about 50 feet. The approximate estimated cost of one mile of single track of protected third rail with 6-inch channel iron protection is given at $5,663; with 8-inch channel iron protection, $6,315; with 8-inch wood protection, $4,540.—*St. R'y Jour.*, August 2, and *Internat. Ed.*, August.

Grades Stated in Per Cent.—HERING.—A short article calling attention to an ambiguity which exists when a grade is stated in per cent. The percentage is, of course, the vertical rise in feet per hundred feet distance, but the question arises whether this distance is measured horizontally, as it would be on a map, or whether it is the sloping distance, as would be measured by the length of the rail. Authorities differ greatly as to which of the two is meant. The former would correspond to the tangent of the angle, and the latter to the sine. In steam railroad work and when maps are used, the horizontal distance is generally understood, while in formulas for the traction coefficient on grades, the latter is usually assumed. For small grades the difference between the two is quite negligible; up to a grade of 14 per cent. or about 8 degrees, the difference between the tangent and sine is 1 per cent. or less; on steep mountain roads it should be clearly stated which of the two is meant when the grade is given in per cent. In France the expression 0/00 is used in place of per cent., and means per thousand instead of per hundred. In England, grades are often stated as the distance in which the rise is 1 foot; that is, they there use the reciprocal of the value used in this country.—*St. R'y Jour.*, July 19.

Electric Brakes for Tramcars.—MUELLER.—A long article, illustrated by many diagrams. He first describes at length, graphical methods for determining the rheostat required for an electric short-circuit brake and for representing the whole mechanical process during braking. He then discusses the disadvantages of the short-circuit brake, namely, that it is dangerous for the motors, and that there is no braking effect on the axles upon which no motors are mounted. An improvement of the short-circuit brake is the electromagnetic brake in which the currents generated in the motor are not destroyed directly in a resistance, but generate a magnetic field, by the action of which a fixed disk and a disk rotating with the axle are pressed against another, so that mechanical friction and eddy current friction is produced. He thinks that electromagnetic rail brakes are an important improvement, and describes the Westinghouse-Newell brake, which he believes to be superior to an air brake.—*Elek. Zeit.*, June 12.

Electric Trams and Trains.—A long editorial on the fact that a steady and substantial decrease in the traffic receipts of English steam railway companies is caused by the running of electric tramways parallel with their steam lines. It would be wrong for those steam railways to think that they have only to equip their lines electrically in order to win back what they have lost. The steam railway company which aspires to compete against parallel electric tramways must be prepared to separate entirely, and at all points, the local from the main line traffic. It is necessary to provide separate and quite distinct tracks for the fast and the local services. On the local lines a service of trains or of separate coaches should be provided running at short intervals, and more closely resembling in its conditions what is met with on a well organized electric tramway.—Lond. *Elec.*, July 25.

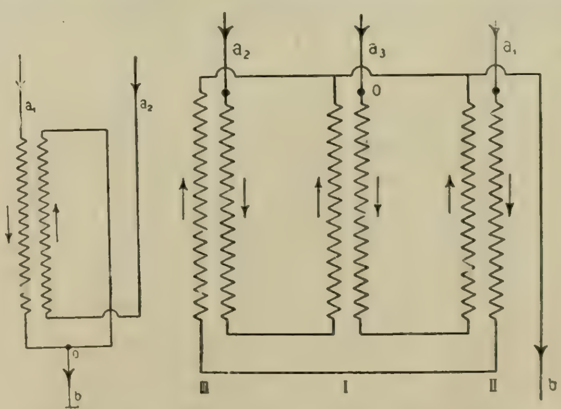
REFERENCES.

Berlin-Zossen High-Speed, Experimental, Three-Phase Railway.—LOCHNER.—A long synopsis of his paper on the results obtained on this railway. The results given by him are in general the same as those noticed in the Digest, May 17. But some additional details are given, together with numerous valuable diagrams and curves.—*St. R'y Jour.*, August 2, and *Internat. Ed.*, August.

New Orleans.—A long and well illustrated article on the New Orleans and Carrollton Railroad, Light and Power Company. The company owns four power houses, two exclusively for electric lighting service and two exclusively for street railway service. Of the latter, one contains three 200-kw and the other two 300-kw railway generators. The traction system is described, and a special article is given on the accounting department of the company.—*St. R'y Rev.*, July 20.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Arnold-Bragstadt-la Cour Polycyclic System of Current Distribution.—ARNOLD.—A long paper read before the Frankfort Electrical Society, illustrated by a large number of diagrams. He begins with the well-known facts that for lighting, high frequency, alternating current is preferable, but low-frequency is better for motors and synchronous converters; for a motor load, a polyphase-current system is decidedly preferable, while for lighting single-phase is better on account of the better regulation and the simpler installation; for motors, double the voltage which is used for lamps is generally more suitable. The object of the Arnold-Bragstadt-la Cour "polycyclic" system is to transmit over one and the same line currents of different frequencies and voltages in such a way that the different currents do not influence one another. He gives some mathematical explanations to show that a sinusoidal e. m .f. can generate only a sine current of the same frequency, and can perform work only with such a current of the same frequency; if there is a second sine current of another frequency in the same circuit, it must be generated by a second e. m. f. of the second frequency; the first current cannot perform work with the second e. m. f., nor the second current with the first e. m. f.; such currents of different frequencies are entirely independent of one another and their energies, powers and losses are simply added. To superpose currents of various frequencies upon another, different methods may be used. The first which he describes is to introduce the superposed current through the neutral points into the system. For instance, in a three-phase system there is an e. m. f. between the neutral points of the transmitting and receiving end, and it is possible to connect the generator which has to give the superposed current—for instance, a single-phase machine—between the neutral points. Diagrams are given showing how to introduce superposed currents into a single-phase or into a two-phase system through neutral points. Bedell has recommended such superposed systems, but in his method the superposed alternating current which is introduced through the neutral point obtains a very large inductive voltage drop in the windings of generators and transformers; this is not the case in the Arnold system. He first describes a method in which a large induction voltage drop is avoided by arranging all windings in a bifilar manner so that the superposed currents cannot act inductively upon themselves. For the introduction of a superposed current, a choking coil may be used, as shown, for a single-phase current in Fig. 1. The two halves of the coil are placed parallel



FIGS. 1 AND 2.—POLYCYCLIC SYSTEM OF DISTRIBUTION.

on the core, but in such a way that the superposed current introduced from the neutral point goes through the two halves in opposite directions, but the main current does not; a_1 and a_2 are the leads to the main system, o is the neutral point; only the superposed current flows through b; the induced actions of the main current in the two halves are added, while those of the superposed current balanced one another. Fig. 2 gives the analagous arrangement for three-phase currents; on core *I* phase 2 and 3 are wound in opposite directions,

on core *II* phase 3 and 1, and on core *III* phase 1 and 2: a_1, a_2, a_3 are the leads for the main three-phase system, while the superposed current flows through *b*. Some modifications are shown in other diagrams. A second method of superposing a current upon a system is by means of transformers which have two primary windings and one secondary winding at the transmitting end, and one primary winding and two secondary windings at the receiving end. Fig. 3 shows the

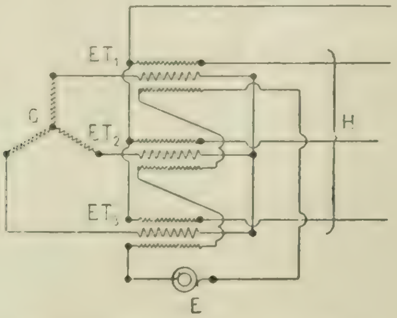


FIG. 3.—POLYCYCLIC DISTRIBUTION.

arrangement for superposing a single-phase current upon a three-phase system by this method. *G* is a three-phase generator, *E* a single-phase generator. $E\,T_1$, $E\,T_2$ and $E\,T_3$ are three single-phase transformers. *H* represents the three main conductors of the three-phase system, *R* the return for the superposed alternating current. The two primary windings of the transformers do not act inductively upon each other. Another arrangement is shown in a diagram, in which a three-phase transformer is used instead of the three single-phase transformers; in another arrangement it is shown how under special conditions a separate return for the superposed current may be avoided. If it is desired to transform the polyphase currents and the single-phase currents, flowing in a polycyclic system at the same time, without separating them, this can be done with the aid of a polyphase transformer with magnetic return, by winding so many turns of the neutral winding (the return of the superposed current) around the magnetic return that the proper ratio of transformation is obtained. It is also possible to induce in the same armature winding of an alternating-current generator, independent polycyclic currents by properly arranging two field systems. He then discusses the distribution of the polycyclic currents in the secondary network and the connections of the transformers which supply, for instance, a three-phase motor load and a single-phase lighting load at the receiving end. He then deals analytically with the voltage difference between the conductors and with the voltage drop of the different currents of the polycyclic system. The following advantages are claimed for the polycyclic system, compared with the usual systems: first, the use of two different frequencies enables one to use the proper frequencies for different purposes; second the connections and installations for light and the regulation of the lighting voltage are very simple; third, the tension for the motor load and the voltage drop in the motor circuits can be much larger than when the same system is used for both power and lighting; this means a saving of

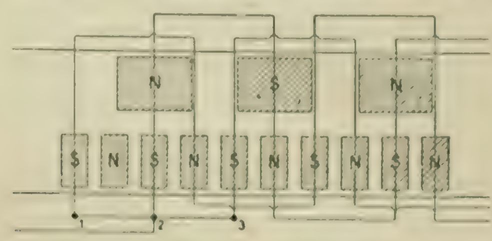


FIG. 4.—POLYCYCLIC DISTRIBUTION.

copper and cheaper motors and generators, because the wattless currents are smaller and of less importance; fourth, if power is transmitted over overhead wires with a four or three-wire system of the power, 100, and a superposed single-phase system of the power, 50, the weight of copper is 66.7 per cent. of the weight of copper required for a single-phase system of the same total power for the same effective voltage between the wires and the same loss of power in per cent; fifth, when power is transmitted over cables, for the same effective voltage between the wires and the same loss in watts, the use of a four-phase system with superposed single-phase current enables one to transmit 23 per cent. more power; the superposed power is then one-half the power of the main system. With a three-phase system, if a superposed current is used, 9 per cent. more power is transmitted if the power of the superposed current is one-half the power of the main system. To show an arrangement of a polycyclic current distribution system as a whole he gives the adjoining Fig. 4. In the double generator, *G* and *E*, with the same armature and two different pole systems which have the relative position to another,

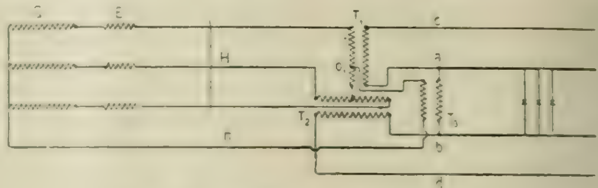


FIG. 5.—POLYCYCLIC DISTRIBUTION.

shown in Fig. 5, the main three-phase currents and the superposed single-phase current are generated at the same time. The single-phase current, which is the triple harmonic of the three-phase currents, is thus superposed upon the main current that the maximum instantaneous voltage between the return, *R*, and the other wires, is a minimum. At the receiving end two single-phase transformers change the current into two-phase currents, the well-known Scott system being used; this is done because, for a polycylic secondary network two-phase is more advantageous in symmetry, than three-phase. The superposed single-phase current does not produce any flux in the two transformers, and can, therefore, be taken off from the point O_1 of the primary winding of the transformer T_1. In the transformer T_3, the superposed single-phase current is transformed, and as the secondary winding is connected between the two wires *a* and *b* of the two-phase system, the lamps can be connected directly across these two wires. The paper is very fully illustrated.—*Elek. Zeit.*, June 26, July 3; *L'Ind. Elec.*, July 10, 25.

Protection Against Accidental High Voltages.—BENISCHKE.—An illustrated paper read before the Berlin Electrical Society. He discusses the different reasons which may cause accidental high voltages. He deals at some length with those dangerously high voltages which sometimes occur when transformers, motors, cable lines, etc., are switched in or out. As a suitable protection, he recommends providing the installation with air-gaps, which have a lower resistance against high voltages than the normal insulation. The ordinary lightning arresters cannot be used for this purpose, because they cannot be adjusted with sufficient accuracy. A curve is given, which shows the length of air-gap required for different voltages; it is nearly a straight line, an air-gap of 1.3 mm. corresponding to 4,000 volts, and 10 mm. to 20,000 volts. If a 2,000-volt installation is to be protected against voltages above 4,000, it must be provided with air-gaps of 1.3 mm. If an ordinary lightning arrester would be provided with such a short air-gap then the short-circuit which would follow a spark discharge would be very heavy, and the electrodes might be fused together. To prevent such heavy short-circuits, he inserts into the earth connection of his protecting device a large resistance; this would not be feasible with lightning arresters. It is, therefore, necessary to install separate and differently constructed lightning arresters and protecting devices against high voltages. For the latter he uses two brass horns; the smallest distance between the same, *i. e.*, the spark-gap, is between the poles of a magnetic blowing device. For the resistance in the earth connection he uses a water rheostat. Some details of construction are described and illustrated. In the discussion which followed, Wilkens remarked that such devices have proven satisfactory in actual service in the Berlin Electric Works, but they use metallic resistances in oil for the earth connection. Benischke explained why water resistances are preferable.—*Elek. Zeit.*, June 19.

WIRES, WIRING AND CONDUITS.

Cables Destroyed by Lightning.—WILKENS.—A brief, well illustrated note presented to the Berlin Electrical Society. He describes the damage done by lightning in a cable line. "From the damage, one sees what an enormous amount of energy there may be in a lightning flash, and that probably all devices used in practice as lightning arresters are not so built that they could lead a direct, full, lightning flash effectively to earth."—*Elek. Zeit.*, June 26.

REFERENCE.

Fuses.—DREEFS.—An illustrated description of a system of Mix and Genest for avoiding any mistakes in the use of fuses.—*Elek. Zeit.*, June 26.

Electro-Physics and Magnetism.

Canal Rays.—W. Wien.—A paper giving an account of "investigations on the electric discharge in rarefied gases," with some editorial comment upon it. Goldstein, in 1898, described certain rays which were observed to emanate from a perforated or "canalized" cathode. These rays proceed in a direction opposite to the cathode rays and form in fact their prolongation backwards. He called them "canal rays," and maintained that they are not deflected by a magnet. We know that they are simply the positive particles coming from the anode or from the intervening gas, and the present author gives some further information with regard to the aspect they present from the point of view of the electron theory. These canal ray particles, identical probably with the particles constituting polonium rays, are discharged from a glowing carbon filament charged to 3,000 volts, even in a practically complete vacuum. Their mass varies from 250 times to 2,700 times that of the negative electron, and they may very well be the remnant of the atom left after the negative electron has been split up.—*Ann. d. Physik,* 8, 2; an English translation begins in Lond. *Elec.,* July 18.

Canal Rays.—W. Wien.—An article on fluorescence, due to canal rays. He had already shown that the fluorescence of glass produced by canal rays depends upon the gas in the tube and upon the magnetic deflectibility of the rays. He has since found that canal rays produce fluorescence in metallic oxides obtained by combustion, but not in oxides prepared in the wet way. He supposes that the former are higher oxides than the latter, and that they give off oxygen when positive electrons impinge upon them. Magnesium oxide fluoresces red, zinc oxide a bright green, while aluminum shows patches of various colors. If the cathode itself is oxidized, it also shows fluorescence where the cathode rays originate.—*Phys. Zeit.,* July 1; abstracted in Lond. *Elec.,* July 18.

Gas Spectra in a Magnetic Field.—Berndt.—An account of an investigation of the general behavior of gas spectra in a magnetic field. The spectra were those obtained from a vacuum discharge through the gas contained in a constriction of the vacuum tube, which constriction was introduced between the poles of a Du Bois half-ring electromagnet giving a field of 20,000 units. Line spectra suffered only little change, whereas band spectra were almost always replaced by the spectrum of mercury. The general behavior of the spectrum is as if the resistance of the gas increased in the magnetic field, which, considering the strong force exerted by the field upon the electrons conveying the discharge, is not surprising. In most of the gases, whether simple or compound, the Zeeman effect is barely perceptible, but helium shows the phenomenon to great advantage in a field of about 10,000 units, about six polarized doublets being discerned with the discharge parallel to the lines of force.—*Ann. d. Phys.,* No. 7; abstracted in Lond. *Elec.,* July 18.

Electro-Chemistry and Batteries.

Lead Zinc Storage Battery.—Gabran.—An account with diagrams and tables of some experiments with zinc-lead storage batteries. He uses an amalgamated copper case, as negative plate, divided into separate compartments by means of perforated amalgamated intermediate walls; the positive plates are ordinary lead peroxide plates. As electrolyte, a mixture of zinc sulphate and sulphuric acid is used. When discharging from 2.4 to 2.1 volts in 10 hours, he obtained with one battery 331 watt-hours per 14.3 kgr. of total weight. He has experimented a year and a half with these batteries, and has not found any reason why they should not be used in practice. Their advantage over the ordinary lead accumulator is the lower weight of the electrodes and the higher e. m. f. The copper was not attacked.—*Elek. Zeit.,* June 26.

Determining the Condition of the Two Electrodes in the Lead Accumulator.—Liebenow.—A German Bunsen Society paper, on the application of the method of Fuchs, which consists in measuring the e. m. f. between an auxiliary electrode and each of the two plates of a storage battery. He describes three different forms of auxiliary electrode. The first consists of a cadmium plate in an ebonite frame, and is sufficiently good for rough determinations. For more exact measurements Liebnow uses solid cadmium amalgam, which is suspended in a small porous bottle, and is surrounded by a solution of cadmium sulphate and sulphuric acid, and is very constant. For very exact measurements a small, carefully treated accumulator plate is suited; as auxiliary for testing the negative plate a small spongy lead plate is used, and for testing the positive plate a peroxide plate, as then very sensitive voltmeters can be used on account of the smallness of the e. m. fs. At the beginning of the discharge the negative plate has an e. m. f. of 0.1 volt, against cadmium; this e. m. f. increases slowly until the plate has been converted into sulphate; after 2½ hours the e. m. f. increases rapidly to about 2.5 to 2.6 volts, if the "discharge" is continued by force, by sending constant current through the cell. On the other hand, the positive plate has at the beginning of the discharge an e. m. f. of 2.1 volts against cadmium, and the curve drops definitely when the plate is discharged. In some cases the Fuchs method gives wrong results, as it seems to indicate that the positive plate is exhausted when it is not the case. Only by continuing the experiment will the real condition become evident. He explains this peculiar phenomenon. In abstract in *Elek. Zeit.,* June 12; the full paper has not yet been published in the journal of the society.

Units, Measurements and Instruments.

Standard Cells.—Jaeger.—A German Bunsen Society paper. Standard cells can now be made to be exact and uniform within 0.01 per cent., and remain constant within this limit. Several forms of Clark cells are described and illustrated. At 15° C. the e. m. f. is 1.433 volts. The formula accepted by the German Reichsanstalt for the e. m. f., E, in internat. volts at the temperature, t, degrees Celsius is $E = 1.4328 - 0.00119\ (t - 15) - 0.000007\ (t - 15)^2$. The Weston cadmium cell is an excellent standard cell, and has a very small temperature coefficient. He believes that by and by it will entirely replace the Clark cell. For a cell with dilute solution the temperature coefficient is practically equal to zero within the ordinary temperatures; the e. m. f. is 1.0191 internat. volts. The e. m. f., E, in internat. volts of the cell, with saturated solution and crystals, is given by the formula, $E = 1.0186 - 0.000038\ (t - 20) - 0.00000065\ (t - 20)^2$. The cadmium amalgam must have between 5 and 14 per cent. of cadmium. From measurements extending over several years the following values of the ratio of the e. m. fs. of the Clark and the Weston cell were found: Clark at 0 degrees to Weston at 20 degrees, 1.42280; Clark at 15 degrees to Weston at 20 degrees, 1.40669.—*Zeit. f. Elektrochemie,* July 24.

Silver Nitrate Voltameter.—Leduc.—A paper on the sources of error existing in the silver nitrate voltameter. The change produced in the acidity of the solution is entirely a question of circumstances, such as the rapidity of the electrolysis. The nitric acid generated is electrolyzed, and precipitates silves from the nitrate. A corrosion of the deposited silver does not exist.—*Comptes Rendus,* July 7; *L'Eclairage Elec.,* July 26; *L'Ind. Elec.,* July 25; Lond. *Elec.,* August 1.

Telegraphy, Telephony and Signals.

Marconi's Magnetic Coherer.—Rutherford.—A communication referring to the magnetic coherer recently described by Marconi. As early as 1897, he himself showed that the demagnetization of magnetized steel wire, by electric oscillations, can be made the basis of a sensitive method for detecting electric waves. He used in the laboratory, for more than a year, a device very similar to that employed by Marconi in his latest form of receiver, viz., an endless moving band of steel wire passing through the solenoid in which the electric oscillations are set up. Instead of using a telephone to detect the magnetic changes in the iron, he used a magnetometer needle, close to which the steel wire passed. "Marconi has apparently applied to the method the principle used by Poulsen for recording telephonic messages with very successful results."—Lond. *Elec.,* July 25.

Coherers.—Fenyi.—An article in which he says that an exceptionally strong current can be used with a coherer if the latter consists of a number of steel needles in series. If six needle coherers are placed in series, it is possible to connect them up with a Leclanche cell of 1.5 volts. If several cells are to be used, it suffices to add three or four coherers for every volt of additional e. m. f. In this manner, currents considerably above the standard "milliampere' may be obtained in the coherer circuit. In fact, 100 milliamperes may be used. In an experiment he had six needle coherers, a trembling electric bell and a Leclanche cell connected in a circuit; a small spark excites the coherer and the bell rings; the ringing ceases abruptly as its trembling decoheres the coherer. If the coherer is put to earth on one side and connected on the other side with a very long insulated conductor, an apparatus is obtained which announces distant thunderstorms. If a magnetic recording device is inserted in parallel with the bell, distant thunderstorms may be recorded. A conductor 26 meters long is suitable for most ordinary purposes, but a length of 360 meters gives

ten times the effect.—*Comptes Rendus,* July 7; abstracted in Lond. *Elec.*, July 25.

Wireless Telephony.—An editorial on experiments with wireless telephony. The first method mentioned is Ruhmer's; this is essentially optical, and a modification and improvement of Bell's old "photophone," as has been described before in the Digest. He has succeeded well over a distance of 4½ miles, and will repeat his experiments between stations 20 to 25 miles apart. This method is thought to have a field of application in military, and possibly also in naval service work—for lighthouses, etc. The second method mentioned is that of Preece, who transmits speech across the intervening space between two parallel aerial wires, one of which acts as a transmitter upon the other as a receiver; a battery and a microphone in the transmitting wire and a telephone in the receiving wire complete the equipment; it has never been conclusively settled whether this system operates by electromagnetic induction or by the stray return currents through the earth; but "this is scarcely wireless telephony, the amount of aerial wire used being often much greater than the distance over which messages are transmitted." It is pointed out that neither of the foregoing methods of wireless telephony bears any real relationship to Marconi telegraphy. There are no Hertzian waves used (but they are used in Fessenden's telephone system, according to the meagre descriptions which have so far leaked out).—Lond. *Elec.*, August 1.

London Telephone Exchanges.—An illustrated description of the new small branch exchanges of the Post Office telephone service in London. The system employed has been worked out for exchanges in which the number of the subscribers is not likely to exceed 1,000, and it may be briefly described as a non-multiple system, in which a common battery is used for signaling, but not for speaking purposes. Both as regards the subscribers' and junction lines, the calling and clearing is automatic, as in the ordinary central battery system. Some features of the old Post Office "permanent current" exchanges have been adopted, notably the employment of 8-point jacks.—Lond. *Elec.*, July 25.

Miscellaneous.

Oxy-Acetylene Burner.—A description of a new oxygen-acetylene burner, in which the admixture of ether vapor is dispensed with and a much higher temperature is attained. One volume of acetylene is mixed with 1.8 volumes of oxygen, this quantity being intermediate between the quantities required for combustion to $C\ O$ and complete combustion, respectively. The pressure used is higher than that formerly employed, being that of 400 cm. of water, and the two gases are mixed inside the apparatus, back lighting being prevented by means of porous bricks. The nozzle velocity of the gases must be 100 m. to 150 m. per second. The flame has at its center a greenish dust of extremely high temperature, and only about 6 mm. long. Iron and steel can be soldered at the point with ease, and the flame neither oxidizes nor carbonizes the iron. Silica is fused in volatilized alumina; magnesia and Drummond lime are also fused. On diminishing the quantity of oxygen, the flame becomes luminous, and when it is projected onto chalk, calcium carbide is produced. With a higher proportion of oxygen the flame becomes oxidizing, as may be seen on fusing a piece of iron in it.—*Bull. Soc. Franc. de Phys.*, June 6; abstracted in Lond. *Elec.*, July 4.

Application of Science to the Electrical Industry.—An abstract of a report of a special sub-committee of the Technical Education Board to the London County Council. It is stated that Great Britain, and London in particular, has lost during the last 20 or 30 years various branches of industry owing to the competition of foreign countries, and that these losses are to be attributed in no small degree to the superior education provided in foreign countries. Prof. Comack is quoted as stating that "the prosperity of electrical engineering in America, Germany and Switzerland can be directly traced to scientifically trained leaders."—Lond. *Elec.*, July 18.

New Book.

Pocket Edition of Diagrams and Complete Information for Telegraph Engineers and Students. By Willis H. Jones. New York: *Telegraph Age.* 260 pages, 126 illustrations. Price, $1.50.

Telegraphers are severely practical men and not theorists, and Mr. Jones, a practical telegrapher himself, has, in this book, undertaken to lay before his fellow-workers all that is modern in telegraphic apparatus and practice. He, moreover, uses the simplest English in his descriptive matter, which no one can very well fail to comprehend. Theory has been studiously avoided, except to a very limited extent, where it was found necessary as an aid to a better understanding of the principles involved in the construction and operation of the apparatus described.

The 260 pages of subject-matter are well printed, and the 126 specially-drawn illustrations are very clear in treatment. The illustrations consist of diagrams showing the wire connections between the various instruments constituting a set; between apparatus and instruments, etc., and form a very important feature of the book. The work possesses an originality that cannot fail to be interesting to all telegraphers and telegraph engineers. It is divided into 41 chapters, and as these cover such a wide range of subjects their headings are given herewith: Introduction; Magnetism and Electricity; The Dynamo; Electrical Measurement—Formulas and Examples; Magnet Windings; Intermediate Station Switchboard—Methods of Testing and Patching; The Stearns Duplex; The Polar Duplex; The Quadruplex; "Bug Catchers," or Quadruplex Accessories; How to Balance the Quadruplex; The Care and Handling of Quadruplex Apparatus—Adjusting for Greatest Efficiency; Quadruplex Faults and Disturbances; Theory and Arrangement of Resistance Coils for Quadruplex Apparatus Employing Dynamo Currents; The Standard Quadruplex; The Postal Telegraph Cable Company's Quadruplex System; The Roberson Alternating-Current Quadruplex; The Morriss Duplex; Local Batteries—Dynamo Arrangement—Sounders in Multiple—Comparative Efficiencies of Chemical and Dynamo Batteries; Self-induction of Relays—Different Windings Give Different Values; The Storage Battery and its Application to Telegraphy; Polarized Relays for Single-Line Telegraph Circuits; The Equipment of a Modern Telegraph Office; Choosing a Dynamo for Local Circuit; Arrangement of House and Floor Conductors; Arrangement of Apparatus; Switchboards; The Wiring and Arrangement of Multiplex Apparatus; Repeaters; Office Loop Connections; Combination Sets for Duplex or Single-Line Circuits; Formula for Obtaining the Number of Cells of Battery Required to Maintain a Given Strength of Current Through a Given External Resistance; A Simpler Formula for Obtaining the Number of Cells Required; The Telephone; Simultaneous Telegraph and Telephony; The Phonoplex; Wireless Telegraphy; The Wheatstone Automatic Duplex; The Argus Lightning Arrester; The Postal Telegraph-Cable Company's Switchboard Arrangement, and, Practical Instruction for Line Construction.

It is evident from the above list of contents that the work is thoroughly modern, and since it bears the stamp of authority (Mr. Jones being associated with the engineering staff of his company) it will probably become one of the standard works on practical American telegraphy. It is written primarily for operators for the purpose of instructing them about the apparatus with which they have to deal, and this educational feature cannot fail to redound to the benefit of the telegraph service, if the ambitious and energetic operator will recognize in it an opportunity to better his condition. The work is "pocket size" (4½ inches wide by 7 inches high), and bound in stout flexible leather.

Directory of Electrical Societies, Etc.

American Electrochemical Society. Secretary, C. J. Reed, Philadelphia, Pa. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

The American Electro-Therapeutic Association. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa. Next meeting, Mount Washington Hotel, White Mountains, N. H., Sept. 9, 1902.

Canadian Electrical Association. Next meeting, Toronto, Ont., 1903.

Indiana Electrical Association, Secretary, Hal. C. Kimbrough, Muncie, Ind. Next meeting, Indianapolis, Sept. 17 and 18, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, Thos. R. Mercein, Milwaukee, Wis.

THE OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION, Secretary, John Brandt, 195 Broadway, New York. Next meeting, Salt Lake City, Utah, Sept. 10, 11 and 12, 1902.

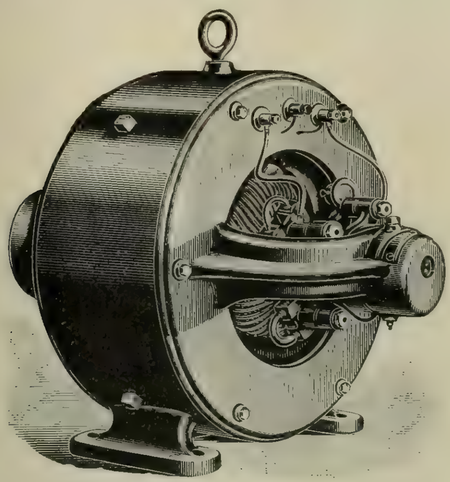
PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION, Secretary, John Ruth. Next meeting, York, Pa., Sept. 10, 1902.

U. S. MILITARY TELEGRAPH CORPS, Secretary J. E. Pettit, Postal Telegraph Company, Chicago, Ill. Next meeting, Salt Lake City, Utah, Sept., 10, 11 and 12, 1902.

VERMONT ELECTRICAL ASSOCIATION, Secretary, C. C. Wells, Middlebury, Vt.

New Towle Motor.

The accompanying illustration shows a new type of motor which has just been put on the market by the Geo. C. Towle Manufacturing Company, of Lancaster, Pa. It is made in sizes ranging from ¼ hp to 7½ hp. The larger sizes (5 and 7½) have been designed so as to make them particularly well adapted to use on electrically-driven elevators. The ring of the motor is in one piece of cast



NEW TYPE OF MOTOR.

steel of the highest permeability. The pole pieces, in one piece, are cast solid on the yoke; obviating any magnetic joint. The armature is of the drum-wound ring type, and well ventilated. The commutator is composed of drop-forged copper segments, and the brush holders are of a neat and thoroughly satisfactory form. The general features of construction can be gathered from the cut.

A De Forest Wireless Telegraph Installation.

At the De Forest wireless telegraph station in this city, on the roof of the Chesebrough Building, was installed last week one of the kerosene engine transmitter sets which has been ordered by the War Department for the coming Fall manœuvers, and which is soon to be located at Ft. Griswold, New London. The engine, which is remarkable for its close and accurate speed regulation under sudden changes from no to full load, is belted to a special 1-kw, 500-volt alternating-current generator, and to a small Crocker-Wheeler exciter.

The 500-volt circuit is broken by the special key, shown in the accompanying cut, and passes through the primary of a special transformer whose ratio of transformation is unity. The object of this transformer is to prevent any high-potential, high-frequency surgings from the condenser discharge from getting back into the generator. Before this arrangement was adopted, considerable trouble was experienced in the way of punctured collector rings and armature windings. As an additional precaution, the frame of the generator is grounded.

The secondary current from the choke transformer is led through a special transformer giving 25,000 volts on its high potential side. This high voltage current passes through a series of specially designed choking coils and is led to the terminals of the spark gap in shunt around a condenser.

To the two-spark gap and condenser terminals are also connected the antenna and ground wires. The capacity of the high potential condenser is adjusted to suit the output of the generator used; and with the 1-kw generator here described can be equal to 6 or 8 quart Leyden jars in parallel. With this capacity across the gap, a spark of surprising volume and fierceness is generated, yet without anything of a flame accompanying it. This result is partly due to the peculiar type of disk or "toadstool" spark terminals used in the De Forest transmitter, whereby the gap is divided into two sparks

FIG. 1.—EXTERIOR OF STATION.

in series, each of only moderate length, one-quarter inch. The spark-gap is always placed in a vertical position, and the tendency to flame or flare out by gusts of wind is reduced to a minimum.

The ease and rapidity with which the current of this De Forest transmitter, even up to one horse-power, can be made or broken by the special key shown is said to be remarkable. As recorded recently, the De Forest operators have attained a record speed of 52 words per minute with this key, and messages are sent regularly at the rate of 20 to 30 words per minute.

In view of the two suits which are now pending between the de Forest and Marconi wireless telegraph companies, respectively, a brief description of the working of the De Forest-Smythe receiver will be of interest. The "responder" works, it is said, on the anti-

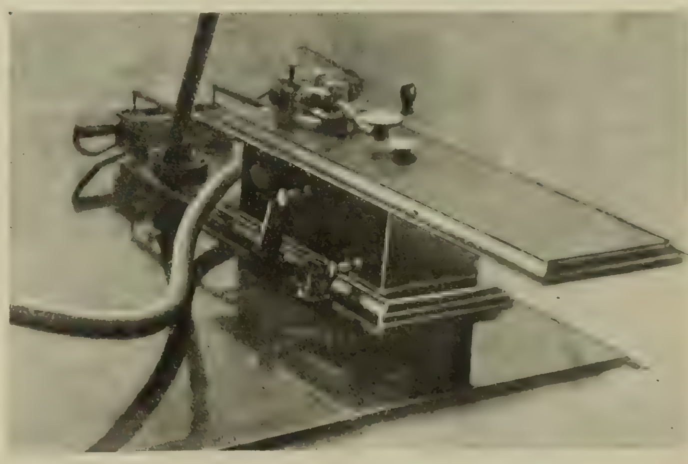


FIG. 2.—TRANSMITTING APPARATUS.

coherer principle, entirely distinct from that of the Branly tube; and in this connection it may be noted that the De Forest Company have just been allowed their main patent on the anti-coherer principle. This embraces 65 claims, all in the "anti-coherer" field. The "responder" of the De Forest Company is believed by them to be the first anti-coherer to be made an actual, practical commercial device, and while the specific claims in the above-mentioned patents refer to the electrolytic principle, these general claims cover a far broader field.

The inventors of the "responder," De Forest and Smythe, started from the bare physical phenomena discovered in 1899 by the German, Neuschwender. The device discovered by him was merely a scratch on a tinfoil mirror on which water was deposited. It was non-

sensitive and altogether unreliable, being entirely useless as a wireless telegraph receiver, even over short distances.

Dr. De Forest for two years has carried on a series of careful scientific researches on this electrolytic principle, studying the theory involved and the requisite conditions for a practical responder. The device to-day is said to differ as materially from that described by the German as does the modern steam turbine from the tea-kettle of Watts.

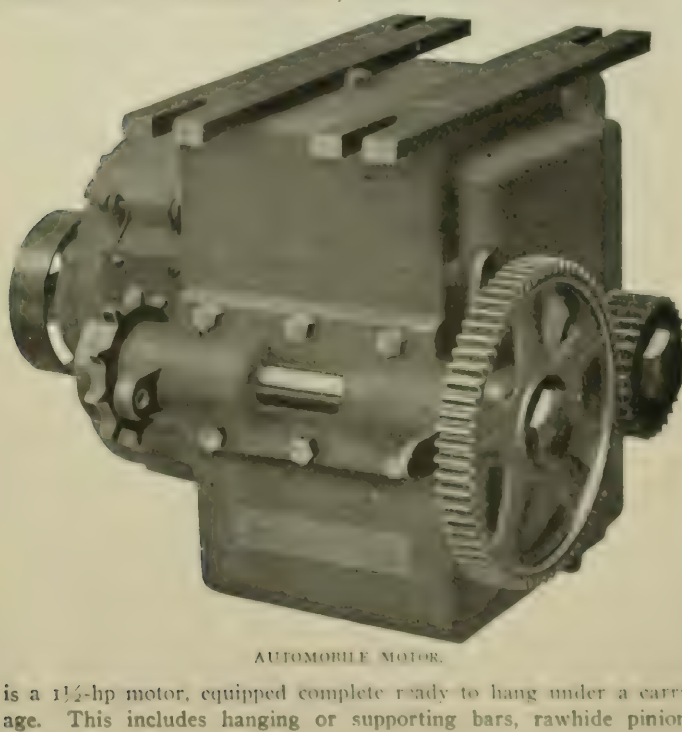
The full history of these interesting investigations would make a valuable addition to scientific literature. In the responder, under

FIG. 3.—RECEIVING APPARATUS.

the influence of the local battery, chains of conducting particles bridge and close the gap between the two electrodes. When the electric impulses traverse this gap, minute bubbles of hydrogen and oxygen are generated from the electrolyte used. This generation suddenly disrupts the conducting bridges, and the resistance is greatly increased. Instantly the wave impulse ceases, the original conductivity of the bridges is automatically resumed, and, no matter how rapidly the sparks at the sending station follow one another, the responder opens and closes in perfect unison. The simplicity of the receiver, freedom from errors in relays, etc., together with a practically unlimited speed, would seem to render it very useful for wireless telegraphy.

New Automobile Motor.

The Lincoln Electric Company, of Cleveland, has put on the market a new automobile motor, which is herewith illustrated. It



AUTOMOBILE MOTOR.

is a 1½-hp motor, equipped complete ready to hang under a carriage. This includes hanging or supporting bars, rawhide pinion, brass gear, cut-steel sprocket and countershaft mounted on ball bearing. This countershaft and motor are arranged so as to connect to a large sprocket near the center of the rear axle. With a motor equipped in this way, it is necessary only to set the motor on the carriage and connect the chain between the sprocket on the motor and the driven sprocket. No special supporting gear is required. This type of support has been used for some time, and has given satisfaction to the Lincoln Company and its clients.

The New "Dublarm" Type of Laminated Circuit Breaker.

The piece of apparatus illustrated herewith operates as a combined hand switch and circuit breaker. The general practice heretofore has been to close the circuit breaker and then the hand switch, so that in case of an overload or short-circuit the breaker will instantly open. The I-T-E "Dublarm" circuit breaker dispenses entirely with the usual hand switch. It consists of a circuit breaker and a switch so constructed that either side of the circuit breaker may be closed first; and on closing the other side, thus completing the circuit, the breaker will instantly open, if there is an overload or short-circuit on the line. Both poles being closed, an overload or short-circuit will open them simultaneously.

The device is specially serviceable for feeder protection on account of its compactness, saving in the expense and complication of switches and connections, and allowing more feeders to be placed on one panel, by using the space formerly occupied by the hand switch. Being provided with a hand trip, it can be instantly opened by hand, thus em-

LAMINATED CIRCUIT BREAKER.

bodying all the features of a hand switch together with those of a double-pole circuit breaker.

Large sizes are made triple pole for the protection of generators running in parallel, the third pole serving as the equalizer switch. The smaller sizes, on account of their compactness, are largely used for the protection of lighting circuits, where in case of a short-circuit opening them they can be instantly replaced, thereby insuring constant service. The Cutter Company, of Philadelphia, owns the patents under which this type is built.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 4½ per cent. for 60 days, and 4½ to 5 for three, four, five and six months. The bank statement was rather disappointing on the stock market, but had little effect, the volume of business being at the low ebb of quality dealings. The market throughout was irregular, with a sagging tendency toward the close of the week. Western Union developed some strength, and on moderate buying scored a fair gain; the general market closed heavy. The traction stocks shared in the general inactivity, Brooklyn Rapid Transit closing at 66⅞, being a net loss of ¼ point. Metropolitan Street Railway closed at 147⅞, and General Electric at 184½. Western Union closed at 93¼, being a net gain of ½ point. Following are the closing quotations of August 19:

NEW YORK.

	Aug. 12.	Aug. 19.		Aug. 12.	Aug. 19.
American Tel. & Cable.	87	—	Hudson River Tel.....	—	—
American Tel. & Tel..	163½	170¼	Metropolitan St. Ry...	148½	147¾
American Dist. Tel....	—	—	N. E. Elec. Veh. Trns.	—	—
Brooklyn Rapid Transit.	67⅝	67	N. Y. & N. J. Tel....	—	—
Commercial Cable	155	—	N. Y. E. V. T. Co....	11⅝	11½
Electric Boat	23	23	Tel. & Tel. Co. Am....	—	—
Electric Boat pfd......	40	30	Western Union Tel....	91¾	92⅜
Electric Lead Reduc'n..	2¼	1¾	West. E. & M. Co.....	215	—
Electric Vehicle	6½	5½	West. E. M. Co. pfd..	—	—
Electric Vehicle pfd....	14	13			
General Electric	185	185			

BOSTON.

	Aug. 12.	Aug. 19.		Aug. 12.	Aug. 19.
American Tel. & Tel..	162½	170½	Western Tel. & Tel. pfd.	—	—
Cumberland Telephone .	—	—	Mexican Telephone	2¼	2⅜
Edison Elec. Illum....	—	—	New Eng. Telephone...	142¼	141½
Erie Telephone	—	—	Westinghouse Elec.	106½	—
Western Tel. & Tel....	—	—	Westinghouse Elec. pfd.	106½	—

PHILADELPHIA.

	Aug. 12.	Aug. 19.		Aug. 12.	Aug. 19.
American Railways	50	50	Phila. Traction	99½	99¾
Elec. Storage Battery..	88½*	88	Phila. Electric	5⅝	6¼
Elec. Storage Bat'y pfd.	87	87	Pa. Elec. Vehicle......	—	—
Elec. Co. of America..	8⅝	8¾	Pa. Elec. Vehicle pfd..	—	4

CHICAGO.

	Aug. 12.	Aug. 19.		Aug. 12.	Aug. 19.
Central Union Tel.....	—	—	National Carbon pfd....	100	100
Chicago Edison	—	—	Northwest Elev. com...	36½	—
Chicago City Ry.......	220	206	Union Traction	15	16
Chicago Tel. Co........	—	—	Union Traction pfd....	—	50*
National Carbon	31	32¼*			

* Asked.

LIGHTING DEAL IN EAST ST. LOUIS.—The Citizens' Electric Light and Power Company, of East St. Louis, Ill., has been acquired by Clark Bros., of Philadelphia, who recently purchased and consolidated all of the electric roads in East St. Louis and the Eads bridge line. The price paid for the electric lighting company was $600,000. The latter company has a lighting contract with the city of East St. Louis which has eight years yet to run. It also has many private contracts, and is the only electric light and power company in East St. Louis. James Campbell, of St. Louis, who was president of the Citizens' Electric Light and Power Company, engineered the deal which resulted in the sale of the plant to the Clarks. He sold all of his holdings, and July 23 announced his retirement from the presidency. In the latter office he was succeeded by L. C. Haynes, vice-president of the East St. Louis and Surburban Electric Railway Company, and the resident representative of the Clarks in East St. Louis. C. M. Clark, of Philadelphia, was elected vice-president, and H. D. Sexton secretary and treasurer. Mr. Haynes has announced that the electric lighting company will be operated in connection with the other Clark interests, which now amount to several million dollars in East St. Louis and the neighboring towns. The new power plant at Winstanley, now nearing completion, will furnish power for both the street railways and electric lighting system. The Citizens' Electric Light and Power Company was organized 12 years ago by H. D. Sexton and others, with a capital stock of $25,000. James Campbell and a number of wealthy St. Louisans were interested in the company.

OMAHA TROLLEYS.—A syndicate of New York bankers, headed by J. & W. Seligman Company, has closed a deal whereby they purchased the Omaha Street Railway from the present owners for 92 cents on the dollar of the stock, the whole amounting to $4,000,000. The new company will get every share of the stock, a large part of which is owned by Marshall Field, of Chicago, and Senator Millard, of Nebraska. E. W. Nash and Guy C. Barton, officials of the American Smelting Company, are also heavy holders of the stock. The property consists of the Omaha Street Railway, the Council Bluffs and Suburban Company, the Omaha and Council Bluffs Bridge and Motor Company, and a bridge over the Missouri between the two cities. It constitutes a monopoly of the street car traffic of the two cities. The Omaha Street Railway Company has a capitalization of $5,000,000, and the Council Bluffs Company, a capital of $1,600,000, and it is stated that the property has paid dividends of 4 per cent. for the past four years.

AMERICAN LIGHT AND TRACTION.—Circulars have been issued by the American Light and Traction Company to the stockholders of the Consolidated Gas Company, of New Jersey, offering to purchase the stock of that company by the issue therefor of stock of the American Company, or by the payment of $17 a share in cash for the stock of the Consolidated Gas Company. The holders of Consolidated Gas Company's stock in case they accept the stock offer, have the choice of receiving for each share $18 par value of the American Light and Traction Company's preferred stock, or $40 par value of the American Company's common stock. It is stipulated that to make the offer effective it is necessary that it be accepted by at least 75 per cent. of the Consolidated stockholders, and in this connection it is announced that already a large amount of stock has been deposited under the plan of purchase. The stock is to be deposited with the Trust Company of America, and the time is limited to August 15.

GERMAN ELECTRICAL INDUSTRY.—A cable dispatch from Berlin, of August 16, says: "The crisis in the German electrical industry is occasioning much discussion. The proprietors of electrical works are bent on finding a remedy for the present ruinous competition and bringing the producing capacity of the works more in harmony with the market's demands. The Bank for Electrical Undertakings of Zurich, which is owned by the Allgemeine Elektricitäts-Gesellschaft of Berlin, discusses the situation in its yearly report, just issued, and concludes that the European electrical companies must adopt the American trust idea, getting all the works under one management and then shutting down the unprofitable ones till the situation improves."

WESTERN UNION STOCK went up gaily last week to 93, chiefly on rumors, it is said, of a Postal deal. The Postal people don't know anything about it. Another story is that there is "gunning for shorts," who sold on the strength of the difficulties with the Pennsylvania road. It is further said that Western Union negotiations to obtain control of the "Telephone Trust" are discussed in Gould circles, though "officially" it is declared that no such purpose is in view. Just what the "Telephone Trust" is does not appear.

MICHIGAN TROLLEYS.—An amalgamation of West Michigan trolley lines has been planned to include the Detroit, Ypsilanti and Ann Arbor and Jackson, Grand Rapids, Grand Haven and Muskegon railways. It is said that an offer of 70 has been made for Ypsilanti-Ann Arbor stock. The capital of the new company will be $15,000,000 to $20,000,000. A strong eastern syndicate is thought to be behind the move, which may mean ultimate consolidation of all the lines with Detroit United, making the big Michigan combine.

DIVIDEND FROM REAL ESTATE.—The Capital Traction Company, of Washington, recently sold to the Government a parcel of land for $550,000. Part of this money will be distributed among stockholders in the form of an extra dividend of 4 per cent., which will be payable August 20 to stockholders of record August 4. The remainder will be invested in the 4 per cent. bonds of the company.

EVANSVILLE BONDS.—The balance of the $950,000 issue of the Evansville Gas and Electric Company, of Evansville, Ind., amounting to $350,000 has been placed on the market. The bonds bear 5 per cent. and are offered at 101 and interest. A block of $600,000 of these bonds found a ready sale in the Chicago market earlier in the year.

CHICAGO COMMONWEALTH.—E. L. Brewster & Co. have bought the Commonwealth Electric $500,000 issue of 5 per cent. bonds. The proceeds of the sale will be used in connection with work on the $6,000,000 plant to be built by the company.

HUDSON RIVER POWER BONDS.—The Hudson River Electric Company has given a mortgage to the Morton Trust Company to secure an issue of $5,000,000 gold bonds.

DIVIDEND.—The directors of the Western Telephone and Telegraph Company have declared a semi-annual preferred stock dividend of 2 per cent., payable August 30.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade prospects, as indicated by the reports to commercial agencies, are favorable. Expansion in the Fall demand for commodities in all the leading markets is noted, and more optimistic views obtain with reference to the Southern cotton crop and its effects on future business. Pig iron production is still restricted by the scarcity of cars, affecting coke supplies, and the anthracite strike; demand is no less active, however. There is plenty of foreign steel offered, but business is not active at the prices demanded, though domestic supplies are scarce. Nothing like the present activity in hardware is recalled. Structural material is sought by car shops and bridge builders, while many office buildings and other steel structures are planned. The less favorable features noted in the general situation are the restriction of trade in summer goods, caused by the cool weather, the continuance of the deadlock at the anthracite coal mines and the unfavorable figures of the July export trade. Collections as a whole are classed as seasonable. The copper market is lower and weak. On Wednesday, 200,000 lbs. of August-September electrolytic were sold on the Metal Exchange at 11.62½, and immediately after the purchasers of this lot bid 11.60 for 800,000 lbs. more of the same grade at the same delivery and were promptly accommodated by the same sellers. The quotations are Lake, spot to September, 11.60 to 11.77½c., and casting, spot to November, 11.50 to 11.60. The July copper production of United States mines exceeded all records. The total output was 26,749 tons, compared with 21,985 tons in July last year. The number of failures, as reported by *Bradstreet's*, numbered 181, against 169 the week previous, and 186 the corresponding week last year.

HARRISBURG ENGINES FOR OFFICE BUILDINGS.—The George A. Fuller Company, of 137 Broadway, New York, has just let some interesting contracts to the Harrisburg Foundry and Machine Works, for engines to be installed for general light and power purposes in new office buildings, now under construction down town in New York. The new Battery Place Building is to be equipped with three Harrisburg engines, representing a capacity of 600 horse-power. One engine will be a 20-inch x 19-inch, to be direct connected to a 200-kw generator. A 16½-inch x 15-inch engine will be direct connected to a 125-kw generator, and a 13-inch x 13-inch one will be coupled to a 75-kw generator. The Wall Street Exchange Building is to have three 16-inch x 15-inch engines, direct connected to 100-kw generators, and a 12-inch x 12-inch engine, direct connected to a 50-kw generator. The new building now under way between 39-42 Broadway, is to be installed with two 18-inch x 18-inch engines for direct connection to 150-kw generators, and a 13½-inch x 13-inch engine, to be direct connected to a 75-kw generator. The contracts for the generators at time of writing were not awarded.

BRITISH COMMERCIAL OUTLOOK.—A cable dispatch from London, of August 6, says: The struggle for trade forms the subject of a report by the Commercial Department of the Board of Trade, issued to-day, in which exhaustive statistics are given comparing the population and commerce of Great Britain with those of her principal business competitors, the United States and Germany, and the conclusion reached is that America and Germany, owing to their greater increases in population, are traveling upward more rapidly than Great Britain. "If peace is maintained," says the official report, "both the United States and Germany are certain to increase the rate of their upward movement, and their competition with Great Britain in neutral markets, and probably even in home markets, will become increasingly serious." The report makes the deduction that in view of changed conditions Great Britain can scarcely expect to maintain her past pre-eminence, at any rate without strenuous effort and careful and energetic improvement in business methods.

SOME C. & C. ORDERS.—The C. & C. Electric Company, of Garwood, N. J., has secured a contract for two 75-kw generators and one 50-kw machine, for installation in the Hamilton Court apartment house, now being built at Philadelphia, Pa. The generators will be direct connected to 110-hp and 75-hp engines, respectively. These engines are to be built by the Watertown Engine Company, whose New York City offices are in the Taylor Building, 39-41 Cortlandt Street. The equipment is to be used for both light and power. J. B. King & Company, of New Brighton, Staten Island, have requisitioned for a 200-kw belted generator, an 85-kw direct-connected one, and a 120-hp motor, as well as a 10-hp motor, which will serve as equipment in their new plaster mills. The C. & C. people have also secured an order for six slow-speed motors, varying from 2-hp to 30-hp, for running blowers in the new Blair Building, Broad Street and Exchange Court, New York. The contract was obtained through Johnson & Morris, of 30 West Thirteenth Street, New York.

TENNESSEE WATER POWERS.—At a meeting of the directors and stockholders of the Knoxville Water Power Company, on August 11, the following New York men were elected: Charles H. Treat, president; H. O. Reed, secretary and treasurer; Henry T. Fay, general manager, and Robert Morris and F. G. Thompson, directors. Messrs. Treat, Reed and Fay were present. The other members of the company are: Vice-President, John T. Wilder; directors, R. W. Austin and Luther M. Parker. The company has been incorporated for $1,000,000, entirely composed of Eastern capital, for the purposes of damming the Little Tennessee River 30 miles above Knoxville, to generate energy for an immense electric power plant to supply lighting and motive electricity to entire East Tennessee. The project will now be pushed to completion as fast as possible, the meeting resulting in that decision after a report submitted by Mr John Bogart was read approving the scheme.

BUFFALO FOREIGN AND DOMESTIC ORDERS.—The Buffalo Forge Company, through its New York offices, in the Taylor Building, 39-41 Cortlandt Street, has obtained a contract through Sheriff, Swingley & Company, 120 Liberty Street, for an 8 x 10-inch horizontal center-crank engine, to drive a lighting dynamo in their machinery repair shops at Johannesburg, South Africa. An induced draft plant has been ordered for the New York University power station, at Morris Heights. It will consist of a 6-foot fan, direct connected to a 5-inch x 5-inch vertical engine. Another order secured by the Buffalo Company calls for four 6-foot fans, belted to 10 x 12-inch horizontal central-crank engines, for installation in the Morris Heights School, at 166th Street, New York. The United Heating Company, West Broadway and Broome Street, New York, has ordered two 12-inch x 14-inch Buffalo engines.

AMERICAN ELECTRICAL APPARATUS is making remarkable progress in European markets. The Societe Anonyme Westinghouse has found it necessary on account of the great number of orders to make extensive additions to its plant, which has been in operation for only five years. This plant is located at Havre, France, and supplies the territory included in Holland, Belgium, Italy, Switzerland, Spain, France and their colonies and protectorates. Mr. Albert Schmid, well known in electrical engineering circles in the United States, is prominent in the direction of this company, and general manager of the works.

EQUIPMENT FOR J. L. MOTT IRON WORKS.—The J. L. Mott Iron Works, at Trenton, N. J., are to be installed with three 300-kw cross-compound, non-condensing engines, to be built for general power purposes by the Buckeye Engine Company, through whose New York manager, Paul Bigelow, the contract has just been secured. These engines will be direct connected to 200-kw General Electric generators. There will also be a 75-kw Buckeye simple engine, direct connected to a 50-kw General Electric generator, for lighting. The boilers will be of Franklin type.

THE FEDERAL ELECTRIC COMPANY, Washington Life Building, Broadway and Liberty Street, has been awarded a contract for some 200 ceiling and desk electric fans, for shipment to China. The fans are being manufactured by the Colonial Electric Company, of Ravenna, Ohio. The Federal people have also recently secured some fair-sized fan contracts through British and South African sources. A 200-subscriber telephone exchange, with instruments, has been requisitioned by Chilian parties.

BALL ENGINE ORDERS.—The Saginaw Sugar Company, Saginaw, Mich. ,Alma Sugar Company, Alma, Mich., and the Lansing Sugar Company, Lansing, Mich., will have electric plants, the engines being furnished by the Ball Engine Company, Erie, Pa. The Naomi Coal Company, McKeesport, Pa., will install an electric power plant in its mines, the engine being furnished by the Ball Engine Company.

STANLEY APPARATUS FOR MEXICO.—The Stanley Electric Manufacturing Company has secured a contract through the Federal Electric Company, of 141 Broadway, calling for a 200-kw two-phase, central station outfit, complete, with switchboard, etc., which will serve as addition to a plant in Monterey, Mexico. The equipment is intended for both light and power purposes.

MESSRS. PARKE, DAVIS & CO., Detroit, Mich, the well-known manufacturers of drugs and chemicals, are making extensive improvements and additions to their electrical, steam and power plant, the work being done under the direction of George W. Scott, consulting engineer, The Rookery, Chicago.

BOOK TYPEWRITERS FOR CHINA.—The Elliott & Hatch Book Typewriter Company, 256 Broadway, New York, has been awarded a contract by T. P. Terry, of Shanghai, for several machines, which are to be used for making English records of Chinese government documents.

CHIMNEYS FOR RAPID TRANSIT.—The Alphons Custodis Chimney Construction Company has secured the contract for the construction of five 225-feet chimneys, for the central power station of the Rapid Transit Subway.

PAWLING & HARNISCHFEGER, Milwaukee, Wis., makers of electric traveling cranes and hoists, state that the booking of orders remains highly gratifying. Among recent contracts are the following: Minneapolis Steel and Machinery Company, Minneapolis, Minn., two 20-ton cranes with 5-ton auxiliary hoists, one 15-ton crane with 5-ton auxiliary hoist, one 5-ton crane; Crane Company, Chicago, one 2-ton crane; Wisconsin Bridge and Iron Company, North Milwaukee, one 10-ton crane; Baldwin Locomotive Works, Philadelphia, four 10-ton cranes; The Standard Steel Works, Burnham, Mifflin Company, Pa., two 10-ton cranes; Pennsylvania Lines West of Pittsburg, Fort Wayne, Ind., one 10-ton crane; Moran Bros. Company, Seattle, Wash., one 5-ton hoist; Columbus Iron Works Company, Columbus, Ga., one 20-ton crane; Lalance & Grosjean Mfg. Company, Harrisburg, Pa., one 15-ton crane; The Spang-Chalfant Company, Sharpsburg, Pa., two 3-ton cranes; The Ball Engine Company, Erie, Pa., three 3-ton hoist travelers; The Berlin Machine Works, Beloit, Wis., one 15-ton crane; The American Bridge Company, Economy, Pa., five 10-ton cranes, each with two 5-ton trolleys; The Ohio Farmers' Fertilizer Company, Columbus, Ohio, two 3-ton hoists; Betts Machine Company, Wilmington, Del., one 20-ton crane,

CONDENSING PLANT ORDERED.—The Commonwealth Electric Company, of Chicago, has ordered from the Alberger Condenser Company, of 95 Liberty Street, New York, a complete condensing plant, including a surface type condenser of the high vacuum system. A 28-inch vacuum will be maintained. This will be the largest surface condenser on land, having 20,000 square feet of cooling surface. The pumping plant will be a Corliss-driven outfit, consisting of circulating pump, dry vacuum pump and hot water pump. Lake water, derived from the Chicago River, will be used for cooling purposes. The condenser is to be used in connection with a large Curtis turbine generator unit, of new design, and built by the General Electric Company. As the water from the turbine will contain no oil, being really distilled water, it will be used over and over again in the boilers. The boilers are to be of the Babcock & Wilcox type, supplied with superheaters. The installation which is now being contracted for is a 7,500-hp unit, and is to serve as a trial unit, and if as successful, will be duplicated several times.

THE ELECTROLYSIS PROOF CONDUIT CO., of Chicago, have just completed their new factory. Heretofore their capacity has been sold long before the season opened, but with the additional machinery just added, their capacity is now practically unlimited. Heretofore, they have been compelled to turn away as much business as they have taken, but they are now in a position to make prompt deliveries on all contracts. They have just taken a contract for 500,000 feet for one of the new independent telephone companies with the guarantee of 30 days' delivery. The conduit is compressed paper and asphalt, and is not only a perfect insulator but it is also claimed to be one of the easiest to draw cables through. The Chicago Telephone Company report being able to draw a two and five-eighth cable in a 3-inch duct of this make, and at a longer distance than any heretofore handled. The Chicago Telephone Company has already laid over a million feet of this style of conduit this year.

FOREIGN AND DOMESTIC HEINE ORDERS.—The Heine Safety Boiler Company, Bowling Green Building, report recent receipt of a number of fair-sized contracts, for both the foreign and domestic markets. The Great Boulder Gold Mining Company, West Australia, has ordered two 200-hp boilers, for furnishing steam to operate the mines electrically. The Kyoto Traction Company, of Kyoto, Japan, has placed an order for a 250-hp outfit. Home orders include two 500-hp units for installation for light and power use in the St. Charles Hotel, New Orleans, La. The Ice, Light and Refrigerating Company, of Beaumont, Tex., has ordered a 150-hp boiler. Two 200-hp units have been requisitioned by the West Central Electric Company, of St. Louis, Mo. A 150-hp boiler is to be erected in the electric light plant at Jekyll Island, Florida. Woodward & Lothrop, of Baltimore, Md., have ordered three 400-hp boilers, for lighting and power use.

KERN RIVER PLANT.—The Kern River Company, of Los Angeles, Calif., has closed contracts for the equipment of the water-power electric station, from which current will be transmitted 110 miles to Los Angeles. The Bullock Electric Manufacturing Company secured the order for the generators through the Wagner-Bullock Electric Company, of California. The contract calls for five 2,000-kw, three-phase, water-wheel type generators. They are 50-cycle, revolving-field machines, wound for 1,100 volts at 231 r. p. m.; two 150-kw exciter sets, to be operated by independent water-wheels, will be supplied by the Westinghouse Electric and Manufacturing Company. The General Electric Company was awarded the contract for transformers of sufficient capacity for the system. It is understood that Stilwell-Bierce & Smith-Vaile water-wheels will be ordered. R. S. Masson acts as consulting engineer for the Kern River Company.

PNEUMATIC TUBE SERVICE.—At Washington, on August 15, bids were opened by the Acting Postmaster General for the rental of pneumatic tube service in New York, Brooklyn, Boston, Philadelphia, Washington, Chicago and St. Louis. The bids greatly exceed the appropriation of $500,000 granted by Congress to be used for this purpose for the fiscal year 1903. It was announced before the opening that no awards would be made at present, as it will be necessary to make some adjustment among the different cities in order to come within the appropriation. Following are the bids for New York and Brooklyn: New York—New York Mail and Newspaper Transportation Company, Route No. 7, $439,500 per annum, or $16,799 per mile; Brooklyn—New York Mail and Newspaper Transportation Company, $48,163, or $16,799 per mile.

PRINTING PLANT EQUIPMENT.—The Buffalo Forge Company, through its New York City offices, has secured a contract from the Wilhelms Realty Company, of 110 Fifth Avenue, for three engines, which are to be used for lighting and power purposes in the new printing plant of the Sackett-Wilhelms Company, at Grand Street and Morgan Avenue, Brooklyn. The plant is to be operated by electricity exclusively. Some 40 motors, varying from 5-hp to 30-hp, will be installed. The order calls for one 13 x 20 inch x 14 tandem-compound engine, for direct connection to a 100-kw General Electric generator; a 11 inch x 18 inch x 12 inch engine of same type, to be direct connected to a 75-kw General Electric generator, and an 8-inch x 10-inch center-crank engine for direct connection to a General Electric generator of 25-kw capacity.

MONTREAL POWER PLANT.—A new power station, the cost of which will run into the hundreds of thousands of dollars, is to be established at Montreal by the Lachine Rapids Hydraulic Company. Plans have been prepared, and the company is now asking for tenders for a building that will comprise a sub-station, a transformer plant, switchboard and distributing system, auxiliary steam plant and technical offices. The engine room will contain six steam turbines of the newest pattern, with a capacity of 2,000 hp each. It has been the company's intention since formation to put up an establishment of this description. Now that the machinery necessary to its equipment has become standardized, and there is no danger of its being relegated in a few years as out of date, the company has decided to proceed.

WESTINGHOUSE GAS ENGINES.—A few recent orders for Westinghouse gas engines are: Consolidated Industries Company, Batavia, N. Y.—two 250-hp horizontal, 2-cylinder, tandem, double-acting; one 85-hp vertical, 3-cylinder; one 35-hp, 2-cylinder; all direct connected to Westinghouse generators for lighting and power work. Zanesville Electric Company, Zanesville, Ohio—one 85-hp vertical, 2-cylinder. Kelly & Jones, Pittsburg, Pa.—one 125-hp vertical, 3-cylinder engine, direct connected to generator for power purposes. H. Garrison Foundry Company, Pittsburg, Pa.—one 125-hp vertical, 3-cylinder engine. Mingo Junction Water Company, Mingo Junction, Ohio—one 125-hp vertical, 3-cylinder engine.

TOLEDO, OHIO, IMPROVEMENTS.—The Toledo Railway and Light Company, through its president, A. E. Lang, has announced that about $75,000 will be spent in the near future in improving the facilities of the company in this city. The first step will be the construction of car shops and storage sheds on Central Avenue. President Lang states that the property will be sufficient to handle the growing business of the company for years to come. The building will cost from $40,000 to $50,000. Concentration of the work will assist to decrease expenses. The railway and electric lighting department will receive attention in the new plant.

RITTER ELECTRICAL COMPANY.—The Ritter Electrical Company and the Cincinnati Machine Works, Cincinnati, have consolidated as the Ritter Electrical Company, at 118-120 West Second Street, to manufacture arc lamps, dynamos, motors and do electrical and mechanical repairing and general machine work. John C. Mulvihill is president; Charles L. Stacy, vice-president and superintendent of machinery department; Charles C. I. Poland, secretary; Henry Bauman, treasurer, and Adelhart Beetz, superintendent of lamp department.

WESTINGHOUSE, CHURCH, KERR & CO. announce the removal of their New York office from the Havemeyer Building, 26 Cortlandt Street, New York City, to the Maritime Building, 8 to 10 Bridge Street, opposite the new Custom House, and near Bowling Green. The change is the result of a largely increased business. Three floors, the first, second and third, will be devoted to their uses. The new quarters will afford about double the floor space available in their present location.

LIGHTING EQUIPMENT FOR SCRANTON, PA.—The Y. M. C. A. building, at Scranton, Pa., is to be furnished with a 10-inch x 10-inch Standard engine, as well as a 9½-inch x 10-inch one, built by the Harrisburg Foundry and Machine Works, New York offices, 203 Broadway. These machines will be direct connected to generators of 40-kw and 30-kw capacity, respectively. The generators will be supplied by the General Electric Company. The outfit is to be used for lighting purposes.

General News.

THE TELEPHONE.

BIRMINGHAM, ALA.—The Peoples Home Telephone Company of this place has declared a dividend of 2 per cent. The following officers were elected at the annual meeting: H. H. Stambaugh, president; Henry B. Gray, vice-president; W. H. Hassinger, secretary, and A. F. Adams, treasurer

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company, which has met with a great deal of competition from barbed-wire fence telephone systems installed by farmers, recently issued a circular announcing that it would equip the fence wire lines with telephones charging a moderate rental. Long distance instruments will be furnished, kept in repair and renewed when necessary. The lines are to be built and repaired by the farmers as far as the boundary of the town where the exchange is located. A single line will serve ten farm houses. The company's representatives will make a thorough canvass of the districts where such a service is likely to be appreciated.

BUNKER HILL, IND.—W. H. Wiles, president of the Bunker Hill Bank, has organized a company for the purpose of establishing a telephone system.

INDIANAPOLIS, IND.—The State Tax Board has increased by $1,720,438 valuations upon which telephone companies doing business in the State must pay taxes, and decreased the valuation of telegraph companies $2,430. The Western Union obtained a decrease of $5 a mile, the valuation being made $57 a mile on 39,346 miles of wires; and the Postal Telegraph Company's valuation was increased from $20 to $25 a mile on 9,001 miles.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company will probably abandon the plan of attempting to secure permission from the present council to increase its rates. It will be impossible to pay dividends until the rates can be raised, but providing there are no serious accidents, President H. A. Everett claims it will be impossible to pay all fixed charges and maintain a considerable surplus. During the first six months of this year the company earned $35,000 in excess of all expenses and interest.

MINGO, IA.—The Mingo Farmers' Mutual Telephone Company, with a capital of $5,000, has been incorporated.

SHENANDOAH, IA.—The Independent Mutual Telephone Company of Shenandoah, capital $50,000, has been incorporated.

FULTON, KY.—The Cumberland Telephone Company has taken charge of the West Kentucky Telephone Company at this place.

HOPKINSVILLE, KY.—The city of Hopkinsville has refused to confirm the sale of a telephone franchise to an outside party for $3.00. The city holds that the Cumberland Company already has a franchise, and that two systems are not needed.

FREDERICK, MD.—Articles incorporating the Maryland Telephone and Telegraph Company of Frederick City have been filed in the clerk's office.

LANSING, MICH.—The Loche Mutual Telephone Company of Ingham County has been incorporated with $100,000 capital to build a local system.

COLUMBUS, NEB.—Messrs. Cottingham and Everett have been granted a franchise to establish a telephone system.

CHARLOTTE, N. C.—The Bell Telephone Company has asked permission to place its wires underground in this town.

MARION, OHIO.—The Marion County Telephone Company has been granted franchises in Agosta and LaRue, and will erect exchanges in both places in the near future.

NORWALK, OHIO.—The Local Telephone Company is connecting up its new instruments, the system having been entirely rebuilt. All party lines have been eliminated.

PORTSMOUTH, OHIO.—The Portsmouth Telephone Company is extending its lines to a number of towns in the county and will open several branch exchanges in the near future. The company has recently been sold by the Federal Telephone Company of Cleveland.

SANDUSKY, OHIO.—It is stated that a syndicate headed by J. F. Laning, of Norwalk, has secured the controlling interest in the Sandusky Telephone Company. It is said that $48 per share was paid for the controlling interest. Mr. Laning is at the head of the syndicate which has secured control of exchanges at Norwalk, Monroeville, and numerous other towns in this vicinity. It seems to be the aim to secure control of all the independent exchanges in Northwestern Ohio.

CLEVELAND, OHIO.—E. A. Ferrin, representing a Philadelphia syndicate, has made a proposition to the Everett-Moore syndicate to buy up the Federal interest in the exchanges at Bowling Green, Fostoria and Findlay. The Findlay exchange is held under option by Findlay people who are already interested in the company. If the Findlay people do not buy, the three plants may be disposed of to the Philadelphia syndicate which is said to be planning to buy up a number of other exchanges in Ohio with a view to consolidating them.

TOLEDO, OHIO.—Barber & Brailey, telephone promoters, have organized the Louisiana Construction Company to build telephone exchanges at Shreveport, La., and surrounding towns. The company has a capital stock of $500,000, of which $120,000 has been paid in. Officers are W. B. Ritchie, Lima, president; M. B. Shaw, Wapakoneta, vice-president; C. D. Crites, Lima, treasurer; C. D. Handy, Wauseon, secretary. The above with J. S. Brailey, C. Campbell and Frank Uffer are directors. J. S. Brailey will act as purchasing agent and F. B. Uffer as superintendent of construction. The same parties are interested in the Southern Trading & Contracting Company and the National Contracting Company. They have established plants in the following cities: San Antonio, Texas, 2000 telephones; Austin City, 1200; Taylor, 600; Temple, 600; Belton, 400; and Waxahachie, 400. They are now building toll lines connecting all these cities with Beaumont, Houston, Galveston, Ft. Worth, and Dallas, and are extending them through Indian Territory, Kansas and Missouri.

CHESTERFIELD, S. C.—The Chesterfield Telephone Company will apply for a charter to build a telephone system in this place, the initial capital being $3,000. J. A. Welsh and R. E. Rivers are interested.

ST. MATTHEWS, S. C.—The St. Matthews Telephone Company has been commissioned with a capital stock of $1,000. The incorporators are L. M. Able, J. S. Wanamaker, H. A. Raysor, M. Jaresy and S. Pearline.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company will extend its line from Beaver to Cedar, St. George, Utah, and Pioche, Nev. At Pioche connection will be made with the Sunset system from the Pacific coast.

ST. ALBANS, VT.—The Franklin County Telephone Company has just completed a toll line from St. Albans to Fairfield Center, two full metallic circuits have been run and some twenty subscribers along the road connected up with the St. Albans exchange. New lines have also been built to Georgia Center where connection is made with the Citizens' telephone line, extending to Georgia Plain, Milton Boro' and Milton. Work is now in progress on an extension to Swanton, Vt., where an exchange will be established and an improved service inaugurated. The many extensions of the company this season, and an increase of 150 subscribers in the past six months, making a total of 600 subscribers in a city of 6,000 inhabitants, is sufficient evidence to the management that the telephone industry is not the "natural monopoly" sometimes pictured and that legitimate business effort is appreciated by the public.

MT. HOREB, WIS.—Mr. Bell, president of the Mt. Horeb Telephone Company, has obtained a fifty-year franchise in Sawyer County to build lines and exchanges.

OSHKOSH, WIS.—The Winnebago Telephone Company, Oshkosh, capital stock $150,000, has been incorporated by A. B. Ferdinand, Walter L. Gold and Kate Kershaw.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The McCloud River Electrical & Power Company recently closed a contract with the San Francisco Construction Company and G. W. Elder for building a concrete and masonry dam on the McCloud River about 20 miles from Baird station, Shasta County, Calif. It is said that a hydraulic development of 27,000 horse-power can be realized in the future, though the initial installation will not exceed 2,700 horse-power. The dam will be 500 feet in length and about 100 feet high. H. C. Wybro is the engineer in charge of the construction work. It is the intention to transmit electric power to nearly all of the towns in Northern and Central California. There is, however, one company already supplying power in this region, which is not largely populated.

PUEBLO, COL.—Taison, Leach & Co., and Devitt, Tremble & Co., Chicago bankers, have closed a deal for the purchase of the Pueblo Gas & Electric Company's property, the consideration being $500,000. Lewis E. Eyman, of Chicago, will be at the head.

WEISER, IDA.—Work will start at once on the new municipal electric light and power plant for Weiser. The waters of the Snake River will be used. Bonds to the amount of $40,000 have been voted.

POCATELLO, IDA.—The American Falls Power, Light & Water Company of Pocatello has turned on power for use in this city over a line 24.8 miles long. The plant has a capacity of 4500 hp and was engineered by J. H. Brady.

EDWARDSVILLE, ILL.—From present indications the franchise recently granted to the J. R. Bennett Company by the authorities of this city to furnish electric light will never be used by the parties securing it. The backers are said to not be satisfied with the conditions of things; that efforts have been made without success to purchase the old plant, and that two plants in a city of the size of Edwardsville would not pay.

EAST ST. LOUIS, ILL.—The East St. Louis Gas Company has filed articles of incorporation at Belleville. The capital stock is $1,000,000 and the incorporators are: Thomas C. Clark, R. C. Dawes, and Henry Wood. The company proposes to erect a gas and electric light plant in East St. Louis. The Clark Brothers, of Philadelphia, recently purchased the Citizens' Electric Light plant at East St. Louis, and the new company, it is stated, intends to enter the field and compete with the Clarks. The new company was negotiating for the purpose of the East St. Louis plant when it was purchased by the Clarks. Negotiations are now pending for the purchase of the Belleville Gas Light and Coke Company's plant, which also operates an electric light plant by some, as yet unknown party.

FT. WAYNE, IND.—The newly organized Ft. Wayne Electric Light & Power Company has applied for a new 40-years' franchise for commercial lighting. The company offers the city $[illegible] for the franchise in forty annual installments, and furnish lights to the city at $15 per year for each lamp.

INDIANAPOLIS, IND.—It has transpired that the Marion County Heating & Lighting Company, which was recently granted a franchise in a certain part of the city is but another name for the Indianapolis Light & Power Company, the franchise being successfully worked through council. The franchise is as good as perpetual, because at its expiration the city has to buy the plant or grant a new franchise. The one corporation has transferred all its stock to the other.

LIVERMORE FALLS, ME.—J. A. Record is to equip a large new machine shop with electric power. He is general manager for the Record Foundry & Machine Company, just formed.

CLEVELAND, OHIO.—The tall electric light mast which for many years has illuminated the public square in Cleveland is being taken down. The lighting authorities have decided that the numerous arc lamps on the mast can be distributed to better advantage. This is the last of a number of similar masts which were erected to illuminate the business section of Cleveland over twenty years ago.

MCMINNVILLE, TENN.—It is stated that New York and Chicago capital-

ists have secured water-power rights at Horseshoe Falls, 13 miles from this place. It is reported that 20,000 horse-power will be developed and transmitted electrically to Nashville and intermediate points.

NASHVILLE, TENN.—The Southern Railway will equip all its dining cars with electric lights and fans as rapidly as it can be done. Some of the cars are already in the shops being prepared for the change. Others will be shipped in return until all are equipped.

HILLSBORO, TEX.—The Hillsboro Electric Company has been chartered with a capital stock of $50,000. Among the incorporators are O. Goodwin and W. C. Ross.

PAYSON, UTAH, will, in the near future, build a municipal electric light plant.

SALT LAKE CITY, UTAH.—The Telluride Light & Power Company has secured the contract for furnishing power and light in the construction of the Niagara Tunnel in Bingham district, Utah.

SALT LAKE CITY, UTAH.—There will be 8000 lights and about 35 miles of wire used on the decorations for the Elk's convention at Salt Lake City. The Salt Lake Electric Company has the contract.

LOGAN, UTAH.—The Hercules Power Company, of Logan, Utah, without notice has raised the rates for electric current from 35 to 75 cents per 16-cp lamp per month. A large number of the business houses have ordered their lights taken out. This move on the part of the Hercules Company will hasten the work on the new municipal plant.

STAUNTON, VA.—C. R. Caldwell and associates have agreed to take over the street railway, gas and electric light plants in this city at a figure stated to be $85,000.

NEWPORT NEWS, VA.—The property and franchises of the Norfolk Heat, Light & Power Company have passed into the hands of the Norfolk, Portsmouth & Newport News Company, in consideration of $125,000.

POMEROY, WASH.—The Washington & Oregon Electric Railway, Light & Power Company has secured a franchise from Pomeroy for lighting the city.

LARAMIE, WYO.—The Laramie Gas & Electric Company has reduced the minimum price of lights by meter from $1.50 to $1.00 per month. The company will also in the near future make extensive improvements to its plant.

CHEYENNE, WYO.—The Cheyenne Light & Power Company will install two new boilers of 60-hp each, two of 150-hp each and one of 200-hp. Two incandescent generators of 1000 lights each will be installed in place of the two generators of 450 lights each now in use. A new engine of 200-hp will also be added. A new switchboard of the latest pattern and numerous other improvements will be carried out.

THE ELECTRIC RAILWAY.

NEWCASTLE, IND.—The Newcastle, Muncie & Alexandria Traction Company has been incorporated with $10,000 capital stock. E. T. Ice heads the board of directors.

ANDERSON, IND.—The Merchants' Traction Company, of this city, has transferred all its franchises and deeds for the right of way for an interurban road to Middletown to Gus M. Hodges, of Dayton, Ohio, for a consideration of $6,000.

MUNCIE, IND.—The Muncie & Portland Traction Company has been incorporated. The capital is $100,000. T. O. Boyd heads the board of directors. The Union Traction Company is behind the scheme and will operate the road when completed.

INDIANAPOLIS, IND.—The Indianapolis Terminal and Traction Company has filed articles of incorporation. The capital stock is $500,000. The directors and incorporators are Hugh J. McGowan, W. H. Schoepf, J. D. Thomas, J. M. Jones and Clarence Winter.

FT. WAYNE, IND.—The Ohio & Indiana Construction Company has filed articles of incorporation with $600,000 capital. H. C. Paul heads the board of directors. The company will build and operate electric roads and power houses in this State and Ohio.

INDIANAPOLIS, IND.—At a meeting of the officers and representatives of the Dayton and Western Traction line and the Richmond Interurban line contracts were entered into by the two companies whereby the former will build from the east to the State line and the latter from the west to the State line, connecting and completing the chain of electric lines between Indianapolis, Dayton, Cincinnati, Piqua, Columbus and other Ohio cities.

INDIANAPOLIS, IND.—The State Tax Board has increased the valuation of interurban electric railroads upon which taxes must be paid from $7,746,452 in 1901 to $9,655,492 making an increase of $1,909,040. The assessment of the Indianapolis and Greenfield line was increased from $7,000 to $11,000 a mile, and the Union Traction Company's line from $8,000 to $13,000 a mile. The Indianapolis Street Railway Company's assessment is increased $1,500 a mile, the valuation being $32,000 a mile for 110 miles.

NEW ORLEANS, LA.—The Pearson syndicate has bought a controlling interest in the St. Charles Street Railway Company. This is the fourth road secured in Nashville by this syndicate.

BAY CITY, MICH.—The council has granted a 30-year franchise to the United Traction Company. This means virtually a nine-year extension to the consolidated company.

LANSING, MICH.—The management of the Michigan Suburban Railroad Company announces that its road which is now operated by steam will be changed to electricity between this city and St. Johns.

TOLEDO, OHIO.—The Toledo & Monroe Railway is to be extended to Detroit by way of Wyandotte and Trenton.

SPRINGFIELD, OHIO.—The Springfield & Washington Traction Company has been granted a franchise in Springfield.

ZANESVILLE, OHIO.—Zanesville parties are securing right of way for an electric railway from Zanesville to Barnesville.

WASHINGTON C. H., OHIO.—The council has granted a 25-year franchise to the Springfield & Washington Traction Company enabling it to enter the town.

NEWARK, OHIO.—Newark people are promoting an electric railway to extend from Newark to Mt. Vernon, by way of Gambier and Martinsburg. John McCrory is making surveys.

CLEVELAND, OHIO.—The Cleveland & Sharon Traction Company has been incorporated with $10,000 capital stock by T. C. Willard, C. W. Dillie, C. G. Mullen, C. W. Wohle and J. C. Young. Frances B. Morgan and Willis B. Hale, promoters of the company, are at the Holland House, New York, arranging for the construction of the road.

SUNBURY, OHIO.—The Delaware, Berkshire & Sunbury Railway Company has secured a franchise through town. It is the intention of the promoters to extend the road to Johnstown eventually.

DAYTON, OHIO.—G. M. Hodges, of Dayton, has an option on the franchises and rights of way secured by the Merchants' Traction Company for an electric railway from Anderson to New Castle, Ind.

SPRINGFIELD, OHIO.—R. C. Gotwald has completed plans for the car barn, machine shop and substation to be erected at Springfield for the Dayton, Springfield & Urbana Railway. The car barn will be 100x300.

CLEVELAND, OHIO.—Cleveland parties are securing right of way for an electric railway from Cleveland to New Baltimore, where it would connect with the Akron-Alliance road, giving connections for both places.

PORTSMOUTH, OHIO.—The county commissioners have agreed to grant a franchise to the Ohio Valley Traction Company. Henry W. Miller, Judge Dever and J. I. Hudson are among the promoters of the company.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Railway has completed a trestle at Slate Hill, 1000 feet long and 65 feet high. The road will be placed in operation from Columbus to Delaware in the near future.

CINCINNATI, OHIO.—Dr. Samuel F. George, president of the Ft. Wayne, Dayton & Cincinnati Traction Company, now states his road will be extended from Ft. Wayne to Chicago, thus making a through line from Cincinnati to Chicago.

STEUBENVILLE, OHIO.—General Manager Flynn, of the Wheeling Traction Company, announces that a new power house, to cost $175,000, will be located at Brilliant. It will take care of the company's interurban lines on the Ohio side.

CINCINNATI, OHIO.—Directors of the Cincinnati, Georgetown & Portsmouth Railway will issue $1,000,000 of 35-year 5 per cent. gold bonds. The road will be extended to Portsmouth with part of the money derived from the sale of the bonds.

CINCINNATI, OHIO.—The tax valuation of the Cincinnati Traction Company has been increased to $179,600. The company originally returned its property at $3,000 per mile, but the Board of Supervisors has increased this figure to $4,000 per mile.

NAVARRE, OHIO.—The council at Navarre has granted a franchise to the Canton-Akron Railway to extend its line through town. This is for the extension of the road to New Philadelphia, now under construction. Practically all the right of way has been secured.

STEUBENVILLE, OHIO.—It is stated that the Steubenville, Mingoe & Ohio Valley Traction Company will build a line into the coal fields of Jefferson County. W. J. McCann, of New Alexandria, has been securing right of way. It is the intention to haul coal as well as passengers.

COLUMBUS, OHIO.—The Columbus Railway Company has obtained another injunction restraining the county recorder from collecting the taxes as levied by the last board of equalization. The company reported its property as valued at $871,429, but the board of equalization increased this to $2,333,000.

COLUMBUS, OHIO.—Superintendent J. R. Harrigan, of the Columbus, Buckeye Lake & Newark Traction Company, has moved his headquarters from Columbus to Newark, although he will spend considerable time in Columbus. He is also superintendent of the Newark & Granville Railway and the Newark city lines.

CINCINNATI, OHIO.—Work has been started on the line of the Midland Traction Company which is to extend from Cincinnati to Milford and Loveland. Contracts are being placed for material, among them an order for 2600 tons of rails to the Carnegie Company. Eventually the road is to be extended to Columbus.

CLEVELAND, OHIO.—The Toledo, Fayette & Western Railway Company has been incorporated with $10,000 capital by F. C. McMillen, C. M. Stone and Luther Allen, of Cleveland; C. F. Franklin, J. R. Seagrave and F. E. Seagrave, of Toledo. The company will build an extension of the Toledo & Western Railway, now operating almost to Fayette.

STEUBENVILLE, OHIO.—The Steubenville, Mingoe & Ohio Valley Traction Company has been granted a 50-year franchise to build a new line to Mingoe. It is probable that when this line is built, the line by way of Altamont will be abandoned. The new line will be an expensive one to construct because of the necessity of immense retaining walls.

CLEVELAND, OHIO.—The Everett-Moore syndicate will shortly formulate a plan for refinancing the Northern Ohio Traction Company. Three plans are under consideration; two of them provide for the retirement of the preferred stock without the issuing of any new preferred stock. It is probable that the capital stock will be increased to $4,000,000 or $5,000,000.

CLEVELAND, OHIO.—H. A. Everett and J. C. Hutchins held a conference last week with Messrs. Black & Mulkey who own the Toledo & Monroe Railway. The Cleveland syndicate has now practically decided to retain the Detroit & Toledo Shore Line, and is again planning to buy back the Toledo & Monroe with a view of operating it in connection with the Shore Line. The plan is to consolidate both roads with the Detroit United Railway, of which Mr. Hutchins is president. The matter will be decided within a few days.

LIMA, OHIO.—The Ohio & Indiana Construction Company of Ft. Wayne has been incorporated with $600,000 capital stock by H. C. Paul and S. B. Fleming, of Ft. Wayne, L. G. Neely, of St. Marys, O.; S. T. Murdock, Lafayette, and J. W. VanDyke, of Lima. The company is chartered to build electric railways and it will take up the immediate construction of the Lima-Delphos-Van Wert & Ft. Wayne Traction Company's line. The parties mentioned are the chief promoters of the road. Practically all right of way has been secured and construction work is to start in the near future.

CLEVELAND, OHIO.—The Everett-Moore syndicate has completed a general plan for financing the Lake Shore Electric Railway. The plan has been accepted by the Cleveland banks which are to purchase a large block of bonds. As soon as it becomes operative, the road will be taken out of the hands of the receiver. The plan contemplates a general consolidated mortgage of $6,000,000. The company is now operating through service from Cleveland to Toledo and the property will be improved as rapidly as possible.

CLEVELAND, OHIO.—The Cleveland, Painesville & Ashtabula Railway Company has been fully financed and work of grading has been started between Painesville and Ashtabula. It is expected that one half of the road will be in operation before snow flies. The people who are building the road are the same as those who built the Toledo & Western Railway, one of the finest electric roads in the country. Officers are Luther Allen, president; W. J. Hayes, vice-president; E. B. Allen, secretary; Joseph Kraus, treasurer. Other directors are C. M. Stone and J. W. Holcomb.

CLEVELAND, OHIO.—The Northern Ohio Traction Company is planning to make extensive improvements in addition to those which have recently been mentioned in these columns. It is stated that fifty new cars will be ordered in the near future; some of them for the Akron city lines and others for the interurban lines. New ties are to be laid over the entire A. B. & C. line and the Barberton line is to be extended to Wadsworth. Work will start in the near future on the large steel bridge to be erected at the Gorge. The improvemnts planned for will cost in the neighborhood of a million dollars.

HARRISBURG, PA.—The Sharon & West Middlesex Electric Railway Company has been incorporated to build a line from Sharon to West Middlesex.

WINNSBORO, S. C.—A commission has been issued by the Secretary of State to the Winnsboro and Rock City Electric Railway Company, with headquarters at Winnsboro. The corporators named are: Thos. H. Ketchin, W. R. Rabb, T. K. Elliott, J. D. McCarley, J. O. Boag, J. E. McDonald and L. E. Owens. The capital stock of the street railway company is to be $50,000. The company proposes building a line of electric road from Winnsboro to certain granite quarries in Fairfield County.

NASHVILLE, TENN.—Nearly one year ago the employees of the Nashville Traction Company went on strike. The strike was finally settled a few days ago by the company agreeing to take the strikers back into its employ as fast as vacancies occur, and the labor union has in consequence removed the boycott on the road.

MEMPHIS, TENN.—The sale of 55 per cent. of the stock of the Union Railway Company of this city to George Gould, president of the Missouri Pacific, is announced. The amount of money involved in the transaction was $148,000. By this purchase of stock the Union Railway Company will be controlled by Mr. Gould, and the policy of the proposed belt line of the Union Railway Company will be shaped under his direction.

MORGANTOWN, W. VA.—Work has been started on the line of the Morgantown Street Railway. Work is under the direction of Walter L. Webb, of Chicago, as chief engineer.

New Industrial Companies.

THE NATIONAL ELECTRIC CLOCK COMPANY, of New York, has been incorporated; capital, $250,000. Directors: R. J. Stuart, New Hamburg; Joseph Butcher and W. L. Rose, New York.

THE DIELECTRIC MFG. CO. has recently been incorporated with a capital stock of $3,000. It is the intention to manufacture and test insulating materials. The office and factory will be in St. Louis. The present address is 3820 Manchester Square, that city. J. J. Kessler, Jr., is general manager.

THE NATIONAL LIGHT, HEAT AND POWER COMPANY has been incorporated at St. Louis, Mo. The capital stock is $1,500,000, and the incorporators are: Frank N. Gordon, Franklin C. Burdette, Jr., Fred L. McGahan, L. C. Spooner, George S. Robertson. The company proposes to develop oil fuel burners for all purposes.

Obituary.

MR. G. M. HOPKINS, one of the foremost technical journalists in the country, died in his summer home, The Cedars, in Cheshire, Mass., on August 17. He was taken ill while on a street car on Friday, and death resulted from uraemic poisoning. The body is to be tāken to Albion, N. Y., for burial. Mr. Hopkins was prominent as a patent attorney and conspicuous in scientific work. He was the author of "Experimental Science," a handbook used in schools, and was at work on a revision this summer. As one of the editors of "The Scientific American," he had charge of the electrical department. He conducted also the department of questions and answers. His work and personality were highly appreciated by a wide circle of friends and admirers. He left a widow and son. The latter was connected formerly with "The Scientific American," but is now president of the Cosmos Company.

Legal.

CLEVELAND THREE-CENT FARES.—Mayor Johnson's three-cent fare plans for Cleveland street railways have been effectually blocked. On Aug. 15 the Supreme Court tied up the City Council by granting an injunction asked for by the attorneys of the two street railway systems of Cleveland. The Council was some time ago about to pass a three-cent fare franchise ordinance when an injunction stopped it. The Circuit Court dissolved the injunction, but the opposition carried it to the Supreme Court and that body has continued the injunction until a full hearing can be given the matter. If the Supreme Court sees fit it can hold the case until next spring. This means that three-cent fare in Cleveland is blocked, perhaps for a long time, as the legislature in special session may remove franchise-granting powers from the present Council.

Personal.

MR. GEORGE WESTINGHOUSE, JR., returned from England this week on the "Kronprinz Wilhelm."

DR. FREDERICK BEDELL, of Cornell University, will reach New York the first week in September, after a year's travel in Europe.

MR. D. MAZENET, of the City of Mexico, managing director of the Mexican General Electric Company, which looks after the interests of the General Electric Company in the republic, has left New York for Mexico after a few weeks' visit to the United States.

MR. HENRY SCHROEDER, E. E., graduate of Columbia University, class of 1899, formerly with the Edison Electric Illuminating Company of New York, has recently been elected treasurer of Thompson, Son & Co., New York. He represents the new interests lately taken in by J. H. Thompson, Jr.

MR. THOMAS ROCHE.—After more than a score of years' service as superintendent of the Western Union Telegraph Company in Boston, Mr. Thomas Roche has resigned, September 1 being the date named for the change to take effect. It is expected that C. E. Page, of Cincinnati, will be appointed superintendent in his place.

MR. H. H. VREELAND, president of the Metropolitan and Interurban Street Railway Companies of New York, gave a large garden party and Rhode Island clambake at his beautiful country residence at Brewsters, N. Y., on August 16, to the numerous heads of departments and members of his staff, as well as the local authorities and friends. It was a most enjoyable affair.

MR. M. H. BENTLEY, chief engineer of the International Telephone Manufacturing Company, Chicago, has just returned from an extended tour through England and the principal countries of Europe, where he has been making a careful study and investigation of the telephone field, and the possibilities of equipment from this country. Mr. Bentley is well known in the electrical and telephone field, as one of the foremost experts in his line, and well fitted for a trip of this kind.

PROF. R. S. HUTTON, of Owens College, Manchester, Eng., has arrived in the United States, and during his stay here will inspect the principal electrochemical college laboratories and manufacturing works of the country. Owens College, the director of which is Prof. Arthur Schuster, Ph. D., F. R. S., has given electrochemistry and electrometallurgy a prominent position in its curriculum. In addition to the regular course in these branches, there is a Saturday afternoon course for the benefit particularly of metallurgists engaged in steel works, and an evening course intended generally for those engaged in electrochemical pursuits.

Trade Notes.

SLATE LININGS.—Messrs. Zimdars & Hunt, New York, have issued a catalogue (No. 3) giving prices of slate linings for panel board cabinets.

THE ANDERSON ELECTRIC COMPANY has leased the Southeast corner of 21st Street and Washington Ave., St. Louis, Mo.; and is having plans made for the erection of a six-story factory building which will be completed by the first of next January at a cost of about $125,000.

SWITCHES.—The W. S. Hill Electric Company, New Bedford, Mass., has just issued Bulletins Nos. 115, 117 and 118 devoted, respectively, to voltmeter and ammeter switches, railway feeder cut-out boxes and "Pioneer" switches. These various devices are illustrated.

SUNBEAM LAMPS.— There is every indication that all records will be broken in the sale of the well-known Sunbeam lamp during the next few months. The factory product shows a steady improvement in quality each month, and those who are not familiar with the Sunbeam lamp will do well to give it a trial.

THOMPSON, SON & CO.—The business of this firm has grown to such an extent that increased facilities are needed all round. The factory and storerooms at 90 Verona Street, Brooklyn, are filled and running to full capacity. The company reports closing lately some of the largest deals in the second-hand machinery business.

NEW FIRM.—The firm of Dittrick & Jordan, of Cleveland, Ohio, has been formed for the purpose of handling electric railway supplies and general repairs. Mr. Dittrick was formerly superintendent of the armature winding department of the Cleveland City Railway Company's shops. Mr. Jordan is superintendent of the Cleveland, Painesville & Eastern. The firm will extend the business which Mr. Dittrick started some time ago and the facilities of their shop will be enlarged for repair work of all kinds.

ELECTRIC APPLIANCE COMPANY'S CATALOGUES.—A new general supply catalogue (No. 16); a new telephone and telephone supply catalogue (No.

17); a new catalogue of Gutmann alternating current wattmeters and a new catalogue showing full line of rubber covered wires and cables, have just been issued by the Electric Appliance Company, Chicago.

RUBBER COVERED WIRES.—The Indiana Rubber & Insulated Wire Company, Jonesboro, Ind., has just issued a catalogue of its "Paranite" and "Peerless" rubber covered wires and cables. The catalogue has 48 pages, is illustrated and is 4¾x7¼ in dimensions. The cover is very artistically executed, the design and lettering representing relief work.

THE W. C. YOUNG MFG. CO., 17 Hermon Street, Worcester, Mass., has recently added several new machines to its line of lathes, viz.: 13 in. engine lathes; 14 in. hand lathe and double-geared shear, and will shortly add a new 12 in. lathe. Its line of iron working machinery, lathes, punches and shears is briefly described and illustrated in a catalogue of recent issue. The catalogue contains tables of dimensions and price-lists of the various machines.

MINIATURE LAMPS.—The miniature catalogue on miniature lamps put out by the American Miniature & Decorative Lamp Co., 436 and 438 Broome Street, New York, is a handsome publication. It is made in vest pocket size and is a splendid illustration of the fact that an immense amount of useful and interesting matter can, when desired, be placed in a small space. An electrical worker handling small lamps would find it profitable to have one of these little catalogues for ready reference.

ELECTRICAL AND STEAM MACHINERY.—Rossiter, MacGovern & Co. (Inc.), 141 Broadway, New York, have just issued a 36-page booklet containing a list of electrical and steam machinery they now have on hand. A complete steam and electrical equipment can be obtained from this stock, which is such a varied one that it would be difficult to not find what is wanted. The firm has recently largely increased its business facilities, and has opened branch offices in Boston and St. Louis. These offices are in charge of Robert J. Randolph, Jr., and J. A. Pierce, respectively.

THE STANDARD POLE & TIE COMPANY, No. 44 Broad Street, New York City, has recently opened another cross-arm mill in the South. It has a large stock of standard arms already milled and its facilities for turning out arms according to special specifications is excellent. All arms are carefully inspected before shipment. Among its regular customers for cross-arms are the General Electric Company, the Central New York Telephone & Telegraph Company, the Empire State Telephone & Telegraph Company, the Hudson River Telephone Company, and the Diamond Electric Company, of Philadelphia.

THE CLONBROCK STEAM BOILER COMPANY, of Brooklyn, N. Y., has issued a new edition of its catalogue devoted to the Morrin "Climax" vertical water-tube safety boiler. It is a handsome pamphlet of 170 pages and contains a large number of illustrations of plants in which this interesting type of boiler has been installed. A great many of these plants are for electric light and power and electric railway purposes, and a large number of testimonials are adduced as to the excellent results obtained in the performance of these boilers. The pamphlet includes reports of several tests and quotes also from the testimony under oath of Mr. Edison as to his high opinion of this type of boiler. The back part of the pamphlet embodies much useful data and information as to the steam, fuel, piping, grate service, etc.

THE BAY COUNTIES POWER COMPANY, of San Francisco, has just issued in a very handsome *edition de luxe* form a collection of several articles by Mr. George P. Low, devoted to its electrical power transmission system. It is a superb quarto bound in stout board covers and using highly glazed coated paper which brings out the values of the halftones most artistically. As will be remembered, the Bay Counties plant, operated by the Standard Electric Company of California, involves the longest power transmission in the world, namely, 220 miles from the Sierras to San Francisco, and Mr. Low has treated every phase of the subject in a most interesting and graphic manner. The pamphlet is indeed a valuable addition to the literature of the power transmission subject, and loses nothing from being written in a style which is more or less popular in its method of treatment. There is a great variety of data embodied, however, in the book.

COLLEGE DEGREES FOR CORRESPONDENCE SCHOOL STUDENTS.—The American School of Correspondence has recently made an arrangement whereby the students are admitted to the classes of one of the great resident technical schools without further examination, and their work counts towards a degree of B.S. This shows in a striking manner the wonderful advance in the standard of correspondence work in the past few years, and marks a new era in the educational possibilities of the common people. Ambitious young men who are too poor to give up four years to obtain a college degree can now do part of their work at home, and, in this way, finish with a few years at a resident technical school. In this connection the free scholarship withdrawal announcement of the American School in last week's issue is of great interest, for it ends one of the greatest educational opportunities of the year. The trustees of the American School of Correspondence, Boston, Mass., have been offering a limited number of free scholarships to deserving young men for the purpose of securing a few representative students in the large shops. The school now announces that after September 30th no more free scholarships will be awarded. This is a good opportunity for a bright young man to get a course in mechanical, steam, textile and sanitary engineering (including heating, ventilation and plumbing) and mechanical drawing. Tuition to successful applicants is entirely free, the only expense being (as in all schools) for postage and instruction papers. A postal card addressed to the school will bring any information that may be desired.

WESTERN ELECTRIC PICNIC.—A most successful picnic was enjoyed on Saturday, August 9, 1902, by the drafting department of the Western Electric Company. A special car having been engaged, a party of 80 went by train to Cedar Lake, Ind. The ride was enlivened by music and singing furnished by an orchestra, ably supplemented by members of the party; Mr. Peloubet being chief performer of the home team. A steamer conveyed the party across the lake to Cedar Point Hotel, where arrangements had been prepared beforehand for having a good time. The party then proceeded to take possession of the hotel and grounds, and sports were soon in full swing. The ball game was won, after an exciting contest, by the team captained by Mr. Krivanek. The 100 yards dash brought about 30 entries, the winner being Mr. T. Nelson. The swimming race was captured by Mr. R. S. Hawkins. The event of the day was the tug of war between four departments; this was won by the telephone switchboard department, their opponents in the final round being the dynamo department, the latter having to give way to the superior avoirdupois of the victors. The running long jump produced great excitement and was captured by Mr. A. Olsen, after a hard struggle. The dinner bell was then heard and the party adjourned to the large dining hall of the hotel, where full justice was done to a good dinner, Messrs. Harper and Tapley occupying the places of honor at the table. The dinner was enlivened by music from the orchestra and a cake walk executed by a member of the staff. While coffee and cigars were being discussed, some speech making was indulged in, followed by presentation of prizes to the successful competitors of the various contests. Some photographs having been taken, the party proceeded to cross the lake and returned to Chicago by their special car.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 12, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

706,508. ARMATURE WINDING FOR INDUCTION MOTORS; A. H. Armstrong, Schenectady, N. Y. App. filed Nov. 3, 1897. The conductors are made of drawn metal and have end connections cast integrally therewith in closed circuit relation.

706,527. ELECTRIC SWITCH; E. R. Carihoff, East Orange, N. J. App. filed Feb. 8, 1901. A "face contact" switch in which the contacts have a sliding motion with relation to each other after the initial contact is made and before the final contact is broken.

706,529. ELECTROCHEMICAL APPARATUS; C. C. Clark, Philadelphia, Pa. App. filed Sept. 20, 1901. (See Current News and Notes.)

706,540. ELECTRICALLY CONTROLLED SWITCH; W. L. R. Emmet, Schenectady, N. Y. App. filed Nov. 3, 1899. Comprises fixed contact terminals adapted to be bridged by contacts in a pivoted arm controlled by a magnet. Also has auxiliary shunting contacts to absorb spark of rupture.

706,544. SYSTEM OF ELECTRICAL DISTRIBUTION; R. Fleming, Lynn, Mass. App. filed Jan. 26, 1900. Provides for an increase in the number of translating devices which may be fed from a given series circuit by inserting a plurality of step-up transforming devices in the circuit and feeding a translating device from each of the transforming devices.

706,545. ELECTRIC ARC LAMP; R. Fleming, Swampscott, Mass. App. filed Nov. 23, 1901. Provides a combined spring and insulating support whereby vibrations will be absorbed and danger from short circuit prevented.

706,547. ELECTRIC ARC LAMP; F. A. Gilbert, Brookline, and E. O. Lundin, Beachmont, Mass. App. filed March 24, 1898. Details relating to means for preserving electrical contact at all times between the movable carbon and the actuating means for the same.

706,553.—PROCESS OF MANUFACTURING ALUMINA; C. M. Hall, Niagara Falls, N. Y. App. filed Aug. 10, 1901. (See Current News and Notes.)

706,555. ELECTRIC METER; C. D. Haskins, Schenectady, N. Y. App. filed Feb. 13, 1901. Improvements on U. S. Patent No. 653,806, July 17, 1900.

706,559. ELECTRIC TRANSMISSION OF POWER; E. M. Hewlett, Schenectady, N. Y. App. filed Nov. 23, 1901. Aims to avoid suspension of service during repairs to the system, by providing duplicate transmitting mains connected in parallel at a local distributing point and differential means responsive to both mains for automatically opening the damaged main in case the two sides become unbalanced.

706,567. TELEPHONE CABLE CONNECTION; T. P. Jones, Olyphant, Pa. App. filed June 27, 1901. (See page 293.)

706,568. ELECTRODE FOR STORAGE BATTERIES; C. W. Kennedy, Rutledge, Pa. App. filed July 30, 1901. A grid for storage battery electrodes comprising a frame provided with recesses to receive the material to become active, and having series of horizontal and vertical members forming said recesses, each of said vertical members being disposed opposite one or more of said recesses and serving to resist the pressure caused by the expansion of the active material during the "forming" period.

706,575. MULTIRATE METERING SYSTEM; A. D. Lunt, Schenectady, N. Y. App. filed Jan. 31, 1901. (See Current News and Notes.)

706,577. ELECTRIC SWITCH FOR FLASHING LIGHTHOUSE LANTERNS; F. Mackintosh, Schenectady, N. Y. App. filed Jan. 9, 1899. A rotating switch is provided to switch the current from the lantern to an artificial load alternately.

706,578. MARINE LIGHT FIXTURE; G. L. Martin, New York, N. Y. App. filed Dec. 10, 1900. Details.

706,581. ELECTRIC SWITCH; F. A. Merrick, Johnstown, Pa. App. filed June 26, 1901. Details.

706,586. AUTOMATIC ELECTROMECHANICAL SEMAPHORE SIGNAL; J. J. McGill, Chicago, Ill. App. filed Aug. 19, 1901. Details of a system in which a signal is set to "danger" mechanically by the moving train, and to "safety" by electrical devices also controlled by train on leaving the block.

706,591. SYSTEM OF ELECTRIC DISTRIBUTION; H. F. Parshall, London, [illegible]

706,598. ROTARY TRANSFORMING APPARATUS; E. W. Rice, Schenectady, N. Y. App. filed Dec. 30, 1899. The armature core is provided with two sets of slots, one set consisting of numerous small slots and the other set of a fewer number of large slots. A winding located in the set of small slots is connected with a commutator and a winding of finer wire, the coils of which are separately formed and insulated, is located in the larger slots and connected to the alternating current terminals.

706,599. ELECTRIC CABLE; T. Rosati, Florence, Italy. App. filed Jan. 30, 1901. Details of a coupling for a cable.

706,602. THERAPEUTIC ELECTRICAL APPARATUS; I. E. Shaffer, Mount Vernon, N. Y. App. filed Nov. 27, 1901. Comprises an instrument adapted to convey a liquid to the part of the body to be treated, means to electrically charge the flowing liquid and a spherical terminal provided with perforations so disposed as to disperse the liquid over a large area.

706,607. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Jan. 2, 1901. Relates to certain improvements in constant-potential constant-current transforming devices in which the desired transformation is effected by the employment of suitable combinations of inductances and condensers. Instead of connecting the constant-current circuit directly to terminals of the condensers and inductances, the connection is made inductively through the agency of suitable transforming devices.

706,608. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Jan. 2, 1901. Relates to transforming devices of the class in which combinations of reactance devices of opposite signs are used for changing alternating-current at constant potential into alternating current of constant volume, or the reverse. It comprises constant potential mains, reactances of opposite sign connected in series across the mains, a consumption circuit operatively connected across the reactances, and an additional reactance operatively connected in shunt to said mains.

706,609. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Jan. 2, 1901. Provides for automatic means for maintaining a practically constant consumption of power in consumption circuits, the aggregate resistance of which is variable. It comprises constant potential mains, reactances of opposite sign in series across the mains, a non-inductive energy consuming device operatively connected across one of the reactances, and another energy consuming device across another of the reactances.

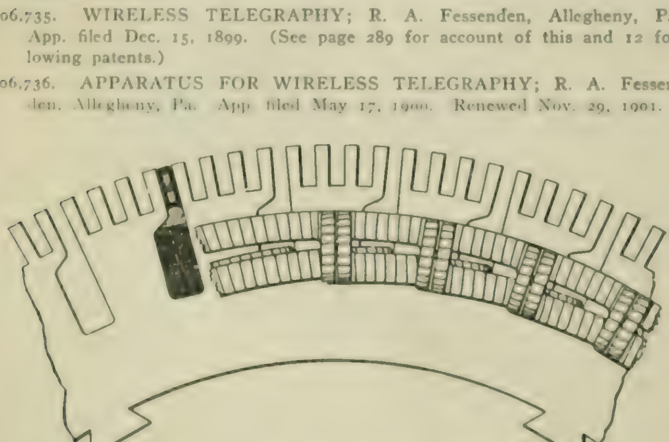
706,612. ELECTRIC METER; E. Thomson, Swampscott, Mass. App. filed Jan. 18, 1900. (See page 293.)

706,631. CHEMICAL GENERATOR OF ELECTRICITY; E. L. Anderson, St. Louis, Mo. App. filed Sept. 30, 1901. Consists of a cell in which there are an aluminum electrode, a negative electrode, and an electrolyte in contact with both of said electrodes containing a suitable halogen salt and nitric acid.

706,632. ARMATURE WINDING FOR INDUCTION MOTORS; A. H. Armstrong, Schenectady, N. Y. App. filed Nov. 3, 1897. A cast-metal grid comprising a plurality of conductors united by web connections at their ends, the grid being adapted to be wrapped around an armature core and secured thereon.

706,735. WIRELESS TELEGRAPHY; R. A. Fessenden, Allegheny, Pa. App. filed Dec. 15, 1899. (See page 289 for account of this and 12 following patents.)

706,736. APPARATUS FOR WIRELESS TELEGRAPHY; R. A. Fessenden, Allegheny, Pa. App. filed May 17, 1900. Renewed Nov. 29, 1901.



706,598.- Rotary Transforming Apparatus.

706,737. WIRELESS TELEGRAPHY; R. A. Fessenden, Allegheny, Pa. App. filed May [illegible]9, 1901.

706,738. WIRELESS TELEGRAPHY; R. A. Fessenden, Allegheny, Pa. App. filed May 29, 1901.

706,739. CONDUCTOR FOR WIRELESS TELEGRAPHY; R. A. Fessenden, Allegheny, Pa. App. filed May 29, 1901.

706,740. WIRELESS SIGNALING; R. A. Fessenden, Manteo, N. C. App. filed Sept. [illegible]8, 1901.

706,741. APPARATUS FOR WIRELESS TELEGRAPHY; R. A. Fessenden, Manteo, N. C. App. filed Nov. 5, 1901.

706,742. WIRELESS SIGNALING; R. A. Fessenden, Manteo, N. C. App. filed June 6, 1902.

706,743. WIRELESS SIGNALING; R. A. Fessenden, Manteo, N. C. App. filed June 26, 1902.

706,744. CURRENT ACTUATED WAVE RESPONSIVE DEVICE; R. A. Fessenden, Manteo, N. C. App. filed July 1, 1902.

706,745. SIGNALING BY ELECTROMAGNETIC WAVES; R. A. Fessenden, Manteo, N. C. App. filed July 1, 1902.

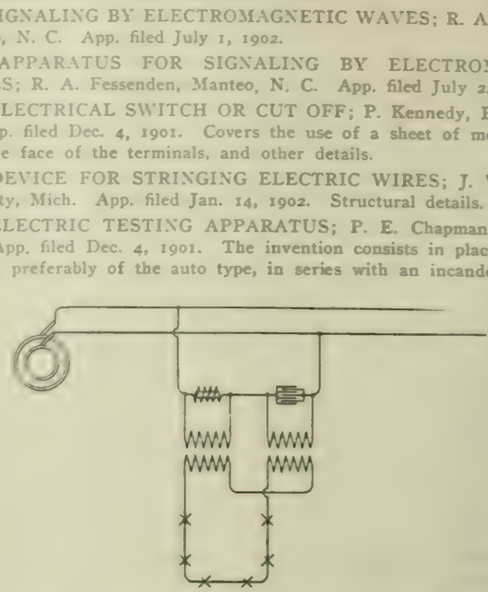
706,746. SIGNALING BY ELECTROMAGNETIC WAVES; R. A. Fessenden, Manteo, N. C. App. filed July 1, 1902.

706,747. APPARATUS FOR SIGNALING BY ELECTROMAGNETIC WAVES; R. A. Fessenden, Manteo, N. C. App. filed July 22, 1902.

706,759. ELECTRICAL SWITCH OR CUT OFF; P. Kennedy, Brooklyn, N. Y. App. filed Dec. 4, 1901. Covers the use of a sheet of metallic gauze over the face of the terminals, and other details.

706,786. DEVICE FOR STRINGING ELECTRIC WIRES; J. W. Seaman, Bay City, Mich. App. filed Jan. 14, 1902. Structural details.

706,798. ELECTRIC TESTING APPARATUS; P. E. Chapman, St. Louis, Mo. App. filed Dec. 4, 1901. The invention consists in placing a transformer, preferably of the auto type, in series with an incandescent lamp,



706,607.—System of Electrical Distribution.

and by means of an adjustable ratio of transformation transform the lamp current to a value that will be greatly affected by the impedance of the work and react on the lamp.

706,817. ELECTRIC CLOCK; H. Gillette, Highland Park, Ill. App. filed June 24, 1899. Relates to improvements in clocks employing a gravitating impelling device which acts against the pendulum or equivalent time measuring vibrator during a portion of the vibratory movement thereof in one direction and is raised to its normal position after such action by an electromagnet, the circuit of the electromagnet being made and broken under the movement of the pendulum.

706,870. HANGER FOR TRANSFORMERS OR THE LIKE; J. J. Wood, Fort Wayne, Ind. App. filed Nov. 29, 1901. (See Current News and Notes.)

706,923. LAMP; C. E. Gervais, New York, N. Y. App. filed April 17, 1902. Details.

706,924. LAMP; C. E. Gervais, New York, N. Y. App. filed April 17, 1902. Details.

706,927. ELECTRICAL FLOOR KEY; E. C. Goodrich, Houghton, Mich. App. filed April 21, 1902. Details.

706,974. CONDUIT FOR ELECTRIC WIRES; R. W. Lyle, Perth Amboy, N. J. App. filed April 10, 1902. Relates to means for aligning and locking together the respective sections of the conduit.

706,982. GALVANOMETER; C. L. R. E. Menges, Hague, Netherlands. App. filed Dec. 23, 1897. According to this invention a galvanometer is provided wherein the magnetic field is controlled by means of the attraction of one part of the magnetic circuit upon another part in combination with means for varying the magnetic flux.

707,007. MULTIPLE TELEGRAPHY; M. I. Pupin, New York, N. Y. App. filed Feb. 23, 1894. (See page 292.)

707,008. MULTIPLE TELEGRAPHY; M. I. Pupin, Yonkers, N. Y. App. filed Dec. 29, 1897. (See page 292.)

707,049. TERMINAL BOX FOR PROTECTED ELECTRICAL CIRCUITS; F. B. Cook, Chicago, Ill. App. filed May 21, 1902. (See page 293.)

707,050. ELECTRICAL PROTECTOR SET; F. B. Cook, Chicago, Ill. App. filed May 21, 1902. (See page 293.)

707,051. SYSTEM OF STRONG CURRENT PROTECTION; F. B. Cook, Chicago, Ill. App. filed May 21, 1902. (See page 293.)

707,052. REGULATION OF ELECTRIC LIGHTING SYSTEMS; J. J. Creveling, New York, N. Y. App. filed July 17, 1901. Provides electric means for compensating for the lag of the mechanical governor of regulator for the generator.

707,055. CABLE SLEEVE; C. M. Earl, Detroit, Mich. App. filed Dec. 6, 1901. Details for a water-tight sleeve for covering a cable splice or joint.

707,056. AUTOMATIC SELECTIVE SYSTEM; C. D. Ehret, Philadelphia, Pa. App. filed Jan. 10, 1902. Comprises an automatic selecting device whereby one station may be put into communication with any other of a series or group, each station always transmitting messages by energy of a definite frequency or frequencies.

707,064. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed June 1, 1901. A receiving apparatus consisting of a series of coherers in the same main circuit and in parallel, and a decohering device for each coherer, the decohering devices being dependent upon the action of the coherers, one being operated when the coherers conduct and the other when one of the coherers has been decohered.

12,[illegible]. (Reissue.) ELECTROCHEMICAL GENERATOR; H. S. Amwake, Camden, N. J. App. filed June 17, 1902. An electrochemical generator consisting of a single fluid cell, provided with a positive electrode and a negative fixed electrode, an electrolyte, and a current conducting baffle-partition in said electrolyte, between said electrodes and normally insulated therefrom.

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CONTENTS.

TELEPHONE EXCHANGES AND CONDUITS.

The various branches of applied electricity—electric lighting, the transmission of power, electric railways, and the construction of dynamo machinery—have from their inception received the closest attention of the highest engineering ability, until to-day electrical engineering at least now begins to equal the other members of the great constructive quartet in the number and ability of the men engaged therein. But the art of the electrical transmission of intelligence, telephonically, absorbing a goodly share of the billions of capital invested in electrical enterprises, has received the least share of engineering attention. This is partly due to the nature of this department. To design a thousand-kilowatt dynamo, to build a railway to run 60 miles an hour, to illuminate a million lamps, to transmit a hundred thousand horse-power, are present questions that are both attractive and tangible in magnitude; but to construct a pole line carrying a handful of No. 10 wires, to bury a few cables in a city street, or to deal with the micro-amperes of the telephone transmitter, are problems that lack exciting attraction. Further, in the case of the telephone, in ante-independent days only a special few were admitted inside the technical arena.

To-day these conditions are already changed and are rapidly undergoing further modification. And as engineering is only scientific planning, millions invested in telephonic plants are certainly entitled to their share of consideration. The expense of the wire plant forms about one-half of the total investment in a telephone exchange; and in the extensive series of articles just completed in these pages Mr. Abbott has developed more clearly and extensively than had previously been attempted the method of design to render the quantity of wire plant for a given territory a minimum. In our current number, wire-plant construction is taken up by Mr. Abbott and treated in a similar fashion, with particular attention to methods of estimating cost of installation and the annual amounts required for depreciation and maintenance. Taken in conjunction with the preceding series, the telephone engineer will be advised as to the design of a given installation to reach all subscribers with the minimum of wire-plant expenditure, to calculate its installation cost, and to estimate the proper annual expense to be charged against this portion of the plant in making up tariff sheets.

The object of all this construction is, of course, to maintain continuity of service and enable subscribers to get swiftly into touch with each other. Another part of the work which has proceeded with equally liberal outlay has been that of exchange construction, aiming at identical purposes, and, indeed, depending for its ideal development upon the perfection of trunking methods and an abundance of well-insulated cables. We present in this issue also a most interesting article by Mr. H. L. Webb, in which that well-known engineer traces with accustomed clearness and charm of style the evolution of the modern telephone exchange building. The article is, we believe, the first of the kind; at least we do not recall anything of the same nature, and probably only New York could afford an example of so many modern types of exchange buildings connected into one city network. This line of development, like that of subway construction, is expensive, and involves a tremendous investment in real estate and plant. It is obviously that success depends not only on skilful engineering but the highest quality of business management; and we

imagine that there are points touched upon and discussed of interest to the telephonists wherever they are found, and no matter what the size of their plant.

The Freedom of the Air.

Anent wireless telegraphy, what a truly beautiful chance for litigation will arise when the various systems get down to doing commercial business. One cannot patent the winds of Heaven nor copyright the ether, and if the Etheric Vibration Company, Limited, and the Donnerwetter Communications Company get by accident or design into dynamical conflict, who shall decide between them? One cannot order the former on higher poles or compel the latter to use complete metallic circuits. This is no mere fancy picture of twentieth century complications, but a condition that is quite likely to arise within a very few years, perhaps even sooner. And when the wireless systems are regularly used in the army and navy it is doubly necessary that the ordinary exigencies of commercial work should not be allowed to interfere with national defense. An example in point is given by a recent experience off Tunis, where communication between French warships and the shore was interrupted by a French resident, who explained that his apparatus had been fitted up to interfere with messages between foreign ships. A serious condition of affairs is thus likely to arise at almost any time, and it is no subject for joking, however facetious the idea may seem.

We are no advocate of the general government ownership of public utilities, but it seems to us that in this case if ever it is not only justifiable but necessary. As well permit every steamship line to maintain an independent system of buoys and light houses as to allow half a dozen warring codes to interfere with national necessities. We believe it would be wise to have by international agreement, if necessary, all land stations absolutely owned and operated by the respective governments involved, and if necessary in one uniform way. Such a step might hamper the adoption of improved apparatus as it may in course of time be invented, but it would do what nothing else except a private monopoly could do—reduce the matter to general and harmonious usefulness. Uncle Sam has been very chary in using his right of eminent domain—often to his great loss, but other governments have discovered long ago the advantage of controlling some things of national importance, and have not hesitated to do so. Our government cannot in time of peace take property without reimbursement, and does not do so in time of war, but it has the right and should exercise the power to take when necessary what it requires at a fair price, and so the acquirement of what rights might be necessary is not really a complicated matter. Not only is wireless telegraphy likely to assume no small importance in the regulation of commerce, but it has international relations that remove it from the category of ordinary commercial enterprises and make it a proper subject for exclusive control by the government. Only in this way can its full usefulness be realized when it reaches complete commercial development. At least, so it seems now.

A Single-Phase Electric Railway

As our readers are aware, we have in season and out of season during the past several years preached the doctrine of alternating-current traction, pointing out in particular that in view of the work being done along this line in Europe the apathy here toward this development seriously menaced American leadership in electric railway engineering. This attitude was far from meeting with approbation in all quarters, and it is, therefore, a natural source of gratification that recent events have vindicated our stand. At the recent meeting at Great Barrington of the American Institute of Electrical Engineers, the feature of the sessions was the announcement by Mr. B. J. Arnold of an entirely original system of single-phase alternating-current traction, soon to be installed on a Western road, and which contains every promise of commercial success. We have now the pleasure of announcing, as will be seen elsewhere in our columns, that the Westinghouse Company has contracted for the equipment of an important long interurban road with alternating current. More than this, it has developed and will here install a complete traction system for the use of single-phase currents, employing variable speed motors. Heretofore in this country, alternating polyphase currents have been used for traction purposes merely for the operation of rotary converters, gaining thereby the power to use standard railway equipments, but forfeiting the chief advantages of alternating-current distribution. So long as the substation with rotaries is retained, there is a very material loss of energy, need for considerable attention and a severe limitation upon the voltage of the working conductor. In using polyphase equipments for the cars along the lines developed abroad, the full advantage of the alternating system is realized, but the trolley system becomes seriously complicated by the need for two or three working conductors. One may realize how considerable an obstacle this may be by noting the recent proposal of so eminent an engineer as Mr. Huber, to use single-phase alternating currents for the distribution at high voltage and to reduce this to usable form by a rotary converter on the car.

In the equipment now under way, a radical step has been taken in the adoption of single-phase variable speed motors on the cars, thus gaining the advantage of alternating distribution without a sacrifice in the simplicity of the system of working conductors. The details of this new motor system are promised soon to be forthcoming, but it is safe to say in advance that it must embody some novel and valuable features, else so powerful and conservative a corporation would not venture to stand behind it in so important an installation. We shall not venture to comment upon the means employed before the whole matter is made public, but it is safe to say that they have been worked out in a manner at once thorough and resourceful. Up to the present time the single-phase alternating motor has been essentially a one-speed machine capable of doing excellent work at its designed load, but weak in starting and performing badly, save near its regular speed. Both strong starting torque and variable speed have been in one way and another secured, but hitherto at very serious sacrifices, so that the system has hardly been commercial. But inventive genius and constructive skill combined sometimes accomplish the unexpected, and we do not believe that the new system of Mr. B. G. Lamme will be found wanting in these particulars. It should be remembered that the ordinary series-parallel control was tried and cast into the scrap heap some years before it was, largely by the efforts of a single indefatigable engineer, converted into a brilliant success. Such may be the history of the alternating current railway motor, and while it is unwise to crow before one is out of the woods, we hope to hail with unqualified commendation the success of so notable an enterprise as the one now announced. The proof of the pudding will be in the eating, and practical results in the severe work of interurban traction is a test from which there is no appeal. We shall follow this installation with the greatest interest and care, and meanwhile tender our hearty congratulations on the inauguration of what we hope will be another epoch-making enterprise.

The Second Law of Thermodynamics.

In our correspondence columns this week, Mr. Irving A. Taylor discusses the questions raised by us in a recent editorial on the second law of thermodynamics. Mr. Taylor agrees with our position from

a practical point of view, but demurs when the subject is discussed theoretically. Our position has been that in any space containing a warm fluid, such as air, at one and the same temperature throughout, there will be heat energy in the fluid, but none of it will be available for conversion thermodynamically into mechanical work, because all heat-engines require and operate by virtue of difference of temperature.

It is true, as pointed out by our correspondent, that according to the existing kinetic theory of gases and to Maxwell's theory of imaginary daemons, it would be possible to utilize the heat of a uniformly warmed air-chamber and convert it into mechanical work. Maxwell drew, in imagination, a bulkhead or partition across the chamber, thus converting it into two sub-chambers, punched myriads of extremely minute holes in the partition, set a little trap-door over molecules of air at any uniform temperature, say traveling to-and-fro at a certain mean velocity, colliding, rebounding, and zig-zagging in every direction. The actual velocity of any one molecule will often be much more than the mean, and also often much less. If the daemon at each hole opened the door whenever a molecule happened to head for it at any velocity above the mean, but kept it shut when the velocity was less than the mean, the temperature on the sides of the partition would commence to differentiate, one sub-chamber becoming full of hotter air, and the other of colder air, although the mean temperature of all would remain unchanged. After a sufficient lapse of time there would be enough difference of temperature between the two sub-chambers to work a heat engine, and bring both to one and the same lower temperature, after liberating mechanical work.

This is all theoretically true. It merely means that a difference of temperature is conceivably obtainable from uniform temperature by the action of intelligence upon a sufficiently small scale. It does not really imply any fallacy in the second thermodynamic law. Intelligence acting on the scale of our own mundane affairs produces results that to sufficiently magnified giants might seem equally wonderful. To a being of sufficient size to make a coal mine seem as but a capillary tube, the human realization of energy by burning air and coal together, might seem fantastically wondrous. Intelligence acting on any scale may, by utilizing natural law, seemingly infract other natural law. In the absence of intelligence it is difficult to see how any difference of temperature could be made to arise within a heat-light and energy-light chamber, containing only a fluid at one temperature. Consequently, the second law of thermodynamics seems to apply to every case we can conceive of. Of course, we can postulate conditions under which the second law of thermodynamics would fail. But this is virtually postulating a new world. The burden of proof lies on the asseverator of the fallacy of this rule, which is in accordance with all human recorded experience up to the present time. In all these views we think we retain our correspondent's acquiescence.

The Magnetic Properties of Iron and Steel at Low Temperatures.

The article of Mr. C. C. Trowbridge on this subject, appearing on page 325, deserves careful attention. In the first place, it clears up a common misconception as to the temperature of liquid air. This is usually accepted as — 185° C., as though it had a definite value like the boiling point of water under normal atmospheric pressure. Owing, however, to air being a mixture of the two gases, oxygen and nitrogen, each having a different boiling point, the temperature of liquid air may be anywhere between these two boiling points, according to the relative proportions of the two gases present, and to their previous history. That is to say, the temperature will be not above — 181.4°, nor below — 194.4°, and usually in the neighborhood of — 185°.

Liquid air with this low temperature, less than 90° above the inferred absolute zero, gives to the experimentalist a rich field of investigation concerning the influence of low temperatures upon any particular phenomenon. The descent from normal temperature to that of liquid air is nearly as great as the ascent from normal temperature to that of boiling oils.

The results of the magnetic researches at the temperature of liquid air, mentioned in the article, lead to the remarkable conclusion that, in the samples tested, the magnetization of steel was practically the same, whether effected at the temperature of air liquified, or at the temperature of the air we breathe. We know that at red heat it is impossible to communicate any appreciable magnetization to a bar of steel. The magnetization increases as the temperature falls; but in the case of the samples here tested, the magnetization is not very different whether communicated at 20° C. or at — 185° C.

It is much to be desired that all such magnetic tests might be made on steel rings magnetized by coils of wire, so as to obtain a closed magnetic circuit, and a complete Ewing cycle, at these temperatures contrasted. With simple steel bars, although the information gained by measuring the magnetic moment is certainly better than none, it is inferior, from a quantitative point of view, to the complete hysteretic cycle or loop.

A very interesting deduction is raised by the determination of the permeability of liquid air. It seems that although liquid air is regarded as a magnetic substance, yet its permeability is only about one-third of 1 per cent. in excess of the permeability of ordinary gaseous air. In spite of this relatively feeble permeability, as compared with iron, it seems that, volume for volume, the susceptibility of liquid oxygen is about 1,600 times greater than that of gaseous oxygen. According to this deduction, magnetic susceptibility increases markedly in oxygen with the density, or mode of aggregation.

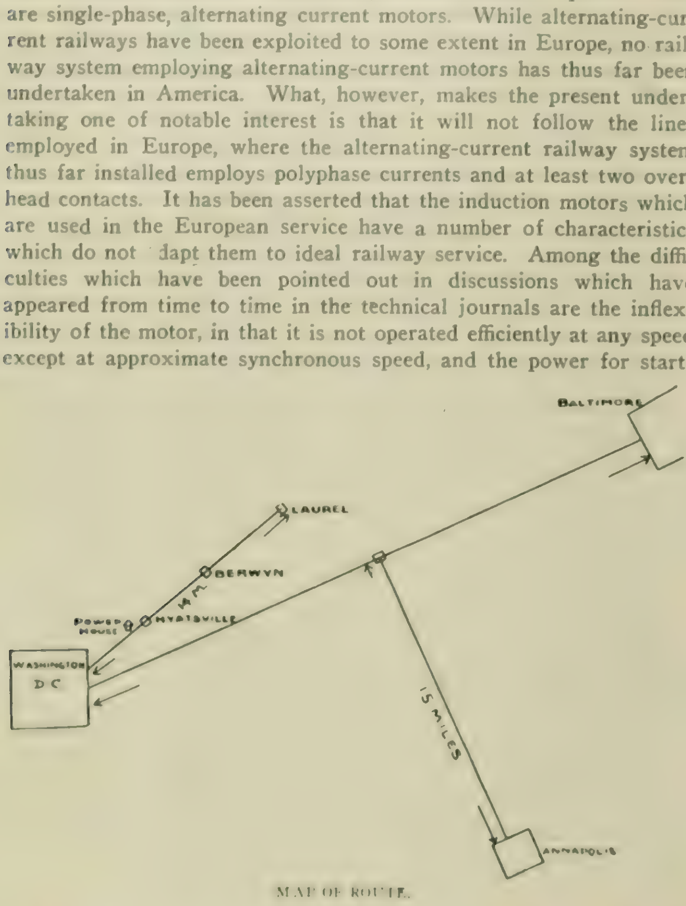
The following interesting fact is also elicited from the results: When an iron or steel bar is powerfully magnetized at ordinary temperatures, it will lose magnetism if heated, and it will also lose magnetism if cooled. The loss accompanying initial heating is greater than the loss accompanying initial cooling; but what goes off within a small range of temperature in either case may be regarded as sub-permanent magnetism readily dislodged. After a few cycles have been passed through, however, and the magnet enters a fairly steady condition, then heating will always weaken the magnet, while cooling in liquid air will usually strengthen it. This is what one would expect from a Ewing model, containing a number of poised compass needles freely suspended in each other's vicinity. The separation of the needles, as by thermal expansion of their framework, should diminish the total magnetic moment of the mass, while the act of crowding the needles nearer together, as in cooling, should increase the total magnetic moment.

It is stated that the hysteresis loss in iron at high induction densities is the same at normal and at very low temperatures. If this is a correct generalization it is very remarkable, since it would tend to show that not only the area, but also the shape of the hysteresis loop is the same at these various temperatures.

Westinghouse Single-Phase Railway System for Washington-Baltimore Road.

A contract has recently been closed for an electric railway on entirely new lines, to connect Washington, Baltimore and Annapolis. The importance of the work as measured by the magnitude of the road itself and the novelty and possibilities of the system which is employed, promise to make this one of the most notable steps in electric railway work which has been undertaken in this country.

The Washington, Baltimore and Annapolis Electric Railway Company has awarded a contract for the entire electrical equipment of its lines to the Westinghouse Electric and Manufacturing Company. The road throughout is to be operated by alternating current. There are no rotary converter substations, and the motors upon the cars are single-phase, alternating current motors. While alternating-current railways have been exploited to some extent in Europe, no railway system employing alternating-current motors has thus far been undertaken in America. What, however, makes the present undertaking one of notable interest is that it will not follow the lines employed in Europe, where the alternating-current railway system thus far installed employs polyphase currents and at least two overhead contacts. It has been asserted that the induction motors which are used in the European service have a number of characteristics which do not adapt them to ideal railway service. Among the difficulties which have been pointed out in discussions which have appeared from time to time in the technical journals are the inflexibility of the motor, in that it is not operated efficiently at any speed except at approximate synchronous speed, and the power for starting the car is excessive. Moreover, the use of a double or triple-trolley system is maintained to be obviously highly objectionable, especially where high voltages are employed and cross-overs are necessary. Specific details of the new system as proposed by the Westinghouse Electric and Manufacturing Company, and have been adopted upon this road, are lacking, but it is stated that it avoids the inherent limitations of the induction motor and the disadvantages of a polyphase system of conductors by the use of single-phase current in the trolley and the motors.



MAP OF ROUTE.

The length of the line from Washington to Baltimore is a little short of 40 miles, and the Annapolis branch has an additional length of about 15 miles. For covering these distances from a single power house, the transmission voltage will be 15,000 volts directly from generators wound for this pressure. There are three engine-type generators of 1,500-kw each, at approximately 80 r. p. m. The pressure is lowered by ordinary lowering transformers placed at suitable intervals for supplying the current to the trolleys. There are nine substations with lowering transformers, and these supply 1,000 volts to an overhead trolley, one contact. The cars are of the large interurban type, and are provided with four motors, capable of developing a power equivalent to that of four ordinary railway motors of 100-hp capacity each. The motor is a variable speed motor which is said to have characteristics that adapt it for railway service fully as well as the ordinary direct-current railway motor.

The contract covers the complete equipment of electrical apparatus for power house, substations and cars. The controlling apparatus is of a new type, and is said to possess valuable features which have not been heretofore attained in railway operation, while avoiding many of the inherent difficulties in the ordinary systems of direct-current control.

The advantages in this system through the omission of rotary converters and attendance for them; also the reduction of copper over that which would be necessitated for operating direct-current motors at 500 volts, are among its notable commercial features. The adoption of 1,000 volts as the motor voltage was deemed by the engineers of the railway company to be preferable to a higher voltage, on the ground of general policy, although there is nothing in the system to prevent the use of several times this voltage. A higher voltage would probable be used on longer roads or where the conditions made a higher voltage more advantageous than in the present case. The car equipments are designed for a normal speed of 40 and 45 miles, and a maximum speed of 60 miles an hour.

This system has been developed by the Westinghouse Electric and Manufacturing Company, largely through the work of Mr. B. G. Lamme during the past few years. The final results were so satisfactory that the company was ready to undertake as an initial commercial installation a road of the size and importance of the one above described. The engineers of the railway company made a careful investigation of the system and of the motors which have been made and operated on the company's experimental railway track at Pittsburg, and as the outcome of their investigation they were satisfied to place the whole matter with the Westinghouse Company.

Work on this important enterprise is being pushed most vigorously. Excavation for the foundation of the power house to be constructed by the Washington, Baltimore and Annapolis Electric Railway, in East Hyattsville, will be begun the first week in September. The company has purchased an additional half-acre, making the total area for the power-house site three acres. This means that the original contemplated capacity of the plant will be increased, the additional power being required for the Chesapeake Beach Railway, which will discontinue the use of steam. It will take about 12 months to complete the power-house, the dimensions of which have been increased to 133 by 203 feet. The Hamilton-Corliss Engine Company will furnish the engines, and the boilers will be furnished by the Sterling Boiler Company. The engineers for the road are the Cleveland Construction Company, Mr. W. Christy, president.

The building alone will cost in the neighborhood of $350,000. The site was selected for the reason that it was convenient to water and railway facilities, and on account of its being located about midway between the Baltimore, Washington and Annapolis Electric Railway, and the City and Suburban Railway. It is also believed to be the intention of the officials of the first-named company to furnish power for manufacturing plants, said to be contemplated in this section. It is also probable that power will be furnished for lighting Hyattsville with electricity. A very interesting feature is that the company takes over a small existing direct-current road which will be fed by a substation with two 200-kw single-phase rotaries, these again being new machines of original design.

American Street Railway Association.

A preliminary programme of the twenty-first annual meeting of the American Street Railway Association announces that the meeting will be held in the Light Guard Armory, Detroit, Mich., Wednesday, Thursday and Friday, Oct. 8, 9 and 10, 1902. Papers will be presented on the following subjects:

"The Registration of Transfers," by Mr. C. D. Meenely, Brooklyn Heights Railroad Company.

"Benefit Associations," by Mr. Oren W. Root, Jr., Metropolitan Street Railway Company, New York.

"Discipline of Employes by the Merit System," by Mr. W. A. Satterlee, Metropolitan Street Railway Company, Kansas City.

"The Transportation of Light Express and Parcel Delivery," by Mr. George W. Parker, Detroit United Railway.

"Steam Turbine Engines," by Mr. E. H. Sniffen, New York.

"Signals for Urban and Interurban Railways," by an officer of the Old Colony Street Railway Company, Boston.

"The Adjustment of Damage Claims," Mr. M. B. Starring, Chicago City Railway Company.

There will be a large exhibition of street railway suppplies, as all the space in the hall is applied for. Thursday, Oct. 9, has been set apart as Exhibitors' Day.

The Housing of a Telephone Plant.

By HERBERT LAWS WEBB.

LIKE other parts of a telephone system, the telephone building has undergone a striking evolution during the past few years. In New York, the city which has witnessed at once the greatest architectural and the most rapid telephonic development of any city in the world, a typical telephone building has been evolved, of which there are now six in use and five others planned or in course of construction. A large telephone exchange, needing a clear space for the operating room, has always required some amount of special construction or arrangement of the building to contain it, but the advisability of a specially designed telephone building first urged itself when underground conduits and cables came into extensive use; as not only was a permanent anchorage for the conduit and cable system most desirable, but it became necessary to provide special accommodation for the cables and their connections with the switchboards. At the beginning of the underground work, the cable and terminal accommodation was comparatively primitive, and but a slight advance on the style of construction used with overhead wires, while the power plant was practically non-existent, consisting usually of a single ringing machine, run by a water-motor. So that ten years ago a telephone exchange equipment required space only for the operating room and for a small terminal room, which contained all the auxiliary apparatus, and something in the way of operators' quarters. The operating room itself then occupied about nine-tenths, or at least four-fifths of the total space given over to the exchange. As telephone engineering has developed, this has changed very much, and the evolution of the modern telephone exchange into a highly complex organization of machinery may be followed in a most interesting way by studying the changes in the telephone building itself and the vastly increased space required in it to accommodate the exchange equipment. So great have been these changes that the telephone plant of to-day calls for a type and arrangement of building quite different from what was considered entirely adequate a few years ago.

The first radical change came about nearly nine years ago, when the bridging board with self-restoring drops came into use. With the bridging board came the power plant, storage batteries, motor generators for charging, ringing, testing and so forth; while these machines were few in number and of small size, they paved the way for the accommodation and treatment of the more imposing power plant required for the common battery system, now the accepted standard style of equipment for city telephone exchanges. Whereas in the telephone building of ten or twelve years ago, but a small amount of space was required for terminal equipment and power plant, in the common battery exchange of to-day the terminal equipment and power plant occupy nearly as much space as the operating room itself, in some exchanges quite as much. This is not suprising when it is considered that the terminal room of a common battery exchange contains, besides the main and intermediate distributing boards, apparatus that substitutes all the drops formerly in the switchboard and all the batteries and hand generators formerly at the subscribers' stations, together with a battery of generators of various types for furnishing the different kinds of current required to operate the exchange. With this extensive collection of machinery and its intricate and costly system of wiring to be accommodated, the operating room is no longer the main point to be considered in planning a telephone building, but equal consider-

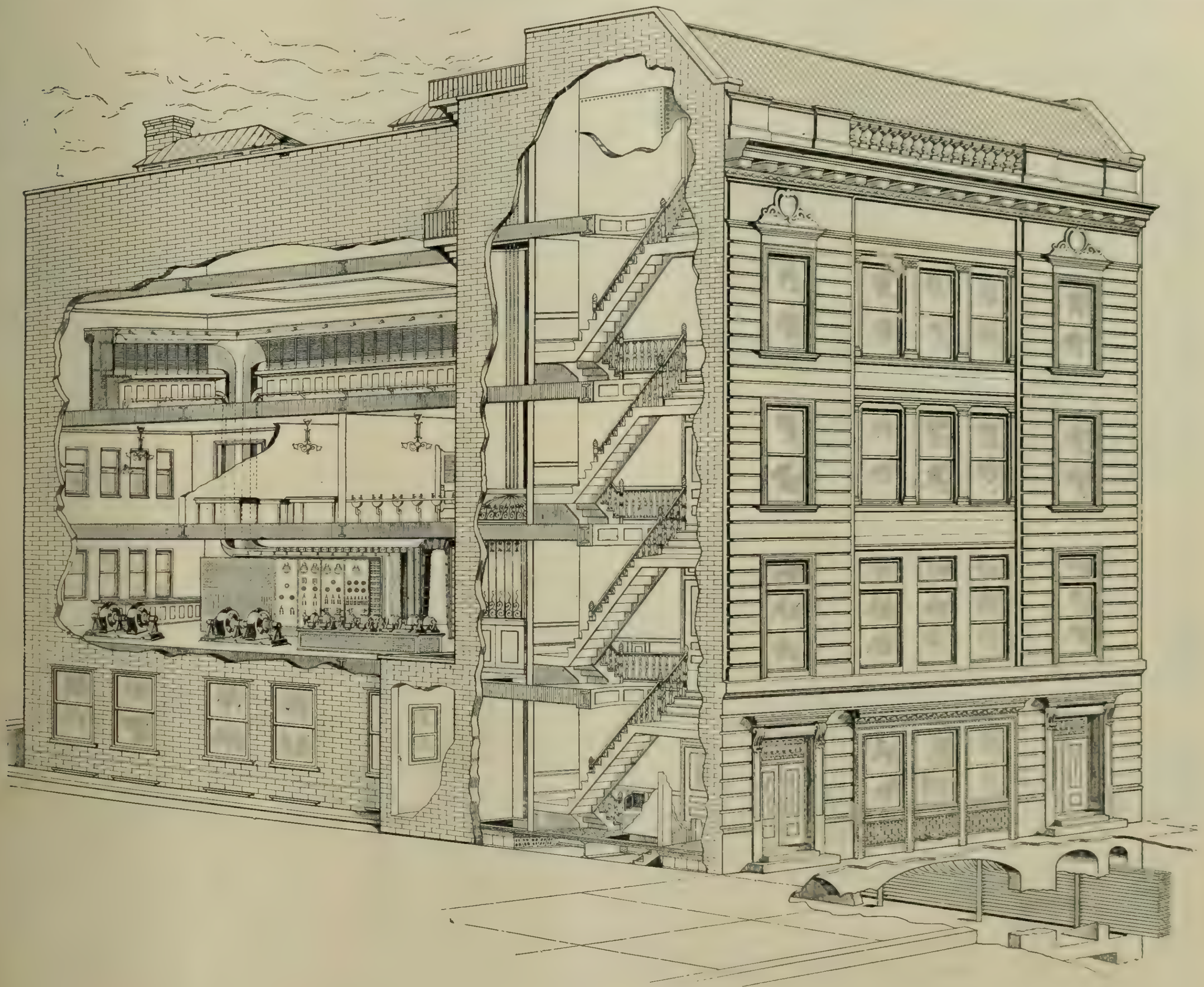


FIG. 1.—PLAZA CENTRAL OFFICE BUILDING, NEW YORK, SHOWING INTERIOR ARRANGEMENT.

ation must be given to the terminal room. The terminal room, in fact, has become the brains of the organism of which the switchboard is the face and the distributing cables are the nerves.

Perhaps the best way to illustrate the change that has taken place in the telephone building is to compare one of ten years ago with one of to-day. The Cortlandt Street building, completed in 1888, was designed mainly with a view to providing a top-story operating room for a 6,000-line switchboard, some 250 feet long, and an anchorage for the underground cable system of the downtown section of the city, in a structure as fire-proof as it could be made according to the methods of that day. The building was of eight stories, with a front of 72 feet, and two wings running back and enclosing a court reaching from the skylight of the second floor to the sky. This U-shaped form of building is the best arrangement for light and ventilation, and is adopted wherever possible. The eighth floor of the Cortlandt Street building was given over to the operating room, the ground floor to stores and a public pay station, and the intervening six floors to offices. As originally planned, the distributing rack was at the back of the switchboard, and the cables were led in from the street vault to a cellar on the same level, where they were headed up, and the wires were extended to the rack in the operating plant, but also for the offices of all the departments of both telephone companies, and numerous offices were rented to outside tenants, chiefly electrical concerns. With the growth of the telephone business the telephone companies' offices expanded and the tenants were crowded out, and a few years later the Dey Street building was planned to provide additional office accommodation. This building adjoins the Cortlandt Street building at the back, and the two floors on the same level as the old and new operating rooms of Cortlandt Street are designed for operators' quarters. The other ten floors are occupied by the offices of the American Telephone and Telegraph and New York Telephone Companies, as are all the floors of Cortlandt Street not taken up by telephone plant. The working force of the New York Telephone Company has expanded so prodigiously since the days when *the* telephone building accommodated it all, that branches of it now occupy wholly or partially several other buildings in different parts of the city. The construction, maintenance, supply and repair departments occupy all of the John Street building not taken up by the John Street exchange equipment. The traffic department occupies a floor of the new Eighteenth Street building and part of a floor at Franklin Street, and the contract department has branch offices in the Thirty-eighth Street building, at

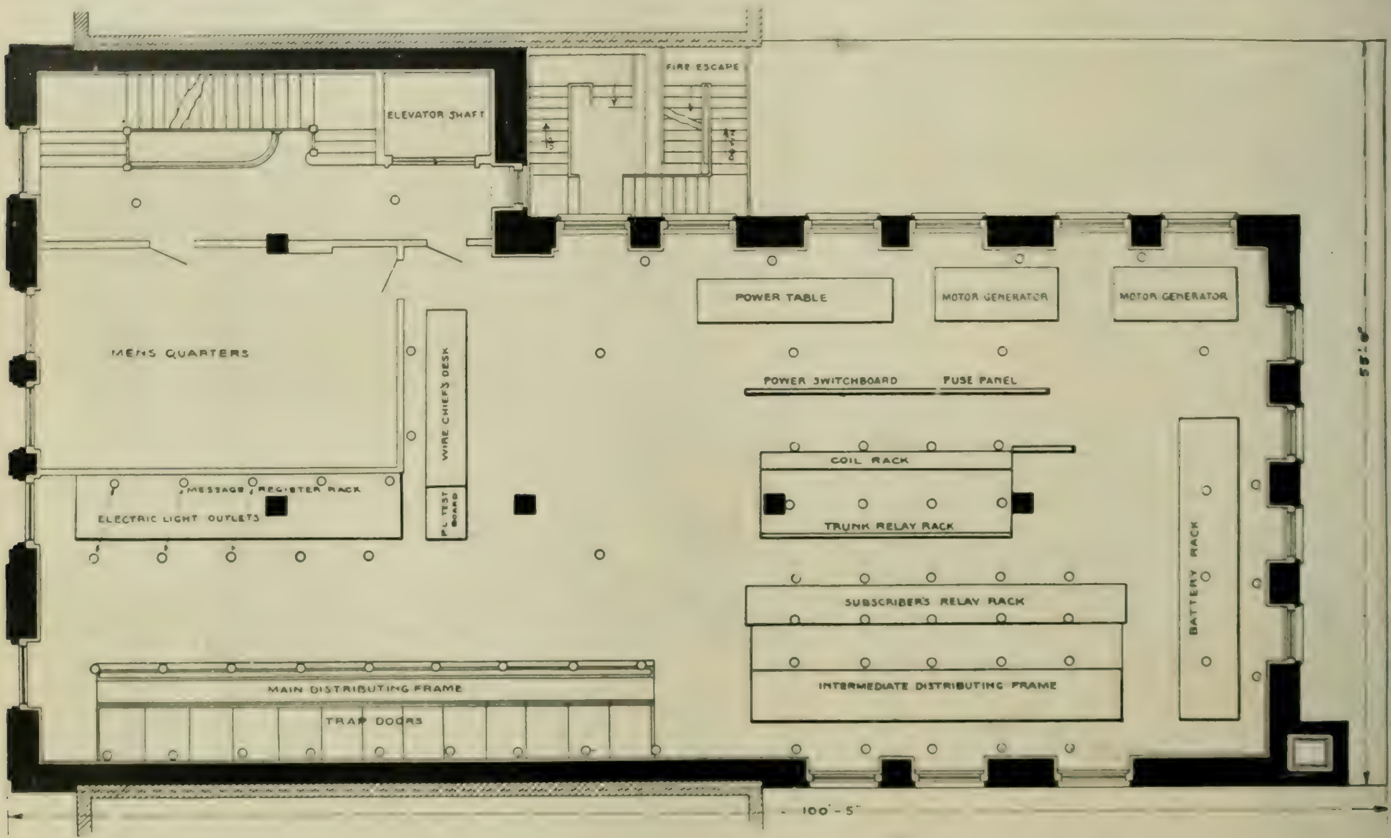


FIG. 2.—SECOND FLOOR PLAN, PLAZA CENTRAL OFFICE.

room by means of rubber-covered cables carried in ducts built in the wall of the building. This plan of handling the connections between the cable system and the switchboard was found to be unsatisfactory, and later a Hibbard distributing board was built in the cellar, to the opposite sides of which were connected the underground cable conductors and the house cables; these latter were then connected directly to the switchboard in regular order so that they became downstairs the terminals of the switchboard wires from having previously been upstairs the terminals of the cable conductors.

Practically all the room occupied by the telephone plant in the Cortlandt Street building, then, was the entire eighth floor and part of the cellar. A part of the seventh floor was used for operators' quarters, and the long-distance operating room occupied a small department at the end of the other wing of the seventh floor. The operating room and terminal room of the Long-Distance Company now occupy the entire seventh floor of the building, and the operators' quarters of the Long-Distance and of the New York Company occupy two whole floors of the Dey Street building. The Dey Street building was put up in 1896, as the accommodation in Cortlandt Street had become inadequate to the demands on it. At first the Cortlandt Street building provided space not only for the telephone Harlem, and in the new Melrose Building for the Bronx. It is at times almost as much of a problem to house the working force of the New York Telephone Company as it is to house its rapidly growing plant.

The recent additions to the Cortlandt Street building to accommodate the new common battery equipment were described in an article in ELECTRICAL WORLD AND ENGINEER at the time the new exchange was put in service. They comprised the supplement of a new wing to the building on its eastern side, to accommodate the terminal equipment, and the construction of a new top story over the old operating room. In a short time the construction will be begun of a new wing to the west on the lot at 22 Cortlandt Street to meet the ever-increasing demand for space for telephone exchange equipment. At the same time, the expansion of the offices will be met by the addition of three stories to the Dey Street building, making that building the full height of fifteen floors, for which it was originally planned. The additional wing to the Cortlandt Street building will also be of fifteen stories.

A few interesting reminiscences cling to the Cortlandt Street building, as is but natural with the first real telephone building. At the time I first knew it, the office of the electrician was one small back

FIG. 3.—BROAD STREET CENTRAL OFFICE.

FIG. 4.—CORTLANDT STREET CENTRAL OFFICE.

FIG. 5.—DEY STREET BUILDING.

TYPES OF TELEPHONE EXCHANGE BUILDINGS.

FIG. 6.—JOHN STREET CENTRAL OFFICE.

FIG. 7.—FRANKLIN STREET CENTRAL OFFICE.

FIG. 8.—SPRING STREET CENTRAL OFFICE.

SOME OF THE CENTRAL OFFICES OF THE NEW YORK TELEPHONE COMPANY.

room, and the staff of that important department consisted of a foreigner of somewhat erratic disposition, and myself. The principal work of the electrician's department was the testing of underground cables, then being put in at the rate of several miles a week, and this had to be done with a very decrepit portable set of instruments supported on a barrel in the cellar, where the conditions were excellent for obtaining a good "spot," but unfavorable otherwise. The standards in the testing-set were none too reliable, and some of the results that my German confrère worked out from his tests would have startled any cable-maker. Shortly after this the present chief engineer of the company took the office of electrician, and from that time staff, instruments and accommodations improved quickly. At the present time the engineering department occupies the best part of a floor of the enlarged Cortlandt Street building, and its filing cases for drawings alone would not go into the room we had when Cortlandt Street was young. In 1890, in the budding electrical department, were carried on the experiments that resulted in the production of a piece of telephone equipment which shall be nameless here. That invention created a minor revolution in the art, and has contributed much to recent telephone history. In 1892, in the luxurious public station fitted up by the Long-Distance Company on the second floor of Cortlandt Street, occurred the historic inauguration of the New York-Chicago line by Professor Bell.

Leaving reminiscences and coming back to telephone buildings proper, the second telephone building to be erected in New York was Thirty-eighth Street. Here the experience gained at Cortlandt Street in handling the underground cables was taken advantage of in devising special arrangements for the treatment of the cables, terminals and connections to the switchboard. As the Thirty-eighth Street building and equipment served as a model for the other exchange buildings put up or converted during the next few years, in fact until the first typical common battery exchange of three years ago, a comparison of Thirty-eighth Street and one of the latest exchange buildings designed will show the great changes in the treatment of the building that the development of the telephone exchange equipment has brought about. The Thirty-eighth Street building is a copy of Cortlandt Street on a somewhat smaller scale, U-shaped, of fire-proof construction, and built of red brick and terra-cotta, after the same general Cortlandt Street style. As at Cortlandt Street, the operating room occupied the top floor, but it was determined, instead of terminating the underground cables in the cellar as at Cortlandt Street, to take them directly to the operating room floor and establish the terminal room at the back of one wing, separated from the operating room by a partition. This involved taking the cables from the street vault through the cellar the entire depth of the building and running them up a shaft to the top. The advantages of this plan were that it put the terminal equipment in light and airy quarters where everything was easily accessible for testing, and brought the distributing board close to the switchboard, thus simplifying the wiring between the terminals and the switchboard. The disadvantages were the length of underground cable required to reach from the exchange manhole to the rear of the top story, and the amount of construction required in the cellar and shaft to support the cables. These are pretty serious disadvantages. The cost of the cables entering a good sized exchange may amount to over a hundred dollars a foot, while the expense of a special shaft running the entire height of a building, the fire-danger of such a shaft, and the difficulty of placing new cables in it, furnish good reasons for abandoning the top-story terminal room wherever possible. The change in the type of exchange equipment has favored this, and the terminal room now needing an entire floor for its accommodation, the main distributing-board in the most modern exchanges is placed as near to the exchange manhole as possible. This applies, of course, to buildings situated in localities where space for renting to outside tenants would meet with no demand; to buildings, in short, designed exclusively for telephone purposes. In a district where office floors would be in demand, a high building would naturally be put up, and the whole exchange equipment would be on the upper floors. The cables would then have to go up the building to the terminal room, whose proper place is as near the operating room as possible. New York has several examples of each type of building.

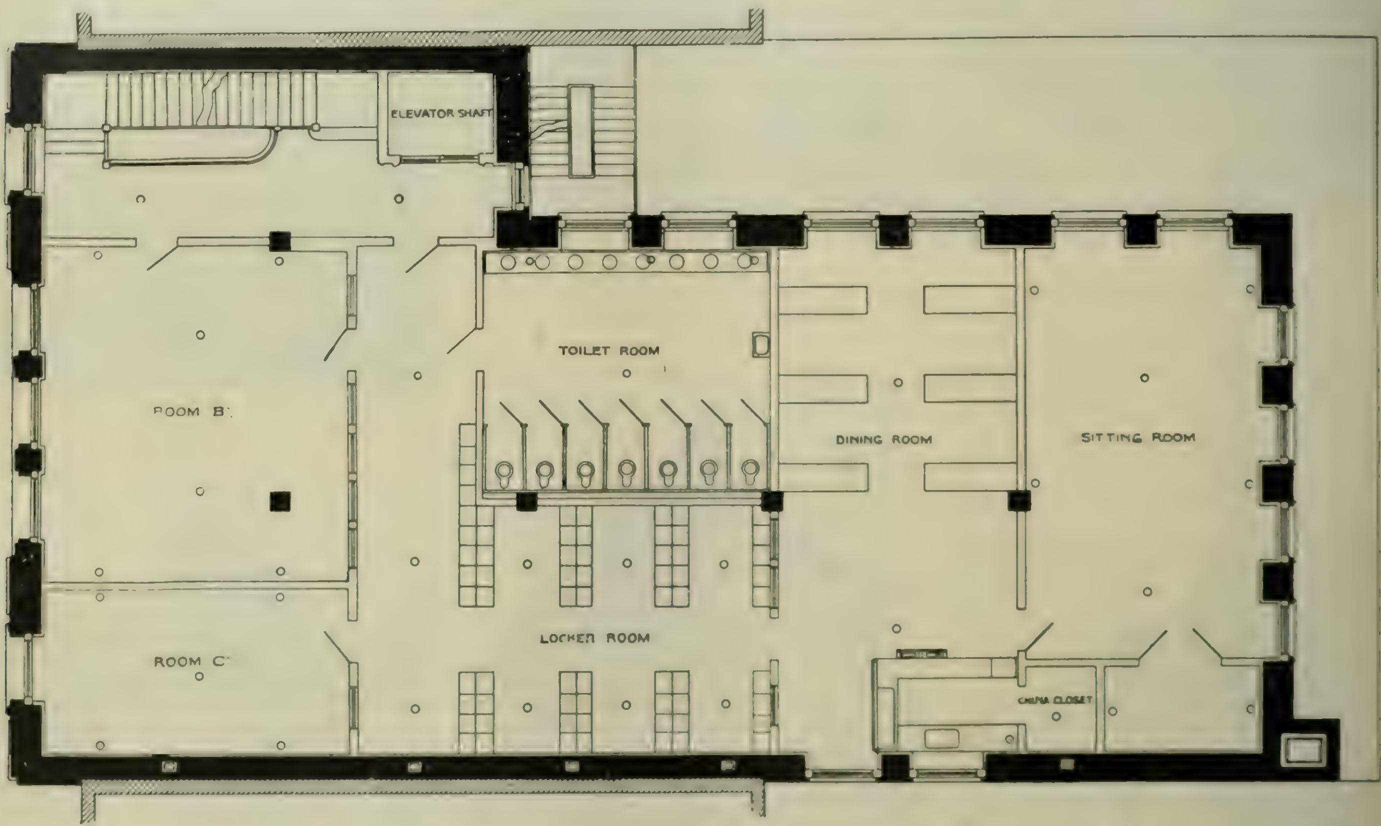


Fig. 9.—Third Floor Plan, Plaza Central Office.

The type of building and style of equipment adopted at Thirty-eighth Street were followed along the same general lines at Spring Street and Broad Street. Each of these exchanges is in a specially-designed telephone building, arranged, like the Cortlandt and Thirty-eighth Street buildings, so that the space not occupied by the exchange equipment could be rented for business purposes. At Spring Street the operating room occupied the whole of the top floor, the terminal room being placed one floor below; at Broad Street the terminal room was on the same floor as the exchange, in a separate apartment. The intermediate distributing board, by which the distribution of the line terminals in the switchboard may be changed, became standard practice in the early nineties, and was at first at-

FIG. 10.—EIGHTEENTH STREET CENTRAL OFFICE.

TYPES OF TELEPHONE EXCHANGE BUILDINGS.

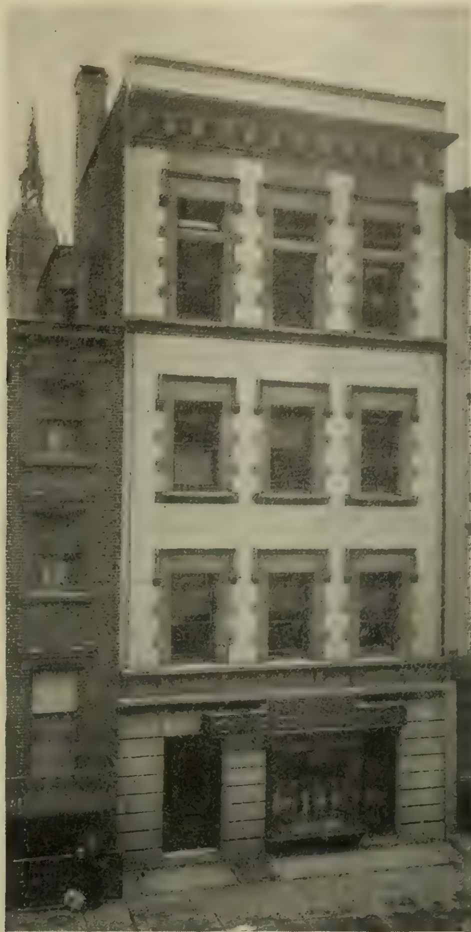


FIG. 11.—MADISON SQUARE CENTRAL OFFICE.

FIG. 12.—THIRTY-EIGHTH STREET CENTRAL OFFICE.

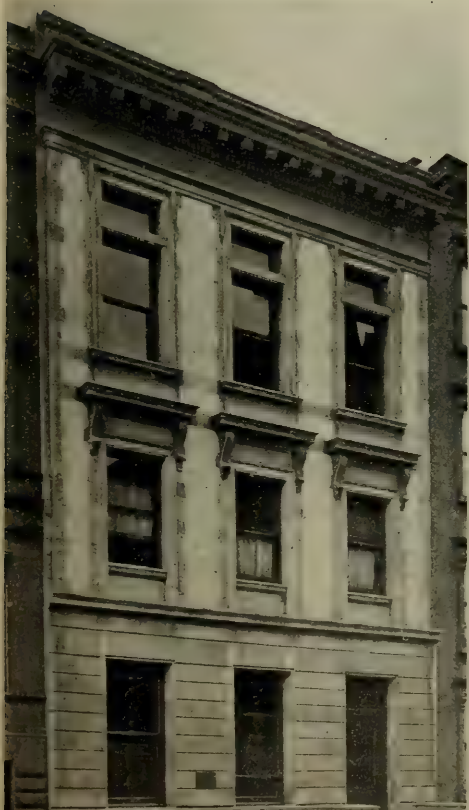


FIG. 13.—COLUMBUS CENTRAL OFFICE.

FIG. 14.—SEVENTY-NINTH STREET CENTRAL OFFICE.

FIG. 15.—MELROSE CENTRAL OFFICE.

SOME OF THE CENTRAL OFFICES OF THE NEW YORK TELEPHONE COMPANY.

tached to the switchboard proper. It has since been moved into the terminal room, so that the operating room now contains nothing but the switchboard—and often is hard put to it to contain that, so rapidly do Manhattan exchanges grow. The cable shaft underwent some improvements in the buildings erected during the few years immediately after the equipment of Thirty-eighth Street. The shaft, from an ordinary square well, took the form of a broad shallow shaft, in which the cables were supported in a single row by means of transverse girders carrying cable clamps. Access to the shaft was had by means of doors at each floor. A little later both shaft and cableheads were done away with, the underground cables being brought up the building, each in a separate iron duct, and connected to the rubber cables leading to the distributing board by means of pot-head joints. These pot-heads were easily disposed of at the top of the ducts or under a false flooring, and the cumbersome cable-heads and spacious racks needed to support them disappeared from the exchanges for good. This improvement was introduced at the John Street exchange in 1896. This method of handling the cables when they have to be carried to any height, is safer both from the building point of view and from the cable point of view. The objections to a shaft and the danger to the cables in a shaft in case of fire are well understood. In the newer exchanges, as will be seen later, the cables do not run to the top of the building, but the most rigorous precautions to render the cable run fire-proof are observed. The house ducts are built into the wall and bricked over so that in no way do they form a shaft. Ducts not occupied by cables are plugged up at both ends. The latest practice in dealing with the cable heads is to do away with false floorings and to set the cable heads in the main floor itself, immediately adjacent to the main distributing frame, providing sheathed trap doors in the floor to give access to the cables. This is a gain in space and improves the general arrangement by giving a flush floor.

The John Street building was the first of the New York telephone buildings to be used from the beginning entirely for telephone purposes. Besides the exchange, it contains the supply department, the repair shop, and the offices and headquarters of the construction and maintenance departments. The first telephone building in New York occupied exclusively by a telephone exchange equipment was the Riverside exchange building, in West Eighty-ninth Street, which began service in 1899. The Riverside building is the type of the modern telephone exchange building, and has been the model for those erected since and for those now in course of construction. The Seventy-ninth Street and the Madison Square exchange buildings are almost exact replicas of Riverside, and the Columbus building is an enlarged Riverside. The Eighteenth Street building is still larger and has several floors arranged for offices, but the general style of the building and the arrangement of the equipment are similar to those adopted at Riverside, while the new exchanges, Orchard, Chelsea, Plaza, Harlem and Morningside, in Manhattan, and Melrose in the Bronx, will all be improved and enlarged Riversides.

In planning all of the telephone buildings, it has been a special point with the architects to make the general design of the building harmonize with the style of the surrounding houses. Most of the new exchanges are in residence districts, and, judging by a casual glance at the exterior, the telephone buildings, crammed from basement to roof with the very essence of business, might easily be taken for private houses or small apartment houses.

The Riverside exchange was the first of the real common battery exchanges. A start was made with the system at Harlem, in 1898, the existing exchange building at One Hundred and Twenty-fourth Street, which was ill-adapted for the purpose, being equipped with a plant which was more or less experimental. This exchange will shortly be superseded, lock, stock and barrel, by a new exchange equipment in a new building. The experimental common battery plant installed at Harlem in 1898 giving successful results, the Riverside building was planned as a type of common battery central office building. It is built of Perth Amboy terra-cotta brick and terra-cotta ornamentation, or "trimmings" in imitation of stone, the general treatment of the exterior being similar to that of the Dey Street building. This style of exterior has a lighter, cleaner appearance than red brick, and at the same time is not so glaring as marble and stone. The terra-cotta brick, having a hard, dense, non-porous surface, is easy to clean when it becomes weather-stained. The building is as fire-proof as modern architectural science can make it, and every possible precaution is taken to guard against fire risks even to sheathing trap doors in the false floorings covering the cable heads with sheet iron to render them non-inflammable. The floors of the terminal room and of the hallways are of mosaic and tiling, which is fire-proof, easy to keep clean, and practically everlasting. For the flooring of the operating rooms, hard wood has hitherto been used, but rubber tiling is to be adopted in future. Although the rubber tiling costs more in the first place, it is much quieter than a wood floor, and more economical to keep clean than

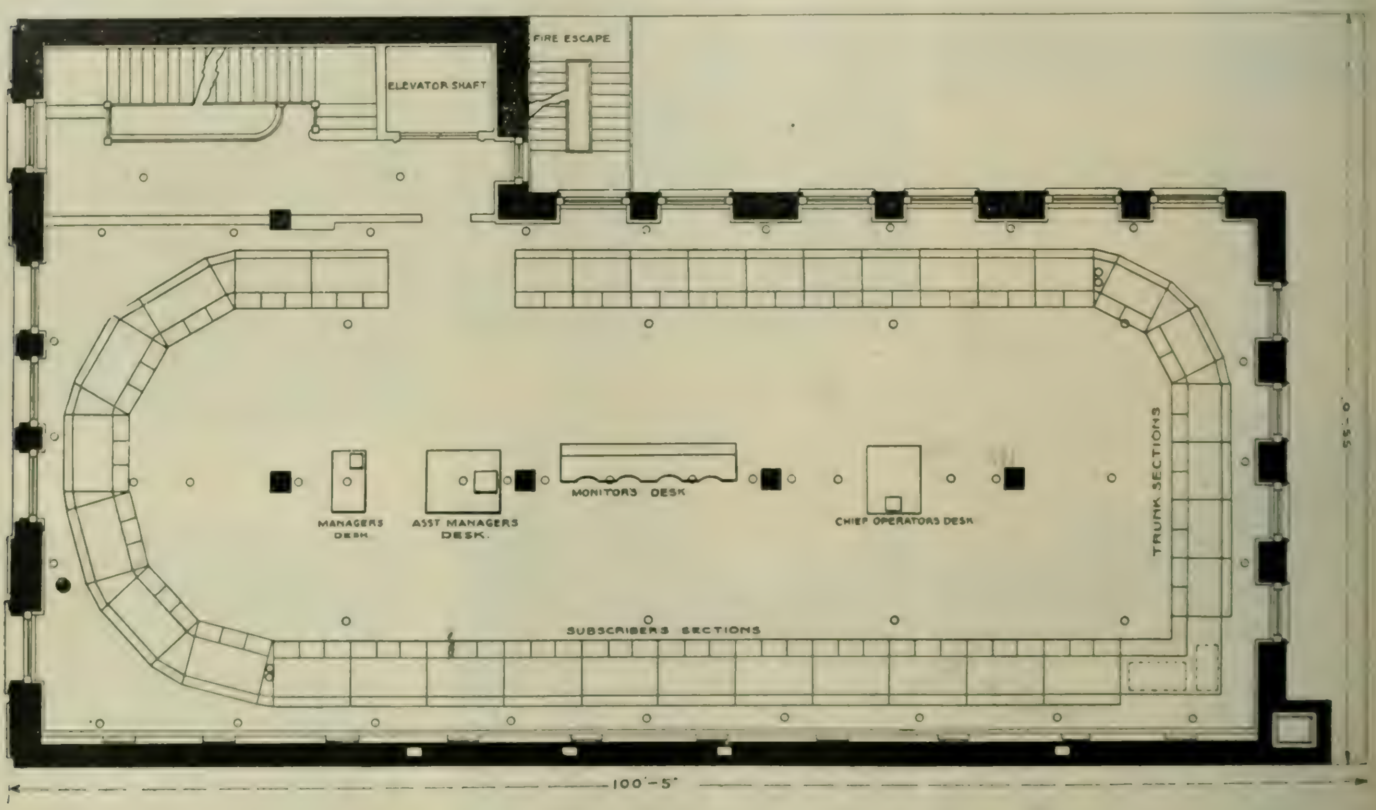


Fig. 10.—Fourth Floor Plan, Plaza Central Office.

the parquetry flooring, which requires much care and attention to keep in good condition, if there is any traffic. The stairways are of iron and marble with iron balustrades.

In planning a telephone building, there are two important points to keep forward, besides the prime necessity of rigorous fire-proof construction; these are, great strength of flooring in order to carry the concentrated weight of the terminal equipment and power plant and of the switchboard; and the greatest possible amount of unencumbered space on each floor, that is, freedom from pillars, columns, projections and recesses. The architect responsible for the New York telephone buildings has been singularly successful in meeting these requisites. In the spacious terminal and operating rooms of the new exchanges there is such a clear range of vision in all directions that one accustomed to the modern office building of the grated packing-box variety is tempted to wonder where the support comes from. The floors of the regulation office building are designed to support a maximum weight of 100 pounds to the square foot. In the telephone buildings just double this, 200 pounds to the square foot, is provided for. In the way of minor details, great care is exercised to avoid construction that will harbor dirt and dust, and to eliminate inflammable material; the walls are made entirely smooth, the ordinary wood trimming and wainscoting being dispensed with, and a marble surbase fitting tightly to the floor is substituted for the regulation wooden surbase. An additional fire precaution adopted in all the latest buildings is the adoption of metal

FIG. 17.—MT. VERNON CENTRAL OFFICE.

window frames, thus getting rid of one more inflammable fitting, and abolishing one risk of catching fire from the outside.

In the arrangement of the modern exchange, the old order of things has been entirely changed. The terminal room is brought down, both because its greatly enlarged equipment needs much more space than it formerly occupied, and also in order to bring the distributing board near to the exchange manhole, so as to make the house cable-run as short as possible. The drawing, which shows partly in section the arrangement of the new Plaza exchange, illustrates the most modern layout of a common battery central office. The terminal room is on the second floor, the end of the main distributing board being at the extreme front of the building. The cables are brought in from the exchange manhole in iron ducts, and are connected to the distributing board by pot-head joints, the length of cable run from the street vault or exchange manhole to

FIG. 18.—NEW ROCHELLE CENTRAL OFFICE.

the distributing board being a little over 20 feet. In the Thirty-eighth Street building, as originally equipped with the terminal room at the back of the top floor, the length of the cable run from the exchange manhole to the cable rack was about 200 feet; so it will readily be seen what a considerable gain is made in the important items of cables and house ducts by the new style of arranging a central office equipment. Following the main distributing frame, which in the drawing is hidden by the stairway and elevator shaft, come the relay racks and intermediate distributing frame, from which the house cables go up to the switchboards on the fourth floor, as shown clearly in the drawing. The two generating sets, a duplicate set always being provided for reserve, are at the rear of the room. The motor generators that furnish current for ringing, testing and signalling are mounted in a compact battery on a single bed-plate to the left, and the power switchboard and fuse panels are mounted parallel with the length of the room with a clear space in front, the storage battery running across the room at the extreme rear. The only part of the terminal room equipment not indicated in the drawing is the wire chief's desk, which, like the distributing frames, is hidden by the elevator shaft and stairway. The floor plans show the complete arrangement of each floor of the exchange. The floor above is occupied exclusively by the operators' quarters. The New York Telephone Company has always made it a practice to provide the operating staff at each exchange with comfortable and spacious quarters in which to spend the time when the operators are not on duty at the switchboard. Like other departments of the central office, these operators' quarters have steadily improved in various details, and in the newer exchange buildings they need only a little more decoration to be positively luxurious. As it is, they are eminently practical, and have the solid luxuries of perfect cleanliness, light, ventilation and spaciousness. The operators' quarters are divided into three main departments; the locker room, equipped with steel wire lockers, in which the operators keep their hats and wraps, as well as their individual telephone sets when off duty; the dining room, furnished with ample dining tables and chair accommodation, and equipped with urns from which the matron in charge supplies the operators with tea, coffee, etc., the operators providing themselves only the solid parts of their meals; and the reading room, comfort-

ably furnished to serve as a resting place for the portion of the staff off duty, and kept supplied by the company with newspapers and current periodicals. In addition to these departments there is a special room, to serve as a sick-bay in case of sudden illness, and lavatory accommodation on an ample scale. A further illustration of the care that is taken to insure the best possible conditions for the operating force is the method of ventilating the operating rooms. A ventilating plant is installed in every building, which delivers constantly to the operating room a supply of fresh air. The air is filtered to deprive it of dust, and is humidified and warmed according to the weather conditions. This results in practically perfect ventilation of the operating rooms, which, as may be easily understood, are difficult to ventilate satisfactorily by the ordinary methods of windows and skylights.

The operating room occupies the whole of the top floor, which gives a clear and spacious apartment nearly 100 feet by 50 feet, amply lighted by windows and skylight. The switchboard, as shown in the drawings, is divided into two parts, one containing all the subscriber sections, and the other all the incoming trunk sections. The equipment of subscriber and incoming trunk sections under the common battery system is so different—practically the only common feature being the multiple jacks—that in modern practice the two switchboards are made entirely separate, the multiple cables branching to each length of switchboard from a common point called a cable-

FIG. 19.—TARRYTOWN CENTRAL OFFICE.

turning section. The capacity of the Plaza exchange is 9,600 lines, about the same as that of the new Cortlandt central office recently described in ELECTRICAL WORLD AND ENGINEER, and the equipment will be practically of the same style as that installed at Cortlandt Street

The buildings for the new Harlem, Morningside, Orchard and Chelsea offices will be of the same general type as the Plaza building, the only difference being those due to the varying size of the lots. The Chelsea building will be the largest of the five, and will be U-shaped, that being the design adopted whenever the shape and size of the building lot permit. This building will contain, be ides the central office plant, the repair shop, now outgrowing its quarters at Gold Street, a laundry, and, possibly, other departments required to meet the company's varied and ever-increasing needs.

In illustration of the importance of the power plant and terminal equipment and the large amount of space now required for their accommodation, it may be mentioned that in the buildings now in service the terminal room space amounts to over 28,000 square feet, as compared with 48,000 square feet of operating room space. The terminal and power plant, therefore, now takes up nearly 60 per cent. as much space as the switchboards themselves, and the operators' quarters occupy space nearly in the same proportion. These figures show strikingly how the layout of a telephone exchange has been transformed during the last few years. The point is even more forcibly illustrated, however, by the drawings of the Plaza exchange, which show that the amount of space occupied by the operating room, terminal room and operators' quarters is practically the same. The area occupied by a telephone building has always necessarily been governed by the space required for the operating room, and when the operating room was practically the sole point to be considered as regards the telephone plant, the building was designed so that the space between the basement and the operating room could be used for offices, and rented to tenants when not required for telephone offices. Now, the telephone plant and staff require practically the whole building and a telephone building nowadays is a telephone building pure and simple. In fifteen buildings now in use, the central office equipment occupies a total of 115,000 square feet—nearly three acres of telephone exchange in a single city

North of the Harlem River there are several interesting telephone buildings, the largest and most interesting being the new Melrose building in East 150th Street. In Westchester County, Mount Vernon, New Rochelle, Tarrytown and Yonkers, all have special telephone buildings. The New Rochelle building has been in service several years, those at Tarrytown and Mount Vernon are quite new, and the Yonkers building is now approaching completion. Each of these is a telephone building exclusively, containing nothing but telephone plant and telephone offices. In each of the Westchester buildings is a branch of the contract department for attending to new business and general relations with the public, and a branch of the maintenance department. The Mount Vernon building, equipped with a common battery exchange, contains the headquarters offices of the Westchester Division, and very spacious, light and airy offices they are, arousing rather a spark of envy when one compares them with the accommodation one has to put up with in the heart of Manhattan. The Yonkers building will also be equipped with a common battery exchange. The new Melrose building merits a description by itself, as it is a highly interesting telephone building. It contains, besides a common battery exchange of an ultimate capacity of 7,200 lines to serve the Melrose district of The Bronx, a special equipment occupying a whole floor for handling the Westchester trunks, hitherto operated at a special board in the Harlem exchange. The new Westchester switchboard has several novel features, notably an automatic ticket-distributing system for conveying the toll-checks from the recording operators to the positions of the operators charged with making the connections.

Insurance on Automobiles.

Fire insurance companies are reported to be declining risks on automobiles. The president of a large fire insurance company is quoted on the subject, as follows: "To make an adequate rate on automobiles it is necessary to consider the machines under separate headings, relating specifically to the machine itself, without foreign considerations, then the increase in hazard of the building and contents containing the automobiles. To consider the question of automobiles as it applies separately to the make-up of the rate it is necessary to consider the several different styles of machines, o which, naturally, the electric machine is the safest, no appreciable hazard arising from such power. The gasoline, which is next, increases the hazard in the same ratio as to the quantity of the fluid necessary to its operation, not only in the tank of the machine itself, but to the increased hazard of the storage of the fluid and the constant dripping on the floors, making the entire contents dangerous. The steam machines are perhaps the most dangerous, as this style requires not only the presence of gasoline in bulk, but the increased hazard of the pressure tank containing gasoline under pressure at 40 to 60 pounds, by which it is forced to the burner, and the presence of the naked flame, which, should any derangement of the regulator or leak occur, would be likely to create a blaze of dangerous extent. The continued flow of gasoline when the flame is extinguished, and the method of igniting also make this system extra hazardous."

Ohio Electric Light Association.

The next annual meeting of the Ohio Electric Light Association will be held at Columbus, Oct. 14, 15 and 16. This is one of the most successful State associations, and a large attendance is expected.

The Magnetic Properties of Iron and Steel at Liquid Air Temperatures.

BY C. C. TROWBRIDGE.

LIQUID air has been the means of extending research in the various branches of physics to extremely low temperatures. Among the investigations of industrial importance that have been made are those relating to the effect of low temperatures on the magnetic properties of iron and steel. It is the purpose of this article to give a brief account of these investigations and the results obtained. A statement first in regard to the temperature of liquid air will not be out of place, and an account of the results of measurements of the peculiar magnetic property of liquid oxygen should be of interest.

THE TEMPERATURE OF LIQUID AIR.

If a quantity of atmospheric air is liquefied its temperature becomes — 191.4° C. at normal pressure. Liquid air, however, changes in composition when it is boiling, the percentage of nitrogen in it diminishing while that of oxygen increases. This change occurs because the boiling point of liquid nitrogen at atmospheric pressure is — 194.4° C. and that of liquid oxygen — 181.4° C., and the former liquid boils away at a higher rate than the latter. It follows that boiling liquid air also changes in temperature. If liquid air is allowed to boil for a considerable time its temperature gradually approaches that of liquid oxygen, — 181.4° C., but when it is used for experimental purposes its temperature is usually about — 185° C. The temperature of the liquid air is, therefore, at least 200° C. below normal room temperature, which is generally considered 20° C. This difference gives a wide range of temperature for experimental purposes. In addition, opportunity is offered of studying the properties of materials at the very low temperature of — 185° C. While considerably lower temperatures than this have been obtained by Professor James Dewar and others, research in this direction has been confined mainly within the low temperature limit mentioned.

A number of investigations on the effect of low temperatures on the magnetic properties of iron and steel have been made, liquid air being employed to cool the specimens tested to about — 185° C. These have been on the strength of permanent magnets and on magnetic permeability and hysteresis in iron and steel. The results of these investigations will be presented separately. Experiments of this nature are of industrial importance, for they will unquestionably lead to a more definite knowledge of the molecular change in iron and steel when subjected to magnetic influences. It is to such experiments that the great progress in practical electricity is primarily due. The subjects to be presented will be taken up in the following order:

1. The magnetic permeability of liquid oxygen and liquid air. 2. Experiments at low temperatures on permanent magnets. 3. Magnetic permeability and hysteresis in iron and steel at low temperatures. 4. General summary of the results of the experiments described.

MAGNETIC PERMEABILITY OF LIQUID OXYGEN AND LIQUID AIR.

The magnetic permeability of liquid oxygen as compared to that of other liquids is very high, as can be seen from the results of an investigation of Fleming and Dewar, who have studied the magnetic permeability of liquid oxygen and liquid air. They find that the magnetic permeability of liquid oxygen is 1.00287. This number is the ratio of the magnetic permeability of liquid oxygen to that of cold gaseous oxygen, and by the same method used in the given determination no difference was detected between the magnetic permeability of gaseous oxygen at — 182 C. and at normal temperatures. The value 1.0024 was obtained for liquid air, its magnetic permeability being chiefly due to the liquid oxygen it contained.

A short table is given herewith to show a comparison of the magnetic permeabilities of various liquids. The values for permeability (μ) were calculated by the use of the formula $\mu = 1 + 4 \pi \kappa$ from determination of magnetic susceptibility (k) of liquids made by various investigators. The value for susceptibility for liquid oxygen is about four times as great as that for ferric chloride, one of the most magnetic of the iron salts, the magnetic permeability of which is given third in the following table:

Table I.—Magnetic Permeability of Various Liquids.

Liquid.	*Permeability* (μ).	*Determined by*
Liquid air	1.00287	F. & D.
Liquid oxygen	1.00240	F. & D.
Ferric chloride (Sat. Sol.)	1.00072	Townsend.
Manganese chloride	1.00019	Wähner.
Cobalt chloride	1.000038	"
Nickel chloride	1.000023	"
Water (D .9993)	.999993	

All of these values are, however, far below that of the so-called non-magnetic iron alloys. Twelve per cent. manganese steel, usually called non-magnetic, has a magnetic permeability of 1.3 to 1.4.

An important note relating to the investigation on the magnetic permeability of liquid oxygen, by Fleming and Dewar, has been published by the authors, and is as follows: "In connection with the above investigation, it is interesting to note one remarkable difference between the magnetic susceptibility of oxygen in the liquid and in the gaseous state. The mass of 1 c.c. of gaseous oxygen, taken at 15° C. and 760 mm, is 0.00134 gramme. The mass of 1 c.c. of liquid oxygen, taken at —182° C. and 760 mm, as determined by one of us (J. Dewar), is 1.1375 gramme. Hence the ratio of the density of liquid oxygen to that of gaseous oxygen is 849 to 1.

"The magnetic susceptibility of gaseous oxygen at 15° C. and 760 mm, as obtained from the figures given by Faraday and E. Becquerel, is 0.143×10^{-6} per unit of volume, whilst the magnetic susceptibility in the liquid state is, as we have shown, $228 \times {}^{-6}$. Hence the ratio of the magnetic susceptibility of liquid oxygen to that of gaseous oxygen for equal volumes is 1594 to 1.

"In other words, the magnetic susceptibility of liquid oxygen is nearly twice as great as that of gaseous oxygen of equal masses. The inference is that magnetic susceptibility is not merely a property of the molecule *per se*, but is a function of the state of aggregation."

EXPERIMENTS ON THE STRENGTH OF PERMANENT MAGNETS.

Dewar has investigated the effect of lowering the temperature of permanent magnets to — 182° C. and determining their magnetic moments at + 15° and — 182° C. through several cycles of temperature change between these limits. Subsequently, more extensive experiments of the same nature were performed by Dewar and Fleming together. Among the conclusions reached by them are the following:

"1. That the sudden cooling to the temperature of liquid air usually permanently decreases the magnetic moment of short magnets made of many varieties of steel, assuming them to have been magnetized initially in a strong field.

"2. This initial decrease is found both in hardened steels having great coercive force and also in the same steels in a soft or annealed condition, and especially conspicuous in the case of the 19 per cent. nickel steel.

"3. In the case of most steels so far examined the effect of cooling magnets made of them to — 185° C. is to temporarily increase the magnetic moment after the permanent magnetic condition has been reached.

"4. The exceptions of the above rule so far noted are the nickel steels with percentages of nickel from 19 to 29 per cent., in which case the magnetic moment is always decreased temporarily by cooling to — 185° C. after the permanent condition has been reached."

In the experiments just referred to, performed by Dewar and Fleming, the steels tested were magnetized at normal temperatures and then subjected to temperature changes through the range + 15° to — 185° C.

The writer has recently made a series of experiments with permanent magnets which were magnetized at the temperature of liquid air. (— 185° C.) The magnetic strength of the magnets were shown by their magnetic moments determined by means of a magnetometer. The magnetic moments obtained by magnetization at approximately — 185° C. were compared with the magnetic moments of bars of the same steel obtained by magnetization at normal temperature, 20° C. The change of magnetic strength produced by heating bar magnets to 20° C. which had been magnetized at — 185° C. was determined also and compared with the change produced by cooling magnets of the same steel to — 185° C. which had been magnetized at 20° C. The experiments were chiefly confined to carbon magnet steel and

tungsten magnet steel. Among the results obtained were those given below, which are shown for convenience in tabular form.

In these experiments the initial change of magnetic strength or the first gain or loss in the magnetic moment, accompanying the first change of temperature of the bars of steel after they were magnetized was determined, because it has been shown that the change of magnetic strength of a permanent magnet due to a change of temperature depends partly on the previous history of the magnet. Special care was taken not to jar the magnets throughout the experiments, and also to determine their magnetic moments immediately after magnetization.

Three bars of carbon steel, size 83 x 10 x 3 millimeters, weighing 24.45 grammes, were heated together to a red heat and then hardened in water at 20° C. They were magnetized at — 185° C. and then immediately warmed to 20° C. The magnetic moments at these temperatures were as follows:

Table II (a).—Carbon Steel Magnetized at — 185° C.

Magnet.	*Magnetic Moment at — 185° C.*	*Magnetic Moment at 20° C.*	*Difference (Loss).*	*Percentage (Loss).*
1	211	131	80	37.9
2	202	140	62	30.6
3	211	147	64	30.3
Mean	...	...	..	32.9

Another bar of this steel of the same dimensions and weight as the magnets 1, 2 and 3 and hardened with them, was magnetized at 20° C. and then immediately cooled to — 185° C. The magnetic moments at 20° C. and — 185° C. were as follows:

Table II (b).—Carbon Steel Magnetized at 20° C.

Magnet.	*Magnetic Moment at 20° C.*	*Magnetic Moment at — 185° C.*	*Difference (Loss).*	*Percentage (Loss).*
4	208	189	19	9.1

It is evident that the initial loss in magnetic moment due to change of temperature when the steel is magnetized at — 185° C. and then warmed to 20° C. is much greater than for the reverse operation, although in either case, a considerable loss in the magnetic moment is the result of a change in temperature of the steel of 205 degrees.

These carbon steel magnets, 1, 2, 3 and 4, were allowed to rest undisturbed for nine days at approximately constant temperature (room temperature in April). Their magnetic moments were then determined, and are given in Table III.

Table III.—Carbon Steel: Total Change of Magnetic Moment at the End of Nine Days.

Magnet.	*Original Magnetic Moment.*	*Magnetic Moment After 9 Days.*	*Difference (Loss).*	*Percentage (Loss).*
1	211	127	84	39.8
2	202	136	66	32.6
3	211	138	73	34.6
4	208	170	38	18.2

Magnets 1, 2 and 3 were magnetized at — 185° C. and then warmed to 20° C. The total loss of magnetic strength of these magnets since magnetization was approximately twice as much as magnet 4, which was magnetized at 20° C., cooled to — 185° C. (with a loss of 9.1 per cent.), and then warmed to 20° C. again.

Tungsten Steel from Sheffield.—Three bars of tungsten steel, sizes 89 x 2 x 3 millimeters, each weighing 5.05 grammes, were hardened together in water at 20° C. They were magnetized at — 185° C., and then warmed to 20° C. The magnetic moments at the two temperatures were as follows:

Table IV (a).—Tungsten Steel Magnetized at — 185° C.

Magnet.	*Magnetic Moment at — 185° C.*	*Magnetic Moment at 20° C.*	*Difference (Loss).*	*Percentage (Loss).*
1	212	179	33	15.5
2	228	192	36	15.7
3	232	206	26	11.2
Mean	...	...	..	14.1

A bar of this steel, hardened with magnets 1, 2 and 3, was magnetized at 20° C. and then cooled to — 185° C. The magnetic moments obtained were as follows:

Table IV (b).—Tungsten Steel Magnetized at 20° C.

Magnet.	*Magnetic Moment at 20° C.*	*Magnetic Moment at — 185° C.*	*Difference (Loss).*	*Percentage (Loss).*
4	213	200	13	6.1

Bundle of iron wires (not pure iron), 9 cm. long, heated to a red heat and cooled in air at 20° C., magnetized at — 185° C., and then warmed to 20° C., showed the following loss of magnetic strength:

Table V.—Iron Wire Magnetized at — 185° C.

Magnetic Moment. at — 185° C.	*Magnetic Moment. at 20° C.*	*Difference (Loss).*	*Percentage. (Loss).*
22.3	13.5	8.8	39.4

Another fact is shown by these experiments; approximately the same magnetic moment is produced, whether the steel is magnetized at 20° C. or — 185° C., other conditions being equal. This is evident from a comparison of the magnetic moments obtained after magnetizing steel bars at — 185° C., with the magnetic moment obtained after magnetizing a bar of the same steel at 20° C.

Table VI.—Carbon Steel, Magnetized at — 185° C. and at 20° C.

Magnet	*Magnetized at*	*Magnetic Moment*
1	— 185° C.	211
2	— 185° C.	202
3	— 185° C.	211
4	+ 20° C.	208

Table VII.—Tungsten Steel, Magnetized at — 185° C. and at 20° C.

Magnet	*Magnetized at*	*Magnetic Moment*
1	— 185° C.	212
2	— 185° C.	228
3	— 185° C.	232
4	+ 20° C.	213
5*	+ 20° C.	232

*5 magnetized previously at — 185° C.

The writer's experiments on the magnetization of steel at liquid air temperatures seem to warrant the following general conclusions.

1. That approximately the same magnetic moment is obtained whether a bar of tungsten steel or carbon steel is magnetized at normal or at liquid temperature, other conditions being equal. This is evident from a comparison of the magnetic moments obtained after magnetizing steel bars at — 185° C., with the magnetic moment obtained after magnetizing a bar of the same steel at 20° C.

2. That the initial loss in the magnetic moment, due to change of temperature, of a bar of steel magnetized at 185° C. and then heated to 20° C. is much greater than when the bar is magnetized at 20° C. and then cooled to — 185° C., a considerable loss occurring in both cases.

3. That there is a certain amount of unstable magnetism in a newly made steel magnet, which tends to permanently disappear at the first change of temperature in either direction from that at which magnetization takes place, much more of the unstable magnetism passing off by heating than by cooling.

Concerning these results, Mr. F. A. Griffin makes the following suggestions, that "In the light of the molecular strain hypothesis, the fact that molecular rigidity increases with descending temperatures may explain the relative rapid recovery, *i. e.*, decrease in magnetic moment of those bars which were magnetized at lower temperatures. In other words, the strained condition of a magnetized cold bar is relatively artificial, and any rise in temperature tends to leave its molecules free to respond to the restoring action of internal stresses. It would appear that the molecular moment due to the magnetic field was large in comparison with the opposing intermolecular moment developed in the bars under experiment; this would make the magnetic moment independent of the temperature." This assumption is, of course, meant to refer to the initial magnetic moment, or

that immediately after magnetization, and it seems most probable that it would be found to be true for strong magnetizing forces, while, perhaps, not for those that are very weak.

It is necessary here to call attention to the fact that in several cases mistakes have been made by writers in stating the results of investigations on magnetism at low temperature. Among these is the following statement, taken from Thompson's "Elementary Lessons in Electricity and Magnetism." Edition of 1901, p. 104.

"Trowbridge found severe cooling at 100 degrees below zero to destroy the magnetism of steel magnets; but Dewar has observed that when cooled to —185° C. in liquid oxygen, the magnetic properties of the iron are nearly twice as high as at 0° C."

What Professor John Trowbridge found was as follows: That a bar magnet magnetized at 6° or 8° C. when cooled from 4° C. to —25° C. lost less than 4 per cent. of magnetism. For a greater reduction of temperature, to about —80° C., a far greater percentage loss of magnetism was observed. In one case a bar magnet magnetized to saturation lost 66 per cent. of its magnetism.

The latter part of the statement quoted above probably refers to an investigation of Fleming and Dewar, on the permeability of iron and steel at liquid air temperatures, the results of which are given below.

PERMEABILITY AND HYSTERESIS LOSS OF IRON AND STEEL AT LOW TEMPERATURES.

Fleming and Dewar found in an extensive series of measurements that the magnetic permeability of annealed soft Swedish iron decreased when cooled to low temperature, but that the permeability of unannealed Swedish iron increased as the temperature diminished. In the case of hardened iron, the permeability increased several hundred per cent. when the iron was cooled to liquid air temperature. These results were for both weak and strong magnetizing forces.

A steel pianoforte wire behaved the same as annealed soft iron; when a strong magnetizing force was used its permeability decreasing over 50 per cent. when cooled from 0° to —200° C.

These investigators found that for various induction densities the hysteresis loss was the same at —186° C. as at normal temperature. Curves showing affect of low temperatures on magnetic permeability of iron and steel, according to Fleming and Dewar, are given opposite.

T. Claude has also studied the magnetic properties of iron at low temperatures. According to his experiments, for high induction densities, the permeability and hysteresis loss of iron are the same at —186° C. as at 20° C., except for a slight tendency toward diminution at the low temperature.

For low induction densities the permeability and hysteresis loss diminish with the temperature to a marked extent.

A. H. Thiessen has investigated the hysteresis of iron and steel at 100° C., 20° C. and that obtained by using solid CO_2 (about —80° C.) He found that for soft wrought iron, the hysteresis losses increase with decreasing temperature when the maximum magnetizing force causes approximate magnetic saturation, and that the reverse is true for low magnetizing forces.

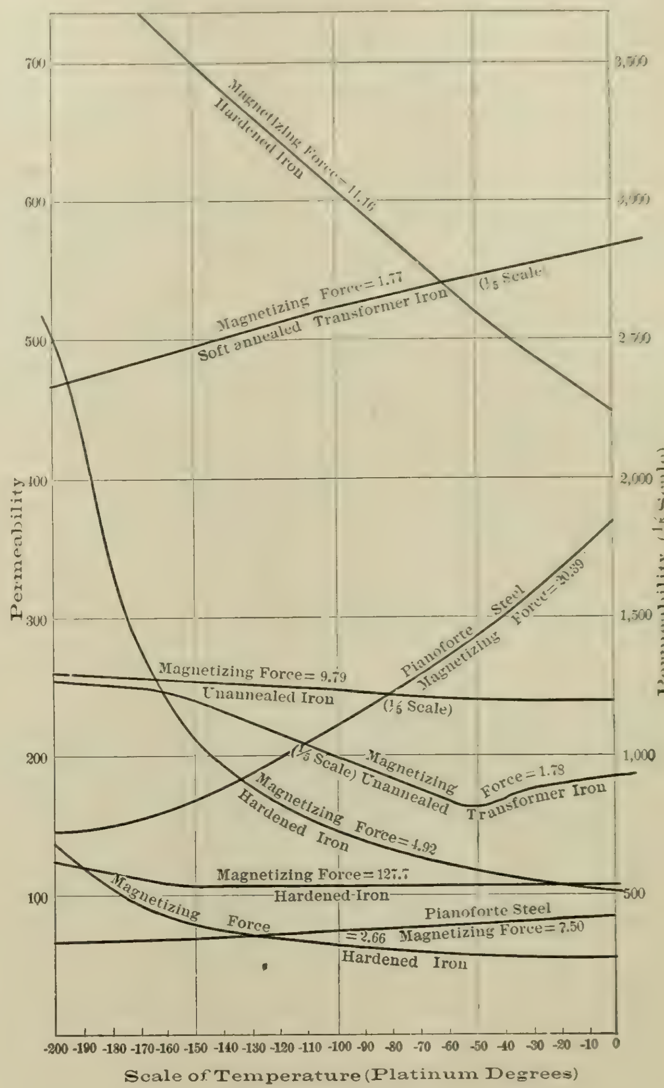
The same effects of temperature are found for annealed crescent tool steel.

In the case of 5 per cent. nickel steel, for a maximum magnetizing force, the hysteresis loss likewise increased as the temperature diminished. While these results are in agreement with previous determinations at very high temperatures, they are not in agreement with the results of Fleming and Dewar and Claude, who found that the hysteresis loss of soft iron was the same at 20° C. and about —185° C. Thiessen, however, did not experiment below —80° C. Fleming and Dewar refer to the experiments of Lows and Warren, who found that the hysteresis loss in very soft steel began to decrease only after the material was heated to above 150° C.; after that it decreased regularly in accordance with the simple linear function of the temperature.

In one experiment which Lows and Wrren tried with the same material cooled to —78° C. in solid carbonic acid and ether, they found no difference between the hysteresis loss of soft steel at that temperature and at normal temperatures.

The results of these experiments clearly indicate that determinations of the magnetic properties of iron and steel at different temperatures largely depend on the composition and the degree of hardness of the samples tested. It is most probable that the difference in the results of the experiments cited above is due to a difference in the material used in the tests and the conditions of the experiments, rather than any mistakes on the part of the investigators.

It will be difficult to formulate laws in regard to the magnetic properties of iron and steel at very low temperatures, unless the complete analysis of the material and the thermal and the mechanical treatment of the sample immediately previous to the experiment are known.



CURVES SHOWING EFFECT OF LOW TEMPERATURE ON MAGNETIC PERMEABILITY OF IRON AND STEEL.

GENERAL SUMMARY OF THE RESULTS OF THE EXPERIMENTS DESCRIBED.

The credit of the greater part of the work done thus far on magnetism at low temperatures is due to Professors James Dewar and J. A. Fleming, who have made a number of investigations together in England. Work has also been done by Professor T. Claude, in France, and the writer in this country.

A brief general summary of the results of the experiments described is given below. The investigations made, while not entirely conclusive in some cases, seem to indicate the following facts:

1. It appears that liquid oxygen has a magnetic permeability that is considerably higher than other liquids, but far below the magnetic permeability of the so-called non-magnetic iron alloys, and that, at least in the case of liquids, magnetic susceptibility is a function of the state of aggregation rather than merely a property of the molecule *per se*.

2. That the magnetic moment of a permanent steel magnet is independent of the temperature at which magnetization takes place, and that a change of temperature in either direction after magnetization will cause a permanent loss in the magnetic strength of the magnet, the amount of this loss depending upon the composition and the hardness of the steel and the number of degrees change in temperature to which the bar is subjected.

It is also evident that steel magnetized at liquid air temperature in a strong field becomes saturated magnetically almost instantly, as it does at normal temperatures. That when a magnet has been subjected to a series of temperature changes, has lost some of its initial magnetic strength and has reached a permanent condition, that cooling (to liquid air temperature) causes an increase in the magnetic moment, and that heating diminishes the magnetic moment. That steels containing 19 to 29 per cent. of nickel behave in an exceptional manner, for the effect of cooling them to — 185 degrees is to temporarily decrease the magnetic moment after the permanent magnetic condition has been reached.

3. That the magnetic permeability of annealed soft iron is less at liquid air temperatures than it is at normal temperatures, but if the iron is hardened then the magnetic permeability becomes greater at the low temperature. Highly tempered steels, however, appear to behave like annealed soft iron, the low temperature having the effect of diminishing the magnetic permeability.

4. Two separate investigations have thus far been made on the effect of liquid air temperatures on the hysteresis loss in iron for high induction densities. The results obtained are in agreement and indicate that the hysteresis loss is the same at normal and very low temperatures.

Underground Work for Telephone Exchanges—I.

By Arthur V. Abbott, C. E.

WIRE PLANT.

STRETCHING between the substations and the central office extends the wire plant, an enormous copper net-work, outrivaling in intricacy and complexity the elaborate creations of the most ingenious of the geometricidæ. Unfortunately in the construction thereof the telephonic arachnid cannot in the least depend upon any inherited instinct like his crustaceous confrere, but must design and spin his web on what grounds of logic and probability he may, trusting to the future to justify or condemn the result.

To deal with the conducting system in a comprehensive manner, it is convenient to analyze it according to the following table:

Table No. 1.

- Wire Plant.
  - Type.
    - Aerial.
      - Open wire.
      - Cables.
      - Distribution.
        - House top wire.
        - Pole lines.
        - Back lot lines.
    - Underground.
  - Quantity.
    - Block system.
    - Multiple terminal system.

It is now proposed to describe in a general way each of the preceding heads, to supplement these descriptions by detailed specifications under which, with such modifications as would be necessitated by changes in time and location, a wire plant could be constructed, and finally, subject to the specifications, to calculate the wire plant cost.

Considering the table, it is seen that the first subdivisions are those of "*Type and Quantity*," The quantity of wire plant needed will depend on the area of the district, number of stations to be served and the method of distribution, but as the total cost of the plant is a question of both *Type and Quantity*—for example, underground wire if there is a sufficient amount will cost less than one-third as much per wire mile as overhead wire—it is well to commence the analysis with a consideration of the various types.

UNDERGROUND PLANT.

Historically it is hard to assign priority to either underground or aerial construction, for the original experiments of Morse on the Baltimore-Washington line were commenced with a gutta-percha covered wire buried in a trench dug in the earth. The means at the command of Morse were inadequate to secure permanent insulation, and as a temporary expedient the first telegraph line was strung on poles. Contrary to expectation this device yielded satisfactory results, immediately becoming standard practice, and—with the exception of subaqueous cables—the sole method until the middle 80's, when the introduction of the electric light and the rapidly extending use of both telegraph and telephone required the erection of pole lines of such enormous dimensions as, on the one hand, to become impractical from both a constructive and maintenance standpoint to the operating company, and on the other, an unbearable nuisance and encumbrance to city thoroughfares. Some method of relief was necessary, and the only conceivable one was that of placing the objectionable circuits underground. Early inventors attacked the subterranean wire problem from two standpoints; one class followed the example of the Atlantic cable designers, attempting to manufacture all kinds of electric conductors into cables having sufficient mechanical strength to protect the enclosed circuits from injury, either during the process of laying or subsequently thereto. On this plan the finished cable is the entire structure, merely needing to be dropped into the trench dug in the highway and covered up. Such so-called "*Built-in Systems*" have found considerable favor for telephone and telegraph installations in Europe, but in America it has appeared too difficult and too expensive to make proper cable to withstand the predatory pickaxe of the average street paver, and, further, after completion such systems are found so inelastic and lend themselves so reluctantly to any changes in distribution, that this plan has only found extensive favor with the low-tension multiple-wire distribution of the Edison companies, and in the Edison tube has reached its highest and most extensive development. For telephone work, therefore, "Built-in Systems" need no further exposition.

The other set of inventors conceived the idea that the true solution of the problem consisted in building a good substantial "*hole*" in the street into which the circuits could be introduced and removed at pleasure, and strong enough to amply protect from all outside interference the contained conductors; requiring the cable only to maintain the requisite electrical insulation. The "*Drawing-in Systems*," therefore, while requiring a greater expenditure both initially and finally in street structures, reduce to a minimum cable cost, permit of easy rearrangement, minimize maintenance, and so have furnished a method that is sufficiently elastic to meet requirements of the service. For these reasons the various conduit systems have, with the exception of the low-tension Edison net-works, been adopted for all kinds of electrical distribution in cities of any magnitude, and their manifold advantages are causing extensions of underground wire plants into even the smaller towns.

FORMS OF CONDUIT.

From an engineering aspect, and from the broad idyllic standpoint of that which will produce the greatest good to the greatest number, the typical "*hole*" or conduit is a subterranean tunnel, large enough to permit workmen to have access from end to end, and so designed as to accommodate every form of subterranean structures—gas, water, electric wires of all kinds, steam pipes, pneumatic tubes, sewer facilities, etc., etc., that are needed in the modern city. The Parisian sewer system is the only one in which even a partial attempt has been made to approximate to this end. In all other cases the expense of such construction has made it impossible of realization without the concerted action of all parties concerned therein, and this, owing to the many conflicting interests has not as yet proved feasible; consequently, in the main, each corporation has constructed its own subway as best it might, so that it is not unusual to find one or more sewers occupying the center of a street, several lines of gas pipe and water pipe extending along either side, while the telephone, telegraph, electric light conductors, with an occasionel pneumatic tube and steam heating pipe snugly nestle together, threading their way as best they may in whatever space remains.

The problem in conduit construction is to get the best hole for the least money. As electrical conductors are universally made up in cable form, possessing a considerable degree of flexibility, rarely

over 3-in. in diameter, the unit of conduit construction becomes a single duct, capable of accommodating one cable. In earlier days the plan of building ducts capable of containing several cables side by side gained considerable currency. So far as the introduction of the cable was concerned, no difficulty arose, but after a duct was filled with, say, three cables or more, and subjected for a considerable time to the impacting influence of the debris that in a most astonishing manner finds its way in the tightest conduit, it became a difficult or almost impossible matter to remove one cable without injuring or destroying the sheathes of the others. Thus, experience has declared itself so emphatically and unhesitatingly in favor of the individual cable space that no other form should for a moment be considered.

The present method of conduit building, therefore, resolves itself into obtaining a pipe-like structure or conduit material capable of enclosing the cable, making the necessary excavation in the street in which the ducts may be laid, the placing of the ducts in such a position as to produce a series of long longitudinal tubes, the protection of the duct material by some substance that shall resist the onslaughts of the ignorant pick and shovel, the refillment of the excavation and replacement of the paving.

The ideal conduit should be moisture proof and gas tight. It should be indestructible when laid in street soil, strong enough mechanically, so that the Tammany street paver may pick away at it until he is tired without inflicting any injury, easily, rapidly and cheaply laid, and while the ducts should present a smooth surface to the introduction of the cables, they must contain no substance that can injure the lead sheath. Finally, high electrical insulation is desirable as a protection against the electrolysis of the cable sheath, due to parasitic electric currents. There is no subway that perfectly fulfils all these conditions, though each conduit manufacturer optimistically claims that his particular brand will, but there are a multitude of different makers that in varying degrees realize a portion of the preceding conditions, while all of the manufacturers now offer a material which the telephone engineer may safely use, and which if carefully selected, and installed under rigid specifications, will yield a subway that is of practical utility in all respects—the selection between different duct material makers depending chiefly upon the relative prices quoted by their respective agents.

New York State Electrical Laboratory.

At the recent session of the New York State Legislature, an act was passed providing for the appointment of an Electrical Commission to investigate as to the necessity for the establishment of a State Electrical Laboratory, to provide independent, authoritative information on questions of electrical science, and an official standardizing laboratory for electrical measuring instruments, apparatus and standards for the protection of municipalities and the general public in the use of electrical energy and of the producers of electrical energy. The commission was directed to report to the Legislature at the opening of the session of 1903, and if, in their judgment, the establishment of such an electrical laboratory is necessary, to prepare and submit in connection with their report, detailed plans and specifications for the construction and equipment of a laboratory, accompanying the plans with a specific and detailed statement of the cost.

To carry out the provisions of this act, State Engineer Edward A. Bond, Mr. Charles P. Steinmetz, of the General Electric Company, and Mr. Harold W. Buck, of the Niagara Falls Power Company, were appointed the members of the Commission. Under date of August 15, the commission issued a circular letter asking for an expression of opinion from members of the electrical profession as to the proposed institution, its scope, organization, equipment and location, which we reprint below:

With the extension of the uses of electrical energy, which is rapidly taking place, public and private interests become more and more dependent upon electrical operations, and the need for an official institution, authoratative by its high standing and government relationship, becomes evident, to serve as arbitrator in disputes arising from conflicting interests, and for purposes of standardization.

The following is the capitalization of corporations in New York State engaged in business involving the use of electricity:

(a) Electric railroads, electric light and power stations, telegraph and telephone companies	$1,462,615,595
(b) Companies engaged in the manufacture of electrical apparatus	217,974,695
Total	$1,680,590,290

From these figures an idea can be obtained of the importance and extent of the interests involved.

In the present status of the distribution of electrical energy, disputes arise, among other causes, from the following:

1. From mutual induction, static or magnetic, between independent circuits, especially between circuits carrying large currents or high potentials and circuits used for the transmission of intelligence, such as telephone, telegraph, fire-alarm, railway block signals, etc.

2. Accidents to life resulting from conditions frequently not clearly understood at the time of accident, such as crossing of circuits, failure of insulation, etc.; also from insufficient warning notices on circuits of dangerous potential.

3. Between producers of electrical energy and public consumers, such as municipalities in street lighting contracts, involving the quantity of light supplied, the trouble arising from lack of officially standardized photometric methods.

4. Between producers of electrical energy and public and private consumers on the quantity of current or energy supplied, resulting from inaccuracy of meters or methods of measurement.

5. From electrolysis in railway and other grounded systems

6. From risk and damage to property from fire caused by defective insulation of circuits.

7. Between producers and consumers of electrical energy and Fre Insurance Underwriters on methods of installation.

8. Between independent interests having adjacent distributing circuits under ground from damage caused by heat in short-circuits in conduits and subways.

9. From damage caused by explosions in subways and conduits.

10. Between manufacturers of electrical apparatus and purchasers on guarantees for electrical performance.

11. Between producers of electrical energy and municipalities on the subject of transmission voltage of overhead circuits.

12. Between the producers of electrical energy and the general public in cases of rights of way for very high voltage transmission lines where danger to life and property is claimed.

13. Between the general public and manufacturers of electrochemical products where destructive fumes and gases are claimed to be set free in the process of manufacture.

14. Many other cases which will undoubtedly arise as the art advances, such as interference in wireless messages.

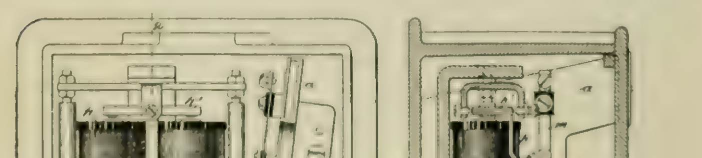
At present, all such disputes, when brought to issue, are settled by the courts, the decisions being based largely upon expert testimony, given by those who may or may not state with accuracy the facts involved. For such expert testimony large fees are required, which add greatly to the cost of settlement, and this obtains even in cases of the most simple and obvious decision. No authority exists which can be recognized by the courts as official, nor any institution where the points involved in such disputes could in many cases be made the subjects of actual demonstration by experiment.

In the establishment of a New York State Electrical Laboratory (which could serve as a precedent for similiar institutions in other States), it is proposed to organize an institution of the highest efficiency and widest scope, which shall be capable of dealing in an authoritative manner with all problems which may arise in the mutual interests of the people of the State; to have its equipment such that all phenomena in question can be reproduced on a large scale, and results under various conditions demonstrated; to have a complete set of standards for the calibration of all types of electrical meters; to have an electrochemical laboratory for demonstrations and analysis; to have the location of the institution such as to be central in the State and near to some large source of power, from which several thousand horse-power can be drawn at times for experimental purposes by a special transmission line; and, last, to have the institution presided over by a man of high standing and ability, assisted by a corps of competent assistants, who can carry out the work which will be called for by the people of the State, for merely its cost.

It is not the intention to have this State laboratory conflict with the Natural Bureau of Electrical Standards, at Washington, but to have it co-operate with it and attend only to such local matters in the State, which can more properly and conveniently be handled within the limits of the State.

Coin Collecting Telephone Stations.

The increasing popularity of message rate telephone service has created a lively demand for a satisfactory automatic coin-collecting box, which will enable the telephone user to pay as he goes, and will do away with the expensive and complicated machinery of accounting and collecting necessary in credit or even in paid-for-in-advance transactions. An automatic public station has always been an urgent need. Two recent patents bearing on this subject are of sufficient general interest to telephone men to merit somewhat extended description. Patent No. 704,268, issued July 8, 1902, to Joseph J. O'Connell, of Chicago, and assigned by him to the Western Electric Company, covers a coin-collector for telephone toll lines, and is an improvement on Patent No. 665,874, granted January 15, 1901, to Albert M. Bullard. In the Bullard device, the central office can be signaled from the subscriber's station only by the deposit of a coin in the toll-box, the coin serving to close together two contacts which control the circuit through the line-indicating device at the central office. The coin remains in the chute until the operator at the central office has ascertained whether or not the desired connection can be made, and an electromagnetic coin-distributing apparatus is provided whereby the operator may cause the coin at the subscriber's station to be either deposited in the cash-box; or in case the connection cannot be had, released and discharged from the toll-box through a return-chute. For this purpose a polarized electromagnet is employed whose armature is normally maintained in a central position, but is adapted to be tilted to one side or the other, according to the direction of the current flowing through the magnet-coils. The tilting armature is connected by lever mechanism with a swinging valve, which is located at the lower end of the coin-chute. The valve is normally maintained in a central position under the discharging end of the coin-chute, and acts as a stop against which the coin strikes in rolling down the chute, so that the coin is held at this point until the valve is moved out of the way. If the valve is moved to one side, the coin is allowed to fall out of the chute and is discharged either into the cash-box or into the return-chute, according to the side to which the valve is moved. The coils of the polarized coin-distributing electromagnet are included in a branch circuit to ground from one limb of the telephone line at the substation; and positive or negative current from a suitable grounded source at the central office may be thrown on the line by the central office operator to cause the magnet to attract its armature to one side or the other, according as



FIGS. 1 AND 2.—O'CONNELL COIN TELEPHONE STATION.

it is desired to deposit the coin in the cash-box or to return it. This grounded branch at the substation in which the magnet is included is also a portion of the circuit of the line-battery which operates the line indicators, and the two contacts before referred to, which are closed together by a deposited coin, control the continuity of the said grounded branch.

In order that the circuit through the coin-distributing magnet may not be broken and the armature of said magnet caused to flutter when the coin is released from the chute, Mr. Bullard provides a shunt around said contact, the shunt being controlled by relay contacts operated by the armature of the electromagnet, so that when the armature is thrown to one side and the coin released, the circuit through the magnet will not be interrupted, but a path for the current will be afforded by way of the shunt. In the O'Connell invention, the shunt is dispensed with, and, instead, mechanical means are provided whereby the two contacts which are initially closed together by the deposit of a coin are maintained in contact independent of the coin after the latter has been released.

Referring to the drawings, Fig. 1 is a view in elevation of the toll-box, Fig. 2 is a transverse vertical sectional view of the device

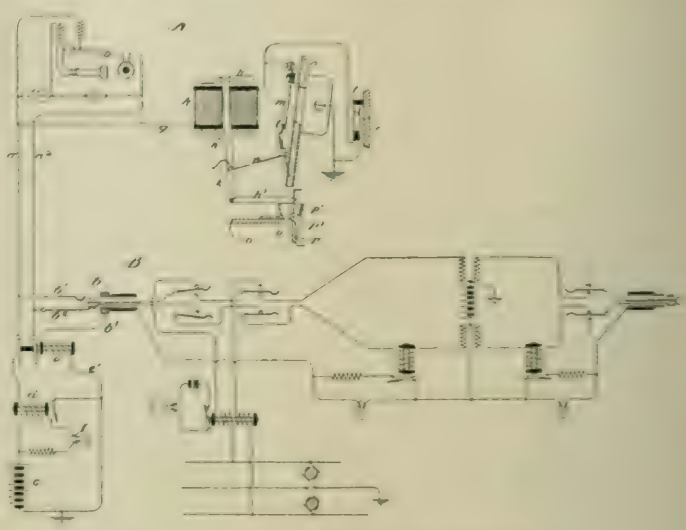


FIG. 3.—O'CONNELL COIN TELEPHONE STATION.

in Fig. 1; and Fig. 3 is a diagram of the circuits and of the principal parts of the coin-collecting mechanism. The central office apparatus shown in Fig. 3 is of the usual common battery system, with the addition of means whereby the operator can put either positive or negative current to limb a^1 of the telephone line. This line is connected at the substation with a grounded branch circuit, *g*, which includes electromognet *h*, and is normally open, being controlled by the coin-actuated contacts *l m*. The closing of these contacts may also be effected by the armature of *h*. The closing of *l m* energizes the line relay by grounded battery *c*, and signals the central office.

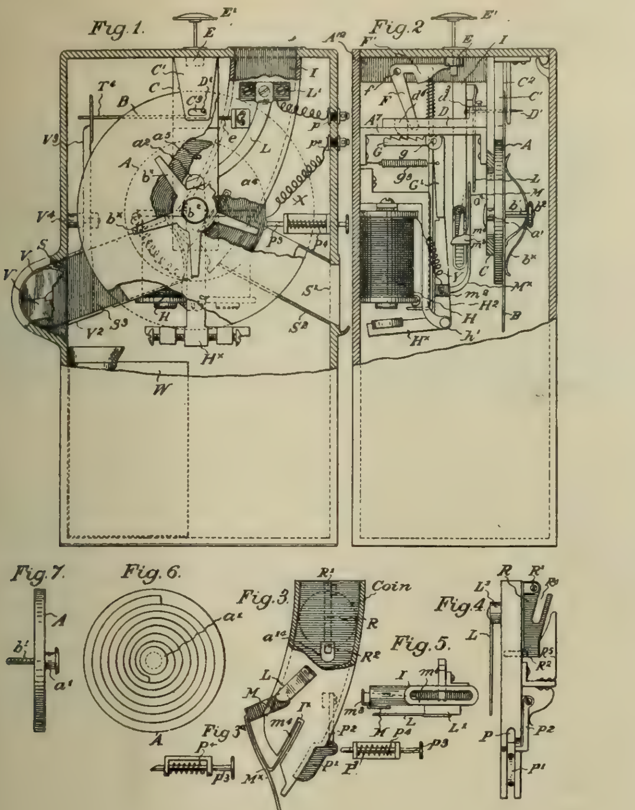
The coin-chute *a* is normally closed by the valve *i*, so that a coin dropped in *a* will be stopped at its lower end by the edge of *i*, which is pivoted so that it may be rocked by the armature h^1 connected to *i* by the rod h^2 and link h^3. A spring, *k*, fastened at the rear of the box, passes through h^2 and holds it and h^1 in a central position. Of the contacts *l m*, *m* is stationary and *l* is a rocking lever pivoted at the side of *a* with its end normally projecting into *a* so as to be in the path of the coin. The stationary contact, *m*, insulated from *a*, is connected to the branch *g* through *h*, and the rocking contact *l* is grounded. When a coin is dropped into *a* it brings up against *i* and presses on *l*, throwing its upper end against *m* and closing the circuit.

The means for mechanically maintaining *m* and *l* closed when the coin has passed the lower end of *l* consist of a cam-lever, *n*, pivoted at n^1 (Fig. 1), concentrically with *l*, having an upper curved end, n^2, engaging the upper end of *l* and a lower end, n^3, bent into cam shape and resting on the end of the spring *k*, passing through h^2. When h^2 is moved either to the right or left, *k* will bear on the cam surface, n^3 and so exert pressure at n^3, maintaining *l* in contact with *m*. If the armature of *h* is tilted to the left moving h^2 to the right, valve *i* is moved to the right and the coin is released from *a* into o^1 leading to the cash-box *o*. If h^1 is tilted to the right, *i* moves to the left, and the coin is guided into the return-chute *p* and the return-cup p^2, accessible to the subscriber. During either movement cam-lever *n* maintains *l* in contact with *m*. A swinging guard, p^1, may be fitted in the return-chute to prevent the insertion of a wire for the purpose of interfering with the mechanism.

A patent granted to James B. Gill, of San Francisco (Reissue No. 12,015, July 22, 1902), covers a toll-collecting device of a more ambitious character than the machine due to Messrs. Bullard and O'Connell, but the instrument is of immensely more complicated construction, and is of uncertain practical value. The Gill

device is both toll-collecting and call-recording, but since it operates with a coin of but a single size, being apparently designed for nickel service, it would seem that the call-recording mechanism is almost superfluous, as the number of coins collected, barring trickery, would indicate the number of effective calls made.

The principal points of Mr. Gill's machine are: First, that it records the calls by means of a rotating card on which the calls are marked by means of a punch, the recording device being controlled



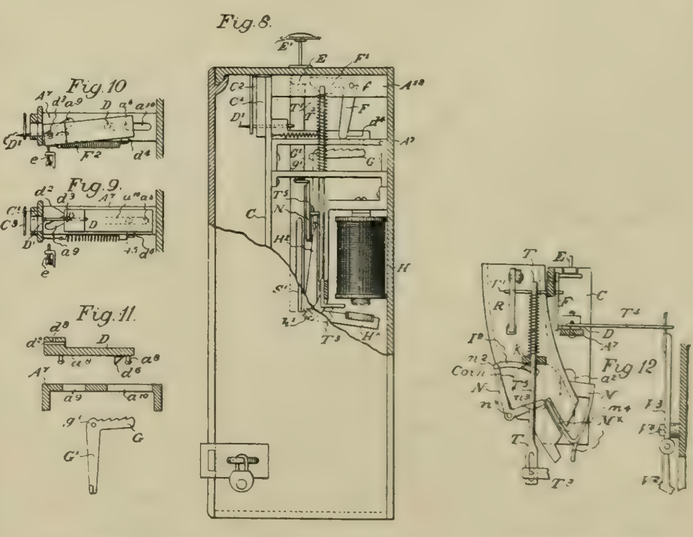
FIGS. 1 TO 7.—GILL TOLL COLLECTING AND CALL RECORDING DEVICE.

by the central office operator and being dependent on the insertion of a coin of given value in the box. It also rejects and discharges a coin inserted in the box which differs in size or value from the standard coin with which the machine is constructed to operate. It places the coin under the control of the operator to be either discharged or deposited, and it exposes the coin to view for inspection on its way to the coin receptacle. With so many objects to fulfil, the device is naturally a complicated one; indeed it has almost as many parts as a typewriter. In this respect it fails to meet an important requirement of coin-collecting boxes, viz., simplicity. While one would not venture to predict any very widespread adoption of Mr. Gill's device ,it has a sufficient number of novel and ingenious features to merit at least a detailed description.

The drawings show the various parts as follows: Fig. 1 is a front elevation of the recording mechanism, the front of the box being removed, and parts of the record card and mechanism being broken away and shown in section to expose parts in the rear. Fig. 2 is a side elevation taken from the left-hand side of Fig. 1. Fig. 3 is a detailed view, in front elevation, of the coin-chute and parts of the electrically-controlled mechanism, operated from the central office, to drop the previously inserted coin, the upper portion of the coin-chute being shown in section. Fig. 3a is a top view in detail of the push-rod P^8. Fig. 4 is a detailed view of the same parts, taken from the back of the coin-chute. Fig. 5 is a top view of Fig. 3. Fig. 6 is a back view of the rotatable disc, and Fig. 7 an edge view of Fig. 6. Fig. 8 is a side elevation of the device, taken from the right-hand side of 1, with the enclosing box partly broken away. Figs. 9 and 10 are top views in detail of the marking device in two portions, Fig. 9 showing it drawn back and set for operation, and Fig. 10 representing its position at the end of its forward throw after it has marked the card. Fig. 11 is a side view in detail of the slide, the stationary support, and the locking lever of the marking device. Fig. 12 is a rear view of the coin-chute, illustrating an attachment that is combined for operation with the other mechanism to close the contact springs in the circuit of the controlling magnets when the coin is too light to act on the springs.

The disk A, carrying record-card B, clamped to it by b^x, is mounted on pivot a^1; A rotates on the pivot, and the pivot is capable of a rectilinear movement, so that a marker held against the card while it is rotated will produce a continuous spiral line. The pivot a^1 works in a slot, a^2, in bracket C, and on the rear of disk A is a spiral groove in which pin a^5 works, producing an upward movement of the pivot a^1 in the slot a^2 and the consequent spiral mark of the pointer on the card. On C is a block, C^1, having a vertical slit to admit rim of card B, and a horizontal slot, C^3 to permit the movements of the punch, D^1, by which the calls are recorded on the card. So far, Figs. 1 and 2. Turning now to Figs. 9, 10 and 11, which illustrate the recording device, D is a slide bar mounted on bracket A^7, so as to slide thereon at right angles to the plane of the disc, studs $a^8\,a^8$ working in slots $a^9\,a^{10}$ in A^7. The bar D carries needle D^1, which projects through slot C^3 when D is moved forward. Besides puncturing the card, D^1 moves it forward at each throw by means of a sideways movement of D^1, obtained by setting the front guide-slot, a^9 at an angle, so that the front end of the slide will be moved at an angle, the rear end swinging on the stud a^8. The effect of this lateral movement is that D^1, besides puncturing the card, moves it forward, so that the punctures are evenly spaced on the card. The slide-plate D is set by push-button E^1, working by head E on bell-crank lever F, the lower end of which bears on lug d^4. The slide is pulled forward by spring F^2, and held in place by the dog, d^6, engaging in the ratchet G on lever G^1; the spring g^3 holds G against d^6. The ratchet G by means of its member, G^1, is controlled by the armature H^x of magnet H. When H^x is attracted, arm H^2 will tilt G^1 and release G from d^6, allowing slide D to be pulled forward by spring F^2, causing D^1 to pierce the card. The normal position of D is forward; it is set by pushing the button E^1, and can then be released only by the action of magnet H, which is controlled by the operator.

At the subscriber's station the circuit is normally open, and is closed by the coin, so that the relay cannot be energized until the coin is in, and then only at the will of the operator. The two springs $L\,M$ form the contacts of the relay circuit; they are in the chute so as to be acted on by the coin (see Figs. 2, 3, 5 and 8). Spring L is on front of chute I, insulated from it by block L^1; M is secured to block M^x on lever H^2 of the relay armature, M^x being insulated at m^2, and carrying a wedge m^4, setting through slot I^x in I, so that the coin striking wedge m^4 will press M out into contact with L. M^x



FIGS. 8 TO 12.—GILL TOLL COLLECTING AND CALL RECORDING DEVICE.

has also a lip, m^3, standing across the chute, so that it will hold the coin in the chute until the armature is attracted and H^2 moved. M^x thus acts to close the circuit at $L\,M$, so that H may be energized and lip m^3 retains the coin until the armature lever by a further movement of M^x causes it to be withdrawn and allow the coin to proceed.

The coin-discharging mechanism, by means of which coins differing in size or value from the standard coin can be ejected, consists of an opening, P, in the chute and a gate, P^1, operated by push-rod P^8, having a wedge-shaped end setting in line with the rear face of

P^1, so that the movement of the rod will force P^1 away from the slit, P^1 is restored by hinged lever P^2, and P^2 by spring P^4. Trough S^2, leading from I to slit S^1 in the side of the box, discharges the coin when P^1 is opened.

To insure the proper cycle of operation, the deposit of a coin and the depression of button E^1, a cut-off R is connected with E^1, closing the chute when E^1 is up, and opening it when E^1 is depressed. This cut-off (shown in Figs. 3 and 4) consists of latch R pivotted to I at R^1, and having end R^2 working through slot a^{14} in I, so as to lie across the coin passage. In the upper part of R is an inclined slot, R^4, to take a cross-pin, T^1, that is fixed in an upright rod, T, working in guide K. One end of cross-pin T^1 works in the slot, R^4, and the other is under support of lever F, projecting in path of projection F^1 on the horizontal arm of lever F. Thus push E^1 while acting on F to set slide D also draws R back from the coin-passage at the same moment; the latch R is restored to place when E^1 is released by the spring R^5. Rod T terminates in foot, T^6, adapted to strike armature lever H^x (Fig. 8). The rod T thus serves the double purpose of releasing latch R to open the chute and of forcing H^x away from H should it be held by residual magnetism.

The coin pocket V, with glass front V^1 (Figs. 1 and 12), enables the last deposited coin to be seen before being dropped in the receptacle W. The outlet is controlled by a swinging gate, V^2, held forward by gravity, and moved away by the action of arm T^4, attached to slide D. When D moves forward, T^4 tilts lever V^3, pivoted at V^4, and so retires the gate V^2, carried on its lower end; this allows the previously deposited coin lodged in V to drop through, clearing V for the one just dropped in the chute.

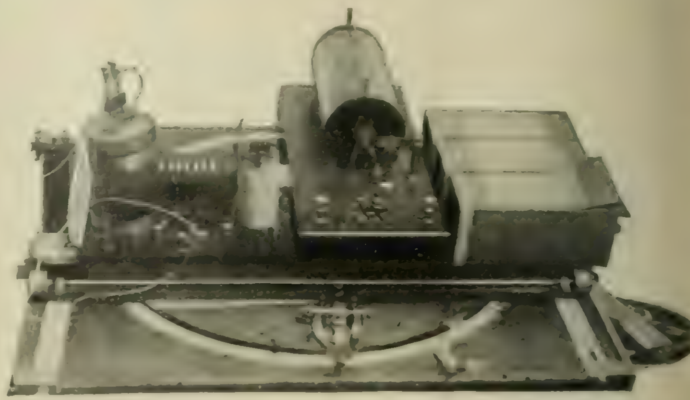
Fig. 12 shows the arrangement for insuring the proper movement of wedge m^4 in the presence of a coin of too light weight to act properly. Lever N, pivoted at n^x to back of I, has a pin, n^2, crossing the chute I and working through a slot, I^2, so as to lie across the coin-passage, and an angular member, n^3, in the path of a pin, T^5, in in rod T, Pin T^5, when I is depressed engaging lower limb of N, will throw pin n^2 in slot I^2 against the edge of the coin with sufficient pressure to push the coin against m^4, and so cause the contacts $M\,L$ to be closed. This attachment is designed to be used only in cases where coins of light weight may be dropped in the box, and under all other conditions it may be dispensed with.

The operation of the device is as follows: After the coin is inserted in the box and the push-button is pressed down and released, the coin drops into the lower part of the chute, where by contact with the wedge m^4 it throws the spring M against L. The same movement of the button sets back the slide D ready for action, and the magnet circuit being closed at $L\,M$ by the coin, the lever G^1 will trip the ratchet G holding the slide as soon as the central office operator throws battery on the relay H. By that operation the needle is projected against the record card and punctures it. In this movement the lateral throw of slide D causes B to turn on its center a short distance, according to the extent of the lateral throw of the needle. The disc is, therefore, turned slightly forward at each puncture. When E^1 is again pressed, D is drawn back and set for the next operation. In that movement the needle is withdrawn from the card without moving it, as the amount of penetration is only sufficient to cause the needle to engage the card enough to turn it, and the resistance of the fixed pin engaging the spiral groove at the back of the disc suffices to prevent the card from being turned back by the retraction of the needle. A relatively small disc can be made to contain a considerable number of record marks by giving the disc an upward movement in a vertical plane, in addition to its rotary movement, as already described, so that the line of punctures made by the needle will run in a continuous spiral line, beginning at the circumference and decreasing in size as it runs toward the center. In this operation also the necessary coin to pay for the call is retained in the chute until the operator is ready to give the required connection, and is released by the movement of the armature lever that causes the call to be recorded.

Mr. Gill has certainly produced a coin collector that is a marvel of ingenuity. Whether all the various functions that it performs are worth the elaborate mechanism required to carry them out; whether such a complicated mechanism will stand the hard use of an active pay-station, and whether the limitations of a single size of coin—which is apparently an inherent feature of the device—will not seriously interfere with its extensive adoption are questions that only practical experience can decide.

Fessenden Wireless Telegraph Apparatus.

In our issue of last week, an account appeared of a number of patents on wireless telegraphy, issued to Prof. R. A. Fessenden, and we are enabled to present herewith an illustration of a receiving and transmitting apparatus embodying in practical form some of the features covered by the patents. The apparatus shown combines a



FESSENDEN WIRELESS TELEGRAPH APPARATUS.

complete sending and receiving outfit, which has been in daily use in working between Hatteras and Roanoke, a distance of 50 miles.

It gives a spark of 1/32 inch when attached to the vertical wires, which are 140 feet long. No transformers or Thomson-Tesla coils are used in circuit. The speed of sending has been 35 words per minute, and the apparatus will operate over a distance of 100 miles.

The Value of Telephone and Telegraph Investments.

Some weeks ago comparative data was presented in these pages to establish the values of telephone and telegraph stocks; in other words, an effort was made to arrive at an idea as to the relative value, net earning capacity, etc., of American Bell Telephone, Western Union and Postal Telegraph securities. An interesting discussion has arisen over these figures, and Messrs. Moffat & White, the New York specialists in telephone securities, takes issue with the Boston *News Bureau* in respect to the value of American Telephone and Telegraph stock.

The main point of controversy is in the assumption made in the article referred to that $45 is the average gross earnings per telephone subscriber throughout the United States. Messrs. Moffat & White have compiled statistics embracing eleven of the telephone sub-companies, showing that the average is $54.87 in the cases named, which, they say, may be taken as fairly indicative of all. The eleven companies used in calculating the averages were Chicago Telephone Company, New York and New Jersey Telephone Company, Bell Telephone Company of Pennsylvania, Central District and Printing Telephone Company of Pittsburg, Bell Telephone Company of Buffalo, Hudson River Telephone Company, Cumberland Telephone Company, Missouri and Kansas Telephone Company, Nebraska Telephone Company, Rocky Mountain Telephone Company, Colorado Telephone Company.

The averages determined by the statistics of these companies are as follows:

Average gross earnings per subscriber	$54.87
Average percentage of operating expenses to gross earnings	73.16
Average percentage earned on stock	[illegible]
Average rate of dividends paid	[illegible]

With this basis, Messrs. Moffat & White contend that the conclusions and deductions made must be amended, assuming that the eleven companies named are fairly representative of all.

Following are calculations by Messrs. Moffat & White:

Gross earnings estimated	$33,708,000
Expenses and interest	22,640,715
Net earnings	$0,015,583
Dividends paid	5,050,023
Surplus	$4,865,560

Messrs. Moffat & White may be nearer correct, says the Boston *News Bureau*, as to the average amount paid per subscriber, but it submits that while its own figures may be too conservative, those above given are too large, and it has, therefore, prepared a larger table of telephone statistics, given below:

Name of company.	Subscribers.	Gross revenue.	Gross expense.	Div. earn.	Div. paid.
Cumberland	$66,806	$2,642,563	$1,889,766	$9.53	$7.00
Wisconsin	21,363	880,303	559,407	....	....
Missouri & Kansas	17,691	1,056,638	816,791	8.24	6.00
Southern New England	14,630	813,063	607,053	6.43	6.00
Chesapeake & Potomac	12,147	846,768	736,938	5.24	4.00
New York & Pennsylvania	9,873	394,322	315,291	1.98	3.00
Pennsylvania	17,925	426,125	300,579	4.10	5.00
Central New York	4,855	258,791	239,209	2.03	3.75
Colorado	14,412	858,820	623,550	9.70	6.00
Southwestern	41,199	1,617,675	1,144,241	....	....
Northwestern	22,155	1,014,388	541,439	....	....
Cleveland	14,887	601,024	387,060	....	....
Rocky Mountain	7,289	522,989	347,417	10.97	6.00
Nebraska	13,735	754,971	603,050	9.17	6.00
Central Union	85,920	2,584,790	1,956,800	6.92	....
New England	84,325	5,177,412	3,913,805	6.19	6.00
Sunset, estimated	59,875	....	....	21.33	6.00
Chicago	44,962	3,775,002	2,691,129	12.04	12.00
New York & New Jersey	38,653	3,376,433	2,397,252	9.51	7.00
Michigan	46,846	1,333,260	1,126,084	....	....
Total or average	*$579,673	$29,933,337	$21,195,860	$7.71	$5.23
* Not including Sunset.					
Per subscriber		$51.54	$36.50	..	..
Per cent. expense			70.83	..	..

Subscribers all companies Dec. 31, 1901, 1,030,647.

The above table would seem to call for a revision of both estimates, and until some details can be shown to prove the calculation erroneous, it might be safe to revise the figures of the previous article on a basis of $50 as the average payment per telephone subscriber in the United States, instead of $45. In data compiled and published on this subject by one of the editors of ELECTRICAL WORLD AND ENGINEER, the average for the country has been given in these columns as $40 per year.

A slightly different calculation from the previous one, revising the amount of stock outstanding is given by the *News Bureau*. As the earnings of the telephone companies are for the last year, the capital stock should not include new shares, which do not issue until next year.

The amount of capital stock of the American Telephone and Telegraph Company at the close of the last fiscal year was $114,858,400, and the amount outstanding in the hands of the public was $82,748,000, the balance being held in the treasury of the old Bell Company, which is now practically all owned by the American Telephone and Telegraph Company. Taking the amount of stock and bonds outstanding at the close of the year, we may compare the capitalization of the telephone company with that of the Western Union and of the Commercial Cable, as follows:

	Am. Tel.	West. Un.	Com. Cable.
Stock outstanding	$82,748,000	$97,370,000	$13,333,300
Bonds outstanding	25,000,000	19,660,000	20,000,000
Total capital	$107,748,000	$117,030,000	$33,333,000

The total selling values of the companies in the market, taking the bonds of all three companies at par, compare as follows:

	Am. Tel.	West. Un.	Com. Cable.
Price of stock	165	90	160
Market value of shares	$136,534,200	$89,933,000	$21,333,280
Bonds at par	25,000,000	19,660,000	20,000,000
Total selling value	$161,534,200	$109,293,000	$41,333,280

The gross Bell telephone business of the United States at $50 per subscriber would be about $51,500,000. Of this amount about $3,500,000 represents the direct gross business of the parent company, and one-half the remainder, or $24,000,000, its share in the gross business of the sub-companies. Of the latter amount 71 per cent. may be allowed for disbursements before dividends of the sub-companies, leaving $6,960,000 as the parent company's share in the net earnings of the sub-companies. A former estimate was $7,000,000.

The parent company last year received in dividends $4,988,207. The undivided earnings in the treasuries of the sub-companies, therefore, amounted to $1,971,793. The parent company reported net earnings from traffic rentals and from dividends paid as $7,398,285. The total net earnings of the parent company, therefore, adding in the undivided earnings in the treasuries of the sub-companies, amounted to $9,370,078. On this basis we may compare the operations of the American Telephone and Telegraph Company with those of the Western Union (year ended June 30, 1901) and the Commercial Cable (year ended Dec. 31, 1901), as follows:

	Am. Tel.	West. Un.	Com. Cable.
Gross (estimated)	$30,181,353	$26,354,150	$3,592,129
Expense and interest	20,811,275	20,625,062	2,061,166
Net	$9,370,078	$5,729,088	$1,530,963
Dividends paid	(7½%)5,050,023	(5%)4,868,997	(8%)1,066,664
Surplus	$4,320,055	$861,081	$464,299

Adding to Western Union's figures the gain in surplus to Dec. 31, we may figure comparative share earnings and the returns to an investor as follows:

	Am. Tel.	West. Un.	Com. Cable.
Price of stock	$165	$90	$160
Dividend to price, per cent.	4.54	5.55	5.00
Earned on par value	11.33	6.38	11.47
Earned on price	6.86	7.09	7.16

Although the return on the price of the shares of the Telephone Company is shown to be lower, this is not at all unfavorable to that stock. The securities of all companies with good credit sell higher in proportion to earnings. There is, furthermore, a probability that in the next five years, with the expansion of the telephone business, rights of at least 10 per cent. to 15 per cent. will accrue yearly, so that at the end of that period an investor will be receiving 7½ per cent. dividends on stock whose net cost might have been reduced by subscription rights to about par. It will be observed that the calculations do not make any allowance for "independent telephone" inroads, but the Western Union also might be adversely viewed, or the Postal, as to the possible effects of competition.

American Electrochemical Society.

The programme of the American Electrochemical Society for its second general meeting has been completed, and includes no less than 20 papers, with several more to be announced later. The meeting will be held at Niagara Falls, September 15-18, with headquarters at the International Hotel. The mornings will be devoted to the reading and discussion of papers, and the afternoons and evenings to professional visits and social occasions. Following is a list of the papers to be read:

"Note on Testing Carbon Electrodes," by Francis A. J. Fitzgerald, Niagara Falls, N. Y.

"Efficiency of Electric Furnace Operations," by Prof. W. J. Richards, Ph. D., Leigh University, Bethlehem, Pa.

"Additional Notes on Lead Reduction," by P. G. Salom, Philadelphia, Pa.

"Cathodic Reduction," by Alfred T. Weightman, Niagara Falls, N. Y.

"Differences of Potential between Metallic Cadmium and Solutions of Cadmium Iodide in Various Solvents," by Prof. Louis Kahlenberg, Ph. D., University of Wisconsin, Madison, Wis.

"The Fusion of Quartz in the Electric Furnace," by Prof. R. S. Hutton, Owens College, Manchester, England.

"Developments in Electrometallurgy of Iron and Steel," by Marcus Ruthenberg, Philadelphia, Pa.

"Theory and Practice of Continuous Flow Calorimetry," by Prof. H. T. Barnes, Ph. D., McGill University, Montreal, Canada.

"An Apparent Electrochemical Paradox," by Carl Hering, Philadelphia, Pa.

"Some Phenomena of Electrolytic Conduction," by C. J. Reed, Philadelphia, Pa.

"The Nickel Concentration Cell," by Prof. Henry S. Carhart, LL. D., University of Michigan, Ann Arbor, Mich.

"Electrochemistry at the World's Fair, St. Louis," by Prof. W. E. Goldsborough, Lafayette, Ind.

"The Electronic Hypothesis and Its Applications," by Arvid Reuterdahl, Providence, R. I.

"Electrochemical Polarization," by Prof. John Langley, Ph. D., Cleveland, Ohio.

"Storage Battery Invention," by Hugh Rodman, Philadelphia, Pa.

"The Electrolytic Dissolution of Soluble Metallic Anodes," by Woolsey McA. Johnson, New Brighton, S. I., N. Y.

"On the Electrolysis of Sodium Nitrate and the Composition of the Developed Gases," by C. W. Volney, Ph. D., Keyport, N. J.

"Pumps and other Accessories in Electrolytic Plants," by D. H. Browne, Cleveland, Ohio.

The titles of papers by Prof. G. B. Frankforter, of the University of Minnesota, and Mr. Titus Ulke, of Sault Ste Marie, will be announced later.

Transposition of High-Potential Alternating-Current Lines.

One of the "Question Box" queries considered at the Cincinnati Electric Light Convention was concerning the best practice in the concatenation of the conductor of high-potential transmissioon lines. The Portland (Me.) Light and Power Company reported that it is operating two 10,000-volt, three-phase, 60-cycle alternating-current lines, one of which is ten and the other thirteen miles long. No transpositions have been placed in either of the lines, and no difficulty has been experienced on account of induction. Mr. J. W. Cortwright, of the Public Works Company, Bangor, Me., said that the 6,600-volt alternating transmission of his company, about five miles in length, is not transposed at all. It is run on the old single-petticoat glasses formerly used for a direct-current arc circuit, and shows next to no leakage in wet weather, and no line characteristic of a troublesome nature. Mr. E. Grissinger, of the Buffalo General Electric Company, considered that lines of this length mentioned do not involve considerations other than the mechanical features. In a 15-mile line of moderate power, three transpositions should give all the necessary flexibility. If such a line were made up of more than one circuit, then the transpositions should have some regard for the amount of power transmitted in each circuit, the voltage, phase and frequency, in order to compensate inductive effects between circuits.

Dr. F. A. C. Perrine went into the subject of transpostions at considerable length. The transposition of any line, whether long or short, high or low potential, he said is for the purpose of overcoming the evil effects of mutual electromagnetic induction. This mutual induction may result in interference with neighboring lines of the same class and character, or may result in interference with neighboring lines of an entirely different class. For example, many parallel lines running out from a station may act inductively on each other, the lines carrying low currents disturbing the potential on lines carrying low currents and *vice versa*; or the lines from any station running parallel to telegraph or telephone lines may, by inducing current upon these neighboring lines, interfere with the apparatus connected with them. This mutual induction may be due to the electrostatic effect or the electromagnetic effect.

Dr. Perrine said that so far as he is aware, no satisfactory cure has been effected of the electrostatic interference. The electromagnetic interference may be overcome by proper transpositions, and whether transpositions shall be placed in lines from one to fifteen miles in length depends almost entirely upon the quantity of current these lines are carrying and on the proximity of other lines and their character. Telephone lines run for one mile or more parallel to power lines are almost invariably seriously affected, and for these lines transpositions should undoubtedly be introduced either in the telephone lines themselves or in the adjoining power lines. The telegraph not being as sensitive as telephone apparatus, is not so readily affected, and the cases are rare where the interference is serious where the lines are parallel for distances less than four or five miles; indeed, the problem of properly doing away with mutual induction between power lines and grounded telegraph lines is one that has to be handled most carefully, since the ordinary method of transposition is generally unavailable to remedy the difficulty. Power lines carrying less than 100 amperes do not ordinarily interfere with each other to a serious extent where they are run parallel for less than two or three miles, but for greater distances and greater currents they undoubtedly interfere and should be transposed. In one case where many lines carrying large currents were run out of the station for distribution to a city and were parallel in some cases for not over 1,000 feet, the interference between the different power lines was so serious that pressure wires run back to the station gave no indication of the pressure at the terminals, since both the power lines themselves and the pressure wires were seriously affected by neighboring currents.

Dr. Perrine pointed out that transpositions carelessly done without due regard to what a transposition is to effect are of comparatively little value. He cited a line where the telephone circuit was transposed every eighth pole and where not only was the telephone useless, but the bells burned out, although the power line was carrying only about 20 amperes. This trouble was remedied altogether by taking out these transpositions and putting in transpositions about one every 80 poles, but properly located with reference to the transpositions of the power line, which had not previously been taken into account. In order to lay out the transpositions of any line it is necessary to follow in direction and amount the field of force surrounding the line itself. Single-phase lines are transposed simply as telephone lines by crossing them, since any two sections of equal length between which there is a cross have equal fields of force acting in opposite directions, and consequently neutralize each other. A barrelling of a three-phase line rotates the field of force one-third of a revolution, and in consequence, it is necessary to rotate the line twice before the individual equal sections neutralize each other, and in this case no two of the three equal sections between which there are transpositions neutralize, though the three are neutral when taken together in reference to any parallel line. The four-wire, two-phase line is only neutralized when there are three barrelings and four sections of equal length; the three barrels divide the line into four sections of equal magnetic strength. These four sections neutralize each other in pairs, but no two neighboring sections neutralize. The first and third neutralize each other, but the first has no influence on the second or fourth, the second has no influence on the first or third, and so on.

Dr. Perrine said that it is stated that the barrelling of a line is necessary for neutralizing the effect of the earth upon that line itself, but so far as he has been able to observe no such effect is to be found, two and three-phase lines without any transpositions working as well as those which have been transposed or barrelled, provided the three-phase wires are located at the corners of an equilateral triangle and the wires of each phase of a two-phase line at the diagonally opposite corners of a square. In transposing any line with reference to any other line the transposition should be introduced in sections where the current and consequently the magnetic field is constant. If this question of the constancy of the magnetic field and the effect of its direction already described be taken into account, all interference to or from neighboring lines is readily overcome. The question whether the lines carry high or low potential is not important with reference to transpositions, since the effect of high potential is to produce electrostatic induction, and this effect is not readily overcome by transpositions.

Mr. P. M. Lincoln, of Niagara Falls, said that his experience has pointed to the fact that most of the trouble on high-tension lines is due to static and not dynamic induction. He has been told by others who have run high-tension lines that as long as they could keep the telephone and telegraph lines insulated from the ground, and overcome the static induction, they had no trouble from dynamic induction, although there is no transposition on telegraph and telephone lines.

Mr. P. A. Bertrand, of Peoria, Ill., said that last summer his company changed from 1,000 to 2,000 volts. While that is not a very high tension compared to the system which Mr. Lincoln represented, it brings out the point. The primaries, he said, were divided by two right through. The effect on the city telephone lines and police alarm lines was not to decrease the induction on their lines, but rather to increase it, which would point to the fact that it is static rather than dynamic effects which cause the trouble.

Telegraphy in Alaska.

Gen. A. W. Greely, Chief Signal Officer of the Army, who has just returned from Alaska, reports that before the end of the year Alaska will be connected with the United States by wire. In two weeks, he says, many hundred miles of telegraphic communication will have been established in that territory between the coast towns and those remote in the interior. Gen. Greely has been inspecting the operations in regard to telegraph lines. "This," he said, "will for the first time make it possible for intercommunication to be had at a small expense between those portions of the territory where previously correspondence could be had only by mail, and where letters and answers could not be exchanged more than twice or thrice during the year. Valdez, Alaska, will soon be in telegraphic communication with the outside world.

"That line runs from Dawson through Egbert, as a military wire, and is about 450 miles long. There are now in operation in the territory about 800 miles of wire in the central and lower Yukon Valley. They will be connected with the Valdez system, which will bring the lower Yukon, St. Michaels and Nome within daily reach of the rest of the world." The main trouble up in Alaska has consisted in the regular maintenance of submarine lines, which so far have experienced a series of disasters and interruptions.

Electrical Classification of Exhibits, St. Louis Fair.

Following is the official classification of electrical exhibits at the St. Louis World's Fair, which forms Department F of the general classification:

GROUP 67.—MACHINES FOR GENERATING AND USING ELECTRICITY.

Class 428.—Apparatus for generating electricity. Dynamos producing direct, simple alternating or polyphase currents.
Class 429.—Motors for direct or alternating currents.
Class 430.—Modification of currents. Motor-generators. Transformers.
Class 431.—Application to transportation. Electric locomotives, electric railway motors. Methods of control of cars and trains.
Class 432.—Application to mechanical purposes. Elevators, winches, cranes, capstans, transfer tables, traveling cranes, printing presses and machine tools.
Class 433.—Appliances and methods for the distribution of electric energy; conduits, cables, wires, switches, insulators, lightning arresters, circuit breakers, complete switchboards.

GROUP 68.—ELECTROCHEMISTRY.

Class 434.—Primary batteries. Storage batteries.
Class 435.—Electrolytic appliances and processes. Reduction of ores, electroplating, electrotyping.
Class 436.—Electrothermic appliances and processes. Production and refining of metals or alloys.
Class 437.—Application to industrial chemistry; bleaching, disinfection of sewerage water, manufacture of soda, chlorine, chlorate of potash, etc.

GROUP 69.—ELECTRIC LIGHTING.

Class 438.—Use of continuous or alternating currents. Arc lamps, regulators, carbons for lamps, incandescent lamps, other forms of lamps.
Class 439.—Complete installation. Factories, dwelling houses, public buildings and central stations.
Class 440.—Application to lighthouses, navigation, military service and public works.
Class 441.—Photometry. Apparatus for determining the intensity, the distribution and illuminating power of light.
Class 442.—Electric appliances. Apparatus for safety and regulation. Conduits, junction boxes, switches, cabinets, cut-outs, fixtures, chandeliers, etc.

GROUP 70.—TELEGRAPHY AND TELEPHONY.

Class 443.—Telegraph instruments, transmitters and receivers, recording apparatus, multiplex apparatus, synchronous apparatus, wireless apparatus.
Class 444.—Transmission of speech. Appliances and methods. Instruments, switchboards and complete exchanges.
Class 445.—Telegraph and telephone wires and cables. Overhead, subterranean and submarine, construction, materials and appliances.

GROUP 71.—VARIOUS APPLICATIONS OF ELECTRICITY.

Class 446.—Scientific apparatus. Laboratory standards. Indicators and recording apparatus for natural phenomena.
Class 447.—Electricity as applied in therapeutics, surgery and dentistry.
Class 448.—Electric signalling. Application of electricity to railways, mines, public works and buildings. Clocks, annunciators, chronographs, alarms.
Class 449.—Methods of measurement. Instruments; indicating, recording and integrating.
Class 450.—Apparatus for heating by electricity. Cooking apparatus. High temperature electric ovens. Electric welding.
Class 451.—Progress and development in electrical science and invention. Historic and statistical exhibits. Instruments, machines, models, drawings and publications.

Electroplated Lace.

By Clinton Paul Townsend.

In depositing metal electrolytically upon a non-conducting base it is, of course, essential that a conductive surface be afforded, and this is in general accomplished by the chemical precipitation of a thin layer of silver or other metal, or by the mechanical application of graphite or metal powders, often with the aid of an adhesive binding medium. Such coatings, and especially the highly perfect ones formed by the chemical precipitation of silver, are of a high degree of tenuity, and, therefore, of high electrical resistance, from which it follows that even with the low density currents used for electroplating the deposit cannot take place evenly over any extended surface. The important point, therefore, in securing a perfect cathode connection to work of this character is the number of the contacts.

Mr. John A. Daly, of Washington, D. C., offers a simple arrangement for electroplating lace, consisting of an open-meshed basket of copper wire upon which the lace, suitably prepared with a conductive coating, is stretched. Fine copper wire is then wound in coils around the basket and over the lace in such manner as to secure the fabric and to provide a number of contacts which must be greater in proportion as the mesh of the lace is more open. Deposition is said to proceed evenly over the entire surface, and it is claimed that the simplicity of the manipulation effects a saving of 90 per cent. of the time usually required for wiring.

The deposition should proceed under these conditions for a few moments only, the object being merely to stiffen the fabric by a preliminary deposit in order that it may be hung in the bath from the usual supports to receive the final and heavier coating.

CURRENT NEWS AND NOTES.

PATENTS ON MANUFACTURES.—The U. S. Census Office has issued a bulletin on the relation of patents of manufactures. It states that New York State, though third in population and patent rank for the first decade, has since been first in both as well as in manufacture.

"THE TELEGRAPH KAISER."—Apropos of Emperor William's telegram to the Prince Regent of Bavaria, resenting strongly the refusal of the Bavarian Diet to vote certain art funds, the *Wiener Allgemeine Zeitung* publishes an article headed, "The Telegraph Kaiser." The paper says that the Emperor's advisers ought to keep him as far as possible from facilities for telegraphing, and provide lightning conductors, which would prevent the flashes so easily drawn from the imperial mind by every passing event from causing panic and confusion in public life. That, says the *Wiener Allgemeine Zeitung*, would be of advantage not only to Germany, but to the Emperor himself, who betakes himself to the wire whenever he is gratified or irritated, amused or saddened. The dispatch is sent off in the twinkling of an eye, but the task of remedying the consequent evil is extremely slow. The paper remarks that the famous telegram to Mr. Kruger after the Jameson Raid was followed by the investment of Lord Roberts with the Order of the Black Eagle.

GIRL MESSENGERS.—A special telegram from Chicago, of August 22, says: Girl messenger boys in office buildings were an innovation which Chicago experienced to-day. They took the place of the striking messenger boys of the Illinois District Telegraph Company. The girls came in answer to the following advertisement: Wanted—100 young ladies for work within large buildings; salary $15 to $25 per month. Apply I. D. T. Office, 820 Western Union Building. Tenants in the skyscrapers were surprised when in answer to their call for a telegraph boy they were confronted with stately-looking "young ladies," who announced themselves as messengers who had responded to the call. The striking messenger boys were startled, too, when they learned that girls had been secured to take their places, and declared their determination to make love to the non-unionists and thereby induce them to stop work. Attempts to enter the buildings, however, were frustrated, and as the girls did not carry messages outside, the boys failed in their plans, being forced to look on at a distance.

RELIABILITY AUTOMOBILE CONTEST.—The Automobile Club of America has announced conditions for a 500-mile automobile reliability contest to Boston and return, with a view of affording an opportunity for the various types of motor vehicles to demonstrate their reliability under circumstances as closely as possible simulating general touring conditions in the United States. The contest will be one of seven days. The vehicles will start their journey on Oct. 9, the first day's run being to New Haven, and the competition will end on Oct. 15. Speed in excess of the legal limit will be absolutely prohibited under pain of disqualification. It is reported that vehicles equipped with the Edison storage battery will be put into this test.

ROTARY CONVERTER "PUMPING."—Two patents, issued August 19, to Alexander Churchward, describe a means for overcoming the difficulties encountered in operating synchronous alternating-current motors when the generator fluctuates in speed in different parts of a revolution, the effect of which is to produce "pumping" at the motor. The method consists in applying to the shaft of the motor, or on a shaft driven by it, a flywheel connected to the shaft through a yielding connection in the nature of a friction brake. The effect of this flywheel is as follows: If the generator speed suddenly increases, the armature tends to correspondingly accelerate its speed; but the flywheel lags behind, thereby putting a slight load on the motor. When the generator slows down the motor-armature tends to run slower, while the flywheel, tending to run at a uniform speed, catches up with the motor-shaft and forces it ahead or resists its tendency to slow down, thereby again putting a slight load on the motor. The load in either case serves to steady the armature and prevent pumping. One of the patents describes details of the flywheel flexible connection.

THE NAVAL MANŒUVRES.—Two squadrons of U. S. men-of-war have been engaged in manœuvres the past week off the New England coast. Admiral Higginson, commander of the victorious defensive fleet, says: "To me the one great lesson of the search problem which we worked to a finish to-day is the absolute need of wireless telegraph service on the ships in our navy. Do you know we are three years behind the times in the adoption of the wireless system aboard our ships, and its value to me during the last four days would have been incalculable? I could have spoken my ships at sea night or day at any moment by wireless telegraphy; whereas during the last four days, while all were in touch with me, they have been far beyond signalling distance, and, as it were, beyond my reach altogether. I am convinced of the value of manœuvres of this kind. It has been excellent training and as near an approach to conditions of actual warfare as could be devised for manœuvres of this measure. The schooling of the work of the last four days, while a little different from the actual work of routine, has been held under conditions which have made them of extraordinary value."

ALTERNATING CONSTANT-CURRENT CIRCUITS.—Two patents relating to alternating, constant-current, arc-light circuits were issued, August 19, one to John F. Kelly, and the other to Walter S. Moody. The latter relates to a means for avoiding injurious effects arising from grounds on a circuit, including a Thomson constant-current transformer. This is accomplished by causing the current to pass first through one portion of the transformer or reactive winding, then through the lamp circuit, and finally through the other portion of the winding. To still further guard against bad effects from grounding, the neutral point of the supply circuit is permanently grounded, either at the generator or through the middle point of a transformer primary. The above-mentioned method of winding the constant-current transformer also admits of the attachment of a simple device for indicating when a ground comes on the circuit. The Kelly patent describes an arrangement whereby an alternating constant-current circuit may be maintained without the accompaniment of low power factor affecting the supply circuit, as when a reactive transformer is employed. The system consists of a synchronous motor driving an alternating-current generator, so designed as to maintain automatically a constant current in a circuit of varying impedance, such as a series arc-lamp circuit. Though the power factor of the lamp circuit will be low at light loads, the main supply circuit will not be affected, the motor operating just as it would with any corresponding load of a mechanical nature.

LETTER TO THE EDITORS.

The Second Law of Thermodynamics.

To the Editors of Electrical World and Engineer:

Sirs.—Your editorial in the issue of August 2, 1902, on "The Alleged Fallacy of the Second Law of Thermodynamics" was very interesting reading. On the whole I thoroughly agree with the position there taken, or possibly with the tone of the position. I think your statement of the question is very pointed and just.

The law, as you say, states that a heat motor must necessarily work between different temperatures, or rather between a source of heat and a refrigerator. At the risk of speaking heresy, I would like to say that while, as regards the law itself, I agree with it from a practical standpoint—that is, what we are able now to do—still I cannot say that I do from a theoretical one, or what may yet be done.

Sadi Carnot, I believe, proposed that it might be possible to run a heat engine from the intrinsic heat in sea water. Several years ago I noticed the fact that a reversed heat engine, or in common parlance, a refrigerating machine, operated at an efficiency of 300 to 500 per cent. That is to say, that a ton of refrigeration accomplished represented, in heat units, three to five times the equivalent energy in foot-lbs. required to do the work. I investigated theoretically the possibility of running a heat engine between sea water or air as the source, and a refrigerator worked by its own power, but I finally concluded that when the efficiencies of the two machines were multiplied up together, the result would in all cases equal unity, thus:

$$\frac{t_2 - t_1}{t_2} \times \frac{t_2}{t_2 - t_1} = 1.00.$$

The first factor is the theoretical limiting efficiency of the heat engine, the second is that of the inverted heat engine or refrigerator. This is to say that the large efficiency of the refrigerator, in any case *I could imagine*, would be just equal to the inefficiency of the heat engine, and that, therefore, no extra power could be produced. So from a practical standpoint, the second law has some ground for existence. But does it from a theoretical?

J. Clerk Maxwell showed if a roomful of air were divided by a partition having frictionless doors, at each of which was posted an intelligent being devoid of energy, with instructions to manipulate the door at the proper times to allow all the fast moving air particles to go to one side of the partition, and all the slow to the other, the resulting condition would be that on one side of the partition the air particles would be moving very rapidly, and on the other side, very slowly. One room would be hot and the other would be cold; in other words, a source and refrigerator produced from a uniform medium without the expenditure of energy. Of course, a heat engine could be run from this, so that a process can be imagined in which a heat engine can be run from a uniform medium.

Another instance in which Maxwell's daemons of the imagination have been pressed into service is afforded by the proposition of Lord Kelvin, to place a lot of these little fellows around a flexible bag of air, with instructions to push in the wall of the bag when no air particle was striking it, and to hold it in place while a particle was striking it. The motion and the force being applied at different times, no energy would be consumed, though the bag would finally contain compressed air. This is a direct and very pretty proof that compressed air has no more energy than the same mass of air not compressed.

It may be novel to some of your readers to consider that some of the cars operating in New York City are run by heat engines, which do not work between a source and a refrigerator. I refer to the compressed-air cars.

An air motor working without a reheater of any kind is essentially a heat motor and draws its power from the heat in, and not from the compression of the air which works it. The compression of the air is only a mechanical daemon or vehicle through which the extraction of the heat in the air and its transformation into work is made possible. Even supposing that it could not be imagined, as above, that air could be compressed without energy, yet the knowledge that the compression of air does not represent energy would be a direct proof that a heat engine, which an air motor is, can be operated (practically, notice) in a uniform heat medium.

Now truth comes to us not only through scientific processes of reasoning, but also through the imagination. It is by this, I think, that we realize the infinity of time and space. In this case, I believe that the imagination is distinctly at variance with the scientists. Yet this is no reason for doubting the imagination. Her truth is true. Its qualities are not different from any other truth, though arrived at by another avenue. I believe that here science has made the mistake of taking a limited premise instead of a universal one.

In the particular case which I investigated, the law was true; but in the subsequent cases to which we have given our attention, it was not true.

Now, I would not like to say that I think it possible to produce a practical heat motor along the lines which we have traced; still I think it is not a good scheme to set up a barrier because in our *practice* (perhaps the result of our peculiar education and experience) such a barrier exists, and this is particularly true when our imagination finds none. The older I grow, the more I learn to place only a tentative trust in the statements of science, and I believe that modern thought is doing the same thing. We have had a very recent experience with the atomic theory, which for nearly two thousand years has been accepted as axiomatic, and yet has broken down on the addition of only "the last straw."

It is well to quelch quasi-scientists, for they do a great deal of harm. And yet some day the race must obtain a new source of power or our giant civilization must fall to the dust. The road by which our children's children's children will travel to that sure goal may very possibly be in the face of the science of to-day, which may be forgotten then—but a poor thing, which has served its use well, and has gone.

Montreal, Canada. Irving A. Taylor.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Heyland Motor.—Heyland.—A reply to Latour's last communication, noticed in the Digest last week. The 27-hp Latour motor has 4 poles and 159 segments, *i. e.*, 40 segments per pole. A 45-hp Heyland motor has 8 poles and 36 segments, *i. e.*, 4.5 segments per pole. The commutator of the Heyland motor has "per hp" a ten times smaller surface than the commutator of the Latour motor; the former has the dimensions of an ordinary slip-ring, and is only an accessory. The compounded Heyland motor has one commutator; the compounded Latour motor has two commutators. The editors state that this controversy is now closed in that journal.—*Elek. Zeit.*, July 17.

Heyland Motor.—Ziegenberg.—A brief communication stating that a patent of Hasslacher seems to anticipate some special features of the Heyland motor, so that the Heyland motor might be called an application of the device of Hasslacher to the old Georges motor.—*Elek. Zeit.*, July 17.

Determining the Efficiency of an Electric Motor.—Jobst.—A brief illustrated article on the most suitable arrangement for an exact braking method for determining the efficiency of an electric motor. For counting the revolutions he uses a speed counter of Siemens & Halske, which is based upon the principle that the voltage of a dynamo depends upon its speed, the poles of the dynamo being highly saturated by means of a special source of current, so that the armature reactance and oscillations of the exciting current do not influence the constancy of the magnetic field; the voltage is then proportional to the speed; for measuring it a millivoltmeter is used. For braking, an eddy current brake is most suitable, together with a spring balance. All the instruments are mounted on a board, and instantaneous readings are obtained by photographic means.—*Elek. Zeit.*, July 17.

Definition of Armature.—Ziegenberg.—A communication in which he proposes to define as the armature (anker) of an electric machine as that part in which by the relative motion with respect to a magnetic field, an interchange of mechanical and electrical energy takes place, characterized by the occurrence of a higher e. m. f. than is due to the effective resistance.—*Elek. Zeit.*, July 3.

References.

Commutatorless Continuous-Current Motor.—Bruger.—Such a motor for meters is described in the abstract on motor meters, under instruments.

Sparkless Commutation.—Kehse.—A communication referring to a special point in a recent paper of Niethammer. He remarks that sparkless commutation can be accomplished by two different means: First by the carbon transition resistance, second by the e. m. f. induced in the short-circuited coil from the external field. He gives some mathematical formulas.—*Elek. Zeit.*, July 3.

Theory of Commutation.—Pichelmayer.—A supplement to a former article which he had published on this subject.—*Elek. Zeit.*, July 17.

Armature Winding.—Kuebler.—A brief article in which he describes a very simple tabular representation of continuous closed circuit windings.—*Elek. Zeit.*, July 17.

Armature Reaction.—Bauch.—A very long illustrated paper, read at the recent meeting of the Association of German Electrical Engineers. He endeavors to give a complete theory of armature reaction and discusses the distortion of the field by the armature current, and the diminution or increase of the e. m. f. by means of the armature current.—*Elek. Zeit.*, July 10, 17.

Calculating the Characteristic Curves of the Induction Motor.—Berkitz.—A brief critical note on Lindstroem's method noticed recently in the Digest.—*Elek. Zeit.*, July 17.

Preventing the No-Load Loss of Transformers.—Ankersen.—A rather long communication, in which he criticizes and corrects several statments in a recent article on switches for disconnecting transformers at a distance, recently noticed in the Digest.—*Elek. Zeit.*, July 17.

Lights and Lighting.

Reference.

Mercury Vapor Lamp.—Stoeckhardt.—A brief communication, in which he suggests that a still better economy might be obtained if the whole lamp or tube be placed in another evacuated glass globe, as the conduction of heat would then decrease.—*Elek. Zeit.*, July 17.

Traction

Sutton and Howth Tramway.—An illustrated description of this newly opened electric line in the vicinity of Dublin. Steep gradients on a hill presented many difficulties in the construction of the line. These were finally overcome by the adoption of long S-shaped curves, which were arranged so as to reduce the rise to one in twenty. The equipment of the power plant consists of three vertical compound, non-condensing steam engines direct connected to compound-wound generators of 125-kw capacity, at 550 volts, running at 350 r. p. m. Three brakes are provided for each car, namely, the ordinary hand-brake, an electric brake, and a Westinghouse air-brake, the latter being supplied with air at 75 lbs. pressure from storage reservoirs placed under the car seats; these are fed at the car shed by Westinghouse motor-driven condensers. A signal system has been established and consists of electric lamps placed in combined signal and telephone boxes along the route at each loop; the heat from the lamps circulates through the telephone compartments and thus keeps the instruments in good condition and free from moisture. At the summit, there is also a substation equipped with a battery of 255 Tudor cells of 200 amp.-hours capacity, with the necessary booster for charging it.—*St. R'y Jour.*, August 2, and *Int. Ed.*, August.

Automatic Signal for Block Systems and Car Spacing.—An article in which it is said that the importance of a block system on steam roads is little greater than the importance of having such systems on the high-speed electric roads now in operation. With the device described there is always a light burning at each turnout, in-

candescent lamps being used. The signal is operated by the trolley wheel making a contact between the trolley wire and the independent circuit. The operation of the system is such that if a white light signal is set there will be a red light on the far turnout in front and a green light on the near turnout; thus the motorman seeing a green light knows that the signal is set at danger at the next turnout. When a car is passing over a section both lights will appear white and a car can now enter from either end with a clear track. With the double-track system a similar combination of the lights indicates the position of the car ahead of the motorman; thus, a white light shows that the car can proceed at full speed, a green light shows that a car is one block ahead, and a red light means that the car is within one block of its leader.—*St. R'y Jour.*, August 2, and *Int. Ed.*, August.

Trolley Omnibus Line Between Nice and Monte Carlo.—An illustrated description of the auto-trolley system of omnibus which it is proposed to introduce upon the Corniche road extending through the mountain district between Nice and upper Monte Carlo. Similar equipments have been installed in several places in France and Germany, as has been noticed in the Digest. The buses used on the Corniche line will be a modification of those that are now employed on the French and German lines. They will be equipped with the Lombard-Gerin type of current-controller, which was shown at the Paris Exposition, as has been noticed before. There is a small three-phase motor, suspended between two conducting trolley wires. The motor is hung on a frame which supports at the same time two trolley wheels. It is of fixed armature type, and its pole pieces impart a rotary movement through fibre friction wheels to the two trolleys which are fixed on the same axle and run over the trolley wires. An even friction adjustment is obtained by the regulation of special suspension springs. A flexible cable leads the current from the main line to the car, and the three-phase current from the car to the little trolley motor which is fed from the motors which run the vehicle. As the speed of a three-phase motor is synchronous with the current feeding it, it is evident that the trolley motor runs automatically at a speed proportional to that of the motor on the vehicle. In this special case the proportion of gearing has been calculated so as to allow the trolley motor a slight lead over the car itself, in order to have the flexible cable at the proper tension. A small electro-magnetic brake blocks the trolley motor on the wire whenever the vehicle is obliged to stop on steep grades. The trolley motor with its accessories weighs about 40 lbs. It is proposed to take current for the operation of the system from the Mediterranean Power Company, which has a large central station at Nice and others at convenient points. Three sub-stations will be erected along the line, one at each end and one midway, in which will be installed rotary converters for reducing the three-phase current from 10,000 volts to 500 or 550 volts, at which it will be delivered to the motors.—*St. R'y Jour.*, August 2, and *Internat. Ed.*, August.

Through Traffic on Tramways for Passengers and Goods.—WALLER.—An abstract of a paper presented to the Liverpool Chamber of Commerce. The author proposes to link together several systems, and persuades the local authorities to grant "through" running facilities. He describes the advantages which would result, as a much larger traffic could be dealt with. The parcel traffic would probably be considerable and would be carried in the day time, either by trailer cars or by special independent vans. The cost of conveyance of both goods and parcels would undoubtedly compare most favorably with that entailed in the present method of railway carrying, and the profits gained thereby would go a long way towards making electric tramways still greater financial successes than they are at the present day.—Lond. *Elec.*, July 25.

REFERENCES.

Traction Stations.—FISIG.—A long article, in which he discusses some special features of traction stations, and the different sub-headings being boilers, engines, gas motors, turbines, the choice of the generating sets, storage batteries, substations, automatic circuit breakers.—*Elek. Zeit.*, July 3, 10.

Calculating the Feeders for Tramway Installations.—LIEBER-WIKANDER.—Two communications giving critical notes on the recent paper of Lengel.—*Elek. Zeit.*, June 19, July 3.

Wear and Maintenance of Tramways.—WIKE.—An illustrated paper, read before the Association of Municipal and County Engineering. He discusses the wear of rails, the rail joints, points and crossings, and paving.—Lond. *Elec. Eng.*, July 25.

Street Railway Investments and Earnings.—ADAMS.—A statistical article on the investments and earnings of the street railways in Massachusetts between 1888 and 1901.—*St. R'y Rev.*, July 20.

Electrolysis of Gas Mains by Tramway Return Currents.—SWINBURNE.—The first part of a reprint in full of his recent paper, an abstract of which was noticed in the Digest.—Lond. *Elec.*, August 8.

International Permanent Tramway Union.—A full account of the proceedings at the recent London convention of this association, with reprints of the papers. A general account of this meeting has already been given in the ELECTRICAL WORLD AND ENGINEER.—*St. R'y Jour.*, August 2, 9, 16, and *Internat. Ed.*, August.

WIRES, WIRING AND CONDUITS.

Self-Induction and Capacity in Transmission Lines.—BAILLIE.—The conclusion of his article. He discusses the effect of capacity. While self-induction affects the drop of pressure, but not the power wasted in the line, capacity has the opposite effect. Capacity has practically no effect on the drop in pressure, but with a power factor less than unity it diminishes the power lost in the line, provided that it be not so large as to produce a large advance of phase. With a low power factor the saving due to capacity will in general be greater than any loss due to dielectric hysteresis or charging current, when the load factor is not very low. He first gives formulas for single-phase and three-phase overhead lines. He then discusses single-phase concentric cables, and gives various formulas and diagrams. In one of them the saving in per cent. of power loss, due to resistance, is given as a function of the ratio of the charging to the effective current, for various power factors. The saving due to capacity reaches a maximum for a certain ratio, depending on the power factor. For a power factor of 0.9, the maximum is reached when the charging current is three-quarters of the effective. With the charging currents only one-fifth of the effective current, the saving is not inconsiderable; with a power factor of 0.7 it is 9.3 per cent. A 9.3 per cent. saving, due to capacity, means that for a given loss the cable may have a sectional area about 9 per cent. less if the capacity be taken into account. For a given cable end pressure the effect of capacity increases as the square of the length of the cable. For long transmissions the saving is very large. He then gives formulas for three-phase cables. In conclusion the author states that so great is the saving which can be effected in a supply at low power factor that, in spite of previous failures, it is not improbable that condensers will eventually come into use in cases where the line capacity is insufficient. An instance where this has already been done is on the Tivoli to Rome, 10,000-volt transmission, a condenser made by Prof. Lombardi having been connected across the line. With a condenser at the far end of the line a greater saving is possible than with distributed capacity, and less capacity is required to give the same saving. At a power factor of 0.7, the section of copper could be halved by the use of a condenser to produce balance at full load; but then, unless the load factor were very high, it would have to be cut out below half-load. The method of neutralizing lagging currents by over-excited synchronous motors is complex in comparison, but is free from the dangers attendant on breaking a circuit having capacity. "After all, these may prove so serious as to counterbalance all the virtues of capacity."—Lond. *Elec.*, August 8.

Three-Wire Distribution.—An editorial discussion of several problems arising in connection with the three-wire, direct-current system, with 400 to 500 volts between the outers. The degree of interconnection of the network is first discussed, that is, whether the distributing cables should be connected up in a closed network fed at certain feeding points or whether the district should be divided up into sections, each with its own distributing network and with its own feeder or feeders; it depends upon local conditions. The former method has the advantage of better pressure regulation, the latter the advantage that the effect of a fault is more local, and that the fault itself is easier to detect and locate. It is recommended to earth the middle wire at the station only and to avoid fuses on the middle wire.—Lond. *Elec.*, August 8.

REFERENCE.

Sag of Copper Lines.—KROHNE.—An article on the question of how much sag should be used in bare soft copper wire lines. He gives various tables and diagrams. *Elek. Zeit.*, July 3.

ELECTRO-PHYSICS AND MAGNETISM.

Conductivity and Atomic Heat.—STREINTZ.—A paper in which he shows the existence of some interesting relations. Clausius believed

that the resistance of metals was proportional to their absolute temperatures, and that, therefore, the coefficient of thermal increase of resistance was the same as that of the expansion of gases, viz., 1/273; more recent measurements made with carefully purified metals have shown that the rule does not hold good, as palladium, according to Demar and Fleming, has a smaller coefficient, and all other substances a large coefficient. The present author shows, however, that if the metals are arranged in groups of lower and higher atomic weights, a general rule may be formulated, according to which the coefficient increases in each group with the atomic weight. A more important relation is that between resistance and atomic heat. As the thermal coefficient of the atomic heat falls, so the thermal coefficient of the resistance rises. In all metals whose atomic weight is above 100, the thermal coefficient of the resistance is the greater the greater the atomic volume, and the smaller the displacement of an oscillating atom in comparison with the distance from the neighboring atoms.—*Ann. d. Phys.*, No. 8; abstracted in Lond. *Elec.*, July 25.

Radioactivity Produced by Light.—LE BON.—An account of experiments in which he studied the effects of light of different wavelengths upon all kinds of material bodies. He found that practically every kind of matter may be made to emit Becquerel rays by the action of light alone. If a body is exposed to sunlight, or, still better, to ultraviolet light, it gives off a form of radiation which is capable of discharging a positively charged electroscope. Amalgamated tin, copper or zinc show the strongest effect, black paper and lamp-black are almost as good. Living matter shows least of all.—*Comptes Rendus*, July 7; abstracted in Lond. *Elec.*, July 25.

Tesla Currents from Induction Coils.—MOEHLMANN.—A paper in which he maintains that the difference between Tesla currents and those furnished by an induction coil is only one of frequency and of tension. With an induction coil giving sparks of 50 cm., fed by an alternating-current dynamo giving 350 reversals per second, he obtained all the characteristic phenomena described by Himstedt, viz., that a disc placed opposite a point connected with the source was positively charged at short distances, and negatively at greater distances. Between the two cases there was a point at which the disc was not charged at all. The position of the point of reversal was found to be only dependent upon the potential of the source, and not upon the frequency. The higher the potential, the further do the positive ions penetrate, and the greater; therefore the distance of the neutral position. It appears that smooth, rounded surfaces give off negative ions by preference, and rough or pointed surfaces, positive ions. This explains why positive ions are best obtained by fusing a platinum wire into a glass tube and filing the projecting point down to the level of the glass. The sides of the wire, which are smooth, are thus prevented from sending out negative ions, and the point alone remains in action.—*Ann. d. Phys.*, No. 8; abstracted in Lond. *Elec.*, July 25.

Optical Effect of a Current in a Metal.—BEVAN.—A discussion of the question whether the optical constants—such as the reflective power of a metallic mirror—are altered on conducting a current through it, and whether such alteration persists as long as the current lasts. He calculates the effect theoreticaly on the basis of Drude's theory. He finds that the effect of the current in the metal is to cause an alteration in the constants of the metal, but this aleration is too small for the effect to be measurable, taking one-hundredth of a wave-length as the minimum change of phase which can be detected.—*Proc. Cambridge Phil. Soc.*, May 5; abstracted in Lond. *Elec.*, July 25.

Hall Effect in Gases.—WILSON.—A paper describing experiments in which he demonstrates with great success the existence of a Hall effect in the positive column of a vacuum discharge. The condition theoretically necessary for the existence of a Hall effect is a difference between the velocities of the two kinds of ions, and this is known to exist between the fast negative and the slow positive ions of the vacuum discharge. He found that the Hall effect was independent of the current, but proportional to the intensity of the magnetic field. The arrangement of his apparatus is described and illustrated. His results show that the Hall effect varies along the tube very nearly as the electric intensity, but in the striated positive column the Hall effect falls to an almost zero value between the striæ, whereas the electric intensity only falls to a comparatively small extent. It appears, therefore, that the difference between the velocities of the negative and of the positive ions in the dark spaces between the striæ is very small. It is probable that when a molecule is ionized, a free electron or negative corpuscle is split off, which is of very small mass compared with the positive ion. The difference of the velocities is thus at first very large. After a short time, however, the negative electron probably becomes attached to a neutral molecule, so that the two ions are then at almost equal mass, and the difference between the velocities is very small. It seems, therefore, probable that electrons are formed largely in the striæ, and that by the time they get into the dark spaces the electrons have become attached again to molecules.—*Proc. Cambridge Phil. Soc.*, May 5; abstracted in Lond *Elec.*, July 25.

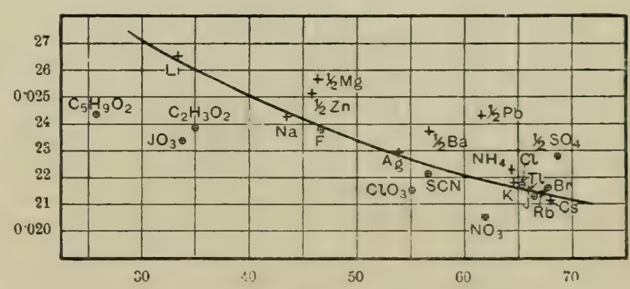
Electromagnetic Relations.—RIGHI.—A discussion of the experiments of Cremieu, and their bearing upon the four electromagnetic effects predicated from Maxwell's theory. The four effects are: First, the production of a magnetic field by a moving electric charge; second, the production of an electric impulsive force by a varying magnetic field; third, the production of an electric field by a moving magnetic pole, and, fourth, the production of a magnetic impulsive force by a varying electric field. Of these, Cremieu denies the existence of the first and second; the third and fourth have not yet been studied. The fourth offers the same difficulty as the first, inasmuch as the magnetometer must be protected from direct electrostatic action by a conducting shield. The author deals especially with the second effect, and gives reasons for regarding Cremieu's results as inconclusive. He describes his own experiments on the same subject, which are of extreme delicacy, but also hitherto inconclusive, owing to the many sources of error involved. In conclusion, he shows that Cremieu's negative results are not able to shake our confidence in the soundness of modern electromagnetic theory; but it would be very desirable that experiments be made along all the four lines indicated, so as to clear up the matter thoroughly.—*Phys. Zeit.*, July 1; abstracted in Lond. *Elec.*, July 25.

REFERENCE.

Phase Difference.—BENISCHKE.—A communication in which he makes some critical remarks on Orlich's recent article on the definition of phase difference.—*Elek. Zeit.*, July 10.

ELECTRO-CHEMISTRY AND BATTERIES.

Ionic Mobilities.—F. KOHLRAUSCH.—An account of an investigation, in which he has succeeded in discovering and confirming a new law with regard to the mobility and temperature coefficient of conductivity of monovalent ions. It appears that the temperature coefficient is simply a function of the mobility, quite apart from the chemical nature of the ion. The accompanying diagram shows



IONIC MOBILITIES

the mobilities at 18 degrees as abscissas, and the corresponding temperature coefficient as ordinates. He further found the mobilities of the positive and the negative ion tend to become equal with increasing temperature.—*Sitzunzsber Berl. Akad.*, May 29; abstracted in Lond. *Elec.*, August 1.

Electro-Chemical Behavior of Sulphur.—KUESTER.—A German Bunsen Society paper on the causes of the peculiar periodic changes sometimes observed in electrolytic measurements. By electrolyzing polysulphide solutions, he observed that the voltmeter and ammeter, connected with the decomposing cell in the usual way, showed regular periodic vibrations. He found that these are due to a layer of sulphur on the anode, being periodically formed and destroyed. This layer acts like an insulator and increases the resistance of the cell, hence the periodic vibrations of current and e. m. f.—*Zeit. f. Elektrochemie*, July 24.

Behavior of Diaphragms During the Electrolysis of Aqueous Solutions.—HITTORF.—A German Bunsen Society paper, in which he corrects a mistake made by him 45 years ago in his determinations of

transport numbers. When for the determination of transport numbers diaphragms are used, endosmosis takes place. Through clay diaphragms the solution goes in unchanged composition, and there is no error in the determination of the transport number. But animal membranes behave differently, at least for most aqueous solutions; changes are caused in the anode and cathode part which are not due to the electrolytic transference of the ions; hence the determination of the transport numbers from the concentration changes which actually take place becomes wrong.—*Zeit. f. Elektrochemie*, July 24.

Behavior of Bromine Against High-Tension Discharges.—Kellner.—A German Bunsen Society paper. He discovered several years ago that pure dry chlorine gas when high-tension electric currents are sent through it shows some properties which the ordinary chlorine gas does not possess. He has now made experiments with very carefully purified bromine in vessels of glass, free from lead, and found yellow crystals deposited on the walls of the vessel; he does not know what they are.—*Zeit. f. Elektrochemie*, July 24.

Sterilizing Water by Ozone.—H. J. van't Hoff.—A German Bunsen Society paper on the Vosmaer-Lebret system of sterilizing water at a large scale by means of ozone. This system has been used commercially, first in Schiedam, later in Nieuwersluis, near Amsterdam. In Schiedam this system has been used for about six months, for eleven hours per day, without any interruption. An alternator gives alternating current at 110 volts and 100 periods. A transformer raises the voltage to 10,000, at which tension the current is supplied to the ozone apparatus; one pole of the same is earthed. The ozone is formed by means of dark discharge, without any solid dielectrics. Through the ozonizer the dried air is driven at a speed of about 40 liters per minute; a concentration of 3.5 to 5 mgr. of ozone per liter is obtained. For sterilization purposes a concentration of 3 to 3.5 mgr. has been found to be sufficient. The ozonized air is then pumped into the sterilizer, which it enters at the bottom and leaves at the top. The coarse impurities of the water are filtered off by means of a quick filter, before the water is sterilized by the ozone. He gives some details of various tests. The sterilizing result is said to be at least as good as with other ozonizing systems; a brief comparative table of such systems is given. The cost of ozonization is said to be 1/16 to 1/8 cent per cubic meter. The cost of installation is not given, as it is said to depend upon the local conditions. Sterilization by ozone is generally superior to central sand filtration. It is proposed to introduce ozonization at the water works in Rotterdam.—*Zeit. f. Elektrochemie*, July 24.

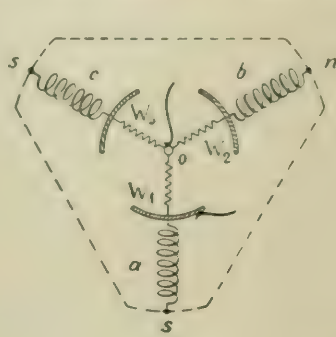
REFERENCES.

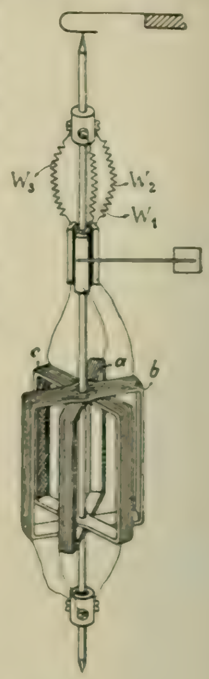
Electrolysis of Chlorides.—Mueller.—An illustrated account of an experimental investigation of "the electromotive behavior of the hypochlorous acid and of chloric acid." The great difference of the results obtained with plain platinum anodes used with platinized platinum anodes is pointed out.—*Zeit. f. Elektrochemie*, July 3.

Course in Physical Chemistry.—Loeb and Rimbach.—An illustrated article on the course in physical chemistry in the chemical laboratory of the University of Bonn.—*Zeit. f. Elcktrochemie*, July 10.

Units, Measurements and Instruments.

Motor Meters.—Bruger.—An illustrated paper, read at the recent annual meeting of the Association of German Electrical Engineers. In an ordinary direct-current motor meter the speed is proportional to the power only when the friction is negligible. If there is friction, a means must be provided by which the error resulting from the friction is annulled. Several such devices are described. He has worked, however, in another direction, endeavoring to avoid this error by making the friction negligible. He states that the axle friction is very small compared with the friction of the brushes sliding on the commutator; the latter is especially great, when a brush passes from one segment to another. He describes a device of Hartmann and Braun, in which the brush friction is made negligible by using three commutator segments and only one brush. How this is done is shown in the adjoining diagrams, Figs. 1 and 2. Three active coils, *a*, *b*, *c*, are used, arranged at angles of 120 degrees from one another. There are three series of resistances, w_1, w_2, w_3, each belonging to one coil. Between each resistance and coil the commutator segment is inserted. The three free ends of the series resistances are connected together and so are the three free ends of the coils. The current enters through the junction point of the three resistances and leaves the system through the brush sliding on one commutator segment. Two of the coils have always the same polarity, while the third one, through which a current of double the strength in the other two flows, has opposite polarity. For a given current and given number of turns the effective ampere-windings are the greater the greater the series resistances in comparison with the resistance of the coils. They make the former 15 to 20 times the resistance of the coils. He describes the construction of a watt-haur-meter and an ampere-hour meter, and then gives an account of experiments in which he tried to devise a direct-current motormeter, in which the use of a commutator with brush is entirely avoided. He has succeeded in devising a motor with continuous movement of this kind, but it is not yet sufficiently reliable to be used in a meter; he, therefore, uses the term "electromagnetic moving apparatus." The principle upon which it is based is as





FIGS. 1 AND 2.—MOTOR METER.

follows: Referring to the adjoining Fig. 3, the armature coils are each wound double, the twoparts of each double coil being connected in parallel with each other, and in series with all the other parts; the current flow through the whole series; each part of the double coils is in series with a small bifilarly-wound resistance spiral of bismuth, which is fixed to the armature and moves with it; the direction of winding of these coils is such that the currents in each pair flow in opposite directions around the armature, so that their ampere windings would ordinarily neutralize each other. These

FIG. 3.—MOTOR METER.

bismuth spirals are so arranged that each is in a magnetic field during half of a revolution of a bipolar motor, and while in that field its resistance is greatly increased, owing to a well known property of that metal; consequent decrease of current in one of the two parallel coils enables the resulting excess of ampere-windings of the other coil to become effective in driving the motor, as the bismuth spiral of this other coil is during thattime outside of the magnetic field. With a field of 9,000 C. G. S. units he obtains an increase of resistance of nearly 40 per cent., so that the active current is always about 35 per cent. stronger. He applies the same principle to an oscillating pendulum motive device, diagrammatic illustration of which is given, as are also views of both the completed machines.—*Elek. Zeit.*, July 3.

Measuring the Iron Losses in Transformers.—GOLDSCHMIDT.—A communication in which he describes a method which he uses in iron tests and for measuring the no-load energy of small transformers. The iron body is provided with two windings, one consisting of a few turns, the other of many turns; the latter is connected to the voltage coil of the wattmeter, while the current flows through the former. With a small 120-volt transformer the no-load current was 0.5 ampere. The number of turns of the 120-volt winding was 80. The deviation of the needle of the wattmeter with the ordinary connections, was so small that it could not be used to take a reading. When the transformer was then excited by an auxiliary winding, consisting of four turns, and the 120-volt winding was connected to the voltage coil of the wattmeter, the deviation of the needle became 20 times larger. By this method, the copper loss in the exciter winding is not measured. The wattmeter gives the pure iron loss. It is easy to put on a separate current winding, as it consists of only a few turns.—*Elek. Zeit.*, July 17.

Standard Cells.—LUTHER.—A German Bunsen Society paper, in which he discusses the question of how great must be the degree of chemical purity of the electrolyte in order to obtain the required exactness. One Clark cell contained an impurity of 50 per cent. by volume of glycerine, the electrolyte in another Clark cell was pure; the difference of the e. m. fs. of the two cells was found to be 0.00744 volt at 25 degrees. From the theory which he advances, he draws an interesting conclusion: if the solid crystals in a standard cell with saturated solution (corresponding to the zinc sulphate crystals in a Clark cell with saturated zinc sulphate solution) are free from water of crystallization, then the e. m. f. must be independent of the impurities and of the solvent. He is trying to devise a practical standard cell for which this is fulfiled.—*Zeit. f. Elektrochemie*, July 24.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Space Telegraphy.—JACKSON.—A paper in which he gives a number of valuable observations concerning the transmission of wireless signals at sea across intervening land. He finds that some of the waves are capable of passing through, over, and possibly round the land, though in doing so their energy is reduced to an extent depending upon the height, extent and nature of the obstruction. He describes a remarkable case of an extremely precipitous, narrow, but high promontory, consisting of hard rock containing iron ore; the distance at which signals could be exchanged in the open sea was 45 miles, but the promontory cut them off entirely, the signals ceasing abruptly as the receiver disappeared behind the cliff. Limestone was found to be less obstructive, and sandstone still less so. Weather conditions also have an important influence, especially in sub-tropical regions; in the Mediterranean, a sirocco wind, holding moisture, salt and dust in suspension, absorbs the waves to a great extent. Lightning flashes always produce signals, and sometimes spell words in the Morse code, though the usual type is that of the letters e i in the Morse code. The absence of earthing in the receiver reduces the signalling distance by 50 or even 70 per cent., and its absence in the transmitter reduces it by 85 per cent.; but a condenser of suitable capacity acts nearly as well as a good earth. The air wire is practically indispensable, as he did not succeed in signalling over more than two miles without an air wire, even with good earthing.—*Proc. Roy. Soc.*, July 8; abstracted in Lond. *Elec.*, August 8.

REFERENCES.

Multiple Telegraphy.—ANIZAN.—The conclusion of his illustrated article on the Mercadier systems of multiplex telegraphy.—*Jour. Tel.*, July 25.

Statistics.—Statistical tables on the telephone service in 1900 in various countries of the earth, the United States not being included. Also the conclusion of the statistical report of the Postal and Telegraph Department of Italy for the financial year 1898-9.—*Jour. Tel.*, July 25.

MISCELLANEOUS.

Magnetic Separation of Zinc Blende.—A note stating that the magnetic separation of zinc blende from mixed sulphide ores by means of Wetherill magnetic machines, is now being carried on as a regular process at Denver, Colo. The crushed ore is separated into galena-pyrites and pyrites-blende classes. The latter is dried and then passed over the Wetherill machines, producing a blende which is sold to zinc smelters, and a pyrites product, containing some lead and about 5 to 7 per cent. Zn, which is united with the galena-pyrite; the mixture being sold to the lead smelters. The capacity of the zinc mill at Denver is about 40 to 45 tons of crude ore per day.—*Eng. and Min. Jour.*, August 16.

German Electrical Engineers.—A brief review of the recent annual Dusseldorf meeting of the Association of German Electrical Engineers. This association was founded in 1892, in order to further the commercial interests of the electrical, as well as the engineering and scientific interests in Germany. The latter purpose has been well fulfilled, but not the former; for this reason a separate society for protecting the common commercial interests of the German electrical interests has just been founded. The papers read at the Dusseldorf meeting will be noticed in the Digest as soon as published.—*Elek. Zeit.*, June 26.

German Bunsen Society.—As has been noticed before, the German Electrochemical Society at its last annual meeting changed its name into the German Bunsen Society for Applied Physical Chemistry. The first president is Dr. Boettinger, while Prof. van't Hoff, who was the first president up to the present, was elected second president. The number of members is now about 650. A good, brief, report of the proceedings by Danneel, with brief abstract of those papers which are of special interest to electrical engineers, appeared in the *Elek. Zeit.*, June 12. The different papers read at the meeting have been or will be duly abstracted in the Digest. A full report of the proceedings with reprints of the papers has begun in the *Zeit. f. Elektrochemie*, July 10, 17, 24, 31.

REFERENCES.

French Electric Industry.—MARMOR.—An illustrated article on machines built by the Society Schneider du Creusot.—*Cosmos*, July 26.

Conversazione.—STRECKER.—An illustrated description of the various apparatus and instruments exhibited at a recent conversazione of the Berlin Electrical Society.—*Elek. Zeit.*, July 10, 17.

New Book.

DIAGRAMS OF MEAN VELOCITY OF UNIFORM MOTION OF WATER IN OPEN CHANNELS. By Irving P. Church. New York: John Wiley & Sons. 11 diagrams and 1 page of text. Price, $1.50.

This book is intended to facilitate the application of Kutter's formula to practical work by giving its results in graphical form. Inasmuch as the practical application of Kutter's formula requires the estimation (guessing?) of a suitable "coefficient of roughness" for the particular case under discussion, the diagrammatic method will easily give all the accuracy attainable in the circumstances, and this is all the author claims for it.

BOOKS RECEIVED.

KOHLRAUSCH LEHRBUCH DER PRAKTISCHEN PHYSIK. By Dr. F. Kohlrausch. Leipzig: B. G. Teubner. 610 pages, illustrated. Price, 8.60 marks.

DIE INTERNATIONALEN ABSOLUTEN MASSE INSBESONDERE DIE ELECTRISCHEN MASSE. Fur Studirende der Electrotechnik in Theorie und Anwendung Dargestellt und Durch Beispele Erlautert. By Dr. A. von Waltenhofen. Braunchweig: Friedr. Vieweg & Son, 306 pages, 42 illustration. Price, 9 marks.

Directory of Electrical Societies, Etc.

AMERICAN ELECTROCHEMICAL SOCIETY, Secretary, C. J. Reed, Philadelphia, Pa. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

AMERICAN STREET RAILWAY ASSOCIATION, Secretary, T. C. Penington, 2020 State Street, Chicago, Ill. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa. Next meeting, Mount Washington Hotel, White Mountains, N. H., Sept. 9, 1902.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

INDIANA ELECTRICAL ASSOCIATION, Secretary, Hal. C. Kimbrough, Muncie, Ind. Next meeting, Indianapolis, Sept. 17 and 18, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, Thos. R. Mercein, Milwaukee, Wis.

THE OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION, Secretary, John Brant, 195 Broadway, New York. Next meeting, Salt Lake City, Utah, Sept. 10, 11 and 12, 1902.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION, Secretary, John Ruth. Next meeting, York, Pa., Sept. 10, 1902.

U. S. MILITARY TELEGRAPH CORPS, Secretary J. E. Pettit, Postal Telegraph Company, Chicago, Ill. Next meeting, Salt Lake City, Utah, Sept., 10, 11 and 12, 1902.

VERMONT ELECTRICAL ASSOCIATION, Secretary, C. C. Wells, Middlebury, Vt.

Small Electric Locomotives for "Industrial Railways."

An industrial or narrow-gauge railway has become a very desirable addition for the transportation of material about the yards, buildings and bays of a large manufacturing plant. If the cars and loads are small, one man—and at the most two men—can push them from one part of the shop to another. However, if there are grades about the plant or large quantities of heavy material to be moved, recourse must be had to some greater power. The storage battery electric locomotive is an ideal motive power for the purpose. The

NARROW GAUGE ELECTRIC LOCOMOTIVE.

view of one now in service in the Westinghouse plant gives a very good idea of the form and arrangement of such a locomotive.

The battery, motors, controllers and gear cases are above the platform surface, so that all the vital parts can be inspected or repaired with the utmost ease. The locomotive is carried on two swiveling trucks with every wheel a driver, giving a maximum tractive effort, and enabling it to draw large loads and ascend heavy grades. It runs smoothly around curves of 12-foot radius so that all parts of works are accessible.

The battery is recharged at night or at intervals during the day when the locomotive is idle. It is divided into sections through the controller with the motor, armatures and fields in various series-parallel combinations. No rheostats or resistances are on the locomotive, and consequently there is no waste of energy in starting or running. Two Westinghouse vehicle-type motors are mounted, one driving each truck, and these are so exactly proportioned to the normal output of the batteries, and the weight of the locomotive that they are not, and cannot be overloaded by the motorman. One of these locomotives is capable of hauling about 50 tons on the level, and corresponding loads on grades.

Two of these locomotives were recently furnished to the Westinghouse Electric and Manufacturing Company and the Westinghouse Air-Brake Company by the C. W. Hunt Company, which company also supplied the industrial railway and all its equipment.

A Gasoline-Electric Dray.

Some few months ago we published a description of the Fischer combination gasoline-electric vehicles. The latest vehicle completed by the Fischer Company is a beer truck, for Jacob Ruppert,

FIG. 1.—GASOLINE-ELECTRIC DRAY.

the New York brewer. The view shown in Fig. 1 was taken of the truck while making its regular trip. At the time it was loaded with 83 half-barrels of beer, or very near nine tons.

In general, the dimensions of the truck is as follows: Total

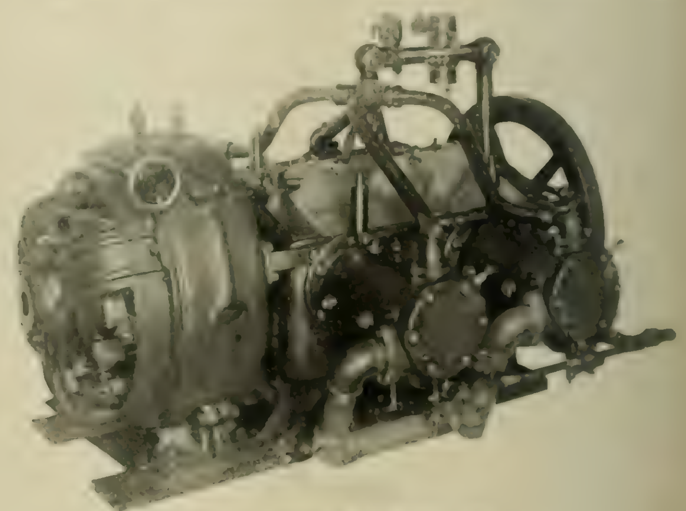


FIG. 2.—ENGINE AND DYNAMO.

length, 18 feet 4½ inches; width inside stakes, 5 feet; width over hubs, 7 feet 6 inches; wheel base, 10 feet 6 inches; size of wheel, front 36 inches, rear 42 inches; equipped with 7-inch Calumet solid rubber tires. Both front and rear axles are trussed. The front springs are

FIG. 3.—DRIVING UNIT COMPLETE.

of the platform type, the rear springs are half-elliptic with free sliding ends. All strain due to driving is taken up by push-rods from spring saddles to frame.

The power equipment consists of a 4-cylinder, 5½ x 6 gasoline

engine, coupled direct to a 9-kw, 110-volt dynamo, running at 550 r. p. m., approximately.

The two motors are of 8 hp, each capable of standing an overload of 150 per cent. The battery consists of 44 136-amp.-hour cells (3-hour rate). The controller has five speeds each way. The maximum speed is 4½ to 5 miles per hour, with full load on level. Fig. 2 shows the engine and dynamo complete. Fig. 3 is a view of the rear axle and motors assembled as a complete driving unit, but with the gear cases removed.

While the vehicle was being tested, it is reported to have hauled a 7½-ton load over a distance of 12 miles, one-third of which was up hill. At one place the grade reached 15 per cent. With the run completed, the gasoline tank was filled, thereby ascertaining how much fuel was used. It cost just three-quarters of a cent per ton-mile to haul the load for the 12 miles.

New Type of Telephone Counter.

TELEPHONE COUNTER.

The cyclometer is a widely familiar appliance in connection with the bicycle, but the Veeder Manufacturing Company, of Hartford, Conn., have of late been pushing the novel idea of applying it to telephony, and with considerable success. The Southern New England Telephone Company, of New Haven, Conn., and the Telephone and Telegraph Company, of Boston, have been testing the appliance for some time past, and report satisfactory results.

A glance at the counter, illustrated herewith, will at once suggest the manner in which it is to be attached and used. The purpose of the counter is to enable the superintendent of the telephone exchange to learn the number of calls each operator is answering per day, as well as the total number of calls answered by the exchange per day. A record is not secured every day, but once every two weeks, or possibly one day every month. If it is found that some girls are doing considerably more work than other girls, the work is re-distributed.

The two socket screws are intended to screw into the table flush, and in front but slightly to the right of the operator. The counter is attached at will by simply inserting the two pins into the two socket screws, and it is firmly held, as can be noted by testing the appliance. The operator after inserting the plug, and when returning her hand, presses the lever, and when this is done, the instrument registers one. The Veeder Company will supply the counters with levers pressing from or towards the operator, as may be preferred.

Telephone Switchboard.

The Western Electrical Supply Co. is placing a new telephone switchboard on the market, for which many claims of superiority are made. The combined drop and jack employed is claimed to be superior not only in mechanical design, but also, by reason of the armature being mounted on the front end of the coil, and the manner in which it is constructed, in electrical efficiency. It is stated that extensive tests have shown that only one-fortieth of the usual expenditure of electrical energy is necessary to operate this drop. Moreover, the simple construction of this combined drop and jack appeals very strongly to the practical telephone man, and combining these features with the compactness and general high grade construction of the switchboard, the manufacturers believe that it will appeal to all telephone engineers.

It is stated that the manner in which the armature is placed is a decided departure from other devices of this kind. The drop shutter when in the retained position rests squarely upon the armature itself, the rod that is customarily used for holding the shutter in place being discarded. Another change is that the armature does not operate on any hinge, but rests by its own weight on a knife edge at the bottom, which is on the principle of the most accurate weighing devices in common use. The space occupied by the complete structure comprising the combined drop and jack is only one by one and one-half inches, which makes the switchboard very compact. Still another point is that the mechanical restoring device is absolutely positive in its operation.

Telephone Service for a New Hotel at Indianapolis.

The Claypool Hotel, Indianapolis, now being constructed by the Indiana Hotel Company, will own and operate a complete telephone exchange, with a telephone in each guest room, as well as in the parlors and offices. The hotel is one of the largest, and when completed will be one of the finest and most modernly equipped houses in the West. The building and its furnishings will represent an investment of more than a million dollars.

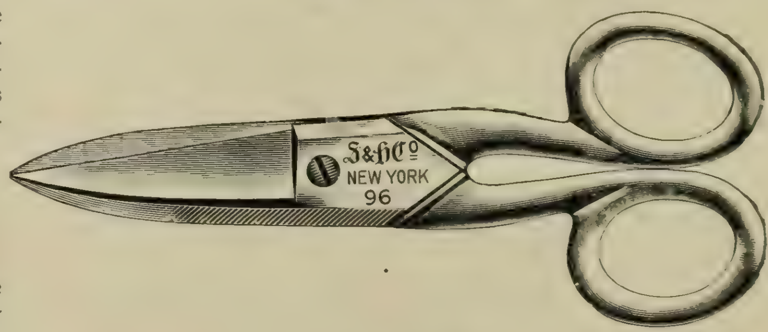
The telephone service will be under the direction of the hotel management, and will be entirely for the convenience of the guests. It is intended to connect the hotel system with the public city exchange and State toll line system, so that long-distance connection may be made from any part of the house.

The equipment will be furnished by the International Telephone Manufacturing Company, Chicago, and will embody all of the improvements in this line recently evolved by this company. The system will be a full central-energy lamp signal, double supervisory switchboard equipment, with long-distance telephones.

The switchboard cabinet work and the telephone woodwork will be of solid mahogany for the parlor floors, of white walnut for the ladies' parlors, and will match the fittings throughout the house. The working parts of the system will have the same grade of work as in this company's public exchange equipment, and it is expected it will be one of the most modern and efficient hotel telephone systems ever installed.

An Electrical "Snip."

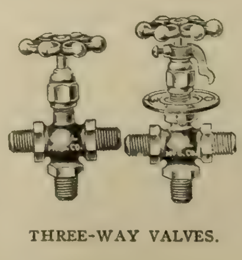
The illustration herewith is that of the telephone or electrical snip now being manufactured by the Smith & Hemenway Company, 296 Broadway, New York City. This device is made from the highest grade material, and nickel plated. It is made very heavy and with a powerful leverage for cutting and stripping wire. It is a tool useful



ELECTRICAL "SNIP."

to any lineman, electrician, bell-hanger or anyone who in any way strings wire. The tool is up to the high standard of goods made by this firm in durability, finish, etc.

Three-Way Valves.


THREE-WAY VALVES.

The Clayton & Lambert Manufacturing Company, of Detroit, Mich., are making three-way valves, of the form herewith illustrated. They are used in large quantities by gas and gasoline engine makers, automobile builders and others. They are made out of close-grained, red-valve metal, and are furnished with and without dials, as shown.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 5 per cent. for thirty to ninety days. The stock market was somewhat unsettled and reactionary, although a strong undertone was exhibited. Western Union was very active and advanced to 95⅞ on pool manipulation, facilitated by vague reports of a possible combination of telegraph interests. It closed at the highest quotation—95⅞—a net gain of 2⅝ points, the lowest figure being 91¾. The sales aggregated 206,780 shares. Steel stocks were more active and firmer, common rising to 41⅝ and preferred to 90⅝. Tractions were weak and neglected. Brooklyn Rapid Transit closing at 66¾, a net loss of ⅛ point, and Metropolitan Street Railway at 147, a net loss of ⅞ The sales were 16,200 and 2,800 shares, respectively. General Electric was firm, closing at 187, being a net gain of 2 points. Westinghouse remains inactive, closing at 220. Other closing prices were: American District Telegraph 38½, a net gain of ½ point; American Telephone and Telegraph 173½, a net gain of 6½ points and Commercial Cable 165, a net gain of 8¾ points. Following are the closing quotations of August 26:

NEW YORK.

	Aug. 19.	Aug. 26.		Aug. 19.	Aug. 26.
American Tel. & Cable.	—	—	General Electric	185	192
American Tel. & Tel..	170¼	173½	Hudson River Tel.....	—	—
American Dist. Tel....	—	39	Metropolitan St. Ry...	147¾	147¾
Brooklyn Rapid Transit.	67	67¼	N. E. Elec. Veh. Trns.	—	⅞
Commercial Cable	—	—	N. Y. & N. J. Tel....	—	—
Electric Boat	23	28*	N. Y. E. V. T. Co....	11½	11⅝
Electric Boat pfd......	30	41*	Tel. & Tel. Co. Am....	—	—
Electric Lead Reduc'n..	1¾	2¼	Western Union Tel....	92⅜	95⅝
Electric Vehicle	5½	5½	West. E. & M. Co.....	—	224
Electric Vehicle pfd....	13	14	West. E. & M. Co. pfd..	—	—

BOSTON.

	Aug. 19.	Aug. 26.		Aug. 19.	Aug. 26.
American Tel. & Tel..	170½	173½	Western Tel. & Tel. pfd.	—	101
Cumberland Telephone .	—	—	Mexican Telephone	2⅜	—
Edison Elec. Illum....	—	—	New Eng. Telephone...	141½	142½
Erie Telephone	—	—	Westinghouse Elec.	—	—
Western Tel. & Tel....	—	30	Westinghouse Elec. pfd.	—	110½

PHILADELPHIA.

	Aug. 19.	Aug. 26.		Aug. 19.	Aug. 26.
American Railways	50	50¾	Phila. Traction	99¾	99¾
Elec. Storage Battery..	88	91	Phila. Electric	6¼	7⅛
Elec. Storage Bat'y pfd.	87	89	Pa. Elec. Vehicle......	—	—
Elec. Co. of America..	8¾	8⅞	Pa. Elec. Vehicle pfd..	4	—

CHICAGO.

	Aug. 19.	Aug. 26.		Aug. 19.	Aug. 26.
Central Union Tel.....	—	—	National Carbon pfd....	100	—
Chicago Edison	—	—	Northwest Elev. com...	—	—
Chicago City Ry.......	206	211	Union Traction	16	—
Chicago Tel. Co........	—	—	Union Traction pfd....	50*	—
National Carbon	32¼*	42¼			

* Asked.

PHILADELPHIA BELL TELEPHONE.—A prominent official of the Philadelphia Bell Telephone Company says: "The company has about completed extensive plans for redistricting its downtown business. The plans involve important changes in four stations. The capacity of the station at Market Street, which was built to handle 5,000 connections, has been severely overtaxed by the rapid increase of business in that district, and it has become necessary to transfer some of the lines heretofore handled there to the station at Eleventh and Filbert Streets. The latter station now accommodates 4,000 lines, but will be rebuilt to accommodate 14,000. In addition to these changes, the capacity of the station at Seventeenth and Filbert Streets will be largely increased, and the station at Seventeenth and Poplar Streets, which now accommodates 2,000 connections, will be given a capacity for handling 16,000, to meet the growth of business in that district. The company has issued $1,000,000 additional stock, making total capital stock $10,000,000, leaving $2,000,000 authorized still to be issued of the $4,000,000 increase voted last April. There was a total gain of 13,785 stations, about 10,000 in Philadelphia and about 4,000 in Delaware and Atlantic, between January 1, 1902, and August 20.

FEDERAL TELEPHONE.—A telegram from Cleveland of August 24 says: The Everett-Moore syndicate has changed its plans with reference to the Federal Telephone Company, and no further effort will be made to bring about a reorganization of that concern. To-day it was learned that not a single company would remain the property of or in control of the Federal Telephone Company, and that that organization would shortly go out of existence. Henry A. Everett said that the intention is to fully protect the stockholders of the Federal Company and to bring about a dissolution of the company in about a month. The United States Teelphone Company and the Cuyahoga Telephone Companies will be handled as separate properties. A development with regard to the People's Telephone Company at Detroit, is expected soon and it is to be arranged by an attorney. It is believed that the money obtained from the sale of the smaller companies will more than offset the indebtedness of the Federal Telephone Company.

BOSTON EDISON.—The amount of the capital stock of the Edison Electric Illuminating Company, of Boston, has now been increased from $7,850,400 to $8,635,500 and the number of shares from 78,504 to 86,355. This issue is a little less than half the amount authorized to be issued by the Gas Commissioners. The directors offer to stockholders 7,851 shares at $200 per share, at the rate of one new share for every ten old shares now held by them. The right to subscribe will expire at the close of business October 8, 1902.

BELL TELEPHONE.—An official of the American Telephone and Telegraph says: "The subscription books of the company, which closed August 15, shows that practically all the new stock was subscribed for by the old stockholders. The present advance in the stock from around 163 to 172 has been principally on buying for New York account, judging from transfers, although there has been considerable buying for local account."

ELECTRIC STORAGE BATTERY.—A director of the Electric Storage Battery Company says: "No result will be reached as to the future of the Electric Storage Battery and Stanley Electric Companies until the fall. Mr. Whitney is out of town and Mr. Ryan is abroad, and action will certainly be deferred until Mr. Ryan returns in October."

MORTGAGE.—A mortgage for $2,000,000 has been given to the Federal Trust Company, of Cleveland, by the Baltimore, Washington and Annapolis Railway Company. The mortgage guarantees an issue of bonds for the completion of the road from Baltimore to Washington and Annapolis, an important article in regard to which appears in our present issue.

THE AUTOMATIC ELECTRIC COMPANY, of Chicago, has increased its capital from $2,000,000 to $3,000,000. This is the company which absorbed the Strowger Automatic Telephone Company last January.

BINGHAMTON BONDS.—It is stated that all the outstanding bonds of the Binghampton (N. Y.) General Electric Company, amounting to $700,000, are called for redemption.

DIVIDEND.—American Railways directors have declared a dividend of 1¼ per cent., payable September 16.

Commercial Intelligence.

THE WEEK IN TRADE.—Favorable conditions obtain in all sections, according to the reports received by the mercantile agencies, fall jobbing activity being widespread and reports as to collections being more uniformly encouraging than for some time past. Industrial activity has apparently never been surpassed. Gross railway earnings for the first half of August are 5 per cent. larger than during the same period last year, while the net returns for the first half of 1902, though reduced in May and June by strike influences, are nearly 5 per cent. better than for the same period in 1901, the best hitherto recorded. Fall trade is at its height at most of the leading centers, and buying is liberal; the Southwest reports the best trade in years. The lack of fuel threatens to make the shortage in pig iron acute; rails and structural material continue in heavy demand the country over, and machinery manufacturers are generally crowded to keep up with their orders. The end of the coal strike is yet a future event, although some isolated instances of collieries resuming are reported. Some Welsh coal has been imported but there is said to be little profit in it below $9 per ton. The business failures for the week ending August 21, as reported by *Bradstreet's* numbered 181, the same as the week previous, also the same as the corresponding week last year. The copper market was dull and featureless with prices a shade lower but in the buyers' favor. The closing quotations were: Standard, September-October, 10⅞@11¼c; Lake, spot to December, 11½@11¾c; Electrolytic, same delivery, 11.40@11.50c; casting, 11.35@1150c.

THE MANSFIELD ENGINEERING COMPANY, Mansfield, Ohio, will build a large power hourse and will purchase two generators, three boilers, two engines, compressors, etc. All machinery will be operated by motors, about twelve of which will be required.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended August 16: Antwerp—26 pkgs. material, $1,193; 12 pkgs. material, $1,531. Brussels—1 pkg. material, $100. Bristol—10 pkgs. machinery, $700. Barcelona—16 pkgs. machinery, $1,353. British Guiana—17 pkgs. material, $407. British East Indies—1 pkg. material, $25. Bilboa—7 pkgs. material, $550. Berlin—3 pkgs. material, $1,500. British Australia—3 pkgs. machinery, $115; 62 pkgs. material, $3,142. British West Indies—86 pkgs. material, $773. British Possessions, all others—4 pkgs. material, $194. British Possessions in Africa—54 pkgs. machinery, $3,414; 234 pkgs. material, $13,267. Colchester—2 pkgs. material, $153. Central America—12 pkgs. material, $375. Copenhagen—5 pkgs. machinery, $155. Cuba—34 pkgs. material, $766. Chili—13 pkgs. material, $967. Dutch West Indies—5 pkgs. material, $90. Ecuador—1 pkg. material, $210. Glasgow—5 pkgs. material, $225; 24 pkgs. machinery, $1,275. Genoa—80 pkgs. material, $1,165. Hamburg—12 pkgs. machinery, $1,524; 34 pkgs. material, $1,757. Havre—9 pkgs. machinery, $500; 30 pkgs. material, $1,250. London—74 pkgs. machinery, $2,729; 91 pkgs. material, $4,569; 17 pkgs. electrical cable, $2,168. Liverpool—271 pkgs. machinery, $18,765; 163 pkgs. material, $6,388. Manchester—117 pkgs. machinery, $13,665. Munich—2 pkgs. material, $220. Naples—2 pkgs. material, $10. New Castle—5 pkgs. machinery, $765. Newfoundland—10 pkgs. material, $75. Nova Scotia—22 pkgs. material, $224. Peru—14 pkgs. material, $453. Portsmouth—1 pkg. material, $82. Stockholm—1 pkg. material, $32; 1 pkg. machinery, $30. San Domingo—4 pkgs. material, $67. Saragossa—8 pkgs. material, $150. Tasmania—16 pkgs. material, $954. U. S. Colombia—9 pkgs. material, $520. Venezuela—4 pkgs. material, $69. Vienna—2 pkgs. machinery, $84.

ALLIS ENGINES IN SCOTLAND.—The following is reported from Glasgow by the *Iron Age*: The performance of the Allis engines at the Glasgow electric tramway station has never ceased to greatly interest all engineers, owing to the fact that the installation of American machinery in a station at Glasgow, the center of a great engineering district, involved much discussion. The question of early delivery was a prominent element in the decision of the Glasgow council, but the American makers were not satisfied with the kudos which came from the acknowledgment of the authorities that, but for the Allis engines, the electric tramways would not have been available at the opening of the exhibition. They have had exhaustive tests made by Professor Barr, of Glasgow University, whose reports carry conviction because of his skill and experience in such work. I have had a reading of the report, which is highly creditable to the Allis engine. The consumption of steam per indicated horse-power, as measured by the condensed water, proved to be 12.12 pounds, and the mechanical efficiency of the engines was 96 per cent. The engines of 4,000 indicated horse-power are coupled to 2,500 kw triphase electric generators and the ratio of the indicated horse-power to the electric horse-power proved to be 92 per cent. Mr. Parshall, the consulting engineer for the Glasgow corporation, commenting upon the report, says that the engines are working perfectly well in all respects and have been from the beginning.

ELECTRICITY IN ENGLAND.—"Apparently we are about to witness a kind of electrical boom," says a leading English financial journal. "This country has been singularly slow in adopting electricity. Former generations of Englishmen were quick to perceive the advantages of new inventions and to turn them to commercial account. But during the past quarter of a century or so there has been a strange apathy. There is no doubt that in regard to electricity we have fallen entirely behind the United States, Germany and France, and, indeed, some of the smaller countries, too. Perhaps there may be an ultimate advantage in this. We were the first in adopting railways, and no doubt part of their present unsatisfactory condition is due to that fact. From what we learn, it seems to be clear that a great development of electrification of railways is imminent. The Northeastern Railway Company has decided to electrify its Newcastle suburban lines. There is keen competition for all sorts of electrical railway enterprises here in London. Curiously, however, there does not seem to be keen interest in establishing great electrical companies. We have nothing in this country to compare with the leading electrical companies in the United States and in Germany. Whether the prospect of the electrification of railways will stir up our moneyed classes remain to be seen. If it does not, American and German companies will reap a handsome harvest, due to the inertia of our own manufacturers."

EDISON ORE PROCESS.—The English correspondent of the *Iron Age* writes: "All the preference shares for the Dunderland Iron Ore Company, formed to work the Edison magnetic process on the Dunderland estate, in Scandinavia, have been taken up. Operations have been vigorously commenced through the contracting company—the Standard Construction Company—and 1,500 men are already employed in making the line and otherwise preparing for the works. Sir David Dale, the chairman of the company, speaks very hopefully of the prospect. Sir J. Lawrence, M. P., states that the ultimate profit which the Standard Construction Corporation are to get out of this undertaking is not to exceed £40,000. The reason for the creation of the Standard Construction Corporation was, among other things, that a private contractor would charge a great deal more for carrying out the work than it could be done for by those specially acquainted with this class of undertaking, and it is computed that the Dunderland Ore Company save £200,000 by contracting the work through the Standard Construction Corporation. The Edison Ore Milling Company get no profit out of the Dunderland Ore Company, except in paper—that is to say, there is no cash profit."

FRENCH INDUSTRIALS.—Mr. Arthur Raffalovich, in *Le Marche Financier,* gives a list of industrial securities quoted on the Paris Bourse, showing the quotations at the end of 1900 and at the end of 1901. In almost every case the depreciation has been considerable. The crisis in industrial securities began in 1900, and, therefore, the comparison instituted by M. Raffalovich is not with the highest quotations. A few of the instances given by him will be instructive to show what heavy losses were incurred during 1901. The shares of the Compagnie de Traction, which were quoted at 156 at the end of 1900, were only 29 at the end of 1901. Those of the Compagnie Generale de Traction fell in the course of the year from 149 to 33; those of the Voitures a Paris from 260 to 153; those of the Bateaux Parisiens from 476 to 240; those of the Est-Parisien from 408 to 117; those of the Compagnie Generale Parisiene from 338 to 207; those of the Malfidano from 1,025 to 410, and those of the Fers et Aciers Robert from 123 to 54½.

WESTERN POWER COMPANY.—James D. Schuyler, of Los Angeles, connected with the Western Power Company, said recently that the company was actively engaged in carrying out its plans for an electric power transmission to San Francisco. Engineers and laborers are at work in the Big Meadows region on the reservoirs and tunnels that will be necessary for the completion of the great enterprise. This supply of water will supplement that which has been acquired by the purchase of the Big Bend Tunnel water system from Frank McLaughlin and his associates. It will cost about $500,000 to put this hydraulic system into proper condition to operate electric generators. The distance of transmission from the Big Bend tunnel site to San Francisco would be about 150 miles, while from the Big Meadows source it is about 180 miles.

ROBERT W. BLACKWELL & CO.—The following has been received from the above firm: "We beg to advise you that we shall close our branch office at 120 Liberty Street, New York, on the 31st of August, 1902. On and after that date, all our shipments from America will be in charge of Messrs. Lunham and Moore, Produce Exchange, New York City. All correspondence should in future be directed to our principal office, No. 59 City Road, London, E. C., England. Kindly advise your several departments to take immediate note of the above." The reason appears to be the domestic activity which prevents the export of various specialties, as prices are high, shipments are delayed, and some of the manufacturers are too busy even to quote for foreign orders.

FOREIGN ORDERS FOR SIGNALS.—The Northeastern Railway Company, of England, has awarded a contract to the Hall Signal Company, of this city, for the equipment of 10½ miles of its double track main line with the new Hall automatic normal danger block system of signals, from Alne to Thirsk. The award of this contract represents a probable revolution in the signaling of British railway lines, as it is believed that the Northeastern and many other British railway companies will adopt the American system for use over all their lines, in place of the English block system now in use.

AUTOMATIC TELEPHONE CONTRACTS.—The Automatic Electric Company, of Chicago—Strowger system—have recently been awarded the contracts to equip the independent exchanges in the cities of Columbus and Dayton, O., with their apparatus. Each of these exchanges is to have an ultimate capacity of 19,000 subscribers. The former is to have an initial installation of 6,000 stations, while the latter will begin, it is said, with 7,000 telephones connected up. These run far beyond anything attempted so far in the automatic telephone field.

OTIS ELEVATOR ORDERS.—This summer has been a remarkable season for the elevator industry, the Otis Elevator Company reporting that within the past week it has closed contracts for no less than 40 hydraulic passenger elevators, to be installed in New York City in large office buildings. Last week's orders include 51 electric elevators for New York City alone. Several of these are of the full automatic or push button type, where no attendant is required.

EQUIPMENT OF LOOM WORKS.—The contract for the entire electrical and mechanical equipment for the new Philadelphia plant of the Crompton and Knowles Loom Works, of Worcester, Mass., has been placed with Sargent, Conant & Co., of Boston. Power for the entire works will be transmitted and distributed electrically.

THE STANDARD VITRIFIED COMPANY, 39-41 Cortlandt Street, New York, was established July 1, 1902, and incorporated by Mr. R. W. Lyle, as president, and B. S. Barnard, vice-president and secretary. Mr. Lyle has had an experience of thirty-five years in the art of clay working, and of late years his time has been devoted entirely to the invention of different forms of conduit to be made in vitrified clay. He has recently had awarded to him four separate patents on multiple duct conduit, which this concern will put on the market. The company's factory, situated at South River, N. J., is one of the largest in the world, having 150 acres of stoneware clay, which will vitrify and make some of the best conduit known. It also proposes to manufacture a single duct conduit with self-centering joint. This is very economical construction, as an ordinary laborer can lay it. It requires no mandril or chalk lines, and aligns itself during construction. It also manufactures a third-rail insulator that is used on the Manhattan Elevated, New York City, and by the Westinghouse Electric Manufacturing Co., London, England. Mr. Barnard who has been in the electrical field for many years, is with Mr. Lyle, and from the experience of both of these gentlemen, both in manufacturing and following the trade closely, their success is assured. The company expects to have a capacity, at this one factory, of 25,000,000 feet a year. It is able to ship by water to all seacoast points, and by rail at very favorable rates. Its catalogue is in the printer's hands, though it is able to take orders at the present time and give immediate delivery. The ELECTRICAL WORLD AND ENGINEER has on many occasions referred to the conduit made by Mr. Lyle, and his new inventions should be more or less interesting to those intending underground construction.

MEXICAN WATER POWERS.—A great amount of United States capital is going into the Guanajuato mining district of Mexico, which gives promise of becoming one of the great mining fields on the American continent. The organization of the Guanajuato Power and Electric Company has been a factor in inducing the investment of capital in the district. This company will expend about $1,500,000 in harnessing the waters of the River Duero near the City of Lamora and transmitting power 110 miles to the City of Guanajuato. From the distributing station at Guanajuato the power will be transmitted to every mining district of importance in the vicinity. Chas. A. Coffin and John S. Barrett of the General Electric Company, E. Rollins Morse, John Hays Hammond and others prominent in mining and electrical circles, are identified with the company. The power plant will cost $1,000,000 and be completed in about a year. It will have an initial capacity of 3,000 hp and will be increased to 7,000 hp. It will make possible the extraction of millions of tons of low-grade ore that heretofore it has not paid to extract on account of expense of steam power. A large water power plant is also to be built in Mexico for pumping and lighting purposes at Parras and Viesca; also farms along the lines for a distance of forty miles. Water will be utilized from the mountain tunnel now being constructed at San Lorenzo. Capitalists at San Lorenzo, Parras and Viesca, State of Coahuila, are reported to be interested in the project.

RAW HIDE PINIONS IN ENGLAND.—Mr. A. Tait, assistant manager of the works of Messrs. George Angus & Co., Ltd., Newcastle-on-Tyne, England, and one of the largest leather manufacturers of the United Kingdom, recently spent two weeks in Syracuse, N. Y., having come to this country especially to visit the works of the New Process Raw Hide Company. An arrangement was made with Messrs. Angus & Co., by T. W. Meachem, president of the rawhide company, during a recent trip abroad, whereby the English concern is to establish a plant in England for the manufacture of rawhide gears and other products under the patents and processes of the New Process Raw Hide Company and using the latter company's trade mark. The plant it is expected will take care of the company's business not only in Great Britain but throughout Europe, Messrs. Angus & Co. having offices in nearly all of the principal cities and therefore being excellently situated to care for this trade. Upon Mr. Tait's return to England he will place orders with American firms for the latest gear making machinery and will proceed at once with the fitting out of the new factory, which will also be located at Newcastle-on-Tyne. Messrs. Angus & Co. have been the agents of the New Process Raw Hide Company in great Britain for eight years and have a well-established trade in these specialties.

DICK, KERR & CO.—English advices note that an amalgamation has taken place between Dick, Kerr & Co. and the English Electric Manufacturing Company of Preston. These two companies, along with the Electric Railway and Tramway Carriage Works, Limited, also of Preston, have previously been closely connected in engineering contracts, such relations being facilitated by the fact that Messrs. Dick, Kerr & Co. are the principal shareholders in both the other companies. It has been found, however, that persons having contracts at disposal could not quite understand the action of Messrs. Dick, Kerr & Co. accepting contracts and giving portions of them to the other companies. Therefore it has been thought advisable to bring the interests of each closer together by amalgamating with the English Electric Manufacturing Company, and it is stated that possibly in the near future the same proceedings may be taken with respect to the Carriage Works Company.

TRAIN LIGHTING CONTRACT.—The Consolidated Railway Electric Lighting and Equipment Company, of 100 Broadway, New York, has contracted with the Chicago, Rock Island and Pacific to equip with its "Axle Light" system of electric lights and fans all the cars now being constructed by the Pullman Company to be used in the new limited trains that go into service November 1 between Chicago and San Francisco via the Rock Island and Southern Pacific. This is the system of electric car lighting now in use on the twenty-hour trains of the New York Central and Lake Shore, and Pennsylvania Limited, and also on the finest trains of the Atchison, Grand Trunk, Chicago Great Western, Missouri Pacific and St. Louis and San Francisco, on the dining cars of other leading railway lines; also on all private Pullman caars, and on nearly all the official cars of railway presidents and general managers.

ALLIS-CHALMERS ENGINE SALES FOR JULY, included Milwaukee Electrical Railway and Light Company, Milwaukee, Wis., two vertical cross compound direct coupled engines, cylinders 28 in. and 60 in. by 49 in. (fourth order). American Steam and Wire Company, Pittsburg, Pa., six pairs of vertical cross compound steeple type plowing engines, steam cylinders 46 in. and 86 in. by 60 in., air cylinders 87 in. and 87 in. by 60 in., two vertical low pressure long crosshead blowing engines, cylinders 80 in. and 87 in. by 60 in. New Orleans Railways, New Orleans, La., two vertical cross compound direct connected engines, cylinders 38 in. and 80 in. by 60 in.

THE CLOVERDALE LIGHT AND POWER COMPANY which was recently incorporated with Asti, Sonoma County, Cal., as the principal place of business, will install a 600-hp electric plant. The directors are A. Sbarboro, P. C. Rossi and Alfred E. Sbarboro, of San Francisco; W. T. Brush and C. E. Humbert, of Cloverdale. The power house and dams are now being constructed on Sulphur Creek, where electric power will be generated and transmitted to Cloverdale, Asti, Geyserville and other points. Contracts will soon be let for the machinery through the Engineering Offices, San Francisco.

WIRING PROPOSALS.—Sealed proposals will be received at the Supervising Architect's office, United States Treasury Department, Washington, until 2 o'clock P. M. on the third day of September, 1902, for the installation of a conduit and electric wiring system for the Hygienic Laboratory, United States Marine Hospital Service, Washington, D. C., in accordance with the drawings and specification, copies of which may be obtained at the discretion of the supervising architect. James Knox Taylor, supervising architect.

GENERATORS FOR JAPANESE ARSENAL.—The Japanese Government, through Rear Admiral Yamouchi, who has just sailed for the Far East, after a short visit to the United States, has placed a contract with the Westinghouse Electric and Manufacuring Company for two 400-kw generators and a number of motors, which will be installed for both light and power use in the Kure arsenal. It is anticipated that further contracts will be placed shortly after Admiral Yamouchi reaches Japan.

MAGNESIA COVERING CONTRACT.—The Philip Carey Manufacturing Company, Lockland, O., manufacturers of Carey's magnesia and asbestos sectional steam pipe and boiler coverings, etc., has been awarded the contract to furnish its 85 per cent. carbonate of magnesia covering for the power station of the Manhattan Railway Company, Seventy-fourth Street and East River. The contract amounts to approximately $25,000.

BALL ENGINE CONTRACTS.—Col. W. H. Dewey, Mampa, Ida., has purchased for his mines two engines built by the Ball Engine Company, Erie, Pa., which will furnish power for lighting. A 150 hp engine built by the Ball Engine Company is being installed at the Williams Brothers Company, pickle manufacturers, Detroit, Mich., and will be used for electric light and power.

LIGHTING PLANT FOR COSTA RICA.—The General Electric Company has secured a contract from the United Fruit Company, of Boston, for the equipment of an electric lighting plant to be built in Port Limon, Costa Rica. At present that Central American town employs kerosene for illuminating purposes.

SHANGHAI TRACTION SCHEME REJECTED.—The China house of Fearon Daniel & Co., 90-96 Wall Street, has received cable advices from its Shanghai office that the municipality of that Chinese city have rejected the electric traction propositions submitted last month by various electrical concerns.

THE PITTSBURG VALVE AND FITTINGS COMPANY is building new works at Barberton, O., and has placed a contract with the Westinghouse Electric and Manufacturing Company for the electrical equipment, which includes generators, motors and switchboards.

General News.

THE TELEPHONE.

COVINA, CALIF.—The Home Telephone Company of Covina has incorporated with a capital stock of $50,000. Directors: J. O. Houser, J. D. Reed, H. M. Houser, C. E. Crawford, all of Covina, and P. T. Spencer, of Los Angeles.

MONTREAL, CAN.—The Bell Telephone Company of Canada has secured a permit for a $20,000 addition to its building on Aqueduct Street.

COLORADO SPRINGS, COLO.—The Citizens' Telephone Company will ask the city council for a franchise to do business in this city.

PUEBLO, COLO.—Mr. J. E. Rizor and F. M. Merit and others petitioned the city council for a franchise to construct and operate a telephone exchange. It was granted with conditions.

AURORA, ILL.—The Inter-State (Northwestern) Telephone Company is building and equipping a plant at Springfield.

COFFEEN, ILL.—The City Council has granted the Citizens' Mutual Telephone Company a twenty-five-year franchise.

PEKIN, ILL.—The contract has been awarded for the construction of the Canton Home Telephone system to Jones & Winter.

PEKIN, ILL.—The Citizens' Telephone Company of Pekin was granted a fifteen-year franchise by the village of East Peoria.

WATSEKA, ILL.—Dr. N. I. Stringer has secured a franchise for an independent telephone company to string its wires about Watseka.

BLOOMINGTON, ILL.—A telephone line, to be owned and operated by the farmers east and southeast of Mason City, will probably be built.

SPRINGFIELD, ILL.—The Salt Creek Mutual Telephone Company has organized with G. W. Tracy, president; J. R. Hull, secretary, and John Martin, treasurer.

NEW ALBANY, IND.—The Cumberland Telephone Company has reduced its toll rate between this city and Louisville to 5 cents.

NEW CASTLE, IND.—Spiceland citizens have organized the Co-operative Telephone Company. Directors: J. T. Unthank, Dr. Jones, W. A. Poarch and others.

NEW CASTLE, IND.—Another gang of linemen has taken the place of the striking linemen and work on the New Castle Telephone Company's plant has been resumed.

DARLINGTON, IND.—The Darlington Co-operative Telephone Company has been incorporated with a capital stock of $2,000. It will operate a telephone line extending through Montgomery, Clinton and Boone counties. Among the directors is William N. Bowers.

COWAN, IND.—The Cowan Rural Telephone Company, capital stock $4,000, has been incorporated. Directors: Abraham McConnell, Charles Springer, George W. Kabrick, Philip Turner, William Clark, Lester H. Painter, Wesley B. Harbaugh and P. Perry Turner.

WABASH, IND.—A severe electric storm occurred here on Aug. 21, damaging telephone property to a considerable extent. Three hundred of the five hundred telephones of the Home Company were burned out, and the Bell Company lines suffered similarly.

EVANSVILLE, IND.—The Cumberland Telephone Company, that has been doing business in Evansville for the past twenty-five years, has been notified that it must quit business within ninety days. At a recent meeting of the city council an ordinance was passed to that effect. The franchise of the Cumberland, according to the advice of the city attorney, expired July 22 last. The Board of Works will ask for new bids, and if the Cumberland Company offers the best bid it will be accepted and a new contract entered into. Other companies will be asked to bid, but if the Cumberland Company tests the matter of limitation of its franchise in the courts the letting of a new contract may be delayed.

NEW ALBANY, IND.—The system of the Home Telephone Company, of this city, has passed into the control of the Home Telephone Company, of Louisville. Negotiations have been in progress for several months and have been completed in the past few days. The Louisville Company has already taken possession of the system and will make a number of improvements. A $12,000 switchboard is to be installed in the exchange. The two systems will be connected by a cable laid across the river on the Kentucky and Indiana bridge. The Louisville Company has orders for 6,000 telephones and has 3,000 in operation. It is believed that the merging of the two companies will result in the abolishing of the toll rates between this city and Louisville eventually.

INDIANAPOLIS, IND.—The final session of the State Tax Board is being given up to representatives of telephone companies that have appealed from the primary assessment of this class of property for taxation. A large number of telephone men were before the board pleading for a decrease in the valuation set against their companies. Hugh Dougherty, of the United Telephone Company, made a strong plea to have his company's valuation of $321,000 reduced to $154,000. He claimed that the method provided by law for arriving at the values of telephone property was not fair. The board takes the stock at a fair cash value, adds to that the indebtedness, and then deducts the assessment on real estate and personal property made in counties through which the company runs. Mr. Dougherty said that real estate owned by the company is assessed at about 45 per cent. of what the company paid for it and he claimed that it was unfair to assess real estate at such a low figure and then make a corporation pay on a cash valuation. A number of companies asked for a reduction on the ground of unprofitableness of the business, stating that they were bound by a low ordinance rate. In answer to a question by Governor Durbin as to what the future had in store for the telephone business in Indiana, Mr. Marvin, of the Frankfort Company, said he believed that men who put money in the business were beginning to realize the real situation. "I do not believe the use of telephones will be diminished," he said, "but companies will have to make a larger charge for their service. It is evident that within twenty years a company will have to rebuild its plant two or three times and this cannot be done on such a low rate." The board has primarily fixed the assessment on 134 companies operating upwards of 88,641 miles and the rate fixed is from $5 to $2,000 per mile.

STORM LAKE, IA.—The Northern Telephone Company is seeking a franchise in this place.

HAVELOCK, IA.—A telephone company is to be organized by the business men of this place.

GRINNELL, IA.—The Carroll County Telephone Company of Grinnell has been incorporated, with a capital of $75,000.

SHENANDOAH, IA.—The Independent Mutual Telephone Company has awarded a contract for a telephone exchange in this place.

DES MOINES, IA.—The Lone Tree Telephone Company has filed articles of incorporation; capital, $5,000. Incorporators: G. L. Day, J. M. Lee and others.

CRAWFORDSVILLE, IA.—The old telephone company has bought the Crawfordsville local system and will consolidate into one company.

DAVENPORT, IA.—All the electrical workers who could get employment have gone back to work for the Iowa Telephone Company, and declared the strike off.

CARROLL, IA.—What has been known as the new telephone system has been purchased by the Carroll County Telephone Company. The officers of the company are C. R. Morse, president; J. P. Lyman, vice-president; C. W. H Beyer, treasurer; Louis Middeldorf, secretary. The company will run rural lines to all parts of the county and connect with the county seat.

UTE, IA.—The citizens of Ute have called a meeting for the purpose of organizing a telephone company.

SPRINGFIELD, MASS.—The City Council has granted the Home Telephone Company a franchise.

DETROIT, MICH.—A. M. Burton and others have filed articles of association of the Peninsular Telephone Company; capital $25,000.

ELBOW LAKE, MINN.—The Elbow Lake Telephone Company has increased its capital stock from $10,000 to $50,000.

WINDOM, MINN.—Jackson County is to have a telephone system. A company capitalized at $20,000 has been organized.

DULUTH, MINN.—The Duluth & North Shore Telephone Company, with a capital of $25,000, has been organized to build lines in St. Louis, Lake and Cook counties, Minnesota.

ARMSTRONG, MO.—The patrons of the Armstrong Telephone Company will not yield to the efforts of the company to increase its rates. At the mass meeting held Aug. 14, it was decided by the patrons that they would order their telephones taken out if the company attempted to raise its price. It is thought the company will yield.

HASTINGS, NEB.—The Adams County Telephone Company has filed articles of incorporation with the county clerk, capital $30,000. The officers are: J. N. Lyman, president; A. L. Clarke, vice-president; W. H. Waldron, treasurer; J. S. Logan, secretary.

LINCOLN, NEB.—Articles of incorporation of the Farmers' Mutual Telephone Company of Eustis, Frontier County, have been filed. The company is capitalized at $20,000. Its incorporators are John D. Anderson, William Walker, William G. Anderson, Daniel Phillips, Peter Kennan and George M. Campbell.

BOILING SPRINGS, N. C.—T. J. Hamrick and others have incorporated the Boiling Springs Telephone Company, with a capital of $1,000.

SOUTHPORT, N. C.—E. A. Perry and E. A. Pifer, of Chadburn, N. C., propose constructing a telephone line from Southport to Wilmington.

TRENTON, N. J.—The Monmouth Toll Line Company, which proposes to construct and operate a line of telegraph or telephone in New Jersey, has been incorporated, with a capital stock of $100,000. The incorporators are George Evans and C. Frederick Long, of Jersey City, and Henry F. Atkinson, of Newark.

AKRON, N. Y.—The Akron Telephone Company, of Akron, Erie County, has been incorporated; capital, $20,000; directors: J. M. Wethy, E. C. Porter, of Ripley, and F. R. Green, of Fredonia.

ITHACA, N. Y.—The Bell Telephone Company has moved into its new exchange on State Street in this city. The company has 800 subscribers in the city. The new equipment is on the central energy system.

ALBANY, N. Y.—The Charlotte Valley Telephone Company has been incorporated. The capital stock is $650. The directors are George Oliver, Meleatus Bruce, Richard Jeffers, Leslie D. Smith, Levi M. Stevens, Hiram D. Haner, Wallace Crapser, P. S. Taber and Nicholas Van Patten, of Charlotteville, and Arthur Hillas, of Worcester.

BUFFALO, N. Y.—The Grand Island Telephone Company has mortgaged its branches, privileges and property to the Bell Telephone Company for $2,500 for a period of five years. The directors of the Grand Island Company are Frederick H. Williams, Josiah P. Wright, Josiah Jewett, Jr., Francis J. Airey, J. Boardman Scovell and John V. Bedell.

POMEROY, OHIO.—The Citizen's Telephone Company will organize and ask for a franchise.

MARION, OHIO.—The Marion County Telephone Company has applied for a franchise in Prospect.

NEW ATHENS, OHIO.—The Flushing Telephone Company is installing a branch exchange at this place.

EAST LIVERPOOL, OHIO.—The Bell Telephone Company is constructing new lines in Carroll County.

GALION, OHIO.—Numerous improvements are being made in the exchange of the Galion Telephone Company.

TOLEDO, OHIO.—The Central Union Telephone Company will install a new board at its East Side exchange, to take care of 2,000 subscribers.

SCIO, OHIO.—Material has been ordered by the Harrison County Telephone Company of Cadiz for a branch exchange which it will establish at Scio.

CADIZ, OHIO.—The Junction Telephone Company will build a line to Cadiz Junction to connect with the lines of the Harrison County Telephone Company.

MANSFIELD, OHIO.—The Mansfield Telephone Company has settled its differences with its striking linemen and work on the system is now progressing.

BERGHOLZ, OHIO.—The Bergholz Telephone Company contemplates building a line to connect with the exchange of the Harrison County Telephone Company at Jewitt.

COLUMBUS, OHIO.—The Rockford Toll Line and Telephone Company, capital $10,000, has been incorporated to operate in Mercer, Van Wert, Darke and Auglaize counties.

MARION, OHIO.—The Marion County Telephone Company is building a line to Bucyrus by way of Caledonia. A large force is at work on the line which will connect up three exchanges.

NORTH LIMA, OHIO.—L. L. Peugh, of Canfield, is at work constructing the farmers' system of the Beaver Township Telephone Company. R. H. Ruhlman, of Youngstown, is president of the company.

XENIA, OHIO.—The Citizens' Telephone Company is constructing a new line from this place to Yellow Springs. It will abandon the old line which is strung on the poles of the electric railway company.

PORTSMOUTH, OHIO.—The Central Union Telephone Company is building long-distance lines connecting Portsmouth with Cincinnati. The company will put in several new local exchanges in this vicinity.

SHELBY, OHIO.—The People's Telephone Company will form a connection with 25 miles of farmers' lines to be built in the vicinity of Tiro. The lines will be owned by the Local Telephone Company of Norwalk.

CHICAGO JUNCTION, OHIO.—The Central Union Telephone Company has been refused a franchise in this town. The Local Independent Telephone Company defeated the proposed invasion of the Bell Company.

NORWALK, OHIO.—Senator J. F. Laning confirms the report that his syndicate has purchased a controlling interest in the Sandusky Telephone Company. The company is a prosperous one, having over 200 subscribers.

STEUBENVILLE, OHIO.—The Phœnix Telephone Company will build lines from Steubenville to Wintersville which will connect with the lines of the Harrison County Telephone Company, affording through connection from Steubenville to Cambridge.

FT. RECOVERY, OHIO.—The Ft. Recovery Telephone Company, which was organized some time ago, is enjoying remarkable progress. It has recently installed a central energy board and has 350 telephones installed. It has in operation about 65 miles of metallic circuit.

HAMILTON, OHIO.—The Miami Telephone Company is moving into its new exchange in the Merchants' National Bank Building. It is completing the work of installing new switchboards and four miles of cable, and considerable underground work. The system has been changed to the full metallic.

MANSFIELD, OHIO.—The syndicate headed by Senator Laning, of Norwalk, has practically closed a deal for the purchase of the Everett-Moore holdings in the Mansfield Telephone Company. Mr. Laning's syndicate is building up an immense system of independent exchanges in Northern Ohio.

CRESTLINE, OHIO.—The Crestline Local Telephone Company has been incorporated, with $50,000 capital stock, by J. Brobst, C. E. Shiner, J. F. Laning, F. J. Morkel and A. B. Kinsey. The company is identified with the Local Telephone Company of Norwalk, of which Mr. Laning is president.

TOLEDO, OHIO.—The Home Telephone Company has begun business in Toledo with 4,200 telephones and long distance connections. It is independent of the Bell interests. Much of the stock is owned in Cleveland and Elyria. It has long distance traffic contracts with the United States Telephone Company, of Cleveland.

CINCINNATI, OHIO.—A meeting of leading independent telephone people of this vicinity was held in Cincinnati last week and there are indications that prominent people are about to make another attempt to secure a franchise for an independent company. Cincinnati is the only city in Ohio without independent service.

TOLEDO, OHIO.—The United States Telephone Company expects to have its switching station at this point in operation about Sept. 1. The exchange is located in a separate building from that of the Toledo Home Telephone Company. The switchboard will have a capacity of 60 toll lines. The completion of the exchange will connect the Michigan and Indiana systems with Ohio, Pennsylvania and New York.

KENTON, OHIO.—The grocers' association has decided that using two telephones in their stores is unnecessary. Hereafter they will only use one line, but which one has not yet been determined upon. There are two lines here, the Bell and the Kenton Telephone Company. The rates are the same, but the Kenton Company, in which there is considerable local capital, has almost twice as many subscribers.

CINCINNATI, OHIO.—The City & Suburban Telephone Association has adopted a rule providing that a person using a pay station must pay a nickel for a call whether the party wanted is secured or not. The Ohio Valley Druggists' Association has passed a resolution protesting against the measure, and an attorney has been retained to examine the legal phases of the matter preparatory to bringing an injunction suit.

VERMILLION, OHIO.—The newly organized Vermillion Telephone Company has secured 125 subscribers and, it is claimed, about 70 of these are present subscribers to the Bell system, but will drop the service when the new exchange is completed. Rates are $12 for residence service, $18 for country lines and $24 for business telephones. Lines will be built to Birmingham and other towns in the vicinity. Work is being started.

CLEVELAND, OHIO.—The United States Telephone Company has just completed long-distance connection with Charleston, Huntington and a number of towns in southern West Virginia. The new line crosses the Ohio River at Ironton suspended from two 90-foot steel towers, the span being 3,600 feet of ten phono-electric No. 8 gauge wires. Connection from Cleveland to Charleston, 400 miles, is made with only two switches. By doubling back into Ohio the West Virginia exchanges are afforded connection with all parts of Pennsylvania through the lines of the United States Company. The Michigan connections will be completed in September. It is stated that there are, in round numbers, 106,000 independent telephone subscribers in Ohio, 34,000 in southern Michigan, 65,000 in Indiana, 20,000 in western Pennsylvania and 12,000 in West Virginia.

PORT CLINTON, OHIO.—Another deal of considerable magnitude has been consummated here in the sale of the Port Clinton Home Telephone Company's complete plant to the Ottawa County Telephone Company, which latter company will now incorporate for $150,000. The property involved in the sale of the local plant includes the cable to Put-in Bay and Middle Bass islands, several hundred miles of lines, toll and central stations on the islands, Catawba Island, Picolo, Gypsum, Peachton, Lakeside, Marblehead, Danbury, LaCarne, Locust Point and Nina, besides the 400-telephone exchange at Port Clinton. The absorbed Port Clinton Home Telephone Company was but a short time ago incorporated for $40,000, the new cable to the islands also having been laid but a short period since at an outlay of over $12,000.

NORWALK, OHIO.—The syndicate headed by Hon. J. F. Laning, of this city, is building up an independent system in this section of Ohio which promises to rival in importance the system formerly controlled by the Federal Telephone Company. The latest reports of the Local Telephone Company, as the parent organization is called, shows that it controls 14 exchanges, 31 toll stations, having an aggregate of 2,548 telephones and nearly 200 miles of country line, with a large number of farmer subscribers not included in the above. The syndicate is just completing a deal for the control of the independent system in Erie County, having 6 exchanges, 10 toll stations, 190 miles of country line and 1,600 telephones. Negotiations are on for the purchase of independent lines in Richland County, including 7 exchanges, 12 toll stations and about 1,600 subscribers. It is expected when the consolidation is fully completed, the Local Telephone Company will have over 6,000 subscribers, with 27 exchanges, 53 toll stations and 450 miles of country lines. Its exchanges at Wakeman, Berlin Heights, Greenwich and New London are being rebuilt and exchanges at Norwalk, Shelby, Chicago Junction and Crestline are being enlarged. The syndicate is not consolidating the various properties into one company, but will continue to operate them as separate units, each on a separate financial basis. The systems will be standardized and made uniform and by the practice of general economies of operation, it is expected the various plants will be placed on a high earning basis. The Local Telephone Company of Norwalk is to be the parent company, owning a controlling interest in the underlying companies.

STROUD, OKLA.—The S. S. S. Telephone Company, capital stock $10,000, has been incorporated by E. Brown, J. Noble, E. Mines and others.

WEST FORD, PA.—The West Ford Independent Telephone Company has been incorporated with a capital stock of $1,350.

PITTSBURG, PA.—It is reported that the Pittsburg & Allegheny Telephone Company will erect a new telephone building at the northwest corner of Fourth Avenue and Grant Street.

MEMPHIS, TENN.—A charter was granted to the Tennessee District Telegraph Company of Memphis, with a capital stock of $100,000. The incorporators are E. Howard, J. Compton, W. T. Gentry, James Merrihew and George H. Fearons.

CLEBURNE, TEXAS.—Cleburne & Bono Telephone Company, capital stock $1,000, has been incorporated.

COOPER, TEXAS.—The Texas Long Distance Telephone Company has been incorporated with a capital stock of $25,000.

WHITEWRIGHT, TEXAS.—The Whitewright Telephone Company, capital stock $10,000, has been incorporated by W. A. Fain, R. May and L. Selph.

AUSTIN, TEXAS.—The Texas Telephone Manufacturing Company, capital stock $10,000, has been incorporated by O. L. Brailey, A. E. Jeavons and H. Snelling.

ITASKA, TEXAS.—The Citizens' Telephone Company, of Itaska, has been incorporated by P. R. Stephens, L. E. Kerr, W. M. Buchanan and others. The capital is $10,000.

ORANGE, TEX.—The Orange Telephone Company, the new independent line, is preparing to make extensive additions to its system here.

FAIRMOUNT, W. VA.—For the second time within a few weeks, the exchange of the Consolidated Telephone Company has been burned out, owing to crossed wires. Nearly all the telephones were thrown out of service and the loss on the switchboard which is practically new, was over $1,500.

MILWAUKEE, WIS.—The settlement of the linemen's strike by the Wisconsin Telephone Company was a compromise, the men are to get $2.40 a day, instead of $2.30 formerly received and $2.50 asked, and the foremen $2.80 a day instead of $2.70 as before and $3 asked. The hours of work will be the same. The men in the country will have monthly paydays and the Milwaukee men semi-monthly. It is estimated that only 100 of the 300 men in the State who struck are at present in Wisconsin.

Electric Light and Power.

SAN FRANCISCO, CALIF.—The United Gas and Electric Company, which has a 30-year contract for distributing the current of the Standard Electric Company in Santa Clara and San Mateo counties, is consolidating the plants of the three companies that were bought out. The combined plant is located in San Jose, Calif. Out of the $900,000 bond issue, $700,000 has been taken and the remaining $200,000 has been offered.

THOMPSONVILLE, CONN.—The Hartford Carpet Company will substitute electricity for steam power in its big mills here. Work has been begun on a power house, which will contain twenty-four boilers and four engines of 7,000-hp each, to drive generators.

NEW HAVEN, CONN.—The Housatonic Mfg. Company, of New Haven, has built a new plant to make all kinds of metal work, including electric light fixture trimmings. The power house, a separate brick building, 45x85 feet, is equipped with Heine safety boilers and Westinghouse engines of the compound vertical type, and the latter, belted to Westinghouse generators, supply current for the motors in the different departments.

ATLANTA, GA.—While the Atlanta Electric Company has been petitioning council for the right to bring its power from the Chattahoochee river into the city, another company, the Atlanta Water Power and Electric Company, has been building a 50-foot dam across the river, six miles above the proposed plant of the first company. The object of both companies is to deliver electric power in Atlanta. Among the gentlemen interested in the company are Jack J. Spaulding, Forrest Adair and S. Morgan Smith, of York, Pa.

HOUGHTON, MICH.—The Houghton County Electric Light Company has been incorporated with a capital stock of $1,300,000. Lawrence A. Ford, of Beverly, Mass., is the manager. Boston men are interested in the Houghton County Street Railway Company and the Peninsula Electric Light & Power Company, which will be taken over by the new organization, with headquarters at Boston. Extensive improvements are contemplated.

ST. LOUIS, MO.—The lighting of municipal buildings will cost the city $7,650 more during the coming year than the one just closed, unless the Board of Public Improvements rejects the bids received Aug. 15. Last year the Missouri Edison Electric Light Company supplied electricity to all the public buildings south of Washington Avenue at 6 cents per kw-hour. The bid of the same company for supplying light this year is 7½ cents per kw-hour. The Laclede Gas Light Company's bid of 8 cents per kw-hour for supplying electricity to the public buildings north of Washington Avenue is the same as last year. The talk of building a municipal lighting plant is said to be responsible for the increased cost of electricity.

OMAHA, NEB.—The Thomson-Houston Electric Light Company has placed a large force of men at work on its new conduit system, which, when completed, will have cost the company $200,000. All main wires in the business district will be placed underground.

CAPE MAY, N. J.—The Cape May Light and Power Company has been incorporated; capital, $15,000. Incorporators: Edward C. Brainard, Chicago; Edward E. Mandeville, Camden, S. C.; and James M. E. Hilreth, Cape May City.

NEWBURGH, N. Y.—The Newburgh Electric Light, Heat and Power Company has commenced the work of stringing its wires to Marlborough. The company will hereafter supply the village with light.

BALDWINSVILLE, N. Y.—The Baldwinsville Light and Heating Company, Baldwinsville, has been incorporated; capital, $100,000. Directors: Jacob Amos, W. F. Morris, W. H. Wells, Baldwinsville.

CHEVOIT, OHIO.—The village has called for proposals for lighting with electricity.

MANCHESTER, OHIO.—The village is offering $8,000 in 5 per cent. bonds to provide for the building of a municipal lighting plant.

MARIETTA, OHIO.—Business men of Marietta are planning to build electric arches on the main business street. The lighting plant will have to be enlarged if the plan is carried out.

COSHOCTON, OHIO.—The Coshocton Light & Heating Company has been incorporated with $250,000 capital stock. W. A. Himebaugh, J. D. Stevens, and T. L. Montgomery are interested.

CALEDONIA, OHIO.—The C. D. Resler Electric Light & Power Company, recently incorporated, needs some house chandeliers, fixtures, meters, etc. Mr. C. D. Resler is the general manager of the Company.

MANSFIELD, OHIO.—The Mansfield Engineering Company has begun work on a new power house to contain one compound engine, one simple engine, one air compressor, three boilers and two electric generators. All machinery in the plant is to be equipped for electric drive, and about 12 motors ranging from 1½ to 50-hp. will be required.

COLUMBUS, OHIO.—The board of public works has been instructed to cancel the advertisement for bids for the erection of the municipal lighting plant under plans which call for the expenditure of $175,000, and to prepare new specifications for a plant to cost about $110,000. The director of public works was enjoined from spending the larger amount.

PITTSBURG, PA.—Chief Engineer W. H. Brown, of the Pennsylvania Railroad, is drawing up plans for a power plant to be erected at South Thirteenth Street, this city. The plant will furnish the electric current for the signal and pneumatic power of the Monongahela division.

SPARTA, TENN.—Dr. W. B. Young, who recently purchased the Young & Simpson flour mill, near this town, may introduce electric power for its operation.

NORFOLK, VA.—The People's Light and Power Company, chartered with a capital stock of $100,000, has applied to the councils for a thirty-year franchise to operate an electric lighting and power plant. This is the second independent company organized during the past year to oppose the consolidated companies, which are controlled by the Williams syndicate, of Richmond. The first company was absorbed by the Williams' interest some time ago, and is now a part of the Norfolk, Portsmouth and Newport News Company, which is the name of the consolidated concerns. John G. Tilton, president of the new independent company, is Commonwealth's attorney of Norfolk, and he claims that his company can furnish lights and power cheaper than the present rate and will do so if granted a franchise by the councils. The application was referred to a committee.

The Electric Railway.

SAN FRANCISCO, CALIF.—The Commonwealth Mining Company, which owns the famous Pearce mine, contemplates the construction of an electric railway. It will extend from Cochise station, near Wilcox, Ariz., on the Southern Pacific Railroad, to the mining property, a distance of 19 miles.

JACKSON, GA.—The Jackson Street Railway Company will build a power plant on the Ocmulgee River, about 7 miles from here, to supply the city with light and power for the proposed new railway system. W. F. Smith is general manager.

INDIANAPOLIS, IND.—The New Castle, Muncie & Alexandria Traction Company has been incorporated with a capital of $10,000. The directors are E. L. Ice, F. P. Ice, Clay C. Hunt, John H. Davidson and J. F. Tompson.

JEFFERSONVILLE, IND.—The Chicago syndicate, which has recently consolidated the heating, lighting and traction interests of New Albany and Jeffersonville, Ind., has decided to undertake immediately the construction of the proposed electric line between those two cities. This line will be known as the Jeffersonville, New Albany and Sellersburg Electric Railway, it being the plan to undertake an extension to the latter town soon. Louis Schenck, of Seymour, Ind., will be the president of the road. The Tennis Construction Company will build the line. C. C. Tennis, of Cincinnati, representing that company, is here making arrangements for the commencement of work.

BRUNSWICK, ME.—The Portland & Brunswick Street Railway Company has opened its new road from Freeport to Yarmouth for public travel, and cars are now running between Yarmouth and Brunswick. By the opening of this road Brunswick, Lewiston and Bath are put in electric car communication with Portland, making one of the largest trolley systems in the country.

BALTIMORE, MD.—The Union Trust Company, of this city, has closed the underwriting syndicate for an interurban trolley line which will fill a link in the long-distance trolley railroad between New York and Philadelphia. The underwriting covers an issue of $600,000 of first mortgage 5 per cent. bonds of the Philadelphia, Bristol and Trenton Electric Company. The trolley line will run from Torresdale, a suburb of Philadelphia, via Bristol, Pa., to Trenton, N. J. The company will have a capital stock of $1,000,000 and an authorized bond issue of $1,000,000.

LINCOLN, NEB.—Minority stockholders of the Lincoln Traction Company have called a meeting to protest against the action of directors in contracting with the Lincoln Heat & Power Company for heat and power at what they claim is a direct loss. Large stockholders of the Traction Company are said to have organized the Heat & Power Company. A majority of the stock of the Traction Company is held in New York City.

NEW HAMPSHIRE.—Mr. Wallace D. Lovell, the New Hampshire street railway magnate, is quoted as saying that he has secured valuable privileges in the White Mountain district, in which he proposes to generate electricity for the purpose of operating electric lights and electric cars. Mr. Lovell, it is understood, has a plan for threading the White Mountain district with electric lines to connect with his other rural lines. It is believed that this can be done with profit. The plan of lighting the district has long been discussed, but never put into operation. The power can be generated at the various stations along the electric lines.

BUFFALO, N. Y.—The capital stock of the International Railway Company has been increased from $10,120,500 to $17,000,000. This is one of the first steps in the consolidation of all the local lines financed by the International Railway Company. During the year the Crosstown Street Railway Company will also be merged and the capital stock will then be still further increased. The International Railway Company now represents the following fourteen trolley lines and bridge companies in Buffalo and along the Niagara frontier: The Buffalo Railway Company, Buffalo Traction Company, Buffalo & Niagara Falls Electric Railway Company, Buffalo & Lockport Railway Company, Buffalo, Bellevue & Lancaster Railway Company, Niagara Falls & Suspension Bridge Railway Company, Niagara Falls Park & River Railway Company, Niagara Falls, Whirlpool & Northern Railway Company, Lockport & Olcott Railway Company, Niagara Falls & Suspension Bridge Company, Clifton & Suspension Bridge Company, Queenston Heights Bridge Company, Lewiston Connecting Bridge Company, and Buffalo, Tonawanda & Niagara Falls Electric Railway Company.

KENTON, OHIO.—Hon. David Joy, president of the Findlay, Kenton, Bellefontaine & Urbana Railway, has applied for a franchise in Kenton.

HAMILTON, OHIO.—The Millcreek Valley Railroad Company will extend its line from Hamilton to Middletown. The new line will compete with the Southern Ohio Traction Company.

WAPAKONETA, OHIO.—The Western Ohio Railway Company is making arrangements to extend its lines from Celina through Rockford and Ohio City to Decatur, Ind., and thence west to Fort Wayne.

COLUMBUS, OHIO.—The Columbus, Newark & Eastern Traction Company has been granted a franchise by the Franklin County commissioners. The road will connect Columbus with Granville and Newark.

JEFFERSON, OHIO.—The Jefferson branch of the Pennsylvania & Ohio Railway is nearing completion and will be ready for business about the last of September. Rails are down and feed wires are being strung.

COLUMBUS, OHIO.—The Columbus, Newark, Zanesville & Wheeling Electric Railway Company has applied to the State canal commission for right of way over the canal towpath from Newark to the Stark County line.

MANSFIELD, OHIO.—The Phœnix Electric Company has completed and delivered to the Citizens' Street Railway Company of this city a 300-kw generator as an addition to its power house.

SPRINGFIELD, OHIO.—Plans for the building of the Springfield & Washington Traction Company from Springfield to Washington, a distance of 42 miles, are in the hands of construction companies, and contracts will be let at once.

TOLEDO, OHIO.—President A. E. Lang, of the Toledo Railways & Light Company, announces that the facilities of the company will be improved by the immediate expenditure of about $75,000. New car shops and barns are to be erected.

CLEVELAND, OHIO.—The Pennsylvania & Ohio Railway Company, now operating between Conneaut and Ashtabula, is endeavoring to make traffic arrangements with the Cleveland, Painesville & Ashtabula Railway whereby its cars may run through from Conneaut to Cleveland.

LIMA, OHIO.—The new Ft. Wayne,Van Wert & Lima Traction Co., which has recently succeeded another company of similar name, has organized with the following officers: James Murdock, Lafayette, president; H. C. Paul, Ft. Wayne, vice-president; L. C. Neely, Lima, secretary-treasurer.

CINCINNATI, OHIO.—Hon. A. S. Berry, of Newport, Ky., is at the head of a projected traction line to run from Covington to Milton, Ky., a distance of 65 miles. The ultimate object is to extend the line to Louisville. The Tennis Construction Company of Louisville is interested in the project.

CINCINNATI, OHIO.—The Cincinnati, Milford & Eastern Traction Company of Cincinnati has been incorporated with a capital stock of $10,000. The incorporators are Sumner B. Day, George H. Chamberlain, J. B. Irven, J. B. Wallace, Wm. R. Medaris and Senator Roudebush, of Clermont County.

YOUNGSTOWN, OHIO.—Mr. Andrews, 91 Ontario Street, Cleveland, Ohio, has charge of the purchasing of the supplies and equipment for the Youngstown & Southern Railway, whose organization was recently recorded in these columns. The company expects to begin construction work soon.

COLUMBUS, OHIO.—F. J. Green, general manager of the Dayton, Springfield & Urbana Railway, has been succeeded by Richard Emery, who will be general manager of all the Appleyard syndicate properties radiating from Columbus. Mr. Green will take charge of the construction work for the syndicate.

SPRINGFIELD, OHIO.—The Springfield & Xenia Traction Company placed its road in full operation last Sunday. It is reported that this company has made a traffic arrangement with the Dayton & Xenia Traction Company, whereby there will be through business from Springfield to Dayton in competition with the Dayton, Springfield & Urbana Railway.

TOLEDO, OHIO.—Officers have been elected by the Toledo, Fayette & Western Railway Company as follows: Judge C. M. Stone, president; F. E. Seagrave, vice-president; Luther Allen, secretary, and C. F. Franklin, general manager. The company will build an extension of the Toledo & Western Railway, and the officers of both companies are almost identical.

COLUMBUS, OHIO.—Electric roads centering at Columbus are agitating the question of asking the legislature to appoint a "State Inspector of Electric Railways," to regulate traction lines in the same manner in which steam roads are regulated. The idea is to have an officer who shall supervise the care of tracks, cars, overhead wiring, etc. The matter will probably be brought up at the coming special session of the legislature.

CINCINNATI, OHIO.—The Cincinnati, Dayton & Toledo Traction Company, formerly the Southern Ohio, is now operating cars to within three miles of the center of Cincinnati, utilizing the tracks of the old Cincinnati & Northwestern steam road, which it acquired some time ago. The struggle extending over more than two years has been ended by the dropping of the suit brought by J. C. Rodgers to prevent the operation of cars over the Cincinnati & Northwestern tracks and by the approval by the railway commissioners of the C. H. & D. crossing at Linden Avenue.

ALTOONA, PA.—The city council of Altoona has granted franchises to a street railway and an electric light company in competition with the American Railways Company and the Electric Company of America.

GALLATIN, TENN.—Mr. Percy Moore, vice-president and general manager of the Louisville, Anchorage & Peirce Valley Interurban Railway, is so well pleased with his line that he is offering $10,000 for the privilege of entering Nashville with a trolley line running from Gallatin, Tenn., a distance of 27 miles, and from Nashville to Columbia. The territory is the most thickly populated in Tennessee, and is a rich agricultural section with many towns.

New Industrial Companies.

THE POTOSNIA ELECTRIC COMPANY, of New York, capital $700, has been incorporated. Directors: L. H. Southwick, C. L. Rossiter, Brooklyn; W. P. Mason, New York.

THE ELECTRO-STERILIZING COMPANY, of Brooklyn, capital, $100,000, has been incorporated. Directors: W. R. Chipman, A. S. Castner, Brooklyn; Sylvester Eastman, Manhattan.

JAMES A. SPARGO WIRE COMPANY has been formed at Rome, N. Y., with a capital stock of $30,000, and has just completed a mill to make bare and tinned copper wire for the electric trade, etc.

THE PAN AMERICAN ELECTRIC LIGHT & POWER COMPANY has been incorporated at Jersey City to manufacture storage batteries, etc.; capital, $1,000,000. Incorporators: Edw. P. Schmidt, Thos. F. Barrett, K. K. McLaren.

THE MAXWELL M. MAYER ELECTRIC COMPANY has been incorporated in New Jersey to manufacture electrical supplies; capital, $100,000. Incorporators: Christian E. Hartshorn, Marshall L. Osgood and Paul E. Hirsh, all of Jersey City.

WILSON BELL CALL & FIRE ALARM COMPANY has been incorporated with a capital stock of $100,000, to make a new line of electrical bells and supplies. Mr. J. S. Craft is president and Mr. J. W. Wilson, vice-president. Its offices are at 319 Main Street, Buffalo, N. Y.

WALTER MOTOR & POWER COMPANY has been formed at Washington, D. C., with a capital stock of $1,000,000, to introduce the paddle wheel for power development of Mr. W. L. Walter, of Port Huron, Mich. Mr. H. Darneille is president; Mr. S. W. Smith, vice-president; Mr. F. Walter, secretary; Mr. B. H. Brockway, treasurer.

Obituary.

MR. T. NEVINS died suddenly at his residence, Mount Shannon, Castleconnell, County Limerick, Ireland, on August 21. He was well known as a contractor and large shareholder in many electric traction companies and lighting enterprises in this country. He resided when in this country at Holly Hall, East Orange, N. J. He and his son, Thomas A. Nevins, went abroad several months ago to look after certain franchises they had acquired for a trolley line between Liverpool and Manchester. He was born at Kells, County Mayo, Ireland, May 30, 1844. He came to the United States in 1864, settled in Orange and embarked in the contracting business. His early work was in connection with the macadamizing of streets and roads. He afterwards secured a bluestone quarry, which laid the foundation of his later wealth. He became interested in the development of trolley systems, and purchased and finally secured control of the street railroad interests of Detroit, Mich. In England Mr. Nevins had engaged to consolidate the main lines lying between Liverpool and Manchester, and convert them into trolley roads under the name of the South Lancashire Electric Traction Company.

Personal.

MR. A. N. BRADY is credited by advices from Japan with having bought control of the gas works at Osaka and Tokyo.

MR. C. O. BAKER, JR., of Baker & Co., the platinum refiners, Newark, N. J., has been elected a director of the National State Bank of Newark.

MESSRS. KEMPSTER B. MILLER and W. W. DEAN, of the engineering staff of the Kellogg Switchboard & Supply Company, of Chicago, are on a hunting expedition in Colorado.

MR. R. C. BLISS has been appointed manager of the Western Union Telegraph Company at Cincinnati, Ohio. He has for some time been representative of the same company at Springfield, Ohio.

MR. C. D. SHAIN, once prominent in Edison and General Electric ranks in New York, is now devoting his energies and his great commercial ability to automobilism, in which he has already built up a large and profitable connection.

PROF. G. F. SEVER, recently appointed consulting electrical engineer to the Department of Gas and Electricity of New York City, will, it is understood, continue to hold his professorship in electrical engineering at Columbia University.

MR. E. H. McKNIGHT, who is at the head of the electric lighting company at Bowling Green, Ohio, has been appointed president of the Ohio Electric Light Association, succeeding Mr. W. T. White, of Cincinnati, who resigned recently.

DR. S. S. WHEELER, president of the Crocker-Wheeler Company, with Mrs. Wheeler and Mr. A. L. Doremus, was registered last week at Claridge's Hotel in London. The Wheelers have been making an automobile trip around the Continent.

MR. PH. SCHRIMPFF, of the Board of Directors of the Allgemeine Elektricitaets Gesellschaft of Berlin, is making a short tour in the United States, during which he will visit some of the larger manufacturing establishments and central and power stations.

MR. T. M. MESTON, secretary of the Emerson Electric Mfg. Co. of St. Louis, is a visitor in New York and the East, studying the general situation. Although the season has been phenomenally cool, Emerson fan output is considerably in excess of last year.

MR. G. W. HEBARD, of the Westinghouse Electric & Mfg. Company, and president of the Union Metallic Company, is one of the directors of the new International Harvester Company, which comprises five of the largest agricultural machinery concerns in the country.

COL. H. A. YORKE.—A cable dispatch from London says that the Times understands that Col. H. A. Yorke, Chief Inspecting Officer of Railways, has been commissioned by the Board of Trade to report on the working of American railway lines, both steam and electric.

MR. A. J. CORRIVEAU, a well-known Canadian in the field of electric lighting and electric railways, has been on from Montreal the last week and attended the automobile races at Brighton Beach. He is now largely interested in a commercial way in automobiles and has several important agencies for Canada.

MR. J. L. PUTNAM, manager of the Clark Automatic Telephone Switch-Board Company, Providence, R .I., has just returned from a trip throughout the Southern and Central Western States, and met with success in establishing companies for several small town plants, while others are in view for early operation.

MR. W. F. D. CRANE, who has been associated with Sanderson & Porter, 31 Nassau St., in an engineering capacity, has recently joined the forces of the American Stoker Company, 277 Broadway, New York, as manager of its contract department. Mr. Crane will have his quarters in the New York office of the company.

MR. JOHN A. WALKER, general manager, etc., of the Joseph Dixon Crucible Company, Jersey City, N. J., on his recent return from a business trip abroad, was presented by the staff with a sterling silver loving cup, having been

subscribed for by members whose service with the company dated from 1867 down to 1901.

MR. JAMES MERRIHEW, for many years general superintendent of the southern division of the Western Union Telegraph Company, has resigned, his retirement to take effect on Sept. 1. Mr. Belvidere Brooks, now general superintendent of the eastern division, will assume the general superintendency of the southern division in addition to his present duties, on Mr. Merrihew's retirement.

MR. EDWARD NOYES, of the Australian electrical engineering and contracting firm of Noyes Brothers, Sydney, which concern represents the Westinghouse and other American manufacturing interests in the Antipodes, is now in New York. He is accompanied by M. Hammond, of Auckland, who acts as sub-agent for the Noyes firm in New Zealand. These gentlemen are guests at the Waldorf-Astoria.

LORD BLYTHSWOOD.—The Marquis of Salisbury is not the only British peer who is a devoted student and experimenter in electricity. Lord Blythswood, a Scottish peer, is noted as an amateur electrical expert. He owns a splendidly equipped private laboratory, in which he spends hours at work. He has just given to the Glasgow Royal Infirmary a dynamo designed and built by himself and assistants.

MR. CESARE PIO, well known as an electrical engineer and as a contributor to these columns, has opened an office as consulting engineer at Milan, Italy, having as an associate Mr. Poggi. They will be glad to get into business relationships with American electrical manufacturers who desire to reach Italian trade as well as to perform technical service. They have opened offices at 18 Via Lazzaro Palazzi.

MR. HADYN T. HARRISON, M. I. E. E., of the English firm of Hadyn Harrison & Co., electrical engineers, is at present in this country for a short trip, making a study of electric lighting conditions. He would like to hear from anyone with good lighting specialties that can be placed on the English market, and can be reached, care of the ELECTRICAL WORLD AND ENGINEER. He is now traveling, but will sail for home next week.

MR. M. R. HUTCHISON.—A cable dispatch from England states that Mr. Miller Rees Hutchison, of New York City, who sailed for New York on August 22 on board the White Star Liner "Celtic," was summoned to Cowes before leaving, and received from Queen Alexandra a special coronation medal. Mr. Hutchison has been treating the Queen for deafness, but her majesty ascribed the gift to her recognition of Mr. Hutchison's services to deaf mutes in London, in whose welfare the Queen is greatly interested. Mr. Hutchison went to England early in May, on the same steamer as Lord Kelvin, to whom he was introduced.

Trade Notes.

THE BUCKEYE ENGINE COMPANY, Salem, Ohio, has shipped a large engine to Valparaiso, Chili, by the way of Cape Horn.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, has moved into a fine suite of offices in a new office building. The Peerless Electric Company will have offices in the same building.

INCREASE OF CAPITAL.—The Nungesser Electric Battery Company, Cleveland, Ohio, has increased its capital stock from $25,000 to $100,000. A short time ago the company moved into a new and larger factory.

WAGNER BULLETINS Nos. 52 and 53 relate to "Static ground detectors" and "Type L" portable instruments for direct and alternating-current measurements, respectively. Both classes of instruments are illustrated and described.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., in bulletins Nos. 1062 and 1033, illustrate and describe, respectively, their differential type of enclosed direct-current series arc lamps and their integrating switchboard wattmeters, type K.

"WOOD" ARC LAMPS.—The Fort Wayne Electric Works, Fort Wayne, Ind., has just issued a folder giving a good deal of practical information regarding the "Wood" direct-current enclosed arc lamps for power circuits. The various styles of the lamp are illustrated.

TO MANUFACTURE SPECIALTIES.—The Bloom-Kloeb Company will erect a factory at Cridersville, Ohio, for the purpose of manufacturing electrical specialties. The company has entered into a contract with the village authorities to furnish light and power. Work on the plant is to start at once.

THE NORTHERN ELECTRICAL MFG. COMPANY, Madison, Wis., has just issued Bulletin No. 29 in excellent style. It is practically a reprint of No. 24, but contains 8 pages more of matter and many new illustrations, and serves in a more complete manner to show the variety and quality of Northern apparatus.

SUNBEAM LAMPS.—The Sunbeam Incandescent Lamp Company reports an unusually good business for the summer months, and the securing of several substantial contracts for export based upon the most rigid competitive tests seem to bear out the claims of the manufacturer, that the Sunbeam lamp is unexcelled.

THE BURT MFG. CO., of Akron, Ohio, has just received an order from the American Steel & Wire Co. for two large Burt exhaust heads and a 200-gallon Cross oil filter for its works at Cleveland, Ohio. The Burt Company mentions that this is the twenty-ninth order which it has received from this one concern for oil filters.

MACHINE TOOLS.—The Garvin Machine Company, Spring and Varick Streets, New York, in its August catalogue (No. 8), describes and illustrates its line of screw machines, monitor lathes, forming machines and double turret screw machines. The dimensions of the various machines are given, together with the principal data.

FISCHER OMNIBUSES.—Mr. S. M. Fischer, president of the Fischer Company, returned from London several weeks ago, where he succeeded in waking up the two largest omnibus companies. Both of them placed orders for omnibuses of the Fischer type. Several orders for similar heavy trucks were also booked by Mr. Fischer on his London trip.

THE MICA INSULATOR CO., of New York and Schenectady, announces that it is making an addition to its plant which will increase its output fifty per cent., and enable it to fill all orders very promptly. It was led to take this step in order to meet the increasing demands of the trade for its well-known specialties, micanite goods, empire goods and M. I. C. compound.

THE INTERNATIONAL TELEPHONE MANUFACTURING CO., Chicago, is said to be having a rapidly increasing demand for its improved long distance transmitters. This instrument, it is reported, is very neatly designed; constructed with the very highest class of workmanship; built along the most scientific lines, and is one of the loudest, most distinct and durable transmitters ever produced.

THE PITTSBURG INCANDESCENT LAMP COMPANY, which was recently organized, has started business in a temporary plant. A new plant will soon be erected, where will be carried on the business of manufacturing new incandescent lamps and renewing burned-out lamps. The company was organized with a capital of $25,000, and its officers are J. B. Tomb, president, and W. A. Hilands, secretary and treasurer.

SIGN LAMPS.—To meet the demand for a lamp in which the "end candle power" is of the first importance, such as in sign work, the Electric Appliance Company, Chicago, is now supplying what it calls a "Multiple Burning Sign Lamp," of which it has a special illustrated circular. This lamp is furnished in 4, 6 and 8 candle power, 45 to 130 volts, with any standard base. All bases are porcelain insulated and are attached with a water proof cement.

REMOVAL.—The Imperial Electric Company of Philadelphia has removed its business to No. 28 North Seventh Street, which is only six doors above the old location. It has leased the entire building, and secures, in consequence, greater facilities for the transaction of its growing business in incandescent lamps of all kinds and allied interests. Mr. Henry A. Truitt is proprietor. A sheet issued by Mr. Truitt shows a great variety of lamps handled by him.

TELEPHONE DRY BATTERIES.—The proprietors of the New Excelsior dry battery manufactory, 32-34 Vesey Street, New York City, have interested a large number of telephone companies in their dry batteries recently because of their willingness to send their batteries to any responsible, well-rated company, on six months' approval. "The proof of the pudding is in the eating," and a concern that can afford to do this must be making batteries of satisfactory efficiency.

BRECHT AUTOMOBILES.—The Brecht Automobile Company, St. Louis, Mo., gives much interesting information about its steam carriages, running gear for automobiles of all classes, supply parts, etc., in a 64-page catalogue of recent issue. This company builds an electric runabout of neat design. The motor is of 2½ horse power; the controller has three speeds forward and three reverse, and the vehicle, it is stated, will run 40 to 50 miles on one charge of the battery.

AMERICAN SHIPPING.—The *Marine Review*, Cleveland, Ohio, has issued the seventh annual edition of its Blue Book of American shipping. This book is a marine directory of the United States and deals with statistics of shipping, naval affairs, etc. The introduction of this edition is a *résumé* of merchant ship construction during the past year, and of the progress of the shipbuilding industry throughout the country. It contains a great deal of interesting information relative to the progress of American shipbuilding and navigation.

ELECTRICAL SUPPLIES.—The H. W. Johns-Manville Company, New York, has just issued a new catalogue of its electrical supplies, including a full line of overhead materials, heaters, rail-bonds, 500-volt fuses, vulcabeston and special molded insulated pieces, together with many new articles, such as double-trolley suspensions. The catalogue has 108 pages, including a complete table of contents at the front and an alphabetical index at the back, and is the largest and most comprehensive electrical catalogue ever produced by this company.

MEDAL FOR WAGNER MOTORS.—The Franklin Institute of Philadelphia has awarded the Edward Longstreth medal of merit to the Wagner Electric Manufacturing Company, St. Louis, Mo., on its single-phase alternating-current motors. The Institute committee, in its report, refers to this motor as a "meritorious contribution to science and the industrial arts." The Wagner Company has published in pamphlet form the committee's full report, together with individual reports of some prominent electrical engineers on tests of Wagner motors. The Wagner Company is justly proud of the distinction conferred upon its motors.

DENVER ENGINEERING WORKS COMPANY, of Denver, Colo., Mr. Lewis Searing, general manager, has just issued an excellent bulletin devoted to electric hoists for mining purposes. One of the main features of the bulletin is the general drawing of each hoist, accompanied by a table giving all of the dimensions which are necessary for the location of the hoist in the plans of the constructing engineer. It is to be noted that a great range of sizes is manufactured, and many prominent companies have given repeated orders for hoists. The Cripple Creek Mining District is a large user of these hoists, as can be seen by the large number of them purchased by the Colorado Electric Power Company which operates in the Cripple Creek District. The bulletin is quarto size, 32 pages, and well illustrated.

AUTOMATIC WATER MOTOR.—The Cassel Automatic Water Motor Company, Seattle, Wash., describes and illustrates its self-governing water wheels in a 76-page pamphlet of recent issue. It is claimed that this wheel governs its speed under all degrees of load within a variation percentage not exceeding that of Corliss steam engines under usual conditions of service. The principle empolyed in the Cassel wheel is that of centrifugal force as the basis of the automatic mechanism, acting in moving the buckets of the wheel out of the line of impact of the jet or flow of water, without interfering in the least degree with the free flow and velocity of the water. The various illustrations show different styles of the wheel, also actual applications to the operation of apparatus, including electric generators.

BEGINNING LIFE AT SEVENTY-FOUR.—The adage, "One is never too old to learn," has been exemplified so many times in recent years by men past middle age taking up courses in correspondence schools that it has grown to be an old story. However, the limit seems to have been reached when we hear of a man seventy-four years old taking up the study of electrical engineer-

ing. Among the men over fifty years of age enrolled with the American School of Correspondence, Boston, is Mr. George F. Carsley, staying at Fairhaven, Mass. Born in America, he has made his home in the Hawaiian Islands, where, for the last thirty years, he has conducted a dairy business with a market for his products located more than two hundred miles away. Mr. Carsley, on his return to the United States, was obliged to use the electric roads, and the impression that they made upon him awakened within him so great an interest in electricity that, although past seventy-four years of age, he promptly enrolled for an electrical engineering course. Mr. Carsley's record as a student is quite as remarkable as his progressive ideas. Enrolling on the twenty-eighth of last January, he has not only already completed his first seven books, but has taken on an average only three weeks for the completion of each—sometimes finishing a book in a week.

THE WESTERN ELECTRICAL SUPPLY CO., of St. Louis, is introducing the Jackson portable hammer, after having tested it thoroughly in every way. It states that this is the first and only electric hammer on the market, and marks a "new era" in reducing one half the cost of work now performed by the well-known pneumatic hammers. It can be used to advantage wherever chipping of any kind, riveting, calking or stone-dressing and carving is required. It is adapted for all classes of work now done by the pneumatic hammers, such as chipping iron or steel, in foundry work, bridge building, calking boilers, structural iron and building work, ship building, heavy stone dressing and light carving. The main points which the company claims for this hammer are its simplicity of construction, efficiency and durability. It is not necessary to install any new plant, as the current may be taken from any electric plant of from 110 to 500 volts. It can be operated by a motor of from 1/6 to 1/4 hp, consuming no more current than an ordinary office fan. The cost is about twenty per cent. of a pneumatic hammer, and the cost of operation is about five per cent. One great advantage is that it can be run in the coldest weather, which is an impossibility with pneumatics. Where no current is obtainable, a small 1-hp electric generator is capable of running three hammers. Such a generator is quickly and cheaply installed, and may be operated by a small gasoline engine, turbine water wheel, or from shafting in machine shop or foundry. The company issues a bulletin fully describing this hammer, which is mailed on application.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 19, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

707,075. COMBINED OVERHEAD AND UNDERGROUND ELECTRIC RAILWAY; D. S. Bergin, Chicago, Ill. App. filed Feb. 10, 1902. Employs a separate underground conductor for the return current.

707,088. MAGNETIC SEPARATOR; A. Dings, Milwaukee, Wis. App. filed April 8, 1901. A rotary separator with a provision for rendering the operation continuous.

707,099. INCANDESCENT ELECTRIC LAMP; E. S. Gardner, Boston, Mass. App. filed July 22, 1901. A reflector is located within the lamp bulb.

707,150. SYSTEM OF ELECTRICAL DISTRIBUTION; W. S. Moody, Schenectady, N. Y. App. filed June 6, 1902. (See Current News and Notes.)

707,180. SELECTOR FOR RAILWAY SIGNALING APPARATUS; J. D. Taylor, Buffalo, N. Y. App. filed Nov. 10, 1900. Improvements on prior patents to same inventor.

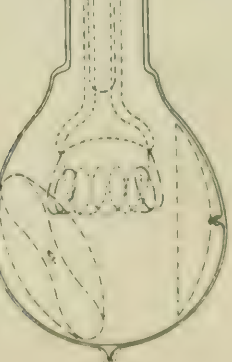
707,181. RAILWAY SWITCHING AND SIGNAL INTERLOCKING APPARATUS; J. D. Taylor, Buffalo, N. Y. App. filed Nov. 10, 1900. Improvements on prior patents to same inventor.

707,182. RAILWAY SIGNALING APPARATUS; J. D. Taylor, Buffalo, N. Y. App. filed Nov. 10, 1900. Improvements on prior patents to same inventor.

707,194. ELECTRIC RHEOSTAT OR HEATER; H. P. Ball, Brooklyn, N. Y. App. filed Nov. 2, 1896. The resistance wire lies in grooves between two corrugated plates riveted together, the wire being insulated from the plates.

707,222. AUTOMATIC LINE CATCH FOR TROLLEY WIRES; G. R. Floyd, Cincinnati, Ohio. App. filed Dec. 31, 1901. A safety device consisting of a supplemental wire or rod to the trolley wire at opposite sides of and beyond a point of probable breakage, by suitable holding ears, said wire having a limited longitudinal movement in said ears.

707,226. ELECTRIC BLOCK SYSTEM FOR RAILWAY TRAINS; J. T. Hambay, New York, N. Y. App. filed March 15, 1902. The semaphore is placed in the locomotive cab and is under the control of the tower-man or operator who has charge of the block.



707,099.—Incandescent Electric Lamp.

707,244. RESISTANCE FOR RHEOSTATS, ELECTRIC HEATERS, ETC.; H. W. Leonard, Bronxville, N. Y. App. filed Aug. 26, 1901. A metallic electrical conductor in the form of a ribbon arranged edgewise under tension around an electrical insulating surface capable of withstanding heat.

707,266. WAVE-DETECTING DEVICE; H. Shoemaker and G. W. Pickard, Philadelphia, Pa. App. filed June 2, 1902. A wave-responsive device comprising carbon terminals bridged by steel needles.

707,300. CONTROLLER FOR ELECTRIC MOTORS; W. H. Chapman, Portland, Me. App. filed March 12, 1902. The controller is adapted, without the use of switches, to start and stop the motor and reverse it my means of rheostats constructed to admit current gradually by fine gradations and in one direction or the other through the armature of the motor.

707,303. INSULATING JOINT FOR PIPES; F. E. Cleland and E. B. Murray, Des Moines, Iowa. App. filed March 10, 1902. Structural details.

707,305. ELECTRIC SIGNAL FOR ELEVATORS; L. K. Curlett, Chicago, Ill. App. filed Nov. 7, 1901. A signal for elevators comprising an electrically operated signal carried by the car, and car-actuated contact devices to operate the signal when the floor of the car is flush with a floor of the building.

707,306. METHOD OF ELECTRODEPOSITING METAL ON LACE; J. A. Daly, Washington, D. C. App. filed Oct. 15, 1901. (See page 335.)

707,312. AUTOMATIC CIRCUIT CLOSER FOR TELEGRAPH KEYS; J. E. Folsom, Mitchell, Ill. App. filed Aug. 29, 1901. Details.

707,334. SYSTEM OF DISTRIBUTION; J. F. Kelly, Pittsfield, Mass. App. filed May 20, 1902. (See Current News and Notes.)

707,338. TROLLEY; P. E. Lorce, Dayton, Ohio. App. filed March 31, 1902. Structural details including a device for diminishing friction of lateral contact on curves.

707,244.—Resistance for Rheostats, Electric Heaters, etc.

707,363. GALVANIC BATTERY; E. L. Slocum, Pawtucket, R. I. App. filed July 1, 1901. Comprises a carbon or negative element made in four divisions, each division having in cross-section the form of a letter W forming ribs on both the outside and inside of the carbon and zinc elements held in the spaces between the divisions, and a containing jar.

707,372. ELECTROCHEMICAL GENERATOR; H. S. Amwake, Camden, N. J. App. filed June 13, 1902. The electrodes are surrounded by, but not in contact with, a case of carbon or other poor conductor, open at its lower end.

707,383. ELECTRIC ARC LAMP; C. L. Bundy, Philadelphia, Pa. App. filed Feb. 12, 1902. Relates to means for varying the attractive force of the magnets, and regulating the resistance of the coils interposed in the lamp circuit; also other details.

707,389. SYNCHRONOUS ALTERNATING-CURRENT MOTOR; A. Churchward, Fort Wayne, Ind. App. filed Oct. 1, 1898. (See Current News and Notes.)

707,390. SYNCHRONOUS ALTERNATING-CURRENT MOTOR; A. Churchward, Fort Wayne, Ind. App. filed Jan. 11, 1899. (See Current News and Notes.)

707,429. INSULATOR FOR ELECTRIC WIRES; T. F. King, Nashville, Tenn. App. filed Sept. 21, 1901. Structural details.

707,438. MEDICAL ELECTRODE; G. G. Marshall, Wallingford, Vt. App. filed May 2, 1902. A specially designed electrode for use by physicians in treating diseases of the stomach.

707,441. TELEPHONE RECEIVER; Lemuel Mellet, Somerville, Mass. App. filed July 5, 1901. (This patent will be described in next issue.)

707,505. ELECTRICAL SWITCH; L. L. Elden, Boston, Mass. App. filed April 15, 1901. An electric switch having a plurality of contact-makers in a successive series for transferring a circuit from one source of supply to another and a series of contacts co-operating therewith, the contact-makers being movable in an unvarying path only into successive contact with the series of contacts, the switch having a break position between every two make positions.

707,508. ELECTRIC ROLLER FOR MASSAGE AND THERAPEUTICAL PURPOSES; J. W. Gibbs, New York, N. Y. App. filed April 17, 1899. Embodies a magneto-generator located within a revoluble metallic cylinder.

707,516. PLUG RECEPTACLE; C. J. Klein, New York, N. Y. App. filed April 5, 1902. The face plate of a plug receptacle is provided with swinging doors which open inwardly on the insertion of a plug and close automatically upon its withdrawal and cover the opening.

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CONTENTS.

EXPORT TRADE.

There seems no reason to doubt the fact that American manufactured goods continue to enjoy the appreciation of foreign purchasers in as marked a degree as ever, although the increase of the home demand has checked the possibilities in the export field. Many a manufacturer has to consider gravely whether he shall develop his productive capacity up to the full limit of the business offering him, and the dictates of prudence often is that he should go a bit slow in putting his profits into fixed plant. One thing is certain, that a connection once made for export trade it is well to maintain it, and even to develop it, we think, at the risk of not filling every domestic order as well. Creating and meeting export demand is not the easiest thing, and there are many pushing for it from other countries, where the home consumption is not so brisk. Aside from its immediate benefit, export trade has also the advantage of affording the manufacturer an outlet when his home trade is dull.

Turning to the figures for July, we are glad to find that the total exportation of manufactures for the seven months reach $245,756,052, as against $236,093,429 in the same period last year. When we remember the decline in metal exports, due to the urgent demand for them at home, this total is very satisfactory, especially as it is now to be reinforced by the figures of the large crops with which America helps to feed the world.

RULES FOR RESUSCITATION.

Some years ago we first issued our rules for the resuscitation of persons suffering from accidental electric shocks. It has been a matter of profound gratification to us to know that the use of these rules has proved efficacious in a number of instances; while the many applications for copies, of which we are continually in receipt, evidences not alone an appreciation of their value, but the great extension in recent years of circuits and apparatus of high, killing potential. In the present issue, which as an export number enjoys a special circulation throughout all parts of the world where such apparatus is in use, we present our readers with the latest revision of these rules and suggestions, brought up to date by Dr. Goelet in the light of the best information, data and theory applying to electro-physiology and electrotherapeutics. In many instances we have found our readers place these rules on the walls of central stations, isolated plants and power houses, etc., and knowing this, we have now printed it on stout, heavy paper, whose color being distinctive and familiar will help in quick reference to the rules in the hour of emergency. Extra copies will be furnished gratis upon application.

CENTRAL STATION RATES.

The discussion on central-station rates at the Cincinnati Electric Light Convention served to bring out not only the live interest which that subject has at the present time for central-station managers, but also the great divergence of opinion existing as to what constitutes a rational system equitable both to the central station and to the consumer. To those who have followed the subject closely, it has been quite apparent that the present time marks a transition period in the matter of central-station rates somewhat similar to that in the early history of the art when the abomination of flat rates was dispossessed. The situation is undoubtedly largely due to the more systematic manner in which central stations are now being conducted—in other words, to the fact that the electric lighting industry is ridding itself of the crudities of the develop-

ment period and settling down to the status of a business in which no detail is so slight as to be inconsequential. The discussion at Cincinnati and the symposium on rates which we print elsewhere in this issue would, however, appear to indicate, by the differences in opinion, that the problem of rationalizing central-station charges is not a simple one, and it may be of interest to inquire into the cause.

The problem involves three distinct elements, namely, the accurate determination of the cost of supply, including every item of expense; the elaboration on the data thus obtained of a general system of rates equitable to both sides; and the acceptance of such a system by the public. Considering current delivered to the customer as a commodity, the determination of the cost of this commodity is surrounded with considerable more difficulty than in the case of the usual manufactured article. This, however, should prove no particular obstacle to the active central-station manager, particularly in view of the enlightenment which he may receive by referring to the very considerable literature on the subject which has appeared. Such an analysis cannot be itemized too minutely in the first instance, for subsequently when the greater problem of a rate system is attacked, every possible means of guidance will be desirable. Or should the manager be satisfied to confine himself to a selection of one of the several rate systems now on trial, their relative desirability for his particular case can be tested by applying to them the results of his analysis.

From the fact that radical differences of opinion as to what constitutes a rational and practicable rate system prevail among central-station men who presumably have accurately and in minute detail determined costs, it is apparent that a difficulty of no mean order is encountered when it comes to elaborating a system of charging based upon such costs. This difficulty is almost entirely incident to the apportionment among individual consumers of the items not directly proportional to the cost of production of current, such as fixed charges, plant investment, etc. For example, we doubt if any rule can ever be laid down as to the exact relative charge there should be for current to the user whose demand is at the peak of the load, and to the one whose service entails little else than the actual cost of the corresponding fuel, as in the case of service only during the hours of light load. But the general principle cannot be contested that each consumer should, as far as possible, pay an amount for his service commensurate with the total cost of the same. In approach to this principle the flat-meter rate is merely an improvement on the old flat rate, and the addition of a system of general discounts merely mitigates the evil. A rate determined, whether by the capacity of the installation, total or partial, or by the maximum demand for current, or by a similar method which differentiates users into classes, is a still further advance, even if it does not meet the approval of those seeking perfection. What should constitute such a system is the matter now uppermost in the minds of progressive central-station men.

Assuming that an exact analysis of the case has been made, and a system based thereon which is entirely equitable from the business standpoint both to the central station and to the consumer, the major difficulty still remains, and that is to secure the approval of the public for the proposed tariff. As a public utility corporation enjoying a franchise which "burdens" the public domain, the business status of a central station with respect to the public differs totally, it is, perhaps needless to say, from that of the ordinary manufacturer, and this must be taken into consideration in any action affecting the public. A new system of rates is apt to be scrutinized by a consumer not as such, but as a citizen who feels that he is one of a body toward which the electric light company cannot afford to adopt an antagonistic attitude. If the rate is considered to be unsatisfactory, complaint will be made, not as an individual, but in the name of the public in general. Moreover, the custom generally obtaining in water and gas supply of not radically differentiating between customers, if at all, tends to cause differential rates for electricity to be regarded with suspicion. In view of the foregoing, it is quite evident that the central-station manager who would adopt a rational system of charging is beset by difficulties of no mean order. This situation undoubtedly accounts for the wide divergence of opinion to which we have referred, and for the considerable discussion of the past several years on a matter, which, if presented as a problem in an ordinary branch of business, would perhaps long before this time have found a perfectly satisfactory solution.

UNWISE CONSERVATISM.

It is most regrettable that at the recent naval manœuvres the regular use of wireless telegraphy was not included, and the implied rebuke to the naval bureaucrats in Admiral Higginson's urgent recommendation to the Navy Department on this subject was well deserved. Doubtless wireless telegraphy has its limitations, and doubtless it is not developed to the point it will have reached five or six years hence; but the fact remains that if the attacking squadron had been a real enemy it would have had the advantage of wireless communication which the defenders lacked. And as a matter of fact, such aid is of more importance to the defense than to the attack, for the former is spread out over a long stretch of coast with which it must keep in touch to facilitate the work of the land forces. No real attacking fleet would lack the services of fast scouts quite capable of coping with the scouts of the defense and crippling them, perchance long before they could communicate with the main body of their fleet. A descent upon the coast for the capture of a base is not likely to be made in broad daylight, but in the gloom of night when a foe cannot be picked up even with the help of searchlights until within easy range. With the wireless telegraph a scout could give the alarm even if she were a riddled wreck ten minutes later, and so would have played her part. As maaters now stand, we would be at a great disadvantage in this respect if attacked by any respectable power. Are we so soon to forget the lessons of 1898 in the danger of unpreparedness? To be sure, we have made advances since then, but they are the advances which should have been already made prior to that date. With the growing commercial jealousy on the part of many foreign powers and increase of jingoism at home, war is a far more likely contingency than it was half a dozen years ago, and when it next comes it will not be with a brave but outworn foe like Spain.

It is high time that the navy were equipped with a wireless telegraph system, and although tardy steps are now being taken in that direction, we are far from being equipped. Had the government purchased from time to time a trial installation of every seemingly practical system of wireless telegraphy put forth during the past six years, the cost would probably be much less than the aggregate expense of the numerous investigations of the Navy Department into the general question of wireless telegraphy. It is, moreover, a long step from bringing three or four competitive systems before a board of examination to the installation of the apparatus where it will be ready in time of need. If we remember correctly, it is nearly a decade since boards were appointed to look into the smokeless powders already in use abroad, but 1898 still found us unready except for some of the smaller guns and a few of medium calibre purchased abroad at the eleventh hour. And not only should we have the wireless system at once, but it is high time that we were hard at work on the matter of breaking down the communications of the enemy. We hear great argument about syntonic methods with loud asseverations that they can or cannot successfully be used. It is time to find out the facts in the case, for there may be a day in

which we shall sadly need to know. The enemy has been working industriously on wireless telegraphy and with a very gratifying degree of success; but it seems to be pretty well established fact that the sea is the best field for the work, and those who fight on the sea should be the first to be prepared. It is a wise policy doubtless to keep a cool head and to be slow in flying after every alleged improvement that may be presented, but wireless telegraphy, while it is still imperfect, is no scheme of a long-haired inventor, but is sufficiently useful and practical to have been already adopted by the navies of the great powers—barring the United States. It is high time to be up and doing and to keep up with the art of war instead of lagging behind.

RATIONAL ELECTROMAGNETIC UNITS.

We reprint on page 368 a translation of an interesting paper by Signor Giovanni Giorgi, of Rome, on a plan for the rationalization of electromagnetic units. The existing practical system of electromagnetic units embracing the volt, ampere, ohm, etc., is quite satisfactory from an industrial standpoint. It is likewise in international use, and formally adopted by law in most civilized countries. It is a scientific system connected with the decimal metric system, and far superior to any of the barbarous tables of weights and measures still employed in English-speaking countries. Nevertheless, the existing electromagnetic system is defective, even gravely defective, from a strictly scientific standpoint, and if we could expunge it and recreate a system of electromagnetic units without any precedents or history to consider, a much better system could be, and probably would be, adopted. The existing system contains three defects.

Firstly it is virtually based upon the earth's quadrant (10^9 cms.) as unit of length, the one-hundred-thousand-millionth of a gramme (10^{11} gramme) as unit of mass, and the second as unit of time; whereas it ought to be the simple and fundamental centimeter-gramme-second system. Consequently electromagnetics are necessarily taught theoretically in the C. G. S. system, and necessarily applied practically in the Q. E. S. system, which is almost as bad and ridiculous as the Chinese systems of speech and writing, where the written language is not spoken nor the spoken language written. The reason for the now seemingly ridiculous transition from the fundamental C. G. S. to the applied Q. E. S. system was that some of the unit magnitudes in the former were inconvenient. Thus, the C. G. S. unit of e. m. f. is very small from a practical standpoint, namely, about the hundred-millionth part of the e. m. f. of a gravity Daniell cell; so, instead of calling the little C. G. S. unit the volt, and employing a prefix, such as megavolt, to arrive at a practical magnitude for industrial purposes, a big decimal kinsman was selected for the volt to the neglect of the fundamental unit. The same was true of the ampere and ohm. The result is that while we have to use prefixes, anyhow, to meet practical requirements, such as in microhm, milliampere, megohm and microfarad, we have awkward decimal numerics separating all practical and theoretical units, an unnatural divorce that gives endless trouble to students, and for which, as we now look back, there was absolutely no use or necessity, no disparagement being offered to the labors of the great and worthy men who decided upon the existing system.

The second defect of the electromagnetic system of units is inherent not only in the practical Q. E. S. system, but also in its progenitor, the theoretical C. G. S. system. This is the defect which Mr. Giorgi mainly attacks. Owing to an unfortunate basis of definition, there is a continual recrudescence of the constant 4π occurring in ordinary unit relations, where it has no business to appear, and where it is a needless encumbrance; while in spherical problems, where the surface of a unit sphere (4π) should naturally appear, the constant is honored in the breach rather than in the observance. So that the C. G. S. system is in regard to 4π, like the cockney dialect in regard to *h's*. There is no *h* where it ought to be, and there is an *h* where it ought not to be. For example, the unit of m. m. f. ought to be equal to the current-turns in the C. G. S. system or to the ampere-turns in the Q. E. S. system; whereas it is 4π times the current-turns, or 4π times the ampere-turns in the two systems, respectively.

The third defect of the electromagnetic system of units also relates to the fundamental C. G. S. system, and that is that the system is not unique. There are two of them. One is the so-called electrostatic system, and the other the so-called electromagnetic system, so that when we speak of the C. G. S. unit of e. m. f., for example, it is not clear whether we mean the electric unit or the magnetic unit. The former has the magnitude of 300 volts, the latter $\frac{1}{100000000}$ volt. So that there is quite a difference, and the difference is different in the case of different units. In some the ratio is 3×10^{10}; in others it is 9×10^{20}. This ambiguity is unnatural, and is a consequence of definition. A strictly scientific system of electromagnetic would be unique. It would be essentially simple and single. It would not admit of duality.

It is evident on reflection that none of these three defects touches the practical man or the industrial user of electricity. A volt as defined by law would be serenely unaffected though the C. G. S. system were replaced by a much more nearly scientific system. The practical man is, therefore, content with the existing order of things, and not only desires no change, but vehemently protests that no change shall be made. Why upset contracts, literature and history, he argues, when we are all so comfortable? The argument is valid, and it is practically impossible to expect any change to be made in practical electromagnetic units in the near future, no matter what improvements theory may suggest. Nevertheless, the artificial difficulties which are raised in the science of electromagnetism by the above defects in the adopted systems of units retard knowledge and hinder progress, so that the defects do have some indirect bearing upon the practical side of the question.

Various attempts have been made to cover the 4π eruption by patching up the practical system. The suggestion of Professor Fessenden was one. The suggestion of Signor Giorgi, here considered, is another. These expunge the intruding 4πs in certain parts of the system by local barriers; so that in practical use the offending constant would seldom offend the purist's sight. But in more deep-seated equations the four pis would come trooping in. The only completely successful way of keeping them out of plane problems and confining them to spherical problems, where they belong, is to go back to the fundamental definitions of units and correct these, as Heaviside has done. This cures the evil, but there results new C. G. S. units of e. m. f. of current, and of everything else, all related to the existing C. G. S. units by awkward functions of 4π; so that the remedy is worse than the disease, unless we can change our practical Q. E. S. units, to match; which is at present a hopeless expectation. Moreover, if we were to "rationalize" the C. G. S. and Q. E. S. systems so as to stop the 4π eruption, there would yet remain the first and third defects above mentioned. Consequently, it seems better to go on in our evil ways and persist in our international Q. E. S. system, which is, after all, very good if it is not scientifically the best. In time, theory will doubtless indicate the best means of jointly eradicating the two defects in the C. G. S. system so as to make it unique, and at the same time to handcuff the vagrant 4πs. Then when a really scientific new C. G. S. system, or its improved representative is agreed upon, it can be imported into practice directly by the use of suitable prefixes and suitable new names, which will not conflict with the present names.

Programme for the Edison Association Meeting.

A very interesting and attractive programme has been prepared for the twenty-third convention (eighteenth annual meeting) of the Association of Edison Illuminating Companies which will be held at the Mount Washington (a hotel near Mt. Pleasant House station, N. H., on the Boston and Maine R. R.), commencing Tuesday, September 9, 1902, at 9:30 A. M. We give below a list of the papers prepared to be read: "Recent Developments in Distribution System in Boston," by Mr. Sidney Hosmer, Boston; "Aspects of Safety and Reliability in High Tension Transmission and Distribution of Current from Annex Stations in Large Cities," by Mr. Philip Torchio, New York; "Construction and Operation of Underground High Tension Transmission," by Mr. H. J. Gille, St. Paul, Minn., and Mr. H. G. Carlton, Chicago; "High Tension Work in the Far West," by Mr. George H. Lukes, Chicago; "Development of New Forms of Illumination and Their Possible Influence on Central Stations (Nernst Lamps, Hewitt Lamp and Welsbach Arc Lamp)," by Mr. George Eastman, Chicago; "The Effect of the Nernst Lamp Upon Methods of Illumination," by Mr. Murray C. Beebe, Chemist Nernst Lamp Co., Pittsburg; "The Distribution of Light from Incandescent Lamps as Affected by Shades Commonly in Use," by Mr. John W. Howell, Engineer Edison Lamp Works, Harrison, N. J.; "Original Researches in Electrical and Chemical Laboratory," by Mr. Charles P. Steinmetz, General Electric Company, Schenectady, N. Y.; "The Order System and Its Influences Upon Cost," by Mr. Wm. M. Anthony, Chicago; "Campaigning for Business," by Mr. John F. Gilchrist, Chicago; "Advertising and Canvassing," by Mr. Arthur Williams, New York; "Commercial Conditions with Customers," by Mr. J. T. Maxwell, Philadelphia; "Some Problems in the Design, Development and Operation of Large Central Station Systems," by Mr. P. Junkersfeld, Chicago; "Utilization of Waste Energy of Central Stations," by Mr. W. H. Schott, Chicago; "Steam Pipe Covering and Its Relations to Station Economy," by Mr. Henry G. Stott, Supt. Motive Power, Manhattan Ry., New York; "Coal," by Mr. Robert Lindsey, Cleveland, and Mr. W. L. Abbott, Chicago; "Storage Batteries," by Mr. Gerhard Gottling, Boston; "Integrating Electric Meters and the Meter Department," by Mr. George Ross Green and Mr. P. H. Bartlett, Philadelphia; "Checking Electrical Instruments," by Dr. C. H. Sharp, Test Officer, Lamp Testing Bureau, New York; "Automatic Voltage Regulators," by Mr. W. S. Andrews, Schenectady; "The Use of Superheated Steam," by Mr. Charles H. Parker, Boston.

Besides these papers there are other subjects prepared for presentation, the reports of various committees and the usual open discussion of the many papers and subjects presented.

The convention this year may occupy four days, with a morning and a night session each day, the afternoons being devoted to recreation. One feature of the entertainment will be a golf contest on the links at the Mt. Washington, open for ladies and gentlemen. It is understood that the parent General Electric Company will extend various courtesies to members while the convention is in session.

Power Development at Niagara.

There is every prospect that the Niagara Falls Power Company will be delivering electric power from its second station about October 1. The output capacity of this second installation will be 55,000 hp, developed by 11 generators operated by a like number of turbines, each being of 5,000 hp capacity. The turbines are being placed in a new wheel-pit that is 178½ feet deep, 18½ feet wide and which has a length of 463 feet 8 inches. This wheel-pit is excavated out of solid rock, and to meet its requirements the tunnel was extended. The new power house covers the pit, having a total length of 500 feet. The power house is 70 feet wide, and on the west side there is a covered forebay structure that has a width of 40 feet. In this covered forebay structure the racks are placed, the water entering from the inlet canal though arches opened beneath the surface. The racks of the original power house are unprotected by a covering, and there is no forebay structure.

The National Contracting Company, of which Walter McCulloh is resident engineer at Niagara, completed its contract early in August. The completion of the contract of the National Contracting Company leaves the future work in charge of the Niagara Falls Power Company and the contractors on the power house and installation. The work of erecting the superstructure is in the hands of Mosier & Sumers, of Buffalo, and they have their contract well advanced. The building is nearly all roofed and slated, and attention is being given to the center gable and the storehouse structure at the rear end. From every point of view the new house is by far the superior of the old station, which has always been considered a very magnificent building. Beauty has been added at several points. The stone used in its construction is the same as used in the original building. The power house is fire proof in all parts.

The turbines to be installed in the new pit are the product of the I. P. Morris Company, of Philadelphia, which company now has a force of men at Niagara on the work. Wheels No. 11, 12 and 13 are in place, and the shaft of Wheel No. 11 has been set. In this new station the wheels and generators will be numbered from No. 11 to 21 inclusive, as the machines in the old station are numbered from 1 to 10, inclusive. Thus the total equipment of the two great stations will be 21 turbines and the same number of generators, the total output capacity of which will be 105,000 hp. The new turbines are of the internal discharge type, the water being carried off through draft tubes, giving an increase of about 10 per cent. to the effective head. The turbines were designed by Escher, Wyss & Co., of Zurich, Switzerland.

The generators for the new station are, as already noted, being manufactured by the General Electric Company, and the work of erecting the first one is now in progress. There will be two styles of generators in the new station, the first six to be very similar in design to those now in operation in station No. 1, with the exception that the bridge over the machines will be dispensed with. These six machines will be of the external revolving field type, while the other five will be of the internal revolving field type. The interior of the new power house, as well as the outside vicinity, presents a remarkable scene of activity, and many men are constantly on the jump in order that there may be no unnecessary delay in obtaining power at the earliest possible date. In the inlet canal a dredge, scow and tug are at work taking out the cofferdam erected to aid the forebay construction, while out in the river in front of the inlet canal, the channel is being dredged in order that there may be a free flow of water to the inlet both in summer and winter. An addition is being built to the transformer station, and this is an intimation that some of the current generated in the new power house will be transmitted to a distance from the Falls. Mr. William A. Brackenridge is the resident engineer of the Niagara Falls Power Company, and is giving careful supervision to the work.

United States Manufacturing Activity and Foreign Trade.

The increasing activity of the manufacturers of the United States is illustrated on both the export and import sides of the latest figures of the Treasury Bureau of Statistics. During the seven months ending with July, 1902, the exportation of manufacturers was nearly \$10,000,000 greater than in the corresponding months of the preceding year, and the importation of manufacturers' materials was 30 millions greater than in the corresponding months of the preceding year. The exportation of manufactures during the seven months of the present year has averaged \$35,108,000 per month, or at the rate of \$421,000,000 per annum, while the importation of manufacturers' materials has averaged \$36,000,000 per month, or at the rate of \$432,000,000 per annum. Nearly all of the principal manufactured articles exported, except iron and steel, show an increase in quantity and in most cases in value, though in a few important articles the reduction in price per unit of quantity has brought the value below last year's figures, while the quantity shows an increase. Copper, in which there was a decided decrease in the exportations of last year owing to high prices, now shows a marked increase, the figures being \$49,614,210 for the seven months ending with July, 1902, against \$20,731,622 for the same months of 1901. The chief decrease in exports occurs in iron and steel, the total exports during the seven months of this year being \$57,263,304, against \$61,160,730 in the corresponding months of last year.

On the import side nearly all the principal classes of manufacturers' materials show an increase. Chemicals increased in imports from \$32,591,372 in seven months of 1901 to \$53,831,377 in the same months of 1902. India rubber shows a slight decrease in importations, the total having fallen from 34,899,446 pounds in seven months of 1901, to 30,308,134 pounds in the same months of 1902, though the figures of 1902 are considerably in excess of those for the corresponding months of 1900.

Water Power Transmission for the Springfield, Mass., Lighting System.

THE Birchem Bend station recently put into operation by the United Electric Light Company, Springfield, Mass., completes a water-power equipment larger than that of any other electrical supply system in the State. In Electrical World and Engineer of Sept. 28, 1901, a full description of the Springfield system as it then existed was given, together with a record of its operation and the percentages of its output derived from water-power for a series of years. At the above date the water-power station at Birchem Bend was under construction and could not be fully described, but it has since been completed, together with some other additions to the system. The new stone dam, canal and power-house at Birchem Bend are designed to utilize the entire flow of the Chicapee River at a point where a fall of about 14 feet between the top of the dam and the level of tail water has been developed. These structures are located in the suburbs of Springfield, at a point about six miles from the steam-driven electric station on the bank of the Connecticut River, in the heart of the city. A short canal with sides of stone and bed of concrete conducts water from one end of the dam at Birchem Bend to the side of the power-house. By a somewhat novel construction, the turbine wheels are mounted in their cases directly on the floor of the canal in two sets. Each set has a single, horizontal shaft that passes through the side wall of the power-house in a watertight stuffing-box. The rating of each set of wheels is 600 hp, at 130 r. p. m. The power-house is a building of pleasing design with walls of brick save on the canal side where they are of heavy stone masonry to a distance of 5.1 feet above the top of the dam. At the floor level, the power-house is 52 feet 8 inches by 26 feet 6 inches, and 26 feet 9 inches from concrete floor to the bottom of the steel roof trusses. A hand-crane sweeps the entire interior of the power-house at a distance of 21 feet 6 inches above the floor.

On each of the two horizontal turbine shafts that enter the power-house through the heavy masonry wall which separates its interior from the water in the canal a generator of 400-kw capacity, together with an exciter, is mounted. These two generators are two-phase with revolving fields, 6,000-volt and 60-cycle, at 130 r. p. m., made by the Westinghouse Company. The frame of each generator extends below the floor in a pit formed for the purpose. A small pump is provided to keep these pits free of any water that may find its way through the wall that separates the interior of the power-house from the canal.

Fig. 1.—Canal and Tail Race.

Current passes from these two generators, at 6,000 volts, directly to the switchboard, where the output is recorded by wattmeters, and then to the steam and substation in the business center of Springfield. The transmission to the substation takes place over either one of

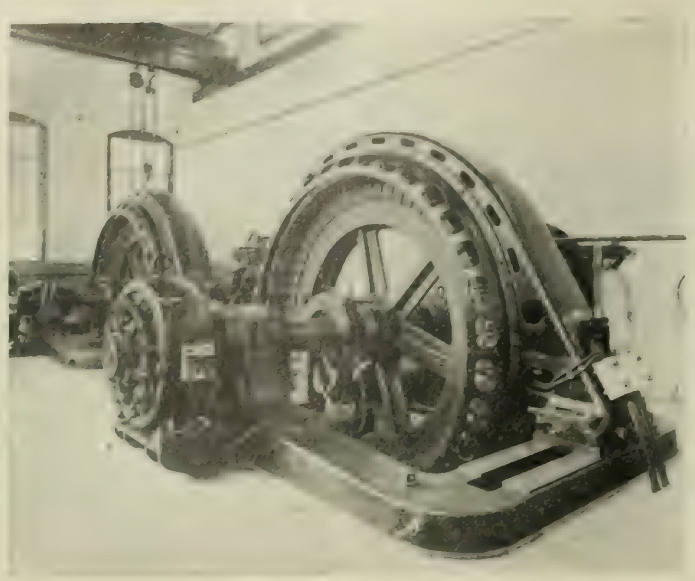


FIG. 2.—400 KW GENERATORS.

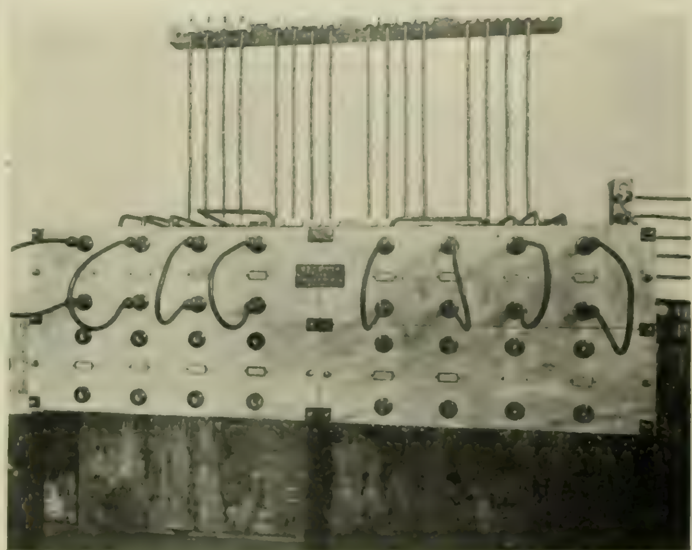


FIG. 3.—PLUG BOARD FOR CONNECTING TWO STATIONS.

FIG. 4.—UNDERGROUND CONDUITS.

FIG. 5.—METHOD OF CONNECTING THE TWO WATER POWER STATIONS WITH THE STEAM PLANT.

FIG. 6.—MAP SHOWING PRESENT UNDERGROUND SYSTEM.

SPRINGFIELD WATER-POWER TRANSMISSION SYSTEM.

two lines. One line passes from the Birchem Bend plant in nearly a direct line to the substation. The other line connects the Birchem Bend station with the water-power plant of the company, at Indian Orchard, about one and a half miles distant, on the same river. From the plant at Indian Orchard another transmission line goes to the substation, so that energy from either or both of the water-power plants may pass to the substation over either or both of the lines to the substation, as may be noted by the drawing. Each of these transmission lines is made up of eight conductors. Four of these conductors carry two-phase energy for general use, and terminate in a fireproof transformer room in the building that serves at once for a steam plant and a substation. Transformers in this room reduce the voltage from 6,000 to about 1,200 for general commercial lighting. The other four conductors of each transmission line connect with two alternating machines at the substation, each of which is rated at 350 kw, 5,500 volts and 60 cycles, two-phase. These two alternators were built by the Stanley Electric Manufacturing Company, and are of the induction type. By means of shaft and belt connections, these alternators at the substation are used to drive a 500-kw, 500-volt generator there, made by the General Electric Company, that supplies direct current for the load of stationary motors, when the water-power is ufficient to carry the entire load of the system. When there is not enough water-power to carry both the lighting and motor loads, the 500-kw, direct-current generator is driven by steam, as also one or both of the 350-kw alternators at the substation. The transmission line from the Birchem Bend station, and also the line from the Indian Orchard plant, are carried about four miles on poles. At a distance of about two miles from the substation, each lines passes

FIG. 7.—POWER HOUSE.

from poles to underground conduits of vitrified clay and so continues for the remainder of its length. In the conduits, the transmission lines are made up of duplex rubber and lead-covered cables, laid one cable per duct. Besides the alternating service to arc and incandescent lamps, and the circuits for direct-current motors from the substation, a line at 110 volts, direct-current, is connected there with a 300-ampere dynamo, and makes a little circuit around about the center of the city to operate several charging stations for the batteries of electric vehicles.

This line, like many of the other distribution circuits of the system, is entirely underground. During the past year the company has laid about 300,000 duct feet of vitrified clay conduit. All of the circuits in these conduits are composed of rubber and lead-covered cables. The accompanying map illustrates the extent of the underground circuits for electric light and power in Springfield. Running directly away from the river in the same general direction as the Boston and Albany Railroad are the transmission lines, which separate at a point distant between one and two miles from the substation. The other underground work forms a part of the distribution system. The total length of underground conduit now in use includes more than 600,000 duct feet.

At the brick building which serves as both a sub and steam-power station, important changes are going on. The building is two stories, and originally had timber floors. These floors have just been replaced with steel beams, brick and concrete, so as to turn the building into a thoroughly fireproof structure.

Capacities of transformers connected for service from the Springfield system, and the number of each are as follows:

Number	Lamps.	Number	Lamps.
23	10	11	80
36	12	3	90
110	20	33	100
1	25	28	150
64	30	18	200
55	40	10	300
32	50	6	400
3	60	2	500
7	75	1	600

The total number of these transformers is 443, with a combined capacity of 28,562 lamps. Of this capacity, that of 10,462 lamps is in transformers rated at less than 100 lamps each, and that of 18,100 lamps is in transformers rated at 100 or more lamps each. The numbers and capacities of consumers' meters in use on the system follow:

100-VOLT METERS.

Number	Amperes	Number	Amperes
11	3	112	50
284	5	9	75
296	10	29	100
291	15	9	150
153	25	3	200
1	30	6	300

50-VOLT METERS.

Number	Amperes	Number	Amperes
1	5	1	30
39	10	18	50
16	15	7	100
1	20	5	150
31	25	1	300

500-VOLT METERS.

Number	Amperes	Number	Amperes
5	3	1	75
10	10	2	100
25	15	1	150
19	25	1	300
6	50		

220-VOLT METERS.

Number	Amperes
1	50

1,000-VOLT METERS.

Number	Amperes	Number	Amperes
1	10	1	25
2	15	2	30

ARC METERS.

Number	Amperes
2	18

The number of public arc lamps supplied is 867, all of the enclosed type, at five amperes, operated by constant current dynamos located at the Indian Orchard station. Commercial enclosed arcs to the number of 522 are in use. The connected load of incandescent lamps amounts to 45,735 of 16-candle-power. Motors with a combined capacity of 1,025 hp, and numbering 264, are connected to the 500-volt, direct-current lines. At Indian Orchard the capacity of dynamos is about 2,000 kw, and the 800 kw at Birchem Bend brings the total for water-power stations up to 2,800 kw, an equipment much larger of its kind than that of any other electrical supply system in the State. The above improvements have been completed under the management of Mr. Walter L. Mulligan, to whom thanks for the interesting facts here presented are due.

Electrical Agriculture in Germany.

In a paper at a recent conference of German electrical engineers, Dr. Haas, of Hanover, referred to the electric power supplied to agriculture in that neighborhood. The greatest demand for current was for the operation of thrashing machinery, although energy was also used for driving pumps, hay presses, straw-cutters, etc. Of the total horse-power installed, 77 per cent. represented purely agricultural operations, and 8 per cent. factories, although the former only yielded 53 per cent. of the receipts. On an average, the annual revenue per horse-power installed amounted to $6.73 (as compared with from $17.03 to $36.50 in towns) at a price of 57 cents per kw-hour, and the average period of use did not reach 150 hours, as against 500 hours in towns. There is little demand for light in the villages, as the people retire early. The author concludes, from the experience in the Hanover district, that satisfactory results are possible in agricultural operations only where cables already exist for the transmission of power or for electric tramways, which can readily satisfy the small and occasional demand for agricultural purposes.

Tests of Steam Turbine Installed at Hartford, Conn.

By Prof. Wm. Lispenard Robb.

The reason for publishing the following summary of the tests made by me of the steam turbine installed by the Westinghouse Machine Company in the plant of the Hartford Electric Light Company, at Hartford, is the frequent requests that come to officers of the company for a copy of the results.

The tests were made primarily for the purpose of determining the efficiency that would be obtained under the actual operating conditions at Hartford. No attempt was made to maintain during the tests any unusual conditions. The station was operated by the regular station force during the tests; the various readings and measurements were made by me with the assistance of several of the students in the Electrical Laboratory of Trinity College.

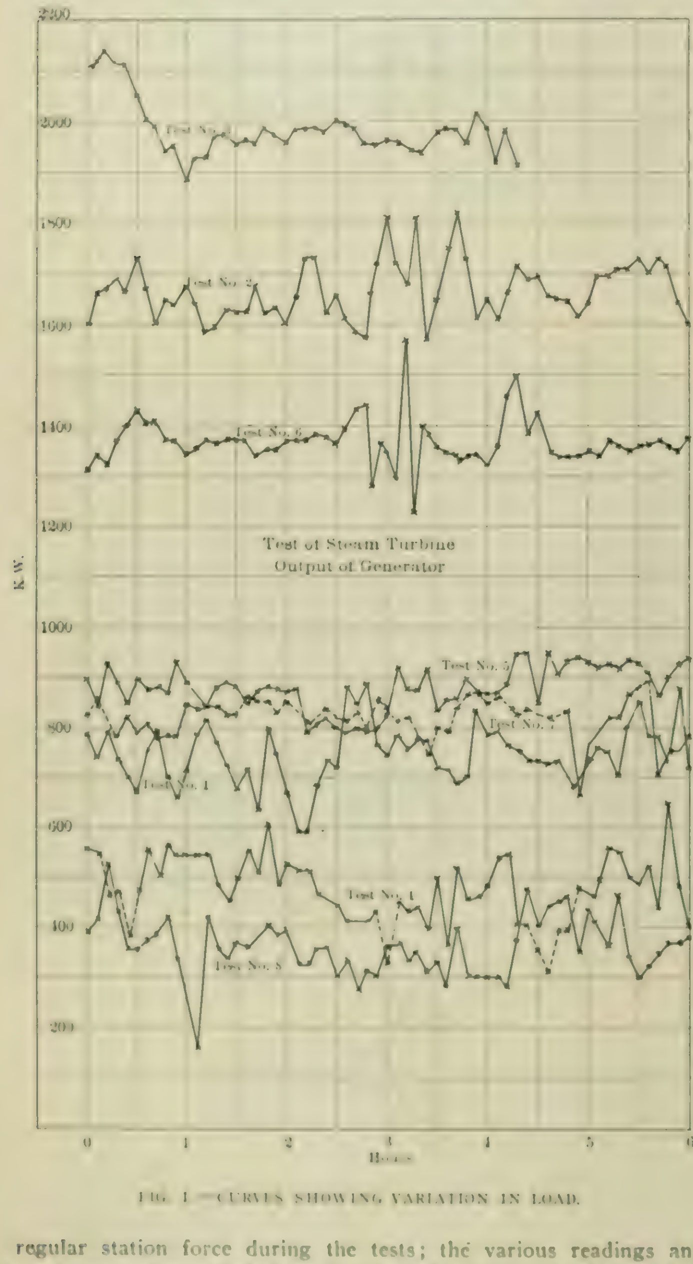


FIG. 1.—CURVES SHOWING VARIATION IN LOAD.

The tests were discontinued from February 1st to May 7th, to permit alterations in the construction of the shaft which previous tests had shown to be desirable.

The following brief description will show the conditions under which the turbine is ordinarily operated:

The chief power of the Hartford Electric Light Company is water power, steam being used simply to supplement this in case of low water. In a year of normal rainfall the steam plant would be operated practically continuously for about three months, and during the peak of the load for about as many more months.

The steam turbine was installed on account of its lower first cost; small cost of installation; relatively small space occupied in the station, and its relatively high efficiency at fractional loads. The turbo-generator installed at Hartford has a rated capacity of 1,500 kw. It has developed, however, that the capacity is considerably greater, and it would now be rated at 2,000 kw.

The boiler plant consists of three Aultman-Taylor water-tube boilers, each having a rated capacity of 550 hp. The condenser is of the barometer type, manufactured by the Worthington Company, and the water for condensing purposes is supplied from three cooling towers.

The output of the generator was measured by instruments carefully calibrated with standard Weston instruments. As the condenser was of the jet type, the steam consumption had to be measured by weighing the input of water into the boilers. In order to obtain accurate results this, of course, necessitated continuing the tests through a considerable time, so as to eliminate any error due to inaccuracy in having the same quantity of water in boilers at the beginning and end of tests.

During the test, one of the boilers was disconnected from the other two and used to operate the steam auxiliaries. The remaining two boilers were used for supplying steam to the turbine itself. One of the two latter boilers was equipped with a superheater, capable of superheating the steam from that boiler to about 60° F. As the steam from this boiler was mixed with the steam from the second boiler it insured superheated steam at the turbine. The degree of superheat, however, fluctuated very widely, depending on the relative amount of steam supplied from each of the two boilers. During the first test the boiler with superheater was cut out.

The accompanying table gives a summary of the readings and results obtained therefrom. The steam consumption represents the steam supplied to the turbine and does not include that used by the auxiliaries. An inspection of the table shows that, owing to the length of time required for the tests and the inability to vary the conditions without interfering with the station operation, all he tests, with the exception of the first one, were made under very closely similar conditions as regards vacuum and the amount of superheat in the steam. It would have been very interesting to have repeated these tests under varying conditions of superheat and vacuum, but as yet the opportunity has not offered, and it would in any case be very much more satisfactory to carry out a special series of tests in a plant equipped with a surface condenser.

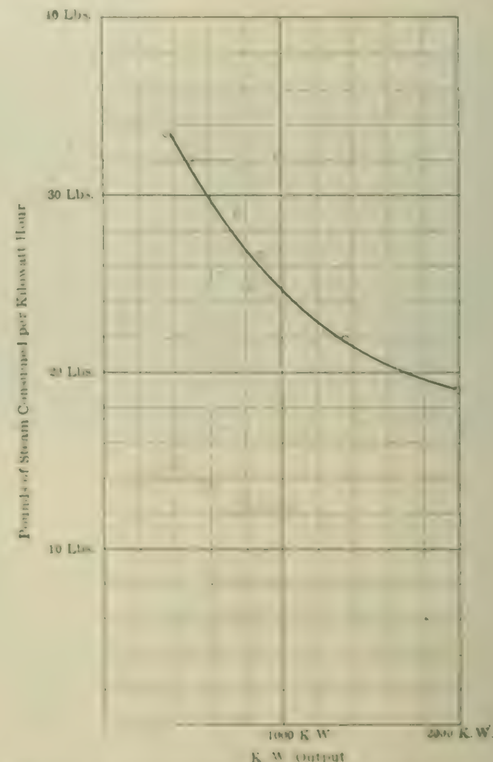


FIG. 2.—CURVES SHOWING STEAM CONSUMPTION PER KW-HOUR

The curves of Fig. 1 show the variation in load during the various tests.

I have embodied the results contained in the above table in the curve of Fig. 2, giving the steam consumption per kw-hour as a function of the load. In the case of the first test, where the steam was not superheated, I have reduced the results to what they would

have been had the degree of superheat been the same as the mean in the other tests, that is 32.9° of superheat. In making this correction I have made use of the data obtained by W. H. Lindley and Schroeter and Weber in their tests of the turbo-alternator for the Elberfeld Corporation. These tests are very fully given in a paper, "On the Trial of Steam Turbines for Driving Dynamos," by Hon. Charles A. Parsons, F. R. S., and published in London *Engineering* for September 6, 1901. These tests show a gain of efficiency of about 12 per cent with 55° C. superheat, and that every inch of vacuum improves the steam consumption about 4 per cent.

TEST		LOAD			LENGTH OF TEST	STEAM GAUGE PRESSURE			BAROMETER	INCHES VACUUM AT TURBINE			SUPERHEAT DEGREES F.			COAL		STEAM	
No.	Date	Aver.	Max.	Min.		Mean.	Max.	Min.		Mean.	Max.	Min.	Mean.	Max.	Min.	E. H. P. Hour	K. W. Hour	E. H. P. Hour	K. W. Hour
	1902	K.W.	K.W.	K.W.	Hours	Lbs.	Lbs.	Lbs.	In.	In.	In.	In.				Lbs.	Lbs.	Lbs.	Lbs.
1	Jan. 27	748	885	580	6	155.5	161.0	143.0	30.70	26.22	27.30	25.50	0	0	0	2.27	3.02	24.13	32.17
2	" 28	1657	1820	1480	6	151.3	158.0	145.0	30.73	28.00	28.20	27.85	40.08	61.34	19.88	1.33	1.76	15.15	20.2
3	Feb. 1	1998	2185	1900	4	155.4	158.0	146.0	30.27	26.91	27.30	26.75	41.56	55.05	32.45	1.28	1.70	14.43	19.12
4	May 7	471	730	310	6	151.8	155.0	147.0	29.86	26.62	26.90	26.20	19.10	29.00	3.50	2.20	2.93	23.97	31.90
5	" 8	888	980	750	6	152.6	156.0	149.0	30.04	25.83	26.70	25.50	32.90	47.50	12.00	1.85	2.46	19.90	25.33
6	" 9	1371	1570	1110	6	151.9	156.0	140.0	29.81	26.26	26.90	25.50	32.10	38.60	12.50	1.52	2.02	16.46	21.94
7	" 12	834	940	660	6	153.2	157.0	149.0	30.26	27.26	27.40	27.00	35.40	45.10	20.10	1.76	2.35	18.50	24.60
8	" 13	364	520	150	6	153.1	156.0	149.0	30.06	27.40	27.60	27.10	29.0	41.00	2.50	2.49	3.32	25.10	33.47

The World's Land and Sea Telegraphs.

"The Submarine and Land Telegraphs of the World" is the title of a monograph prepared by the Treasury Bureau of Statistics which will appear in the forthcoming Monthly Summary of Commerce and Finance. It presents some information regarding the submarine telegraphs of the world which is especially interesting at this time in view of the prospective construction of an all-American cable across the Pacific. It shows that the submarine telegraphs of the world number 1,750. Their aggregate length is nearly 200,000 miles; their total cost is estimated at $275,000,000, and the number of messages annually transmitted over them is more than 6,000,000. Adding to the submarine lines the land-telegraph systems by which they are connected and through which they bring interior points of the various continents into instantaneous communication, the total length of telegraph lines of the world is 1,180,000 miles, the length of their single wires or conductors 3,800,000 miles, and the total number of messages annually sent over them about 400,000,000, or an average of more than 1,000,000 each day.

Nearly a score of cables have been laid across the Atlantic, of which no less than thirteen now successfully operate between the United States and Europe, while three others span the comparatively short distance between South America and the African and South European coast lines. Throughout the Indian Ocean lines connect the Far East with Europe and America via the Red Sea, the Mediterranean, the western coast of Europe, and the great trans-Atlantic lines. The Mediterranean is crossed and recrossed in its entire length and breadth by numerous cable lines, and the "Mediterranean of America," the Gulf of Mexico and the Caribbean Sea, is traversed in all directions by lines which bring its islands and colonies into speaking relations with each other and with South America, Central America, the United States, and thence with Europe, Africa, Asia—the whole world. Along the eastern coast of Asia, cable lines loop from port to port, and island to island, receiving messages overland from Eastern Europe via the Russia-Siberian land lines and forwarding them to Japan, China, Australia, New Zealand, the Straits Settlements, Hongkong, and the Philippines, and receiving others in return. South America is skirted with cable lines along its entire border save the extreme south, where they are brought into intercommunication by land lines. Along the entire coast of Africa, cables loop from place to place and from colony to colony, stretching along the entire circumference and penetrating the interior by land lines at various points.

Every body of water lying between the inhabited portions of the earth, with the single exception of the Pacific Ocean, has been crossed and recrossed by submarine telegraph lines. Even that vast expanse of water has been invaded along its margin, submarine wires stretching along its western border from Siberia to Australia, while its eastern borders are skirted with lines which stretch along the western coasts of the two Americas. Several adventurous pioneers in Pacific telegraphy have ventured to considerable distances and depths in that great ocean, one cable line running from Australia to New Zealand, a distance of over 1,000 miles, and another extending from Australia to the French colony of New Caledonia, 800 miles seaward. A cable which is to connect Canada with Australia across the Pacific is now being laid at the joint expense of the United Kingdom, Canada and the Australian Commonwealth and has already been completed from Vancouver, British Columbia, to Fanning Island, just south of the Hawaiian Islands, and it is expected that the entire line will be completed by the end of the present year.

The chief obstacle to the construction of a grand trans-Pacific cable was found in the fact that mid-ocean resting places could not be satisfactorily obtained or arranged for, no single government controlling a sufficient number of suitable landing places to make this seem practicable, in view of the belief that the distance through which messages could be sent and cables controlled was limited. With landing places at Hawaii, Wake Island, Guam, and the Philippines, however, no section of a cable stretching from the United States to Asia and touching at these points would have a length equal to that now in daily operation between France and the United States. The length of the French cable from Brest, France, to Cape Cod, Mass., is 3,250 miles, while the greatest distance from land to land on the proposed Pacific route would be that from San Francisco to Hawaii, 2,089 miles; that from Hawaii to Wake Island being 2,040 miles, from Wake Island to Guam 1,290 miles, from Guam to Manila, 1,520 miles, and from Manila to the Asiatic coast 630 miles. While the depth of the Pacific is somewhat greater than that at which any cable has been laid, the difference between its depth and the greatest depth reached by cables in the Atlantic would be very slight, the cable recently laid from Haiti to the Windward Islands being in 18,000 feet of water. The recent survey for a cable between the Pacific coast and Manila justifies the belief that a route can be selected in which the depth will not exceed 20,000 feet and may not exceed 18,000 feet. The recent survey made by the Bureau of Equipment, Navy Department, under the direction of Rear Admiral R. B. Bradford, disclosed the greatest ocean depths heretofore known lying between Midway Island and Guam and being 31,614 feet, or but 66 feet short of six miles depth of water. This depression, however, which has been named the "Nero Deep," in honor of the vessel from which the sounding was made, can be avoided by a detour, and it is believed that the necessary depth will not exceed 20,000 feet and may not be more than 18,000 feet.

American Street Railway Association.

The headquarters of the American Street Railway Association during the convention, to be held in Detroit, on Oct. 8, 9 and 10, next, will be at the Cadillac Hotel, where the annual dinner will be held Friday evening, Oct. 10, when the officers-elect will be installed. The passenger associations have granted rates of one and one-third for the round trip. The following resolution was unanimously adopted by the executive committee: "The secretary is directed to request the chief executive officer of the different companies to notify all delegates and heads of departments attending the convention that they are expected to be present at all sessions of the meeting and take part in the discussions." A list of some of the papers to be read at the convention was given in our last issue.

Central Station Rates.

OWING to the interest aroused in the subject of central-station rates by the recent discussion at the Cincinnati Electric Light Convention, and in order to give our readers a view of the existing practice in charging for central-station current, requests were addressed to a number of central stations, so chosen as to represent as far as possible every section of the United States. Below are given a number of replies received.

MR. SAMUEL SCOVIL, Vice-President, Cleveland (Ohio) Electric Illuminating Company:

In the spring of 1899, the Cleveland Electric Illuminating Company adopted a differential system of charging for electric current for lighting purposes, as follows:

Twelve and one-half cents per unit (kw-hour) for 60 hours' use of all lamps connected, and 5 cents per unit for all current used in excess of such 60 hours' use in each month. In January, 1901, the 5-cent rate was made to apply on all current beyond 50 hours' use in any month of the lamps connected.

Our experience of over three years with this system of charging for current has been such that we can state that it has proven quite satisfactory to the company, and we believe it has also met with the approval of the great mass of the company's customers. It has the great merit of being easily understood by them. The monthly bills are always rendered in the same form, and the price for current used is always the same, yet the average rate paid by any customer for all current used may vary from month to month. This is one important point of superiority in the differential system, as against a graded scale system, where the price in the monthly bills must vary as the use of current varies.

This differential or two-rate contract contains a provision stipulating that in consideration of the 5-cent rate being allowed, the consumer guarantees to the company such a use of his installation as will insure to the company a gross sum, equal to at least 15 cents for each standard 16-cp lamp, or its equivalent. It is proper to mention in this connection, however, that the company does not insist upon a customer taking this two-rate contract. If he does not care to make a guarantee of 15 cents per lamp, he can secure the company's service at the base rate of 12½ cents per unit for all current he may use with a merely nominal monthly charge, which, however, also varies somewhat with the size of the installation. In practice, this results in new customers often taking the high-rate contract, and later changing over to the two-rate form, as they find that the saving in the darker months more than offsets the excess payment for current used in one or two of the lighter months.

The lamps connected, generally speaking, are the basis for arriving at the amount of current to be charged for at the high rate in the monthly bill, yet in order to avoid complaint on the part of any customer, the company is always willing to install a demand meter on his installation, and arrive through it at the amount of high-rate current to be billed, if used, in each month.

In the opinion of the writer, the "rationalizing" of central station charges must be in accordance with the costs' curves of the stations. No method of charging for current is rational or can be expected to prove satisfactory that does not make the charge to a customer conform to the cost of the company of furnishing to him the service which he requires of it, in connection with service furnished to other customers.

The cost to a company of furnishing service to a customer is made up of: first, investment and standing (fixed) charges, and, second, operating expenses.

Operating expenses are almost wholly in direct proportion to the amount of product supplied, but fixed charges on a given investment are the same regardless of the amount of product supplied by the apparatus representing this investment. Such being the fact, it is evident that the fixed charges' cost per unit of product of such apparatus is determined by the number of units over which these charges may be distributed. This means that a customer requiring a certain investment to be made in apparatus for his account, and who takes the product of such apparatus but one hour daily, cannot be furnished such product at the same rate per unit as can another customer requiring the same investment in apparatus, and who takes its product for two hours daily. In the latter case there are twice the number of units over which to distribute the same sum. If a customer takes such product ten hours daily, there are ten times the number of units over which to distribute the fixed charges' cost, as against the one-hour user.

I know that this reasoning is elementary, and particularly so for readers of your paper, but, nevertheless, I consider it advisable in discussing the problem of the proper method of making central station charges to call attention to this fact, for the reason that the almost universal practice so long pursued by the gas companies of selling their product at one price to all customers, regardless of the conditions under which the product is taken by the individual consumer, has caused even some central station managers to conclude that such a system is really the correct method of charging for service rendered. As a matter of fact, one price to all consumers alike is a most inequitable system, for it makes one customer, who makes a long use of the investment placed at his disposal by the supply company, pay more for the service which he requires than it would otherwise be supplied to him, because some other customer making a shorter use of the investment placed at his disposal is getting his service at less than it costs the supply company to furnish it to him.

The tendency on the part of electric supply companies to arrange their charges in such a manner that each class of customers will bear their proper proportion of the cost of furnishing the service which they demand, is not only based on common sense, but is forced upon the companies because of the conditions under which they work.

Gas companies are not under the same stress of conditions in the manufacture and distribution of their product. Nevertheless, it is a fairly debatable question whether their policy of maintaining one fixed price to all classes of consumers has not been detrimental to the growth of their business; that they have not nearly met the demand for gas possible on their part is to my mind well indicated by the relatively enormous per capita sale of the product which a natural gas company distributes in those localities where natural gas is obtainable. I do not mean to say that natural gas methods could be followed by an artificial gas company, for the natural gas people simply allow their service to become inadequate at times of maximum demand in a manner which would not be permitted by an artificial company. If the latter encouraged consumers to take its service, it would be compelled by public sentiment to install a distribution system which was adequate to furnish good service at the time of the consumers greatest need for it.

A gas consumer must pay a company's price or do without gas. Not so in the case of electricity. A goodly percentage of the users of electricity can arrange to make it for themselves, and as to other consumers, if their demand is not met by a company, competition, perhaps only for a limited district, at once follows, because such competition is comparatively easily arranged for. Because of these conditions, it is out of the question for a central station company to supply electricity at one flat price to all.

However, a central station company in arranging a system of charging in accordance with its costs should not charge a customer the cost of supplying him with the service which he requires considered by himself alone, but that cost which he occasions the company in taking his service with the service demanded of the company by other customers. That is to say, the diversity of the demands of the various customers must be allowed for in making the calculations as to what is necessary to remunerate the company for a certain class of service.

Now this means, if I understand it correctly, that as the uses of electricity becomes more and more diversified, it is reasonable to suppose that the peak load, which is so troublesome a factor at the present time, will become less pronounced, and as this peak widens it will be possible for a company using a differential system of charging to reduce its base rate to all consumers; but that this widening of the peak load will become so pronounced as to permit of one general flat rate, as was suggested at the last meeting of the National Electric Light Association, is, in my judgment, altogether out of the question (except, of course, in connection with a "readiness to serve" charge, which really simply means to the short-hour user a higher rate per unit for the limited amount of current he uses); so

far as one can look into the future at the present time, as to be not entitled to any serious consideration.

I repeat, therefore, that central station charges to meet the necessities of the situation must be in conformity with the cost curves of the stations, and these cost curves mean a graded charge for current supplied. Whether this graded charge be in the shape of a "readiness to serve" charge, plus a charge for current used, or be applied through a differential, or high first-rate and low second-rate, system, is not material, provided the public can be educated as readily to accept one system as the other. My observation is that the introduction of a "readiness to serve" charge will occasion friction between a company and the community it is serving. To the ordinary lay mind accustomed to gas usage, a "readiness to serve charge" seems entirely too much like paying out good money without getting any return for it; whereas a guarantee of use accompanying a graded scale system, applied directly in the shape of a scale or through a differential method, is in the nature of making a bargain. The consumer agrees to buy a certain amount of goods to be delivered in a certain manner, and secures a discount accordingly.

Mr. Paul Lüpke, Chief Electrical Engineer, South Jersey Gas, Electric and Traction Company:

Before meters could be had, our charges were based on the usual flat-rate plan. After duly passing through the agony of changing over to the straight meter rate system, I soon began to realize the truth of Mr. Doherty's opinion that "flat rates give us a loss of money by long-hour consumption, and meter rates a loss by short-hour consumption."

We were then compelled to meet the effects of a bitter war between two competing gas companies, in which gas was offered at 25 cents before the end came, and a combination settled the price at $1.00. It was evident that the straight rate of 15 cents per kw-hour, which was in effect at the time, would not meet the existing conditions, and I saw plainly that a straight cut could hardly be made deep enough to satisfy long-hour consumers, and would only serve to make short-hour consumers more unprofitable.

A 14 and 8-cent rate, as detailed below, was then made optional, and, rendering bills on both the straight 15-cent rate and the 14 and 8-cent rate, to make the advantages of the double-rate system plain to the consumers, soon brought about its almost general adoption.

The average yearly rate per kw-hour for all consumers, including the few still preferring the straight 15-cent rate, has been a trifle over 10 cents. We have recently made, in special cases, a further reduction to a 14, 8 and 6-cent rate, the 6-cent rate being charged for all consumption above double the minimum charge. The arrangement will probably be made general in the near future. For power service we charge 10, 5 and 3 cents per kw-hour.

Ever since the adoption of this plan, the business of the company has shown an uninterrupted and very healthy increase both in gross and net earnings; and although the gross earnings could probably be increased by any kind of reduction in price, I do not believe the net earnings will increase proportionately unless the reduction is made along the line of some rational double-rate system, which decidedly favors long-hour consumers.

The system we use, no doubt, is not ideal, but in practical use, extended over a period of four years, it has proved itself so valuable that I hardly think we will change for another unless very decided advantages can be shown.

Mr. J. H. Swinarton, General Manager, New York and Staten Island Electric Company; John Greenough, Receiver:

In our present unsettled condition, being in the hands of a receiver and undergoing a reorganization of the properties on Staten Island, we will refrain from expressing our views on the subject of rates for the present. We hope the reorganization will be completed on September 1st, after which time we may be in position to join in the problem of station charges, etc. I will give you, however, our rates for the present year. To commercial consumers of lighting, per kw-hour, 15 cents. To power consumers, between 7 A. M. and 6 P. M., 5 cents. Monthly settlements subject to discounts on meter bills when paid within 10 days from date of bills, as follows: Bills of $2 and under $5, 5 per cent.; $5 and under $10, 8 per cent.; $10 and under $20, 11 per cent.; $20 to $30, 14 per cent.; $30 to $40, 17 per cent.; $40 and upward, 20 per cent.

The minimum charge for any one month's service is $1.50, should meters show consumption of current of less amount. Commencing the first of this year we adopted the policy of free lamp renewals, which is working advantageously. We receive for arcs, 1200-cp., 34 cents per night, and for incandescents, 25-cp, $25 per year for lighting under the New York City schedule of hours of service.

Wyoming Valley Electric Light, Heat and Power Company, Wilkesbarre, Pa.:

The rate of this company for incandescent lighting is on a sliding scale, starting with 10½ cents per kw-hour up to 290 kw-hours and diminishing 1 mill with every succeeding 20 kw-hours up to 600 kw-hours; 40 kw-hours up to 1000 kw-hours; and 80 kw-hours up to 2000 kw-hours. The rate on current for motors is 10½ cents per kw-hour up to 80 kw-hours and diminishes 1 mill with every succeeding 5 kw-hours up to 100 kw-hours; 10 kw-hours up to 500 kw-hours; and 20 kw-hours up to 720 kw-hours. The following discounts are allowed off incandescent light and motor bills if paid on or before the last discount day as specified on the bill: 6 per cent. off on bills up to $28.35 inclusive and 5 per cent. off on bills over $28.35. No lamps are installed nor meter connected for a less rate than $1.00 per month. The company furnishes lamps, but lamps returned with the bulbs broken are charged to the consumer.

Mr. T. W. Pemberton, President, Phœnix (Arizona) Light and Fuel Company:

Our rate for alternating electrical current here is 20 cents per kw-hour, with discounts to some of our largest consumers. We have about completed a water power system here, and in the near future expect to change our method of handling customers as to rates, but are not in a position at present to give anything definite in this line. We favor the system of two rates, making a rate say of 20 cents per 1000 watt hours until each lamp has earned a certain quantity, and then to grade the rate perhaps by cutting it in two, making all over a certain amount 10 cents per kw-hour. The Chicago system that is now in use both for alternating and direct current strikes us as about the best that we have studied. We have a small town here, and instead of putting in two meters, we may make our difference by consideration of the maximum power installed and the maximum amount of lamps worked up, and reduce the rate from this determination.

Mr. A. W. Field, Secretary and Manager, The Columbus (Ohio) Edison Company:

The rate charged for current must be largely determined by local conditions. During the past four or five years this subject has been one of discussion in all the large associations, and in some of the State associations as well, with all of which we have kept in touch. During this time, however, we have not departed to any extent from our present method of charging for current. We use the T.-H. meters, and charge at a very low rate for large quantities of current, and at a moderate rate for smaller amounts, grading the service rendered by a careful analysis of the different classes of customers applying to us for current, based upon use of lamps connected, both as to hours and time when most remunerative to the station, or otherwise, offering special inducements to those who would enable us to use our machinery at a time when it would naturally be operated under a light load.

On general lines, we follow the principles of the demand system, but without the use of elaborate discounts, or investment in special demand meters. With us, this plan has worked quite satisfactorily; with other stations, or those operating under different conditions, it might not work so well. We have comparatively few complaints from customers in regard to inequality of rates, and those we have had we have been able to handle with little difficulty.

Mr. L. J. Moulton, Manager, Boulder (Colo.) Light and Power Company:

We have always had a fixed charge of 15 cents per kw-hour, with a discount for prompt payment. The other systems are confusing to customers, and after the experience of Denver in

this direction we are the more firmly convinced that the straight kilowatt-hour rate gives the best satisfaction, especially for plants of smaller size.

C. L. EDGAR, President, Edison Electric Illuminating Company of Boston:

This company made a somewhat exhaustive study of the question of rates some years ago and finally decided to adopt the Wright or maximum demand system. This has been in use some three or four years and has given excellent satisfaction. I have read with great interest the discussions which have taken place from time to time on this general subject, but have seen nothing up to date which would suggest to us that our conclusions are wrong.

MR. W. E. MOORE, Superintendent, Augusta (Ga.) Railway and Electric Company:

The following system of rates was inaugurated about three years ago, and at this time applies to about one half of our output. We find that it generally works very satisfactory to the consumer, as the fixed charge and the low meter rate tend to equalize winter and summer bills, the difference between which has heretofore been a great source of dissatisfaction to the consumer. The fixed price of twenty-five cents is somewhat high, but this is due to the particular conditions under which we operate, as we rent water power from the city, based on a rating made once per year. The present system of rates is as follows: 1.—A payment of 25 cents per month as matriculation fee. 2.—25 cents per month rental for each meter installed. 3—25 cents per month for each 16-cp lamp demand of current used or contracted for. 4—4 cents per kw-hour for all power registered by meter. The above prices are all subject to a discount of 10 per cent. if paid on or before the tenth day after the date of bill. Renewals are supplied by the company. After contracting for a stated number of lamps demanded for one year, the demand cannot be increased except under a new contract made for one year from date of increase.

MR. R. G. HUNT, Secretary and Treasurer, Fort Smith and Van Buren (Ark.) Light and Transit Company:

We sell all current for lighting purposes by meter measurement. In the business district (which we class A) our rates are much lower than in the residence district (which we class B), where cost of distribution is greater. However, some consumers in the business district take a class B rate, such as theatres, and factories that operate very little at night, yet require a connection. Below is the schedule of rates for the two classes:

	Class A Cents per kw-hour.	Class B Cents per kw-hour.
Less than 5 kw-hours	35	25
From 5 to 10 kw-hours	30	20
From 10 to 15 kw-hours	[illegible]	20
From 15 to 20 kw-hours	[illegible]	20
From 20 to 25 kw-hours	[illegible]	18
From 25 to 50 kw-hours	10	18
From 50 to 75 kw-hours	9	15
From 75 to 100 kw-hours	8	15
From 100 to 500 kw-hours	7	12½
From 500 to 1000 kw-hours	6	10
From 1000 or more	5	—

The above rates are based on a monthly consumption in kw-hours, as shown above. We find that the system has been very satisfactory as a whole. We have no charge less than $1 per month. We do not make any "cutting in" charges. Our power is sold flat.

MR. C. J. ABBEY, Superintendent and Electrician, Skowhegan (Me.) Electric Light Company:

The discussion on the topic of rates which gave rise to such great interest at the recent Cincinnati Electric Light Convention appealed to me particularly as a station manager for the past 12 years. I agree in the opinion that the most perplexing problem that the station manager has had to solve and adjust has been that of rates, and especially that of flat rates. It has been our aim to charge a customer for only the amount of energy consumed, yet at many times and in many ways this proved so misleading that we were forced to do one of three things; viz., run at a loss, raise our rates, or change to the meter system, and we adopted the latter. We are now getting returns for the total output of our plant instead of for about 50 per cent. of it, as on a flat rate basis.

After installing the meters we yet had the great problem of rates to puzzle over, and after giving every system due consideration, and realizing that whatever system we did adopt would be much more satisfactory not only to ourselves, but to our customers as to equality than the flat rate system, we adopted the sliding scale system, which appears to me as the most equitable of all systems in use. We charge the same for dwellings as for commercial lighting and do not give any discounts. For illustration, for the first 15,000 watt-hours 10 cents per 1000 watt-hours is charged, which puts the large consumer and the middle consumer on an equality with the small consumer up to that amount; for the next 15,000 watt-hours, 8 cents per 1000 watt-hours is charged, which places the large consumer on an equality with the middle consumer up to that amount. For over 30,000 watt-hours the charge is 5 cents per 1000 watt-hours, which allows the large consumer during the winter season to get the addditional lighting required at a minimum price. The cost of winter lighting is thus not as much per average hour as in the summer season, which I think appeals to our customers in a very satisfactory way.

I do not regard it equitable to make straight 10-cent, 8-cent or 5-cent basis, or place any class on a straight basis, because there are times when the large consumer will step down to the middle consumer, and even down with the small consumer; and if he had a straight 5-cent rate during such times he would be getting his lights at a much lower price than the middle user, and for one-half that of the small consumer, which, in my view, is not strictly equitable. But by the sliding scale, when he steps down with the middle consumer he is a middle consumer and pays the middle consumer's rate; and he also pays the small consumer's rate when he steps down to him. I think to give a so-called large consumer a low price while he is a small consumer because he may some time, if he remains in business, use a larger amount is a business error; first, because he may not remain in business long enough to compensate the producer for the advantage of the low price; and then again it costs more to supply him with energy during the time he is a small consumer than it does to supply the average small consumer, as there is a larger amount of capital invested in the plant lying idle subject to his requirements than for the small consumer. He should thus not be charged any less than the small consumer, as the rebate for his large consumption has already been provided for by the minimum rate, and I think until he reaches that rate he should pay as all others do for an equal amount consumed. Yet I will agree that circumstances of cases with respect to time of requirement as well as the amount of capital invested to supply the large consumer compared with the amount invested for an equal supply for small consumers, can be taken into consideration, which circumstances undoubtedly vary over a wide range in the many plants now in operation.

MR. W. J. MCMANIGAL, General Manager, The New Omaha (Neb.) Thomson-Houston Electric Light Company:

As will be noted from the following schedule, our discounts for incandescent light is based on the total consumption of each 16-cp lamp per month. Or in other words, if a customer has twenty 16-cp incandescent lamps installed, and his meter shows a consumption of 100,000 watts, we would divide the watts by the number of lamps which would give a total of 5,000 watts for each 16-cp lamp, which would entitle him to 30 per cent discount. As we are using a 6.6-ampere arc lamp, we figure one arc lamp as equal to eight 16-cp incandescent lamps. We have had this rate in effect for about six years, and it has proven entirely satisfactory.

The basic rate lighting service is 15 cents per kw-hour, with free renewals, subject to the following discounts on monthly bills: Up to 2 kw-hours, 10 per cent.; 3.5 kw-hours, 20 per cent.; 7 kw-hours, 30 per cent.; 15 kw-hours, 40 per cent.; over 15 kw-hours, 50 per cent. As stated above, an arc lamp is considered the equivalent of eight incandescent lamps, and a charge of 50 cents per month is added for the loan of an arc lamp.

For power, the basic rate is 10 cents per kw-hour, with discounts on monthly bills ranging from 10 per cent. for 200 kw-hours; 30 per cent. for 600 kw-hours, to 50 per cent. for over 900 kw-hours. The minimum charge is $3 per month.

EDISON ILLUMINATING COMPANY OF DETROIT:

In annual contracts covering all classes of service when the customer guarantees 30 hours' use per month of the demand, the rate of the first 30 hours is 16 cents per kw-hour and thereafter 5 cents per kw-hour. For incandescent lighting on open order with no guarantee, the first 60 hours' use monthly of connected load is at the rate of 16 cents, and thereafter 5 cents per kw-hour. For residence lighting, which is taken on open order and with a demand estimated empirically according to the size of the house, the first 30 hours' use monthly of the estimated demand is at the rate of 16 cents, and thereafter 5 cents per kw-hour. For power, intermittent, the rate is 10 cents for the first 30 hours' use monthly of the rated capacity of the motor, and thereafter at 5 cents per kw-hour. For power, continuous during regular shop hours not less than 48 hours per week, 5 cents per kw-hour.

Some important special rulings as follows: Approved direct-connected passenger elevators are supplied at 5 cents per kw-hour, and when the customer has an annual contract the elevator is connected outside of the demand indicator so as not to raise the demand. Elevators used intermittently are classified as intermittent power. Churches, social clubs open in evening only, theatres, etc., which under no circumstances require supply during the hours of the peak load, are given special rates; so are municipal and government buildings, for which annual contracts must be made. The total of all exceptions is about 5 per cent. of the business, the remaining 95 per cent. being on one or other of the regular forms. All bills under $50 per month are discounted 10 per cent. if paid on or before date due; $50 to $100, 15 per cent.; $100 and upwards, 20 per cent.

The system of rates now in use has conduced to a favorable change in the load factor, though this has been due to several causes. The first cause is the addition of a great deal of power supply. A shop running ten hours a day for 300 days a year uses its power for 3000 hours annually. Such a shop is not so good a customer as would be a municipality requiring street lighting for 3900 hours per annum, or an all-night restaurant requiring light for about 4400 hours per annum; but the workshop is a very much better customer than many others, such as the tenants of office buildings who require light only from dusk until 5:30 during the winter months, to a total of 150 hours per year; or wholesale merchants closing their premises 6 o'clock week days all the year round and requiring about 250 hours lighting per year. The increase in the power business has been very marked, and it still continues. To some extent this has been in response to low rates, but the more important factors have probably been the great reduction in the price of direct-current motors, the increased durability of modern motors, and the education of the machine-using public to the convenience of electric power.

The second cause which has led to a change in the character of the business has been the system of differential rates for lighting under which long hour use of light has been favored by low rates. The result of this second great cause will be evident to anyone who will mentally compare during the late evening the lighting with remembrance of that lighting five years ago. There is not only a more general use of electric light by such stores as are open, but the windows of the stores which are closed are brilliantly lighted for the exhibition of goods; and electric signs and what may be termed decorative lighting are in insistent evidence.

The differential rate system has been applied also to residence lighting. Four year's experience, however, shows that while householders do really under the differential rate system, use light more liberally than under the single rate, they do not and will not change their habits to such an extent as to cause a rapid improvement of the load factor. There is no mistake about such improvement as has taken place in the load factor of residence lighting, but it is a small improvement in comparison with the improved load factor of the business lighting. There is virtually no power business to be had from residences. The use of heating devices, such as laundry irons and the charging of storage batteries for automobiles, are trifling items in the load curve of a residence district, and householders cannot be coaxed by the offer of a low differential rate to leave their windows illuminated until ten o'clock at night, as now do the Woodward Avenue stores.

MR. W. J. KEHL, Manager Electrical Department, New Orleans and Carrolton Railway Light and Power Company:

This company has four forms of contract, as follows:

1. For small users, as in the case of offices and residences. For this service a guarantee is exacted of $1 monthly on 1 to 10 lights, $1.50 on 10 to 20 lights, and $2 on over 20 lights. The basic rate is 20 cents per kw-hour with a discount of 5 per cent. on monthly bills from $1 to $10; 10 per cent. on bills from $10 to $15; 15 per cent. on bills from $15 to $25, and 20 per cent. on bills of $25 and above. An additional discount of 10 per cent. is allowed for prompt payment. Lamp renewals are furnished free.

2. A long-burning rate, which is granted where electricity is used exclusively, the consumer guaranteeing to use current to the amount of 40 cents per month for each 16-cp lamp installed. This rate applies particularly to saloons, small clubs, cigar stores, etc., where the entire installation is used two or more hours daily. The rate is 20 cents per kw-hour, with 50 per cent. discount when the consumer exceeds 40 cents per month on each 16-cp lamp installed, or its equivalent. Ten per cent. additional discount is accorded for prompt payment of bills.

3. A long-term contract, which is made for a period of three years, and only given to the largest consumers. The smallest guarantee in this contract is for $15 monthly. This rate applies to larger stores, theatres, clubs, and such other places having a large installation burning several hours daily. The basic rate is 20 cents per kw-hour, with discounts ranging from 5 and 25 per cent for 25 kw-hours; 20 and 25 per cent. for 250 kw-hours, to 40 and 25 per cent. for over 2,000 kw-hours.

4. A power rate, which was adopted March 1 last. The basic rate is 10 cents per kw-hour, with discounts on monthly bills ranging from 10 per cent. for bills of $10; 25 per cent. for bills of $25; 40 per cent. for bills of $50; to 55 per cent. for bills of $200 and over. In both the above cases the usual discount of 10 per cent. is allowed for prompt payment.

The conditions in New Orleans are such that there are but few places where current is required for lighting earlier than dusk, except on very dark and cloudy days. There are no cellars or business places underground or requiring artificial light during the day. On account of the semi-tropical nature of the climate, houses are built with the view to obtaining all the air and natural light possible; no one could, therefore, be prevailed upon to use light during the day, no matter how low the rate. The system of rates adopted has been largely based upon these considerations.

MR. P. J. BALAGUER, Secretary, Charleston (S. C.) Consolidated Railway, Gas and Electric Company:

After careful investigation of the various systems in vogue at that time, of charges for light and power, this company, in 1899, deemed it advisable to adopt the following system of charging its patrons for current, namely, a meter basis for current furnished, with a graduated scale of discount in proportion to consumption of each individual consumer. With the exception of power for fans and current for commercial arcs, we deal with the public on a meter basis entirely. This system has been carefully followed up, and we find that it gives entire satisfaction, not only to the public but ourselves.

The rates for series arc lamps are $12 per month for all-night lights, and $10 for lights to midnight or 1 A. M. For power, the rate is 7 cents per kw-hour, with discounts on bills, as follows: $21 to $40, 5 per cent.; $41 to $80, 7 per cent.; $81 to $160, 10 per cent.; $161 to $320, 15 per cent.; over $321, 20 per cent.

The rate for incandescent lighting is 15 cents per kw-hour, with discounts on bills, as follows: $11 to $20, 3 per cent.; $21 to $40, 5 per cent.; $41 to $80, 7 per cent.; $81 to $160, 10 per cent. For larger amounts, the discounts gradually increase to 25 and 10 per cent. for bills of $600 and over.

For meters, transformers, service wire, etc., there is a monthly charge ranging from $1 for from 1 to 5 lights; $2 for from 6 to 10 lights; up to $9 for from 300 to 400 lights.

MR. C. R. MAUNSELL, Superintendent, Topeka (Kan.) Edison Electric Illuminating Company:

I give below a schedule of our rates that was gotten out some time ago. We are now contemplating a new schedule, and will base our charges on the kw-hour entirely, as it has been my experience that the public does not care to investigate our business; what it

costs is a net bill, based on the simplest possible method of reading the meter. We have used the two-rate meter to some extent for power users, and it is our experience that the majority of power users endeavor to conduct their business so as to take advantage of the low rate. This system has worked very satisfactorily in general, one favorable result being that it has materially lowered our peak load during the winter months. In view of this situation, we shall continue to encourage the use of the two-rate meter for all customers.

This being a small town, but with a great number of office buildings, we find that the minimum charge of $1.50 per month per meter discourages the undesirable customer from asking for service, and leaves us with the people who use light the year round. To sum this matter up in a few words, it is our experience that a minimum bill in combination with the two-rate system, together with a system of discounts on the total of bills, will serve the greatest number of central stations.

For incandescent installations a charge is made for connecting to street mains, varying from $3.50 for 10 lamps to $8.00 for over 40 lamps. Renewals are furnished free. The minimum monthly charge for 5 or less lamps is $1.00, and for more than 5 lamps, 20 cents per lamp; the charge being based upon the number of lamps applied for as available at one time. For 1 kw-hour up to the minimum mentioned, the rate is 14 cents, and 8 cents per kw-hour for current used in excess of the minimum. Should this straight-meter rate be elected, the charge is 15 cents per kw-hour, with the charge for connecting as above.

For power, the charge for connecting is $3.50 up to 3 hp, and $5.00 for greater capacities. The minimum monthly charge for 1 hp and less is $2.00, and for more than 1 hp, $2.00 per hp, based upon the actual (not rated) capacity of the motor. Up to the minimum named, the rate is 10 cents per kw-hour; 5 cents per kw-hour to double the minimum, and 3 cents per kw-hour for excess of the latter quantity.

The rates for 9.6-ampere series arc lamps, all night, every-night service, is $10 per month; for service from dusk to 11 P. M., seven nights per week, $7, or $6 per six nights per week. A reduction is made for other than all-night lights, if more than one lamp is used; for example, the rate for four lights are $23 and $21, respectively. For motors, the charge is 5 cents per hp-hour. For incandescent lighting the rate is, with free lamp renewals, 1 cent per 16-cp-hour, with the following discounts on bills: Up to $5, 5 per cent.; to $10, 15 per cent.; to $30, 20 per cent.; to $50, 22 per cent., and 25 per cent. for larger bills. An additional discount of 2½ per cent. is allowed for prompt payment.

Mr. Chas. H. Kinsner, General Manager, Harrisburg (Pa.) Light, Heat and Power Company:

Following are the regulations and rates of our company. Worn out lamps are replaced by the company, but lamps accidentally broken are replaced at the expense of the consumer. No meter is installed for commercial or residence lighting for less than a minimum rate of $1 per month. Bills are rendered according to meter registration in all cases where consumption is in excess of the minimum rate. The rates are 15 cents per 1000 watt-hours, subject to the following discounts: On bills from $1 to $20, 5 per cent.; from $20 to $50, 10 per cent.; from $50 to $75, 15 per cent.; from $75 to $100, 20 per cent.; from $100 and over, 25 per cent.

Mr. T. R. Beard, General Manager, Poughkeepsie (N. Y.) Light, Heat and Power Company:

The rates charged for electric current by this company are for light 15 cents per kw-hour with discounts varying from 5 per cent to 35 per cent, according to quantity. The price for power is 10 cents per kw-hour with discounts varying likewise from 5 per cent to 35 per cent. Much of our business is done at special rates, and as far as possible we endeavor to take into account the current furnished and the maximum number of lamps required, having been attracted to this method of charging by the numerous articles in the recent magazines. We have no extended experience that would be of interest, since we have only under-

Mr. Geo. A. Redman, Superintendent, Rochester (N. Y.) Gas and Electric Company:

The question of rates is one that is troubling all central station managers at present. We have tried several systems, but have now decided to give our present schedule a thorough trial. It is based, as will be seen below, upon the amount received per lamp per month, and the discount is based on use of same.

Electric current for arc lamps is charged for at the rate of 10 cents per kw-hour, bills being based per lamp installed. The discounts are, on $4, 40 cents; $8, $2.40; $12, $6, and $13, $6.50. Current for power is charged at the rate of 7 cents per kw-hour, the discount on bills being based per hp installed. The discounts are, on $1.40, 7 cents; $5, $1.90; $9, $5.15; and $14, $8.40. Current for incandescent lights is charged at the rate of 14 cents per kw-hour for residential, and 10 cents per kw-hour for commercial use. The discounts on amount of bills per lamp installed are, on 50 cents, 4 cents; 80 cents, 12 cents; $1.00, 23 cents; $1.50, 60 cents; $2.00, $1.00; and $2.45, $1.32. On all bills an additional discount of 10 per cent. is allowed when paid on or before the 10th of each month.

Electricity in the Naval Manoeuvres.

Capt. E. L. Zalinski, U. S. A., writing to the New York *Herald* about the preparations for the army and navy manœuvres on Long Island Sound, says:

"Numerous searchlights are placed in every advantageous position in the different batteries. Some are said to have been placed in advanced positions beyond the works. The attacking enemy is sure to be greeted with a flood of light from the projectors, which will be followed by a shower of well-directed missiles from the guns of the fortification.

"The lights striking the eyes of those who are steering the ships and aiming their guns have the effect of momentarily blinding them. It will thus be very difficult either to steer the ship or aim the guns properly. Much of the electric installation is of a temporary character, and cables are lying on the ground or on makeshift supports of old barrels, boxes, etc. In some of the works the engines, boilers and dynamos are in temporary buildings of rough boards and tar paper.

"Among the interesting appliances newly introduced is Professor Elisha Gray's telautograph, or writing telegraph. The officers who have used it speak warmly of its efficiency and usefulness. It appears now to be entirely practical and is not affected by rough handling or by the shock produced when firing the heavy guns. Its records are legible and cannot be mistaken or questioned, as may be the telephone. Any man of average intelligence can in a few minutes learn to operate it.

"The Signal Department has placed wireless telegraph outfits at many suitable places, some in advanced positions. Balloons are also prepared for ascents, which should give extensive fields of view and enable detection of the movements of the enemy's fleet, even at night, unless in a fog."

Copper Production and Consumption.

According to the official data of Mr. Charles Kirchhoff, the total production of domestic copper in the United States in 1901 was 268,782 long tons, as against 270,588 long tons in 1900. The estimated consumption of copper in the United States in 1901 was 382,761,014 pounds, as against 356,891,121 pounds in 1900.

The stock of copper on hand in the United States on January 1, 1902, is estimated as having been at least 300,000,000 pounds, equivalent to six months' production.

The copper market opened in 1901 rather dull, at the official prices of 17 cents for Lake and 16½ cents for electrolytic, but actual sales were made at 16⅞ cents for Lake, and at 16¼ cents for electrolytic. By the 13th of January, 1902, the official prices had fallen to 11⅛ cents for Lake copper.

The world's production of copper in 1901 was 511,803 long tons, as against 487,206 tons in 1900, 463,693 tons in 1899, and 429,379

Electro-Metallurgical Development at Massena.

One of the largest and most interesting water power developments in this country is that at Massena, on the Grasse River, a tributary of the St. Lawrence, about thirty-eight miles northeast of Ogdensburg and ninety-five miles southwest of Montreal. At this point, during the past few years, the Saint Lawrence Power Company has developed a very large power by means of a canal 16,200 feet long, and from 18 to 20 feet deep, with a width at the water line of 192 feet. At the end of the canal the water has a velocity of about three and a half miles an hour, and there is a fall of between 45 and 50 feet at the point where the power house was erected. The power house, which is shown in one of the engravings herewith, will have a total length, when completed, of nearly 700 feet, with a width of about 150 feet. The full power plant laid out includes fifteen Victor turbines of Stilwell-Bierce & Smith-Vaile make, set in sets of 6 wheels each on horizontal shafts about eighty feet long, each set operating a 5,000-hp generator. There are three draft tubes to each turbine chamber, each 10 feet in diameter, two turbines discharging through each tube. On the bed-plate at the mouth of each draft tube are set also two Victor turbines of 1,000 hp each, regulated by electric governor in the power house; and there are other wheels, each 27 inches in diameter, for the exciters, two to each exciter, running at 275 r. p. m. The present generators are three-phase Westinghouse machines of 5,000 hp, each 2,200 volts, 3,000 alternations; speed 150 r. p. m. The three exciters are of 400 hp each, at 125 volts.

The St. Lawrence Power Company has already spent several million dollars on its enterprise, but in some way has failed hitherto to attract due public notice, so that it has encountered difficulties in marketing its power, developed at so much initial cost, but vieing in cheapness with anything known on this continent. Such magnificent resources of energy could not, however, long go begging in these busy days, and a new era appears to be opening for the company, as evidenced by the interesting views given herewith. As is well known the aluminum industry in the United States has taken on an enormous development, the production for 1901 being placed officially at no less than 7,150,000 pounds, thanks to the efforts of the Pittsburg Reduction Company. That concern, which was first seated at Pittsburg, using


FIG. 1.—GENERAL VIEW OF ELECTROMETALLURGICAL PLANT AT MASSENA.

coal, has for some few years past been located at Niagara; and it now makes a further very important move in the direction of obtaining cheap power by going to Massena where it has taken property to the extent of 100 acres, and is now erecting works. The two engravings show the works as they will appear when finished and their topographical relation to the power house, canal, etc. There will be

and 2,000 feet long, with access at the southwest corner to the adjacent power plant. There is also a front 650 feet long on the canal, where the Pittsburg Company can at any time in the future, should sufficient demand arise, erect a power house for itself.

The contract under which the Pittsburg Company takes power from the St. Lawrence Company provides for an initial 12,000 hp,

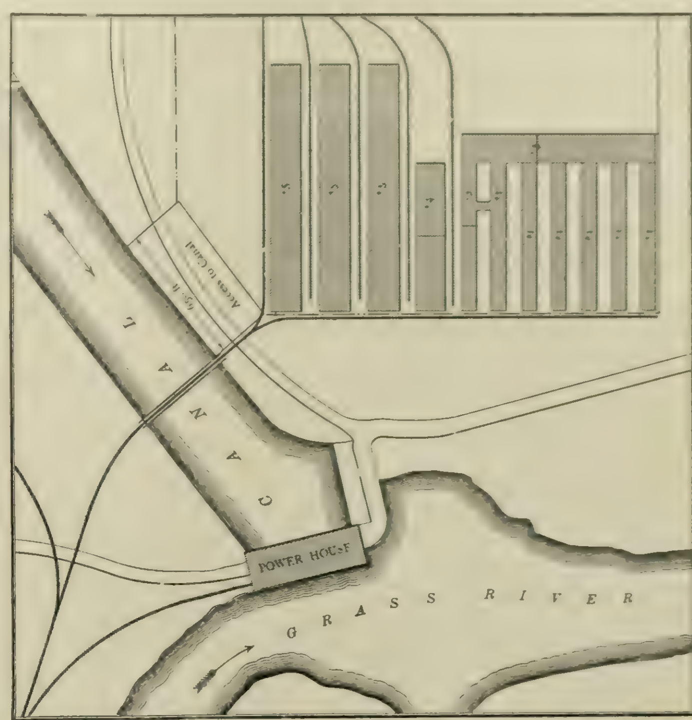


FIG. 2.—PLAN OF THE MASSENA PLANT.

but there is an option on a total of 25,000 hp. The Pittsburg Company will, it is rumored, develop at Massena other electro-metallurgical or electro-chemical work requiring current in large volume, besides the production of aluminum. It uses direct current, and as nothing could be gained by the conversion, for so short a distance of the three-phase alternating current for that purpose, the Pittsburg Reduction Company has made a contract with the Bullock Electric Manufacturing Company for four direct current generators of 2,200

Rational Electromagnetic Units.

SIGNOR Giovanni Giorgi about [illegible] ago brought before an Italian Congress of electrical engineers and physicists a system of rational electromagnetic units, which was referred to a committee for report. Recently this committee, which consisted of Prof. Roiti and four other prominent Italian scientists, recommended the adoption of the system. Signor Giorgi has made his system the subject of a paper communicated to the Physical Society of London, which paper we reproduce below.

It is now generally acknowledged that the system of electric and magnetic measures at present in use is open to an objection, insomuch as it includes an unnecessary factor 4π in the definition of the fundamental units of electric charge and magnetic pole.

We are indebted to Mr. Heaviside[1] for having first expounded the argument. He pointed out, as far back as 1882-83, that the origin of what may be called the "irrational" or "spherical" factor lies in the inverse-square formula, which was formerly adopted as fundamental. The equation for the intensity of field emanated from an electric or magnetic mass had in fact been written thus:

$$f = \frac{m}{l^2} = \frac{4\pi m}{S}$$

while, rationally it ought to be

$$f = \frac{m}{4\pi l^2} = \frac{m}{S}$$

where S is the area of the sphere on which the flux of induction at a distance l from the mass is spread.

From the first, or irrational, formula, the set of units in use has been deduced. Hence the origin of the spherical factor which runs throughout the whole system and appears everywhere in equations that have nothing to do with spherical or cylindrical bodies.

I quote, for instance, the following cases:

(*a*)—Capacity of a plane condenser:

$$C = \frac{\kappa}{4\pi} \frac{S}{d}$$

(*b*)—Characteristic equation of magnetism:

$$\mu = 1 + 4\pi\kappa$$

(*c*)—Magnetic work, per unit volume of a medium:

$$dw = \frac{1}{4\pi} \mathcal{H}\, d\mathcal{B}$$

No doubt, the student who meets for the first time equations of this kind, is induced to think that 4π arises mysteriously from the most intimate nature of electromagnetic phenomena; so that if a day were to come when circles and spheres would be abolished from the world, we ought then to define π electromagnetically, and determine its value by measuring the energy of magnetization of a medium, or the capacity of a plane condenser.

These incongruities are removed when the system deduced from the inverse-square law is rationalized, by restoring the 4π to its right place. No doubt, the change is easy, so far as the presentation of the theory is concerned; there can be no divergence of opinion on the grounds which support it. But the difficulty arises as to the units to be employed for practical measurements. The electric and magnetic units already adopted and legalized throughout all civilized countries have been established in accordance with the spherical definition. What is to be done with them, in view of the results of the rationalistic principle?

Mr. Heaviside insisted upon the necessity of a general reform, and the adoption of a new volt, a new ampere, etc., all at variance with those at present employed. This is a good plan and grounded upon excellent reasons; but the opposition which is likely to be raised against its practical application cannot be ignored, and it is rightly believed that to insist upon a proposal like this would have the effect of delaying the adoption of the rational theory beyond any reasonable limit.

Two years ago Prof. Fessenden[2] and Prof. Fleming[3] advocated another plan, consisting of a partial change of units. Objection was raised against this reform, that it is not radical, and again it implies departures from the accepted systems. The question has been discussed further, but it still remains unsettled

I propose here to show how, in my opinion, the question might be considered under another point of view, and then a solution derived, whereby the present practical systems of measures would be brought into agreement with the rationalistic theory, without either introducing new units or altering those already in use[4].

The principle from which the theory of the rationalization depends may be explained as follows:

When a quantity of electricity, or electric flux, dq, is displaced against an electromotive force e, the work performed is reckoned by

$$dw = e\, dq$$

or writing p for the activity of the electric current i, we have

$$p = ei$$

The magnetic analogue to electric displacement is magnetic flux, and the force acting on it is the magnetomotive force. Consequently the work performed when displacing a flux $d\phi$ against a magnetomotive force $\mathfrak{M}$, ought to be rationally expressed by:

$$dw = \mathfrak{M}\, d\phi$$

or, if $g = \frac{d\phi}{dt}$ is called *magnetic current*, we have its activity:

$$p = \mathfrak{M}\, g$$

The equations of activity, thus, define the rational units of *E. M. F.* and *M. M. F.* in terms of those of electric current and magnetic current, when the unit of energy is supposed given.

Now, on comparing our equations with those commonly written, we notice that the first one is unchanged, while the other, in the ordinary system, is written with a divisor 4π. Therein precisely lies the irrationality.

We see, however, at the same time that this irrationality affects but one side of the ordinary system. It appears that stress on this remark has not yet been laid by those who have hitherto written on the rationalization of units. I see in this the strongest argument in fvaor of the rational theory. For if spherical measures were preferable, the ordinary system ought to be likewise rejected, as not being entirely inclusive of them. These remarks explain also the scheme for a partial reform suggested by Prof. Fessenden.

The reason of the one-sided irrationality is that the usual formulas alluded to are those of the electromagnetic system—that is, deduced from the inverse-square law for magnetism; therefore, the spherical factor is limited to the magnetic equations only. These formulas do not agree with those deduced from the inverse-square law for electricity, or electrostatic formulas; therefore, it has not been possible to introduce the spherical measures both in electricity and magnetism at the same time. This is a reason why all systems grounded upon spherical measures are necessarily unsymmetrical. On the other hand, it is possible to build out a system wherein all measures are free from the 4π and mutually agree with each other; and then the strict symmetry between electric and magnetic formulas are restored.

The above arguments lead into a wider field of inquiry. It often happens that the advantages or disadvantages of a reform of "the usual units" are spoken about, without clearly stating what system of units is alluded to. Now, for practical calculations the units employed are those of the so-called practical set, which includes the volt, ohm, ampere, and similar ones. This set has not been extended to include several other electrical and magnetic units, nor any practical unit of length, mass, area and volume.

This is not an absolute system and may be considered as not bearing any fixed dependence from the theoretical formulas; therefore, the problem of the rationalization does not necessarily touch it.

All theoretical formulas are written with implicit reference to absolute or *C. G. S.* units. These, on account of their inconvenient size could not be adopted for the purpose of calculations, either in the industry or in laboratory practice, but the mathematical theory of electrical phenomena is usually expressed in terms of them. Now, it is to be remembered that the *C. G. S.* systems are in fact two, I mean, the "electrostatic" and the "electromagnetic." The conflict between them arises from the omission of a *physical factor*, viz., the electric or magnetic constant of free ether, just as the intrusion of the 4π arises from the omission of a *mathematical* factor in the formula of the inverse-square law.

These are, in fact, two irrational features which have simultaneously intruded themselves in the system. And I wish here to point

[1] See O. Heaviside, "Electrical Papers," (I) 199, 262; (II) 543; also "Electromagnetic Theory," (I) § 116, (II) 274; in the latter references are given.

[2] See THE ELECTRICAL WORLD, Dec. 9, 1899.

[3] See THE ELECTRICIAN, Dec. 29, 1899, Jan. 5 and 12, 1900.

[4] The present paper is the theoretical development of a scheme which I ventured to lay down in a lecture at the meeting of the Associazione Elettrotecnica Italiana, held in October, 1901. See "Unita Razionali di Elettromagnetismo," in Atti Dell' Associazione Elettrotecnia Italiana, Vol. v, fasc. 6.

out that its rationalization implies that it must be ultimately recast. For, how can a system be called rational so long as the electrostatic and electromagnetic measures are kept distinct? Is it reasonable to correct by 4π the definitions of electric and magnetic mass, and still allow that they conflict together? Therefore, I think that the problem of the elimination of the spherical factor ought not to be distinguished from that of the unification between electrostatic and electromagnetic measures.

It may be remarked that, to attribute to either of the fundamental constant the value unity may at first sight appear a simplification; but the two assumptions cannot be introduced simultaneously[6], so that they necessarily lead to unsymmetry. And moreover, the simplification searched for has no other effect than to lead to a mistake. When either constant is measured by unity, it often happens that its existence is forgotten, and then confusion is made between quantities, such as magnetic force and induction, which are physically as distinct as might be *E. M. F.* and current in a circuit of a unit resistance.

There are therefore proper reasons for having both ether constants measured by other values than unity. But, when these assumptions are discarded, the inverse-square laws cease to bind to any particular choice of units, and we must look elsewhere for the scientific basis of a rational system.

We have already written the rational expressions for electric and magnetic activity. Suppose now that an electric and a magnetic circuit are *interlinked* together, so that the work developed by one is recovered by the other. In this case the activities are equal and opposite, so that

$$\pm\, e\, i = p = \mp\, \mathfrak{M}\, g$$

But these interlinked currents constitute an *electromagnetic loop,* to which the two circuital equations are applicable; these are:

$$e = \mp\, g \qquad\qquad \mathfrak{M} = \pm\, i$$

We have thus a set of four, or rather three equations, which contain explicitly the four concrete units of *E. M. F., M. M. F.,* electric current, magnetic current, together with that of activity.

These equations, instead of the inverse-square laws, are to be considered as fundamental in the electromagnetic science. They are necessary and sufficient for it. I may observe that by application of space differentiators it is easy to convert them into differential equations of the field, of the most general type, which includes the laws of propagation of electromagnetic disturbances and light waves. For our present purpose, however, the finite form is preferable.

On considering the cross-connections established by the circuit laws we notice that the fundamental units needed are reduced to a common one for *E. M. F.* and magnetic current, and to another for *M. M. F.,* and electric current. Their product must reproduce the mechanical unit of activity; in the limits of this condition, their choice is entirely arbitrary.

No scientific reason of any kind may be assigned for preferring any particular choice to another. We are free to select any set of values which suits to practical convenience.

If the *watt* is assumed as unit of activity, we have two units ready made, the *volt* and the *ampere,* which satisfy the condition. Let us assume them as fundamental. This will be on the strict understanding that in the rationalized system they are introduced not as defined by theoretical relations, but in an empirical way. Thus the ampere will be the current which decomposes a stated quantity of silver nitrate; if asked the reason for it, we answer that theoretically all values are equally good, and we have adopted this particular one, because we found it already employed in electrical engineering.

Accordingly, we write down our fundamental set as follows:

Electromotive force=VOLT=Magnetic current.

Electric current=AMPERE=Magnetomotive force.

The product of these gives:

Electric activity=WATT=Magnetic activity,

reproducing in a double form the same mechanical unit.

From the fundamental set here assumed, a complete system of electric and magnetic units can be deduced. This system is rationalized. Therein, the relations between electric current, magnetic current and electromotive force stand as usually written. A change is introduced in the magnetomotive force, on account of the suppressed 4π. But no fresh unit is required for it; the rational measure of *M. M. F.* is simply in amperes. Practicians already employ it under the (improper) name of *ampere-turns.*

[6] Strictly speaking, this is not absolutely impossible; but it would require to reject Ampere's equality, which has practical reasons for its support.

In order to get rid of all other concrete units of electricity and magnetism, it is sufficient to combine together the volt, the ampere, and the second, in various forms, and interpret the results suitably.

The product of the ampere into the second is called *coulomb.* This gives:

Electric flux=COULOMB=Magnetomotive impulse,

and here the dualistic signification is illustrated when discharging a condenser into a ballistic galvanometer.

The product of the volt into the second, which has been called *weber* by the *B. A.,* gives likewise:

Electromotive impulse=WEBER=Magnetic flux,

and here the physical illustration is obtained when exploring a magnetic field by means of a secondary coil.

The ratio volt: ampere is the *ohm,* and the reciprocal ratio is sometimes called *mho.* In electrically or magnetically dissipative circuits, their interpretation is as follows:

Electric resistance=OHM=Magnetic conductance.

Electric conductance=MHO=Magnetic resistance,

and when dealing with alternating circuits, the *ohm* and *mho* are also the units for electric and magnetic reactance and impedance, susceptance and admittance. There are, of course, no magnetically dissipative bodies hitherto known, but apparent magnetic conductance (due to hysteresis), and reel magnetic susceptance and admittance are to be found in circuits subjected to alternating induction.

When a circuit is not dissipative, but electrically accumulative, the ration between quantity of electricity and *E. M. F.* is commonly called *capacity,* but the scientific name for it would be *electrostatic inductance;* the reciprocal quantity is *electrostatic reluctance.*

Their units of measure are the *farad*$=\dfrac{ampere \times second}{volt}$ and its reciprocal, for which no name has been coined. Looking from the magnetic side, the same quantities are exhibited as inertia and mobility, as follows:

Electrostatic inductance = FARAD = Magnetokinetic inertia.

Electrostatic reluctance $= \dfrac{1}{FARAD} =$ *Magnetokinetic mobility.*

The electrostatic inductance and reluctance have been called *permittance and elastance* by Mr. Heaviside; these names appear, however, not to be entirely free from objection.

Any circuit made out of known bodies is magnetically accumulative. Therein, the ratio between the rational measures of magnetic flux and *M. M. F.,* is defined as *magnetostatic* or *magnetic inductance* (in the irrational system we have, instead of it, the *permeance;* it is advisable in order to avoid changes to continue to use this word in the signification now attached to it); its reciprocal is *magnetic reluctance.* Electrically, these quantities are exhibited as electrokinetic inertia and mobility. Under the electrical meaning, the rational unit *henry* has already been defined as $\dfrac{volt \times second}{ampere}$ so that we have but to acknowledge its magnetic signification. We have thus:

Electrokinetic inertia=HENRY=Magnetostatic inductance.

Electrokinetic mobility $\dfrac{1}{HENRY} =$ *Magnetostatic reluctance.*

A caution must here be made, namely, that when simply "the inductance" of an electric circuit is mentioned, its magnetic, not electric, inductance has to be understood.

We conclude then, that the electric and magnetic concrete units in present practical use do not need to be altered, but only to be properly interpreted in order to fall into agreement with the formulas of the rational theory. Ten units are sufficient for the rational measure of all concrete quantities of electricity and magnetism, each one being taken in a double signification.

Now, as far as the relations of these quantities with each other and with energy and time are considered, the system is absolute. But in order to have it complete, it is necessary to introduce a set of specific units; and for this purpose a unit of length is required.

This is just the weak point of all systems employed up till now; for, as they always rest upon the unnecessary assumptions attached to the inverse square formulas, electric and mechanical units of reasonable size cannot consistently fit together. But if this chain is rejected, we are free to choose whatever units of length and mass we like, the only necessary link with the electric measures being that they reproduce the same unit of power.

For instance, the *meter* and *kilogram* are consistent with the

[illegible] may be built up, which covers up electric, magnetic and mechanical measures in a perfectly consistent frame. This system consists entirely of units already in use; nevertheless it is strictly rationalized [illegible] at the same time "electrostatic" and "electromagnetic." It is equally applicable for theoretical and practical calculations, thereby the *C. G. S.* system ceasing to be necessary.

The specific measures in an absolute system are defined by referring the concrete measures to the unit length, unit area, unit volume. Thus, whatever be the fundamental unit of length adopted, the specific units of electric force and electric induction, will be *volt per unit length*, and *coulomb per unit arc;* those for magnetic force and magnetic induction will be *ampere per unit length* and *weber per unit area;* and so on. Similarly the resistivity and conductivity of a body would be defined as the resistance and conductance of a cube of unit dimensions, and measured in *ohms into unit length* and *mho per unit, length.*. Finally, the definition of the electromagnetic constants of a medium is arrived at as follows:

The electrostatic constant or *electric inductivity* is the ratio between electric induction and force in a medium; it is to be measured in *farads per unit length,* the symbol κ being employed for it. Similarly, the magnetostatic constant or *magnetic inductivity* of a medium is the ratio between magnetic induction and force therein; this is to be measured in *Henries per unit, length.* I suggest to represent by the symbol λ the quantity thus defined.[7]

But the electric and magnetic inductivities of a substance can be also defined as the electric and magnetic inductance of a cube of unit dimensions. Thus, the electric inductance of a plane condenser, and the magnetic inductance of a straight core are given respectively by

$$C = \kappa \frac{S}{d} \qquad L = \frac{\lambda S}{d}$$

where, in both cases, S is the section, d the length or thickness of the induced body.

8. Stress must be laid on the fact that in the M—Kg—S system, none of the fundamental and derived units would have an absolute value.

Therefore, it is instructive to investigate by what numbers the two constants of the ether, κ_0 and λ_0 are measured in the units of this system. We get

$$\kappa_0 = 0.\ 000\ 000\ 000\ 008\ 842$$
$$\lambda_0 = 0.\ 000\ 001\ 256\ 637$$

These values are not to be looked upon as an abnormal feature of the system; on the contrary, they express a physical truth. They instruct us that free ether has an exceedingly small susceptivity for electrostatic and for magnetic action, but far smaller for the first than the second one.

Either of these facts, or both, are likely to be obscured in the other systems of measures. We now understand why therein, to equate to unity either of the fundamental constant, has resulted in a set of derived units of abnormal values.

The small values of κ_0 and λ_0 are justified, if we consider their relation with the velocity of propagation of ethereal disturbances. Indeed, these values satisfy the equation:

$$\kappa_0 \lambda_0 v^2 = [illegible] 10^{[illegible]}$$

In view of the definite physical signification attached to κ_0 and λ_0 in the rational system, the direct interpretation of this result is not difficult.

[illegible] afford a method for calculating π, but only the speed of light.

I have mentioned Prof. Fessenden's proposal for the suppression of 4π. My own proposal is grounded on Prof. Fessenden's one. It has a point common with it, that is to alter the traditional value unity of the ether inductivity, and to shift 4π within [illegible]

But Prof. Fessenden's object is simply to get rid of 4π in the formulas; therefore he assumes $\lambda_0 = 4\pi$, and that is sufficient for his purpose. I develop his suggestion still further, and get a scheme which physically is to be interpreted otherwise.

I wish not only to get rid of the 4π, but of a greater evil—that is, the distinction between practical and absolute system of units. In my system λ_0 is not a numeric, nor do I assume any special value for it; it is a physical quantity, having dimensions, and to be measured by experiment. I assume as fundamental the volt and the ampere, as arbitrarily chosen units, and not derived from mechanical units. When I put them in connection with any special unity of length, then I get λ_0 in henries per meter or in henries per inch. Practically this results as follows:

1st. I frame the practical units into an absolute system, and all other absolute systems are abolished.

2d. The practical electrical units may be related to the inch, as well as to the meter, without destroying the absolute feature of the system. This is, I think, an advantage.

3d. The fundamental units of the electric system are not specific, but electric ones. Thus in future, the so-called absolute determinations of the ohm will be interpreted as measurements of the ether inductivity.

I am of the opinion that to start from concrete units and quantities and then to derive specific ones from them will greatly simplify the understanding of the theory to students.

American Electrical Machinery for a British Steam Railway.

The last of the main generators and engines intended to be installed in the power plant of the Mersey Tunnel Railway are about to be shipped from the Westinghouse Works, at East Pittsburg. These generators are of the railway type (1,200-kw, 650-volts, 90 r. p. m.), and are to be direct connected to vertical, cross-compound, Westinghouse-Corliss engines of 1,500-hp each. The power-house lighting and the electric light of all stations, sidings, etc., will be supplied from a separate generating plant comprising two compound-wound generators, each having a capacity of 200 kw at 650 volts, direct-connected to Westinghouse compound engines, and running at a speed of 250 r. p. m. The power generating plant will have an aggregate output of about 6,600 hp—6,000 hp for the railway proper, and 600 hp for lighting. The Westinghouse electro-pneumatic system of train control is to be used, and the cars will be equipped with Westinghouse high-speed air brakes. The rolling stock will consist of 60 cars, each about 60 feet in length. The trains will be formed of five cars each, the first and last cars of a train being motor cars, equipped with four 100-hp motors each.

The Mersey Railway connects Liverpool and Birkenhead, and passes under the river Mersey. The tunnel is double tracked. The route of the railway is about four miles and a half long, the total length of track, including sidings, being about 12 miles long. Its situation is unique, joining two such important business cities, between which the only competition in the transportation of passengers and freight is given by ferry boats on the river, and the traffic on the line is large. The number of passengers carried amounted to between seven and eight millions per year, even with the old steam locomotive system.

The railway is standard gauge, laid in accordance with heavy steam railway practice, the rails being of the ordinary English "bull-head" type, weighing 86 lbs. per yard. The line is to be fitted with the third-rail system, the conductor rail to be laid alongside and just outside of the running track. The running rails will not be used as the return electrical conductor, but a fourth rail is to be placed between them, solely for this purpose. This will entirely prevent any destruction of the track rails or buried pipes in the vicinity by electrolytic action. The third and fourth rails will be similar in size and in arrangement. They are to be of T-section, 60 feet in length, and to weigh 100 lbs. per yard. They will be effectively bonded and carried on stoneware insulators, spaced at intervals of seven or eight feet apart.

It is expected that the trains will run on a three-minute service. The tunnel and the seven stations of the system are to be electrically lighted throughout. The power generating station, the machinery and the track work are all being pushed rapidly to completion.

[7] In the rationalized system inductivity is substituted for "permeability." [illegible] Thus inductivity [illegible] are [illegible] The [illegible] I use F and f for rational magnetic and magnetomotive forces, while H and h are used for the [illegible]. The letter L agrees with L, magnetic inductance, just as μ with K, electric inductance.

Electric Light and Power at the Dusseldorf Industrial and Trades Exposition.

By Frank C. Perkins.

The exhibits of steam driven pumps and electrically operated pumps at the Dusseldorf Industrial Exposition, now being held,

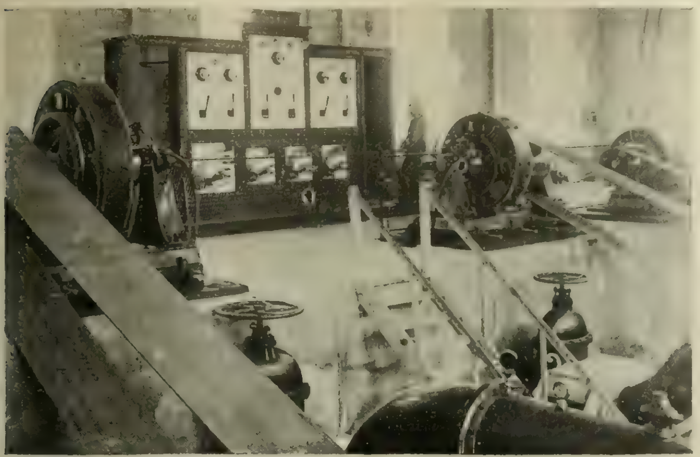


FIG. 1.—PUMPING STATION.

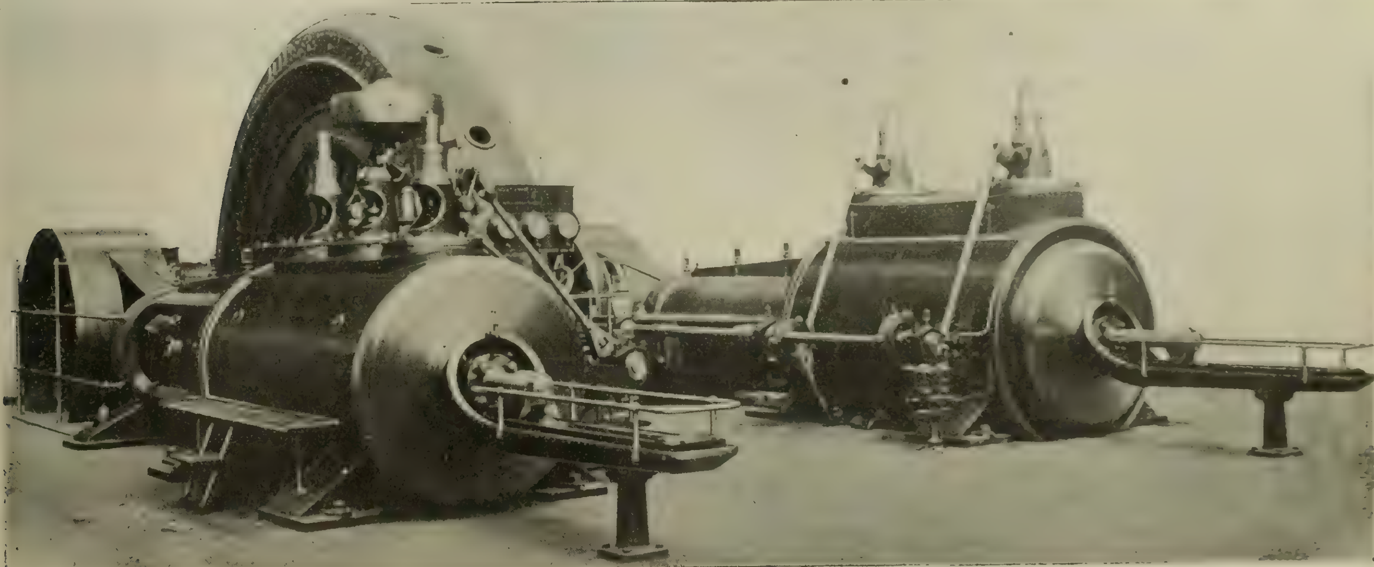


FIG. 2.—ELECTRIC GENERATING UNIT FOR ELECTRIC MINING PUMP PLANT, DUSSELDORF INDUSTRIAL EXHIBITION.

are most extensive and interesting. The joint exhibit of Haniel & Lueg, of Dusseldorf-Grafenberg, and W. Lahmeyer & Co., of Frankfort-on-the-Main, is very complete and well worth consideration. This complete electric pumping plant consists of a generating station, which in practice is installed above ground and the pumping station situated underground. The former comprises an engine, built by Messrs. Haniel & Lueg of 1000 hp, operating a 750-kw Lahmeyer high-tension three-phase generator at a speed of 94 r. p. m. The latter comprises a slow speed Haniel & Lueg pump, coupled direct to a Lahmeyer three-phase motor of a capacity of 650 hp (Fig. 5).

The 1000-hp unit of the generating plant consists of a horizontal cross-compound steam engine, whose high pressure cylinder has a diameter of 670 mm. and the low pressure cylinder a diameter of 1075 mm., the length of stroke being 1200 mm. and the engine speed 84 r. p. m. This engine is directly coupled to a 2000-volt Lahmeyer three-phase machine, which has a frequency of 50 alternations per second. The current from this generator operates a 650-hp three-phase motor, which drives the pump, having a capacity of 5.5 cubic meters of water per minute (1210 gal.) against a head of 450 meters (1485 ft.). The motor operates at a speed of 60 r. p. m. at a potential of 2,000 xolts, and a number of these slow speed motors have been used for pumping plants in the Rhine provinces and Westphalia with great satisfaction, and they have been found to fully stand up to the severe conditions imposed upon them by mining engineers in safety of running and economical working of these important plants.

There is also on exhibit by these joint firms an enclosed three-phase motor coupled to a centrifugal pump of 310-hp capacity when operating at 165 r. p. m. Two of these sets are to be used at the Imperial shipyards at Kiel for use at the drydocks.

In the exhibition of the Bergbauliche Verein one of the chief objects of interest is a large express pump of 440 hp capacity, built of Ehrherdt & Sehmer, of Schleifmuhle, which is directly driven by a Lahmeyer, 2000-volt three-phase motor. This motor operates at a speed of 346 r. p. m. and is started by a specially designed, liquid rheostat. The above manufacturers also are exhibiting an underground pump driven by a direct-current motor at a speed of 125 r. p. m. The motor has a capacity of 23 hp and the pump raises 2 cubic meters of water per minute under a head of 39 meters.

At the right hand side of the hall is shown an electric express pump of the Riedler type, having two simple acting plungers, each 185 mm. in diameter and a stroke of 250 mm. The electric motor is of the three-phase type and constructed by the Helios Electric Company of Cologne-Ehrenfeld. This motor has a capacity of 450 hp and operates at a speed of 200 r. p. m. at a potential of 2000 volts. Another important high power pumping plant is that exhibited by Haniel & Lueg in the Mines Building. This pumping engine has a capacity of 3600-4000 indicated hp, and supplies 25 cubic meters of water per minute under a head of 500 meters. The triple expansion steam engine cylinders are respectively 950 mm. 1500 mm. and 1650 mm. in diameter, while the length of stroke is 1700 mm. This great pumping engine has a

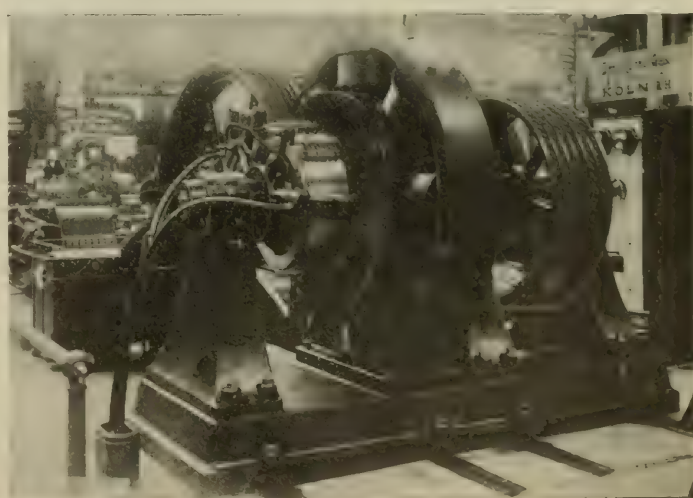


FIG. 3.—GENERATOR CONNECTED BY HEMP ROPE TO ENGINE.

[illegible] The total weight of the engine is 500,000 kilograms and it is in daily operation from 4½ to 6½ hours. Behind the steam cylinders lie the double plunger pumps, and directly back of these the air pump. This engine was constructed for the Harpener Bergbau-Aktien-Gesellschaft.

The firm of Ernst Heinrich Geist, of Cologne, also makes a large and most comprehensive exhibit. In Machinery Hall the firm show a 350-amp., 440-volt direct-current generator which has a speed of 300 r. p. m. It is connected by hemp ropes to a 225-hp Deitrich & Bracksieck steam engine. The shaft is supported by three bearings which are bolted to a foundation, which also supports the cast steel magnet frame which has an external diameter of 1790 mm. The eight pole pieces are also of cast steel, are circular in section, have the pole shoes cast on and are fastened to the frame by two bolts each. Each pole piece can be easily removed without taking the entire machine apart. The external diameter of the armature is 1150 mm. and it is of the drum type, being wound with machine formed bar coils, Fig. 3

The switchboard consists of a rectangular framework which contains the resistances, fuses, switches and connections, so that the marble front of the board only shows the instruments, the switch handles and the regulator hand wheel. This machine, which works in parallel with a Lahmeyer machine of the same capacity, furnishes current for the lighting of the exposition.

The centrifugal pumps which furnish the water for the fountains and boilers are driven by four 440-volt direct current, Geist motors of 120, 80 and two of 55 hp, situated in the pumping station. These motors are built on the same general lines as the generator in the machinery building. The two 55-hp motors, however, only have two bearings, cast iron magnet frame, with cast steel pole pieces and wire armature coils. All four motors are controlled from one central point. For this purpose, a raised switchboard has been erected along the one wall of the building which contains all instruments, switches, rheostats, etc. Only the instruments, hand wheels and switch handles are visible in front of the board, Fig. 1.

In the buildings of the Mining Association of Dortmund, a 55-hp direct current Geist motor has been installed for driving an express pump of the firm of Klein, Schanzlin and Becker, which

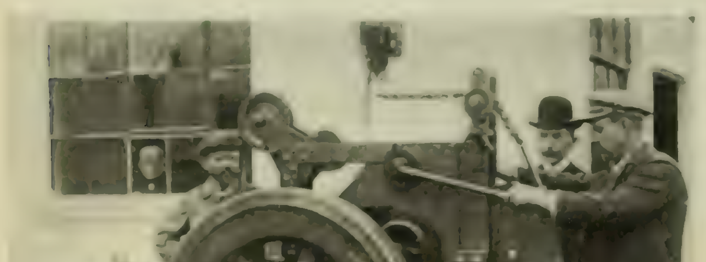


FIG. 4.—PORTABLE CUTTER FOR STRUCTURAL IRON.

is of the slow speed shunt type, built after the pattern of the 120-hp motor in the pumping station for speed of 220 r. p. m. This made it possible to connect the armature direct to the crank shaft of the pump. This method avoids many frictional losses incident to other modes of transmission and gives the combined unit a high efficiency. The armature coils are of wire and the motor has only one bearing at the collector end, as the pump bearing is used at the other.

Another 12.5-hp motor drives a compressor made by the firm of Stahl & Eissen. The motor and the starting box are mounted directly on the cylinder wall of the compressor, so that no extra foundation and room are necessary for the electrical equipment.

Of special interest is the illumination of the Association buildings, which are lighted by 3500 16-cp incandescent and 28 arc lamps. The object of the illumination is to bring out the architectural beauties of the buildings at night and for this purpose the lamps are placed at 50 cm. distances along the edges of the buildings.

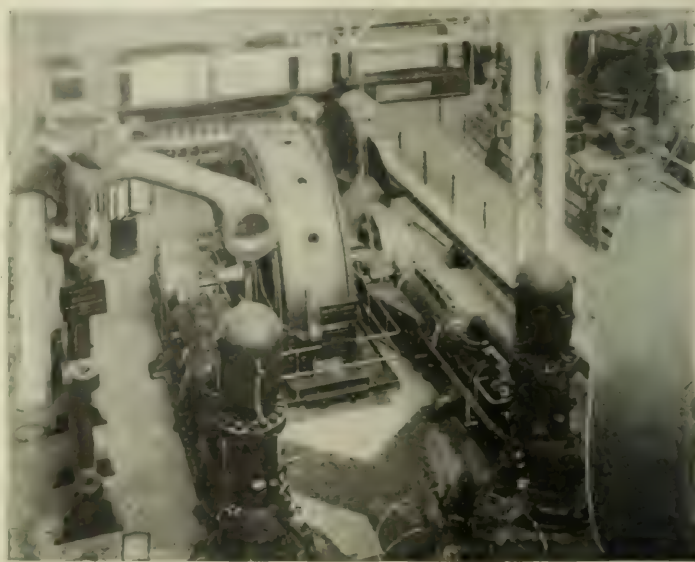


FIG. 5.—650-HP LAHMEYER THREE-PHASE MOTOR.

In order to insure at once a simple, cheap and easily controlled arrangement, on the 2x220-volt circuit, groups containing about 20 lamps are connected in series. In this manner 110-volt lamps could be used and in case one lamp burns out the neighboring lamp is not affected, as is usually the case. It is true that the e. m. f. in the other group is raised a trifle, but the lamps only become imperceptibly brighter. The arc lamps illuminate the windows, four 12-amp. lamps being connected in series, so as to use the entire pressure. The lamps may be pulled down for trimming by means of cords and pulleys, but contact couplings are provided, so as to avoid the unsightly appearance of the leads and have the additional advantage of having the current cut off when the lamp is being trimmed, so that accidents are almost impossible.

In addition to the motors and installation described above, the firm exhibits a number of other interesting machines, including a three-phase motor, with short circuited armature, 5-hp, 110 volts, 1500 r. p. m. for operating a portable, structural iron cutter, built by Pels & Co., Fig. 4. There are also two three-phase 1-hp motors, 1500 r. p. m., for operating American dish-washing machines, and two direct current motors, 0.5-hp, 220 volts, 1000 r. p. m., also for operating American dish-washing machines in the Exposition restaurant. Various automobile motors are shown operating the vehicles of Heinrich Scheele.

"Pioneer Patents."

At the annual meeting of the American Bar Association, which was held at Saratoga last week, Mr. L. L. Bond, for the patent section, read a paper in which he said: "In the year no pioneer patents have been issued, and I use the word 'pioneer' in its usual acceptance, to wit, that of an invention which strikes out a new art or a new industry. A large number of patents have been issued, but almost entirely improvement patents, which are sometimes called 'perfection patents,' which, while they are important, do not produce new machines. There have been no leading decisions, such as will stand out as landmarks in the way of interpreting the law. Patent litigation in many circuits has fallen off materially."

The Electrical Industries of Russia.

A very interesting and comprehensive report on the subject of the development of electrical industry in Russia has been made to the U. S. State Department by Mr. Thos. E. Heenan, U. S. Consul at Odessa, South Russia. We present, very fully, below its leading points:

Until recent times, the electric industry has made extremely slow progress in Russia. Unfavorable circumstances have combined to impede the industry and prevent it from reaching the level found in other countries. One of the principal causes of this lack of development was the absence of schools in which to educate electricians. Foreign engineers and specialists prefer to have recourse to materials and apparatus made abroad, of which they know the value, rather than to try to build factories and works in Russia for the production of the articles required by them. Of late, however, the government, private companies and individuals have opened special schools for electricians; and, in addition, the special art and artisan schools have introduced an electro-technical course. The influence of these special schools and courses has not been slow to make itself felt, and of recent years electric industry has made immense progress. Many towns and cities are lighted by electricity, and electric tramways are numerous. Nearly all of the large factories and industrial establishments have adopted electric lighting and have applied electricity to the distribution of motive power. Electric energy has also been utilized in mining enterprises, particularly in the south of Russia. The use of electricity in soldering, in the extraction and refining of metals, as well as in certain electrochemical works, and in the production of carbons and hypochlorites, is now well developed in Russia. With the increased and varied applications, the demand for apparatus has grown enormously, and dynamo machines, motors, transformers, lamps, conductors, etc., find a large sale. In response to this demand, workshops and factories have been established which produce more particularly the accessory supplies and conductors. There are but two factories in Russia which produce dynamo machinery and lamps, and in consequence most of these are imported. Germany and Switzerland furnish the largest number; next comes England, and then follow the United States, France and Belguim. Statistics on the subject are not obtainable at the present time.

ELECTRIC LIGHTS.

A few years only have passed since such cities as St. Petersburg and Moscow began to have their streets lighted by electricity. At present there are more than 50 towns which employ the electric light, and many other places are erecting the necessary apparatus. The rapidity with which the use of electricity has spread at St. Petersburg will serve as an example of the popularity of this manner of lighting. The first central station was installed in the city in 1881. The power of that station was about 250 kw. Until 1885 the power increased very slowly. After that year the power of the stations and their number grew rapidly, and in 1898 there were several plants, having together 29,000 kw. In 1898 and 1899 three additional central stations were constructed in St. Petersburg, and at the present time the power of all the central stations taken together (exclusive of the private plants) reaches 15,000 kw. Work near completion will raise the power at these stations to 30,000 kw. The number of isolated plants is about 300, and these have a total power of more than 39,000 kw. St. Petersburg is lighted by means of arc lamps on the principal streets and by incandescent lamps on ways of less importance. In addition to the arc lamps on the streets, there are about 300 street lamps fed from private plants. Motors, having a power of about 4,500 kw, have been installed. In many of the private plants storage batteries have been put up, and their capacity exceeds 50,000 amp.-hours. The number of dynamo machines erected is over 500. As a rule the current in the consumption circuits is continuous. Steam engines for driving the dynamos are principally employed, but gas motors and petroleum motors are also in use.

All of the large stations work with alternating currents, and one of them uses three-phase current. The greater part of the network is underground, and consists of armored cables. Aerial conductors are not in use except at a few stations. The aggregate length of the network is over 625 miles. The tension of the current in this network is from 2,000 to 3,000 volts.

In Moscow and in other towns, both large and small (particularly those situated in the industrial region), the use of electricity has made no less rapid progress than in St. Petersburg. In the begining, the stations constructed were almost all for the continuous current, but in the later ones the preference was for the single-phase and three-phase alternating current. The network is sometimes underground and sometimes overhead.

ELECTRIC TRACTION.

Electricity is also coming largely into use for trolley roads. The first electric tramway built in Russia was the one at Kief, which dates from 1893. In 1898, 45 cities had constructed such lines, their length exceeded 312 miles, and nearly 10,000 kw were in use for the motors. The number of motor cars was then about 300, and there were many trailers. The total length of wire for the electric tramways in St. Petersburg is estimated at 1,875 miles. Aerial conductors and underground conductors will be used, and, on the principal streets, accumulator traction. Nearly 400 motor cars will be in use, and 300 trailers. Other cities also contemplate the employment of electricity on a large scale, and plans are under consideration for its use on the great railroads of Russia. These projects include the construction of an electric railroad to connect neighboring towns on the western frontier of Russia, and the establishment of a road to cross the Caucasus Mountains, between the town of Suhkum and one of the stations of the Vladikavkas Railway. For this latter road it is proposed to utilize the water power of the mountain streams. Electric traction is already in use on the railroads serving large factories, in the mining industry, and in other enterprises.

ELECTRIC POWER.

The use of electricity for the distribution of motive power is spreading, and to-day all of the machine works of Russia have adopted this method. Enormous central stations for power purposes have been erected at places where such factories exist; for instance, at the Kolomna machine shops, at the works of the Sormovo Association, at the Putilov works, and many others. All of the larger elevators on the Vladikavkas Railway and on the Moscow-Kazan Railway are operated by electric motors. Up to the present, electricity has scarcely been used at all for the transmission of energy for great distances. Projects, however, are under way to utilize the waterfalls of Marva and Imatra. The Russian Government has granted a concession to a company to supply power to St. Petersburg from the Volhov Rapids. The estimated cost of the enterprise is about $14,000,000. It is said that the power to be transmitted will equal 150,000 kw, and the maximum transmission distance is 188 miles. The company has undertaken to provide the public lighting of St. Petersburg gratuitously, and hopes to furnish current to individuals at about half the price hitherto charged. The engineer of the scheme is a Russian named M. Dobrotvorsky. It is also intended to use the enormous power of the Dnieper Cataracts for the transmission of energy.

ELECTRO-CHEMICAL INDUSTRY.

The progress of the electro-chemical industry and of electrometallurgy is interwoven with the utilization of hydraulic force as motive power. There are now several establishments which obtain copper and refine metal by the electrolytic process. Such establishments exist in the Ural and the Caucasus, and have an output that is important. Thus, the works of Siemens Brothers, at Kedabeg, in the Caucasus, annually produce some 500 tons of copper. Many less important works in St. Petersburg, Moscow, Nizhni Novgorod, etc., utilize steam power for the refining of copper and impure copper waste by the electrolytic process. Some of these works obtain as by-products of the electrolytic process other metals, such as lead, antimony, etc. There are as yet very few special electrochemical works in Russia; one factory near the Imatra rapids produces carbide of calcium, and other works for a similar purpose also exist. A large electro-chemical factory has been erected in the government of Kharkof, for the production of caustic soda. Electric soldering is in use in metallurgical and mechanical works, and also in the railway shops; this is accomplished with the aid of the voltaic arc, a Russian invention.

ELECTRIC APPLIANCES AND MACHINES.

It will be seen that the application of electricity has advanced in Russia, and that electro-technical appliances will have a great future

there. Russian factories cannot supply the demand, and the deficiency is made up by foreign firms which have their representatives there. Russian manufacturers produce many cables and insulated wires. At St. Petersburg and Moscow, there are a number of factories in this line, and their output compares favorably with the foreign articles. The most important of these establishments are the Siemens and the Riben, both of which produce cables of the most satisfactory character. Nevertheless, cables in large quantities are imported from abroad, the home manufacturers not being able to supply the market. Accumulators are also manufactured in various towns in Russia. There are a number of establishments in St. Petersburg which produce accumulators of original design, or after the best-known foreign models, such as the Julien, the Tudor and others; and the importation is small. Such appliances as circuit breakers, commutators, rheostats, etc., are also manufactured in Russia, but not nearly enough to supply the demand. Measuring instruments are scarcely manufactured at all, although the demand for them is enormous, especially of late, since central stations have been constructed in a number of towns. These instruments are imported from France and Germany. The manufacture of porcelain insulators and of porcelain appurtenances in general is so largely developed in Russia as to completely satisfy the home demand, and no insulators are imported. Incandescent lamps are not manufactured in Russia at present; an establishment formerly existed for the manufacture of these lamps, but foreign competition was so strong that the attempt was abandoned. The lamps are at present imported from Germany, France, England, Austria and Sweden. Arc lamps are produced in limited quantities, and the greater number of those used are imported from Germany. Carbons for arc lamps are also manufactured in Russia, though most of them come from abroad.

As regards dynamos, motors and transformers, they are manufactured by only one firm—Siemens & Halske, at St. Petersburg. This house makes annually dynamo machines and motors of which the aggregate strength is about 6,000 kw. It is also the only firm in Russia which produces appliances required in electric traction.

One branch of the electro-technical industry is fully supplied by the home manufacturers, and that is the signalling and telegraphic apparatus in use on the railways. As regards telegraphic appliances proper, some are manufactured in Russia and some come from abroad, chiefly from Sweden and Germany.

HOW TO EXTEND UNITED STATES TRADE.

It will thus be seen that the demand for electro-technical apparatus and machines in Russia is relatively but little satisfied by the home manufacturers, and the progress in the application of electricity for transportation, manufacturing and domestic economy will undoubtedly enormously increase the market for foreign appliances. American manufacturers should have their share of this trade, and there is but one way to secure it—that is, to establish branch houses in this country and place the same in the hands of competent men. The Germans hold the field in supplying this country with electric appliances, because they are ever present and always patient; they study their customers, ascertain their financial condition, give long credit with reasonable interest, and employ men who are either German-speaking Russians or Germans born in Russia, who, of course, speak both Russian and German.

It will require more than a casual visit to Russia on the part of our business men, if we are to win our proper share of the future business to be done in electrical appliances. It is not too much to say that in no other branch of trade is there likely to be such material progress in Russia.

A Faustian Draught.

A Long Island newspaper had the following item recently: "Last Sunday as that heavy storm swept over Queens Borough, a bolt of lightning struck a tree in Fuehrer's Jackson Avenue Park, running down same and all around a keg of beer and around a glass of beer in the hands of a thirsty waiter, and exploded with a loud report as it buried itself in the ground. The glass of beer remained intact, and nobody can drink the same, for as soon as the lips touch the beverage, a shock is felt. The same is on exhibition at Fuehrer's, and must be seen to be appreciated."

German Electrical Manufacturing Conditions.

The U. S. Consul General at Berlin, Mr. Frank H. Mason, has sent to the State Department an interesting report on present conditions among German electrical manufacturers. We give his discussion of the subject herewith:

What is called in headlines by the German press "The catastrophe in the Schuckert Electrical Company," has recalled public attention sharply to the conditions under which some of the great electrical corporations of Germany were promoted, and the embarrassments which some of the methods employed have more or less inevitably entailed. The event alluded to was a meeting on July 26th of the stockholders of the Schuckert Electrical Company at Nuremberg, at which the managers announced that, through depreciation of plant and material, insolvent accounts, and necessary appropriations for a reserve fund to meet further depreciations, the company had suffered losses aggregating 15,500,000 marks, or something more than $3,500,000. As the Schuckert Company is one of the foremost corporations of its class in Europe, with an up-to-date plant and all the accompaniments of a large business, some surprise has been expressed that its affairs should make such a bad showing for its shareholders. The explanation leads back to the fact, now well known here, that the sudden rise of some of the German electrical companies into corporations of vast resources and activities was, in some cases at least, the result of skilful and artificial creation of markets for products, rather than the supply of an actual and legitimate demand. Concisely stated, some of these companies bought their orders for electrical installations and materials by financial operations that left them shareholders in many enterprises which have since proven less promptly lucrative than had been hoped, and have thus drawn more or less heavily upon the capital of the parent companies.

To understand how all this came about, it should be remembered that German progress in electrical science was for a long time far in advance of popular appreciation of its advantages. The companies organized and equipped for the manufacture of lighting and power plants could not wait for the slow growth of public demand for such improvements, and they therefore undertook to finance and erect such installations themselves, confident that, once established and in use, the public would not fail to appreciate them and invest in their securities. This went very well for a time. It created a large and ready market for electrical machinery and materials at high prices, and supplied hesitating municipalities with electric tramways and lighting plants which their citizens greatly enjoyed, but which were built and for a time managed by the electrical manufacturing companies at their own expense. Inevitably, this process of consuming their own capital necessitated heavy loans and frequent increases in the stock of such corporations, together with a steady expansion of their manufacturing capacity. Some of the companies, especially the Schuckert, made enormous investments in electric installations for the manufacture of calcium carbide, putting in the machinery at their own prices, but receiving for it little or nothing except stock in the carbide plants. Thus the supply of acetylene material was soon far beyond all legitimate requirements, prices collapsed, and the carbide industry suffered a serious and permanent reverse.

Another heavy blow for some of the German electrical manufacturing companies has been the failure of storage-battery traction for tramways. When electric traction was introduced into this country, municipal governments were timid and hesitating. They objected to the overhead conductor because it was considered unsightly and dangerous, and in order to obtain any franchise at all the tramway companies and the electrical manufacturers who were behind them had to agree to furnish cars that would dispense with a visible trolley. This meant either the underground-conduit system—which is so expensive to construct as to be justified only by an enormous traffic—or a reliance upon storage batteries, and the companies generally had recourse to the latter. The extent to which this has been done may be inferred from the fact that one company in Hanover has at present 274 accumulator cars in service. There, as at Halle, Hagen, and many other places, they have been found so heavy and costly as to be unremunerative. At Berlin, where many hundreds of them have been in service, all are to be aban-

doned and recourse had to underground conductors for centrally located streets and overhead wires for the less crowded and suburban sections.

The net result of all these conditions was that some of the electrical manufacturing companies of Germany, which had gone on organizing and supplying power, lighting, carbide, and other plants, not only at home but in Russia, Scandinavia, Austria-Hungary, and other European countries, were caught with all sail spread by the turning tide and adverse gale that set in during the summer of 1900. In the stormy weather that ensued, most industrial stocks declined sharply, the investing public became alarmed and timid, the failures of the Leipziger and other banks followed a few months later, and led on to the situation of which the meeting of last week at Nuremberg has been the ultimate result.

The encouraging features of the present condition are the fact that the credit of several of the oldest and strongest of the electrical companies remains unshaken, the general feeling that the bottom has been reached, that the obligations entailed by a system of forced development have been mostly liquidated, and that with the good cereal crops that will be harvested this year, peace throughout the world and the hoped-for renewal of the commercial treaties which are to lapse next year, the foundation will be laid for a renewed and enduring prosperity.

Calcium Carbide Manufacture in Italy.

By Cesare Pio.

IN Italy the industry of calcium carbide production is rapidly progressing, and the number of furnaces operated with direct or polyphase current is increasing every day. The number of patents applied for apparatus, devices, etc., relating to improvements of this industry is rapidly growing. At the beginning of this industry, a great number of ignorant people put on the market faulty apparatus, cheaply built, to make acetylene gas, and called gasogenes. This produced so many accidents and explosions that the industry of calcium carbide suffered a very bad setback, and it is only since last year that business in this line in Italy has become profitable. After the construction of the factory of Pont Saint Martin, near Ivrea (Piedmont), which utilizes water power, many other companies were formed and electric furnaces were installed where it was possible to obtain power from waterfalls. In 1897 the Società Italiana del Forni Elettrici, of Rome, installed a factory at Narny. A little latter, the Società Italina del Carburo di Calcio, capitalized at 3,000,000 francs, installed a 3,000-hp plant near the Marmore Falls (Terni). In the month of August of the same year a company was formed in Turin, and electric furnaces were installed in S. Marcello d'Aosta, in the northwest of Italy, where the water power of the Dora Baltea River was utilized. This last plant, which is one of the most interesting of its kind, just now has been enlarged in view of the increasing demand for carbide.

The author, in Electrical World and Engineer, August 5, 1899, gave an account of this plant in an article on three-phase currents in the manufacture of calcium carbide in Italy. A great field open now to the industry of calcium carbide in Italy is in its application on the railroads, to the trains. A few years ago the use of acetylene was limited to small villages, but at present the number of big centers lighted with this modern system is continually increasing, and the applications of acetylene have increased since it was discovered that this gas mixed with a certain quantity of acetone may be easily transported without danger of explosion. Another field of application is the gas engine for small industries. This class of motor has not yet been satisfactorily improved, and industrial people in Italy are not very fond of testing new types of motors at their own expense.

The price of calcium carbide has been lately raised to 437.50 francs per ton, as against a price of 250 francs per ton last year. This seems to be the result of a syndicate recently constituted on the Continent, which is trying to keep up the price of this product. In a recent paper Mr. Riccardo Memmo, who is an authority in all questions regarding the manufacture of calcium carbide, discusses the conditions of this industry in Italy. According to his opinion, in order to render really remunerative the industry in Italy, the conditions to be met are as follows:

1. The price of the plant per horse-power installed, including machinery, furnaces and all the necessary supplies, must be not higher than 500 francs.

2. A certain ratio between the number of tons of carbide produced, and the number of effective horse-power produced must exist. The price of calcium carbide, including general expenses, must be not more than 120 francs per ton.

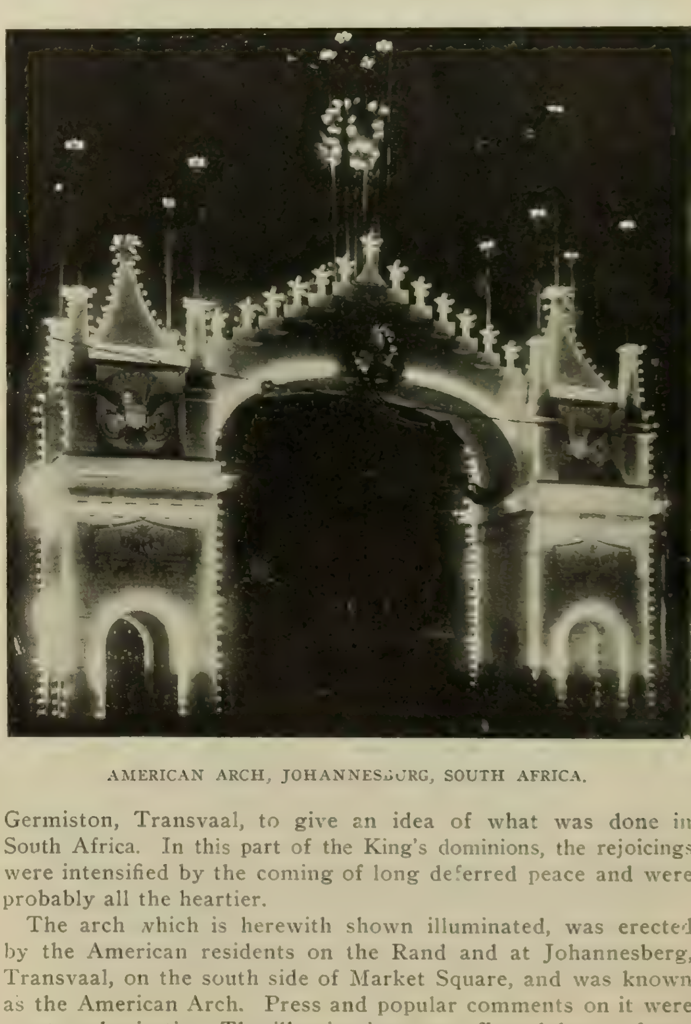
3. The capital expended must be liquidated in ten years. This corresponds to a sinking fund of 40 francs per ton produced.

4. The selling price of the carbide must be 250 francs per ton, so that, including freight, loss, profits, etc., the price to consumer must not exceed 300 francs per ton. On the capital invested at least 6 per cent. must be paid.

These conditions are not entirely fulfilled at present in the majority of existing plants, but with the continual development which is taking place in this industry in Italy, and also in consideration of the great amount of water power to be utilized, not only can these conditions be fulfilled, but the cost will be still further reduced.

Coronation Illuminations in South Africa.

The coronation of King Edward of England was celebrated everywhere throughout the British Empire with rejoicing and illuminations, and in the latter the use of electricity was large and striking, London itself affording perhaps the best example of old-fashioned sticking to gas for such purposes. In the colonies, particularly in Canada, the electrical effects were superb. We are now able, through the courtesy of Mr. A. W. Peirce, of



AMERICAN ARCH, JOHANNESBURG, SOUTH AFRICA.

Germiston, Transvaal, to give an idea of what was done in South Africa. In this part of the King's dominions, the rejoicings were intensified by the coming of long deferred peace and were probably all the heartier.

The arch which is herewith shown illuminated, was erected by the American residents on the Rand and at Johannesberg, Transvaal, on the south side of Market Square, and was known as the American Arch. Press and popular comments on it were most enthusiastic. The illumination was effected by no fewer than 1,300 incandescent lights, and ceurrent was furnished from Brakspan, no less that 25 miles away. The American subscribere were greatly gratified at the reception accorded their efforts, and at their ability thus to mark the enduring and cordial friendship between the empire and the republic in a country where the citizens of the latter had been able to do so much good work for its development alike in war and in peace.

Underground Work for Telephone Exchanges—II.

By ARTHUR V. ABBOTT, C. E.

DUCT MATERIALS.

THE bulks of duct material now on the market, certainly all that is worthy of serious consideration by the telephone engineer, will fall into one of the following four classes:

1. Wood ducts.
2. Cement ducts.
3. Vitrified clay ducts.
4. Asphalted or bituminized wood pulp ducts.

FIRST—WOOD DUCTS.

This was the earliest of the duct materials used, and at its first appearance took the form of a wooden box about 8 ft. long, made of 1¼-in. creosoted yellow pine or similar wood. As is indicated in Fig. 1.

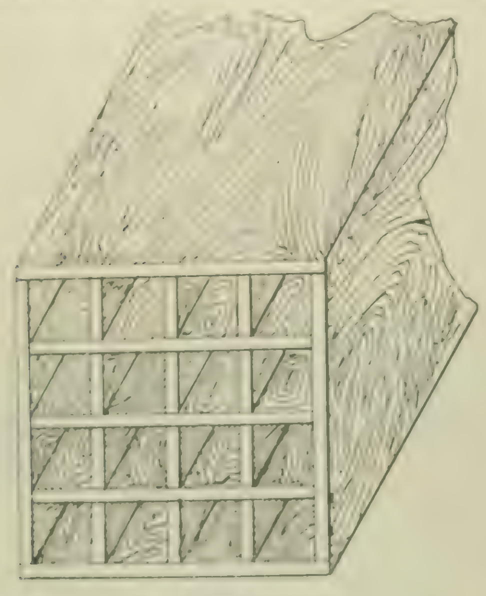


FIG. 1.—BOX CONDUIT.

it was easy to build the box in any convenient length and to construct as many different ducts as the design of the conduit required.

A little later the familiar pump log in its round or square form, as illustrated in Figs. 2 and 3, displaced the box as being mechanically much stronger, cheaper to build by machinery, more flexible as to

FIG. 2.—ROUND PUMP LOG.

the number of ducts, and slightly less expensive to lay—particularly when a large capacity was contemplated. The Valentine duct and its congeners is illustrated in Fig. 4. This duct material consists of wooden slabs carrying a series of semi-circular curves, which may be piling the slabs on top of each other, a subway of any desired duct made of any desired size, or any number placed in each slab, and any capacity is easily constructed. In Table 6 will be found the dimensions of the wood work for conduits of this style, containing varying number of ducts of various sizes:

TABLE 6.

VALENTINE DUCT MATERIAL.

Sizes of Conduit.

Conduit	Inches.
2½-in. Conduit.	
Conduit containing 1 duct, dimensions	3 x 3
" " [illegible] " "	3 x 5¼
" " [illegible] " "	3 x 7½
" " [illegible] " "	5¼ x 5¼
" " [illegible] " "	5¼ x 7½
" " [illegible] " "	7½ x 7½
" " [illegible] " "	7½ x 9¾
3-in. Conduit.	*Inches.*
Conduit containing 1 duct, dimensions	3¼ x 3¼
" " 2 " "	3¼ x 6¼
" " 3 " "	3¼ x 9
" " 4 " "	6¼ x 6¼
" " 6 " "	6¼ x 9
" " 9 " "	9 x 9
" " 12 " "	9 x 11¾
4-in. Conduit.	*Inches.*
Conduit containing 1 duct, dimensions	4 x 4½
" " 2 " "	4½ x 7½
" " 3 " "	4½ x 11
" " 4 " "	7½ x 7½
" " 6 " "	8 x 11
" " [illegible] " "	[illegible] x 11½
" " [illegible] " "	[illegible] x 15
3-in. Conduit.	*Inches.*
Conduit containing 1 duct, dimensions	[illegible] x 5
" " 2 " "	[illegible] x 8¼
" " 3 " "	[illegible] x 12
" " 4 " "	[illegible] x 8
" " 6 " "	[illegible] x 12
" " 9 " "	12 x 12½
" " 12 " "	[illegible] x [illegible]

The street construction involved in laying wooden ducts is exceedingly simple. A trench of sufficient size to accommodate the requisite number of ducts is excavated, and the bottom carefully leveled. A very desirable, though not essential addition, is a bottom layer of plank, as shown in Fig. 5; or, better still, a stratum of three inches of clean sharp sand or gravel that may serve both as a bed for the timber and as a sub-drain to carry away any ground water that may subsequently accumulate. In particularly wet localities the sand, or even a line of open drain tile, may not only be desirable but necessary. When the bed is prepared, the first layer of wood is placed thereon, and gently—to avoid splitting—rammed to a good bearing. When the single duct or pump log forms, illustrated in Figs 2 and 4 are used, the male ends of each piece should be dipped

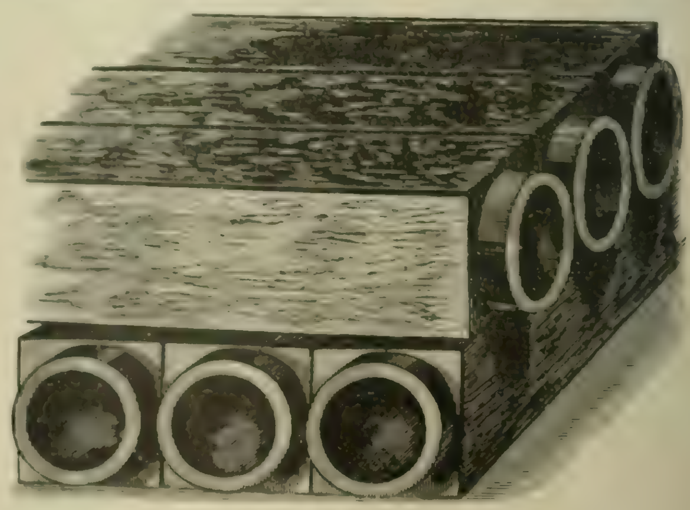


FIG. 3.—SQUARE PUMP LOG.

into hot pitch or tar, then driven firmly home into the female sockets of the preceding ones. In the Valentine or other similar form there is either a piece of felt or a kind of dovetail to be covered with hot tar and inserted between the outside joints of each slab. It is also well to place a piece of tarred paper or roofing felt around each joint and tack the same in place with wood battens. Protection from foreign picks is afforded by placing on the top, and preferably on each

side, a 1½-in. or 2-in. plank. A layer of sand on the top and sides also adds materially towards keeping the conduit dry. In the single duct conduit curves of reasonable radius are easily made with the natural spring of the timber and its joints. With the Valentine, curves are accomplished by cutting the timber into short lengths and mitering the joints. As fast as the duct material is placed, the trench may be refilled and temporary paving placed. To lay the single duct wood conduit requires no skilled labor other than that of a vigilant foreman, while in the Valentine, one carpenter to cut and place the battens and miter for curves will keep a large gang busily employed.

It is hardly necessary to call attention to the necessity of treating the timber with some form of preservative, as otherwise decay—when

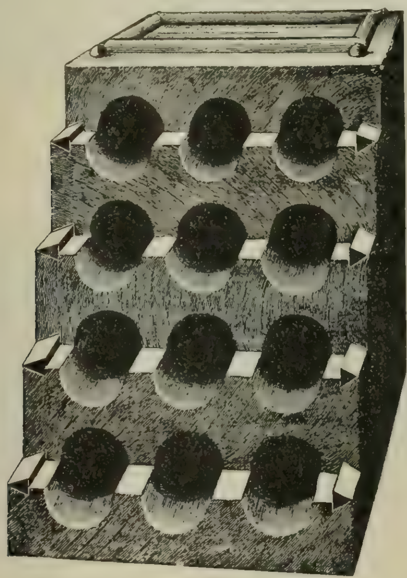


FIG. 4.—VALENTINE CONDUIT.

buried in the street—becomes exceedingly rapid. Probably the consensus of opinion is in favor of creosoting; but this or any preserving process, to be of value, must be carried out with exceeding care and thoroughness. As far as possible all forming and cutting should be done prior to treatment, as it is natural to expect the surfaces of the wood to be the most thoroughly impregnated.

In creosoting, the first operation is that of steaming, which is accomplished by treating the wood in a closed retort for from two to three hours, with steam pressure of from 25 to 50 lbs. The air pump is then applied and a vacuum of at least 20-in. maintained in the retort so long as there is any flow of sap from the timber. The retort is then pumped full of dead oil of tar, and the whole subjected to an hydrostatic pressure of at least one hundred pounds to the square inch. Most scrupulous care must be exercised to see that pure dead oil of tar is employed for impregnation, otherwise the destruction of the cable sheath is simply a question of time. A chemical analysis of the oil used should be required. In order to secure the desired amount of impregnation, the hydrostatic pressure should be main-

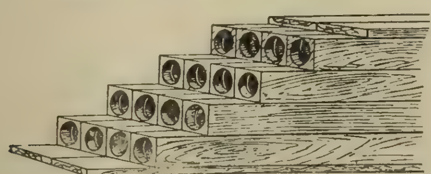


FIG. 5.—FOUNDATION FOR VALENTINE CONDUIT.

tained for at least three hours, and, finally, no timber should be accepted that does not show an absorption of at least 14 lbs. of oil per cubic foot.

After creosoting, the ducts should be allowed to season in the air for some time, two or three months if possible, in order to dispel any possible remains of phenol in the oil, for in the early use of creosoted wood considerable difficulty was experienced with the formation of lead carbonate and the consequent perforation of the cable sheath and the destruction of the cable. So much difficulty was experienced from this source that the use of creosoted wood for conduit purposes was practically condemned. Further experience, however, proved that if pure dead oil of tar was used, and the ducts after treating were thoroughly seasoned, no apprehension need be entertained from any corrosive action upon the cable sheath. Creosoted wood ducts possess the advantage of cheapness, ease of handling, rapidity of construction, flexibility, facility in distribution, for from any duct a wire may be taken by the simple process of opening the street and boring a hole in the side of the conduit. Per contra, they are by no means moisture or gas proof, have only medium insulating qualities and are in no wise indestructible—being credited with a probable life of about 15 years, and are not completely free from the suspicion of originating injury to the cable sheath. For these reasons creosoted wood finds its place in the conduit systems of small towns, and in the laterals and subsidiary ducts of rapidly growing portions of cities where great economy of installation and short probable life of the conduit are likely, but for the main lines and heavy leads of the permanent subway of important cities some of the other and more permanent forms of ducts are preferable.

A New German System of Electric Train Lighting.

The subject of train lighting has of late been even more agitated in Germany than in this country, owing to serious disasters in fires on wrecked trains, due to other illuminants than electricity; and the result is that the thoughts of inventors and manufacturers have been turned in the direction of electric train lighting. One of the latest and most prominent systems now being tried in Germany is that of Mr. Otto Böhm, whose apparatus has been running on a train in Germany, when reports reached us, for 90 days without a single interruption, it is said, making 224 km. per day, or a total of about 12,600 English miles, up to date. Several other equipments are now under trial in Germany and Russia.

The system in question is adapted to the lighting of whole trains as well as single carriages, and belongs to the category in which current for the lamps and batteries is furnished by a dynamo carried upon and driven by the car-axle. When the train is not in motion, current is supplied to the lamps from the battery; this is also the case when the train is in motion, but running below a certain critical speed.

The objections to driving a dynamo from the axle are usually of a practical nature, inasmuch as the machine is exposed to dust, constant vibration and frequent shocks. Whatever arrangements are

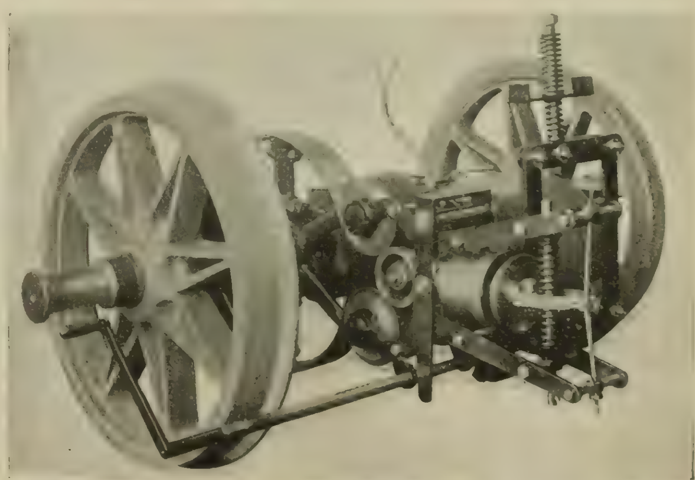


FIG. 1.—FRICTION GEAR.

made for transmitting the power from the axle of the car to the dynamo are, therefore, bound to satisfy first of all the requirements of a very rough service. The Böhm arrangement is simple enough, it is claimed, to meet these practical requirements of the service, and still so delicate as to maintain a practically constant voltage at the terminals, irrespective of the speed of the car within a wide range.

A most favorable element in the system is the fact that during that part of the day when the dynamo is not required to furnish current, it is placed entirely out of connection with the axle by the movement of the lever L (Fig. 2). This lever is operated by an ordinary train-

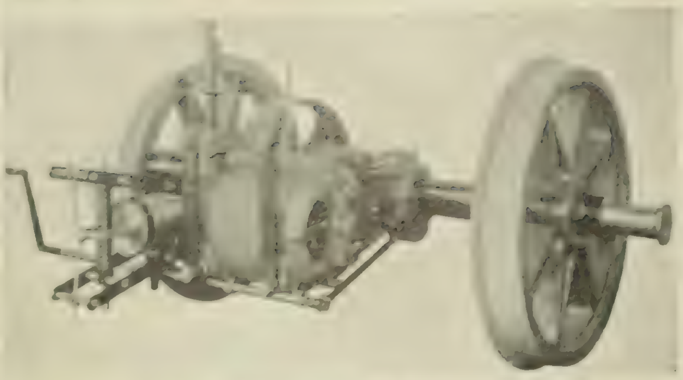


FIG. 2.—[illegible] VIEW OF FRICTION GEAR.

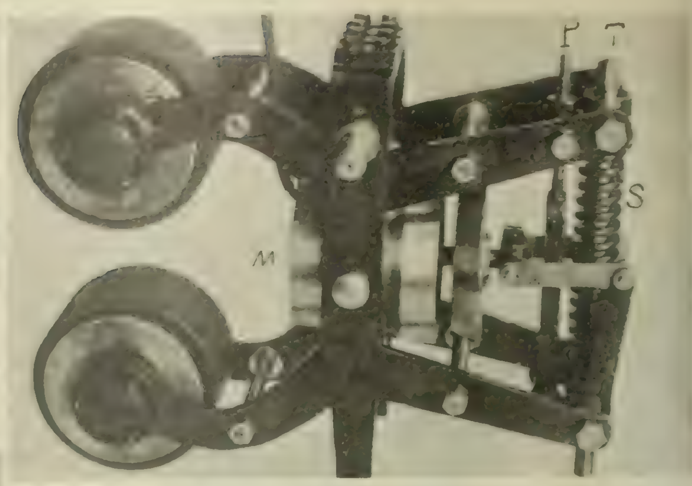


FIG. 4.—FRICTION WHEELS.

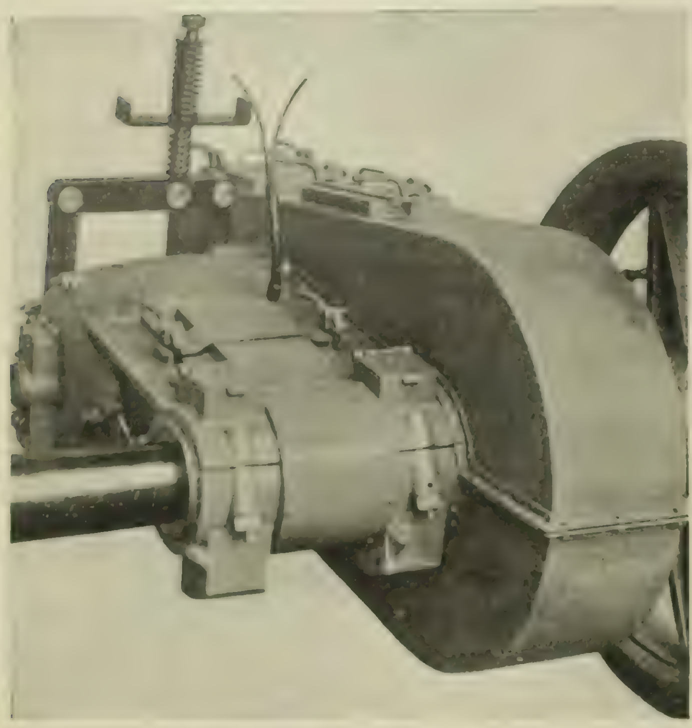


FIG. 3.—DYNAMO AND GEARING ENCASED.

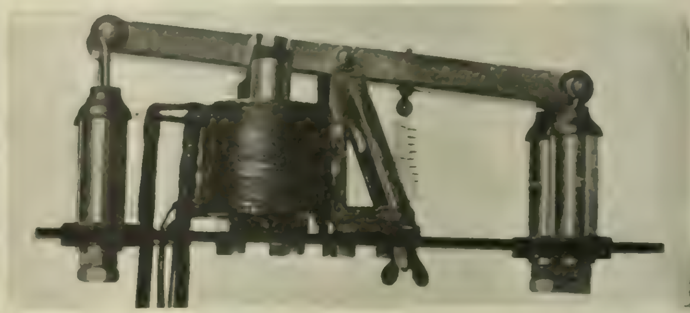


FIG. 5.—AUTOMATIC CUT-OUT.

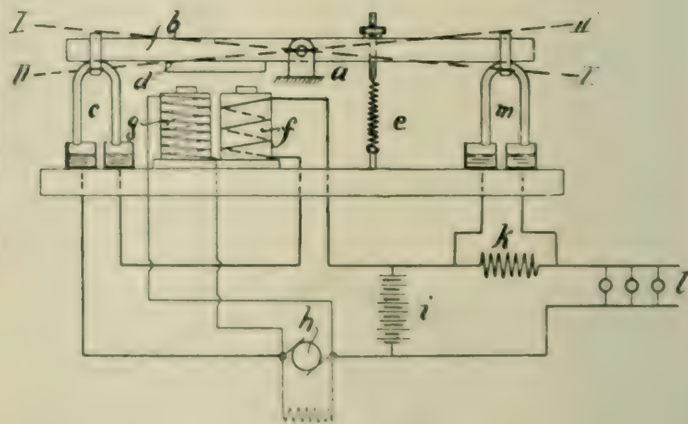


FIG. 6.—DIAGRAM OF AUTOMATIC CUT-OUT.

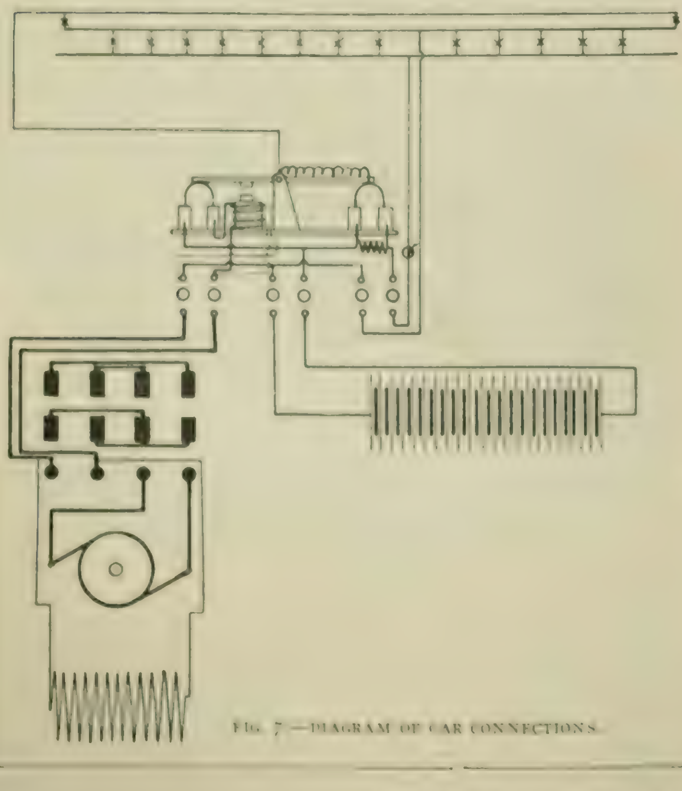


FIG. 7.—DIAGRAM OF CAR CONNECTIONS.

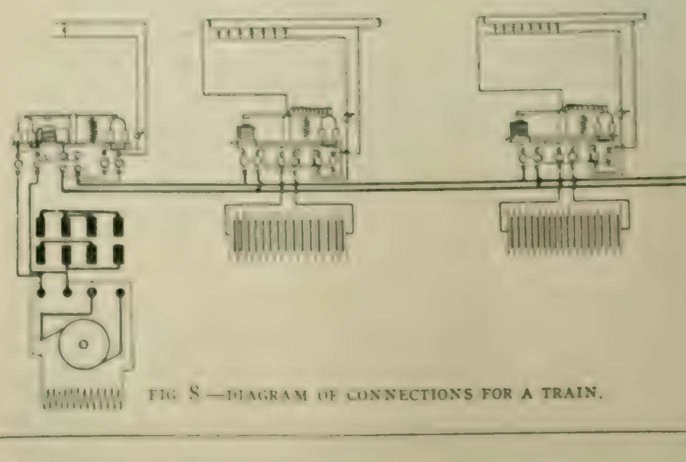


FIG. 8.—DIAGRAM OF CONNECTIONS FOR A TRAIN.

GERMAN SYSTEM OF ELECTRIC-TRAIN LIGHTING.

ian from the side of the car. It may also be thrown into another osition, which allows the dynamo to charge the battery.

The dynamo shaft is connected with the axle of the carriage by ieans of a friction gear, shown in Fig. 1. Another view is given in 'ig. 2; Fig. 3 shows the arrangement fitted with a gear case. By neans of a powerful electromagnet, the friction wheels can be put out of gear, and this is done automatically as soon as the voltage at the erminals of the dynamo passes a certain limit. Fig. 4 shows the riction wheels and the magnet *M*, as dismounted.

The winding of the electromagnet is connected across the terminals of the dynamo, and thus the strength of the magnet increases with the speed of the train. When the train reaches the speed for which the nagnet armature is adjusted, the latter is attracted against the ension of the spring *S*, thereby lifting the friction wheels. The speed of the dynamo tends to fall off, and the pressure of the spring again comes into play in opposition to the magnet. The position of he armature disc may be easily adjusted for any desired speed by inserting a wrench through the car floor at *P*. With the same wrench the tension of the spring at *T* may also be altered if necessary. No matter how great the velocity of the train may be, the dynamo will never exceed that speed which is necessary to produce the requisite voltage.

The wear upon the friction rollers is quite inappreciable, inasmuch as no slip on the surface of the same takes place; even if sand should get between the wheels, it would not cause any wear. As there is no appreciable loss of energy by friction, the efficiency of the gear is, it is said, consequently very high. It may be said that the electromagnetic device in its action produces a certain dancing of the wheels, causing the power to be transmitted at impulses. The speed of the dynamo, however, remains practically constant, so as not to produce any fluctuation of the light. When the battery is connected in parallel to the dynamo, the light is no steadier than when the dynamo alone is in operation.

Should the speed of the train decrease to such an extent that the dynamo is incapable of producing the requisite voltage, an automatic cut-out with shunt and series winding (Figs. 5 and 6) switches the dynamo off, leaving the battery to supply the current for the lamps. At the same time a resistance, *K*, which was in series with the lamp-circuit as long as the dynamo was charging the battery as well as feeding the lamps, is short-circuited. As soon as the train resumes its speed, the same apparatus switches the dynamo in again. An ingenious contrivance is provided, which changes the leads of the dynamo as soon as the direction of the train reverses. This only comes into action at low speeds of the train; at a high speed, however, it cuts itself out, thus preventing unnecessary wear. The connections for the lighting of a single carriage are shown in Fig. 7, while Fig. 8 shows the connections for a train, one dynamo being used.

Before this system was made public, the inventor, in co-operation with two prominent German companies, made exhaustive experiments in order to arrive at the best construction. The system has been patented in the United States.

German Direct-Current Motors with Adjustable Speed for Driving Paper Machinery.

By R. Gundel.

To drive paper machines with variable speeds, up to the present time steam engines have generally been used, the speed of which is adjustable between somewhat narrow limits. Greater variations of speed have generally been accomplished by some sort of mechanical gearing, but this method is usually very complicated and troublesome. Recently, however, electric driving has come into use. For many machines in paper mills, a rather large variation of speed is necessary, so that the maximum speed required may be six times the minimum speed. The design of electric motors for this purpose is quite difficult, especially if they are not to be too expensive. The conditions are, however, more favorable when two voltages are available with an armature with only one commutator.

The results which have been obtained with two motors of this kind, made by the "Gesellschaft fuer Elektrische Industrie," Karlsruhe, Baden, Germany, are given in the curves of Fig. 1. They show that the efficiency is nearly constant for all speeds, the dimensions of the machines having been determined with this point in view. The regulation of speed is accomplished by variation of the magnetic field flux; at the lower speeds the motor is operated at 110 volts; at higher speeds at 220 volts.

The regulation is by means of the rheostat, shown in Fig. 2. For diminishing the field strength, nine main steps are provided. To vary the field still more in the intervals between these main steps, another regulating rheostat is provided with shorter steps. In this way it is possible to regulate the speed between 125 and 750 revolu-

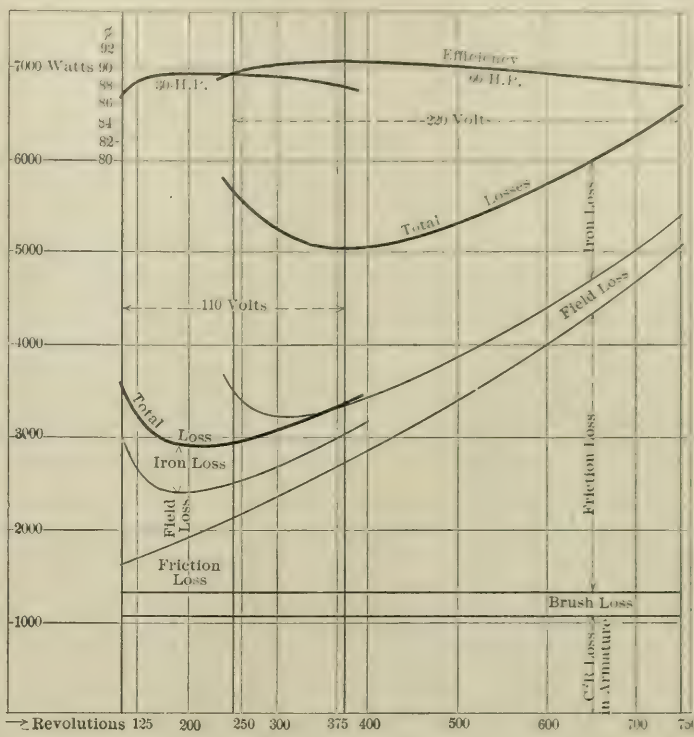


FIG. 1.—30 TO 60-HP MOTOR, 125 TO 750 R. P. M.

tions, or between 150 and 900 revolutions, in about 270 steps, each corresponding to a variation of about 2 or 3 revolutions. For every speed and from no load to full load the motors operate without sparking at the brushes, and without any shifting of the brushes.

Concerning the construction of the motors, it may be briefly said that the magnet frame and the magnet cores are made of cast steel. The pole shoes are laminated, and their geometrical form has been

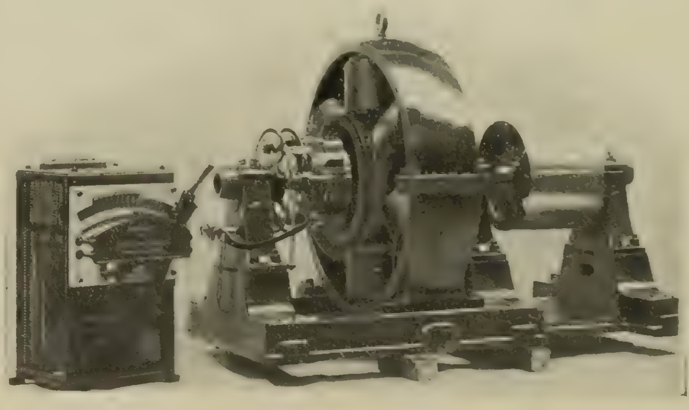


FIG. 2.—REGULATING RHEOSTAT.

chosen with a view of getting a magnetic field favorable to good commutation. The armature has open slots with four bars per slot. The commutator is made of hard-drawn copper, and the brushes are of carbon.

Several motors of this type have been in operation for some time in Germany, and have proved very satisfactory in every respect.

Wireless Telegraphy to Catalina Island.

Catalina Island, California, in the Pacific, has been joined to the mainland by the Pacific wireless telegraph, "a purely American system, now in successful operation," and has exchanged congratulations on the subject with President Roosevelt.

Practical Central Station Information.

One of the queries from the "Question Box" at the Cincinnati Meeting of the National Electric Light Association, was concerning the best voltage of generators for a central station when about one-half the current is for local distribution within a radius of five miles, and the other half to be raised to high voltage for long-distance transmission.

Mr. Dudley Farrand, of the United Electric Company, of New Jersey, expressed the opinion that under the condition named, generators of 2000 to 2400 volts would be suitable. Mr. Henry A. Pierce, of the Pawtucket Electric Company, said that his electrical superintendent considered that the voltage might be 3300. Mr. H. Grissinger, of the Buffalo General Electric Company, was of the opinion that in a large station, the load of which is divided between local service and long-distance transmission, the best practice as to generator voltage is undoubtedly that voltage which is best suited for the local service. For a radius of five miles, if the load is a large one, 4400 volts may be required, while the character of load may be such that 2200 volts would suffice. For the long-distance service step-up transformers would be necessary, and these would cost approximately the same whether the generator voltage were 400 or 4000. It would be poor practice to use one generator voltage for local service and another for long-distance work in order to dispense with step-up transformers, for the reason that the flexibility of the station would be impaired.

Another query related to the best practice with regard to underground distribution and connections to consumers' premises, for a system embracing both 500-volt direct current, 1000-volt alternating current, and direct current series arc. Mr. E. W. Rollins, of Hartford, Conn., in reply said that the question as stated is rather a difficult one to answer, lacking knowledge of the volume of the business, the territory covered and other necessary information upon which to base an intelligent answer. First of all, he thought the system should be simplified so as to supply the outskirts of the city with alternating current of such a character as to meet the requirements for light, power, etc. In the center of this lighting district, it might be advisable to install a three-wire direct-current system, 110-220 volts, for light, power and general uses. The best plan of distribution for direct-current systems would be to run three mains consisting of 3 cables on each side of the street, as close to the curb as convenient, making lateral connections to each building; in some cases one lateral may answer for two or more buildings. The connections can be made up in small hand holes in the street. The lateral ends, or service, should be made up to a water-proof cartridge-fused switch. The ordinary slate or marble-based switch is liable to corrode and cause trouble owing to the dampness to which they are exposed. The mains referred to should receive the supply of current from junction boxes placed in sewered manholes, at points to give a uniform pressure and even distribution of load on the various feeders supplying current to the system. The same system can be employed for alternating current distribution, placing subway transformers in manholes for the supply of current. At Hartford the enclosed primary fuses are placed on a pole, adjacent to the manhole containing the transformer.

In response to a query as to the relative cost of trimming and maintaining inclosed arc lamps as compared with furnishing free renewals of glow lamps, Prof. L. B. Marks said that it costs about four or five times as much to trim and maintain inclosed-arc lamps as it does to furnish free renewals of glow lamps. One trimmer can conveniently take care of approximately 300 commercial arc lamps. He can, of course, trim a great many more, but will be compelled to neglect a great many lamps that need attention.

Assuming an average burning of three hours per day or approximately 45 kw-hours per month for each lamp, the life of one trim being 100 hours and the life of the inner globe 600 hours, the 300 lamps would consume approximately 13,500 kw-hours, 270 carbons and 45 inner globes per month. The expense, not including repairs thereto, would be as follows: One trimmer, $55; 270 carbons at 3 cents each, $8.10; 45 globes at 10 cents each, $4.50, or a total cost of $67.60, thus making the cost approximately five mills per kw-hour.

Assuming the life of an incandescent lamp to be 600 hours, consuming 50 watts or thirty kw-hours during its useful life, and the lamp costing 15 cents in the store house, the total cost is five mills per kw-hour. This cost does not include the delivery of lamp renewals to customers, which is generally customary; but figuring on a storehouse basis for incandescent lamps and trimming arc lamps, there is thus very little difference in the cost. It is assumed that the customer owns the arc lamps.

A query which, judging from the number of responses, elicited much interest, was one asking which is preferred on alternating-current systems to indicate regulation: A system of pressure wires or a compensating voltmeter. Mr. W. T. Oviatt, of the Connecticut Railway & Lighting Company, pronounced in favor of a compensating voltmeter for long distance, and pressure wires for short distance. Mr. H. T. Hartman, of the Electric Company of America (Philadelphia), said that in its Edison three-wire plants his company has had excellent results from the use of pressure wires, which are run to the office of the company situated practically at the center of distribution and there connected at will by means of a voltmeter switch to any one of the various ends. As it is customary to regulate the central-station voltage according to some standard feeder, only one main set of pressure wires is really required, and the plan above outlined enables one to test the voltage at feeder ends when required for comparison. It also avoids the necessity for occupying valuable space on the main pole lines by a multitude of small pressure wires. At the central office there is a pair of Bristol recording voltmeters connected to any desired set of pressure wires. The manager examines the charts every morning and sends them to the chief engineer or station superintendent, who makes such notes as he may require for the guidance of the switchboard attendants. This plan works admirably in practice, the regulation being good and lamp breakage low in proportion to the number of lamps connected.

Mr. E. J. Bechtel, of Toledo, Ohio, expressed the opinion that in alternating current distribution compensating voltmeters have an advantage over pressure wires returning from long distances, in that they are simpler, not apt to be out of order when wanted, less maintenance and just as reliable when adjusted and used in connection with systematic tests and inspections at the consumer's connection. This inspection is advisable under any system.

Mr. F. L. Sargent, of Malden, Mass., preferred compensating voltmeters over pressure wires on the system of his company, as this system is entirely overhead, and using pressure wires necessarily makes so much more overhead construction to maintain and causes trouble during storms. There is very good regulation, using practically the same method as compensating voltmeters. Mr. F. Ellwood North, of Somerville, Mass., said his company used to have pressure wires on every feeder. Last fall it installed compensating voltmeters, doing away with pressure wires, and they answer every purpose. He much preferred compensating voltmeters. Mr. Chas. H. Peters, of Denver, Colo., unhesitatingly favored pressure wires in place of compensating voltmeters, although aware that the makers claim they will compensate for any ordinary drop on lines. These are in use upon four of his company's circuits, but are anything but satisfactory; in fact, a man by means of hand regulation can come nearer making up for line drop by guessing than he can by keeping a voltmeter on the dot and relying upon the action of the compensator.

Mr. Jas. E. Pyle, of West Chester, Pa., considered that it would depend upon local conditions. If three-wire secondaries are used, the three pressure wires would surely gives satisfactory results, providing it did not cost too much to erect and maintain the pressure wires. If the pressure wires were tied into the secondaries some distance from the transformer, they would indicate the load balance on the secondary of the transformer in many cases. Compensating voltmeters with due care in balancing the load on three-wire secondaries, in case three-wire secondaries are used, should be much less cumbersome and in most cases preferable.

Mr. P. Junkerfeld, of the Chicago Edison Company, was of the opinion that in an alternating current distribution system compensating voltmeters arranged for inductive and non-inductive drop are preferable to a system of pressure wires. The first cost, as well as maintenance, will be less, and if compensating voltmeters are properly adjusted, better results will be obtained.

In reply to a query as to the practicability of using three pressure wires on a three-wire secondary system, Mr. Pyle said that a system of pressure wires having a common neutral would not indicate the pressure at the different parts of the system as well as separate neutrals would. In case of a bad balance on any part of the lighting system, the difference of potential between the two outside wires could remain standard, while the heavily loaded side would be low, and the lightly loaded side would be too high. Mr. Chas. H. Peters, of Durango, Colo., said that so far as he could see, there would be no objection to using three pressure wires upon a three-wire system, although the neutral pressure wires would be expensive. Mr. Pyle concurred, if the primary feeders are short; if the primary feeders are very long the maintenance of the pressure wires would be expensive.

Recent Electrochemical Developments.

Clinton Paul Townsend.

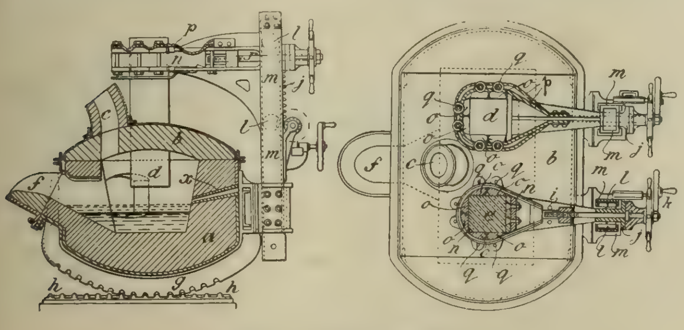
THE PRODUCTION OF OZONE.

It has long been known that the form assumed by the electric discharge through air determines the character of its chemical effect. For the production of the allotropic form of oxygen, known as ozone, the diffused discharge is best suited, whereas it is now shown by the work of Bradley and Lovejoy that the oxidation of nitrogen proceeds best in or around the high-voltage, direct-current arc. The spark occupies a middle ground in respect to both reactions, having as regards the oxidation of nitrogen about one-eighth of the efficiency of the arc, and exhibiting a somewhat larger fraction of the ozonizing power of the diffused discharge. It is, therefore, merely a coincidence that the nitrifying device and the ozonizer should, in their latest development, so closely approach each other that the distinctive feature of each is the passage of the discharge between relatively moving terminals.

In the nitrifying device the purpose is to strike, elongate and extinguish a number of arcs in rapid succession; in the ozonizer it is to quickly extinguish any arcs which may form, such arcs bearing the relation to the diffused discharge of a short-circuit. In the ozonizer the result may be accomplished by the rotation of one or both electrodes, or by the movement relatively to either of a dielectric skeleton frame. Each of these forms has been described by M. Marius Oto, of Neuilly, France. In the several forms heretofore described, the diffused discharge passes between a series of points carried by the respective terminals; in the latest type of apparatus, however, plane discs are used, the two outer ones being stationary, water-cooled, and of the same polarity, while the central revoluble disc forms the opposite terminal. Provision is made for interrupting such arcs as may form by facing the inner side of each stationary plate with a thin dielectric film, and by inserting into the revolving plate a series of radial strips of ebonite. The usual provision is made for distributing the current of air over the opposing surfaces of the plates.

ELECTRIC FURNACE.

An electric furnace for the direct production of steel is the invention of M. Paul Louis Toussaint Héroult, of La Praz, France. The dominant idea of a Bessemer converter, swung upon trunnions and fitted with tuyeres, but provided also with electrodes as an auxiliary means for furnishing the heat necessary for maintaining the metal in fusion, appeared early in the history of the art, and reappears in



HEROULT ELECTRIC FURNACE.

the present device. In the usual converter the heat is derived from the oxidation of silicon, phosphorus, and other metalloids present as impurities, and the addition thereto of means for maintaining the heat in the absence of such impurities considerably extends the field of converter operations. The furnace itself is simply constructed, as shown herewith; it is of the usual converter form, provided with a lining, *a*, *b*, pouring lip, *f*, chimney, *c*, and is mounted for oscillation upon combined cog and guide-rails, *g*, *h*.

The electrodes, *d*, are two in number, and the arcs are struck in series, thereby avoiding the necessity for an electrical connection to the metal. These electrodes are carried by standards, *m*, rigidly attached to the converter, whose movement they therefore share. The terminal connections, *p*, *q*, to the carbons, *d*, are through a series of copper wedges, *o*, forced between the carbon and a surrounding metal collar, *n*. The tuyeres, *x*, lead from a wind-chest carried between the base of the converter and the standards, *m*. For the rack and pinion, *h*, *l*, *j*, shown as serving for adjusting the carbons, the inventor suggests and claims the substitution of hydraulic cylinders; the same devices may also be employed for oscillating the furnace Instead of the lip *f*, the mouth of the converter may be prolonged into a ladle, from which the metal may be cast direct.

SOLUTION OF MINERAL PHOSPHATES.

Messrs. Wiborgh and Palmaer, of Stockholm, Sweden, patent a process for converting the insoluble or mineral phosphates into the so-called reverted salts—a process so rational and withal so simple that it is somewhat remarkable that it has not been before suggested. There are three distinct phosphates of calcium, the mono-, di- and tri-basic salts, the first being soluble in water, the second in certain neutral salt solutions, and the third in acids. Agricultural value decreases in the order named. The present process contemplates the conversion of the tri-basic or insoluble phosphate into the di-basic salt, and consists merely in placing the ground rock in the anode compartment of a diaphragmed cell, containing as an electrolyte a solution of any salt, as the nitrate of an alkali metal, whose acid radical forms a soluble combination with calcium. The phosphate dissolves in the acid liberated at the anode, to be reprecipitated in the di-basic form by the base which is simultaneously formed at the cathode; the reactions involve the regeneration of the electrolyte. In commenting a few months ago upon the Cheeseman process for the solution of natural phosphates, it was remarked that the efficiency of the method would be increased if the solvent effect were limited to the immediate region of the anode; this is, in fact, the principle of the present method.

President Roosevelt in a Trolley Accident.

On Wednesday of this week, President Roosevelt had a narrow escape from death while on his way in a carriage from Pittsfield to Lenox, Mass. The carriage was run down and wrecked by a trolley car, William Craig, a secret service agent, who was acting as a body-guard to the President, being instantly killed. The President received a blow on the right side of the face, which caused the swelling of the right cheek and the blackening of his right eye. Blood was drawn from a scratch on the cheek. With the President in the carriage were Governor Crane, of Massachusetts, and the President's secretary, Mr. G. B. Cortelyou, both of whom were bruised and cut.

The evidence that has been gathered so far points to the conclusion that the accident which brought about these casualties was due to the desire of a Pittsfield electric railway motorman to get his passengers to the Country Club before the President's cavalcade should pass the house. The motorman, Luke Madden, a new man at his employment, was arrested, as was the conductor, James Kelly.

The accident occurred about 3½ miles out of Pittsfield, about 200 yards from the Country Club, toward which the President and some of his party were being taken.

The President, after assuring the members of his party that he was not seriously hurt, approached the motorman, and, shaking his fist under the latter's nose, said "If your car got out of control, if it got away from you, why, then, that is one thing. But if it is anything else, this is a damnable outrage!"

"You don't suppose I tried to do it, do you?" growled the motorman, who instinctively recognized Theodore Roosevelt. As the President turned away, the motorman shouted back to him, "Well, I had the right of way, anyway. You had a right to look out for yourselves."

After the wreck was cleared away and the injured were properly cared for, the presidential trip was resumed, but the sad event marred the pleasure of the remainder of the day.

Recovering Swallowed Gems.

A recent telegram to a daily paper from Greenwich, Conn., says: Mrs. W. McMaster Mill's diamonds, which her pet bulldog, Sport, swallowed on Tuesday afternoon while playing on the bed in the room where the jewels lay, were recovered to-day, and the animal has since been allowed his freedom. Mrs. Mills told her fellow-boarders at the Silleck House this morning that she had the three rings again, and that the dog had truly swallowed them, as she suspected. They were uninjured, Sport having taken them like pills. The dog had been under a veterinary's care, and last night X-ray were used on him, and the location of the jewels was discovered.

New Telephone Patents.

Patents on telephone receivers have been happily rather scarce of late, and it is the irony of fate that the single telephone patent of the issue of August 19th should relate to the freakiest kind of a freak receiver. Mr. Lemuel Mellett, of Somerville, Mass., who is responsible for this addition to the innumerable family of telephone receivers, with the aim to make a receiver more sensitive and loud-speaking, not only suspends the diaphragm between two springs but mounts in the case a number of "harmonic vibrators," adapted to vibrate in sympathy with the diaphragm and so to reinforce its vibrations.

Referring to the drawings, 1 is a cup-shaped steel casing in which is mounted magnet-core, 2, carrying coil, 3. The core, 2, forms one pole of the magnet, and the periphery of case, 1, the other. The diaphragm is simply held in place by cover or ear-piece, 7, and not clamped down tightly on 1 by it. The center of the diaphragm is supported between two conical-coiled springs, 9, 10, one of which rests against the lower side of the cover 7, and the other on the top of the coil 3. This method of suspending the diaphragm allows of the use of a thinner diaphragm than is ordinarily employed, which "will vibrate more freely in all portions, and thus give better acoustic effects." The function of the "harmonic vibrators" had best be described in the inventor's own words: "In the space behind the diaphragm, 6, I locate a series of harmonic vibrators, 11, 12, having their outer ends secured to the side wall of the casing, 1, and their inner ends left free to vibrate, and directed radially inward toward the center of the casing. These vibrators, which are shown both in the form of reeds and of small helical springs, are of different lengths, so as to emit different fundamental tones when vibrated.

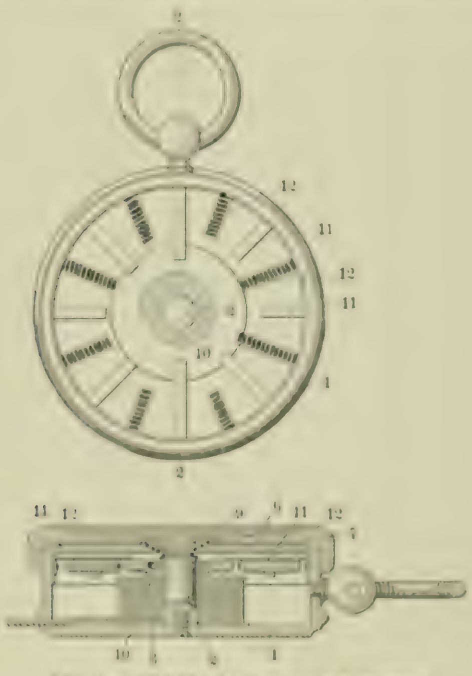


FIG. 1.—MELLETT TELEPHONE RECEIVER

and are shown as 10 in number, corresponding to two octaves. A greater or less number of vibrators may be provided, or vibrators of a different character. When the diaphragm, 6, is set in vibration by a magnetic impulse, received in the electromagnet, emitting a given tone or tones, one or more of the vibrators, 11, 12, will be sympathetically or consonantly vibrated and will have the effect of reinforcing and perpetuating the vibration of the diaphragm, and thus increasing the loudness of the tone emitted thereby." It seems that Mr. Mellett has invented a transmitter which is also garnished with "harmonic vibrators," for he says that "in connection with a receiver of this character the best results are obtained by employing a transmitter constructed as described in a patent, No. 667,546, granted to me February 5, 1901, and tuning the vibrators in each instrument alike."

The issue of August 26 contributes but one patent to telephony, covering a circuit-closing device, the invention of Mr. A. B. Chance, of Centralia, Mo. The object of the invention is to dispense with the use of a generator at the subscriber's station and to provide means actuated by the receiver hook for calling central and for automatically throwing the drop or annunciator at the central office to secure a positive "ring-off."

Referring to the drawings, that to the left shows a diagram of connections, and the others details of the improved switch-hook. The usual contacts for cutting off the bell circuit and throwing on the talking circuit are made by the rear extension of the hook by means of the bridge piece 9, which makes contact with the upper spring 10 when the hook is down, and with

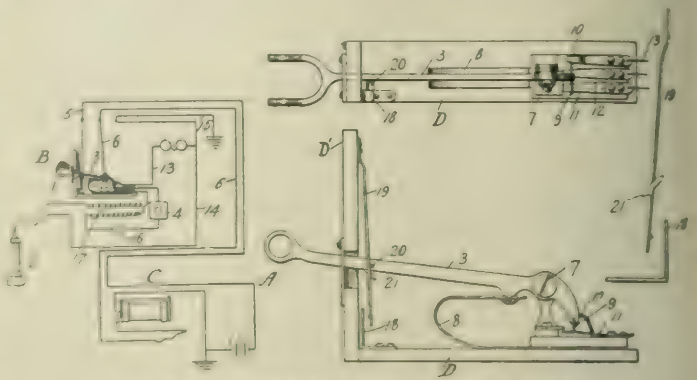


FIG. 2.—CHANCE AUTOMATIC CIRCUIT CLOSER

the two lower springs 11 and 12 when the hook is up. The circuit-closing device consists of the contact plate 18, to which line wire 5 is connected, and the spring 19 having on one side an inclined contact-piece 21. The pin 20 on the hook rides on the under cam surface of 21 when the hook is raised, pressing spring 19 outward, and on the upper surface when the hook is depressed, then forcing 19 into contact with 18 and so completing the circuit between the two line wires, by 6, hook 3, pin 20, plate 21 and spring 19, causing the battery to throw drop *C*.

To call, the subscriber after removing the receiver presses the hook down, thus closing 19 on 18 and throwing the drop; he then releases the hook and in returing pin 20 rides underneath 21 and clears it. When the receiver is replaced, 19 is again closed on 18 giving a "ring-off" signal. Mr. Chance's little device is ingenious, but the modern common battery system is even a little more automatic.

A patent not previously noticed, which was granted July 22 to Arthur T. M. Thomson, of East Dulwich, England, covers an idea in the location of supervisory signal lamps which is not likely to be of much practical value. Mr. Thomson's improvement consists in setting the lamp in the base of the plug. The drawing shows the suggestion sufficiently not to need any description. We say "suggestion" because such a plug would be so unhandy and so difficult to dispose of in a telephone switchboard that no sane telephone engineer would dream of putting it there. Plugs and cords give quite enough trouble at present, and a miniature incandescent lamp is much better off in a stationary socket.

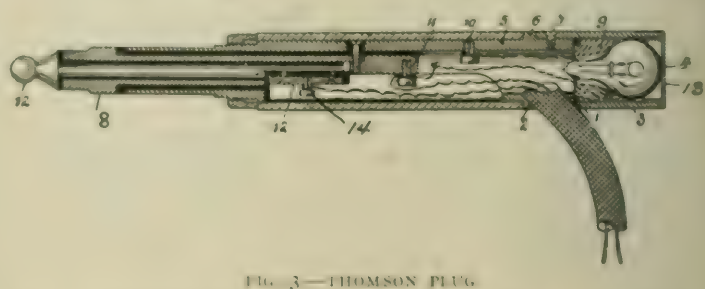


FIG. 3.—THOMSON PLUG

The Alaska Cable.

News has been received at San Francisco, via the steamer "Cottage City" that the cable between Skagway and Juneau is again in working order. Sergt. Bruck opened it for commercial dispatches August 25. The cable has given a great deal of trouble, but it is said to be giving good service now, and little further trouble is anticipated.

CURRENT NEWS AND NOTES.

BERLIN'S LAST HORSE-CAR.—A cable dispatch from Berlin says: "The last horse-car has disappeared from Berlin's streets, owing to the abolition of that means of transportation in favor of more modern conveyances." In this dispatch "more modern conveyances" means the plain old-fashioned trolley, among other things.

THE HIGHEST LIGHTING PLANT was recently illustrated and described by *Harper's Weekly* as being in Bogota, South America, at an elevation of 8,300 feet above sea level. Mr. W. R. Swank, of Stratton's Independence gold mine, in the Cripple Creek district, Colorado, now claims the "highest" for that mine, the elevation being 10,000 feet. Perhaps even this is not the highest in the world.

MARCONI AT WORK.—A cable dispatch from Ferrol, Spain, of August 30, says: "Signor Marconi, aboard the Italian cruiser "Carlo Alberto," says he is in constant communication with Berlin, as well as with British warships, from this station and from Cornwall. Signor Marconi declares that he has solved the problem of maintaining the integrity of individual simultaneous messages." Mr. Marconi was received recently by the Czar, and treated by him with great honor.

LIGHTING SQUABBLE AT HAVANA.—A cable dispatch from Havana, of August 30, says: The Municipal Council of Havana to-day passed, almost unanimously, a resolution asking the House of Representatives to impeach the Secretary of Public Works, Manuel Luciano Diaz, for granting a concession for the electric lighting of Havana, on the ground that the act of the secretary was unconstitutional, as the granting of municipal concessions is within the province of the Municipal Council only. It is thought that the House of Representatives, backed by the influence of the Municipal Council, may take some radical action in the matter.

NEWS FROM PARIS.—Max O'Rell, the well-known literatteur, is evidently a little off in his knowledge of electricity, as witness the following news furnished by him from Paris: "It is not sufficient for the Parisians to have to avoid their cabs which aim at them, or to do their best to get out of the way of the automobiles, which are allowed to go at the rate of 30 miles an hour in the main thoroughfares of Paris, but they will have to be careful to escape electrocution on the very wood pavements. In many parts of the French capital the street-car rails press so much on the wood pavement that the cables, which supply electricity, transform the surface into an electric battery. The other day, on the Avenue de la Republique, it was amusing to witness horses and foot passengers executing wild dances over which they had no control."

MISSISSIPPI POWER.—At the coming meeting of the Trans-Mississippi Commercial Congress, at St. Paul, a proposition will be submitted for damming the river at Keokuk, the foot of the Des Moines Rapids. If Congress will permit the obstruction, the fall will afford 60,000 electrical horse-power for commercial use. Between Leclaire and the cities of Rock Island and Davenport, the river falls 24 feet in 14 miles. Below this fall is another, between Montrose and Keokuk, where the river falls 23 feet in 12 miles. In addition to the normal fall there is another source of power in the flood water. The river fluctuates in level to the extent of 51 feet at Cairo, and the variation is about 15 feet as far down as New Orleans. All along this course there are valleys in which private enterprise might impound flood water, to be used for power after the main stream had fallen to its normal level.

N. E. L. A.—The National Electric Light Association reports the following new members: Akron, Ohio—The Northern Ohio Traction Company; Bellevue, Pa.—Ohio Valley Electric Company; Canon City, Colo.—The Colorado Electric Power Company; Danville, Pa.—Standard Electric Light Company; Dixon, Ill.—Dixon Power and Lighting Company; Ionia, Mich.—Ionia Electric Company; Kenosha, Wis.—Kenosha Gas and Electric Company; Leipsic, Ohio—Leipsic Electric Light, Heat and Power Plant; Lyons, N. Y.—Wayne Country Electric Company; Lynchburg, Pa.—Lynchburg Traction and Light Company; Niagara Falls, N. Y.—Buffalo and Niagara Falls Electric Light and Power Company; Pottsdam, N. Y.—The Pottsdam Electric Light and Power Company; Pocatello, Idaho—The American Falls Power, Light and Water Company; Richfield Springs, N. Y.—Richfield Springs Electric Light and Power Company; Rhinelander, Wis.—Rhinelander Lighting Company; Stockton, Calif.—Stockton Gas and Electric Company; Waynesboro, Pa.—Waynesboro Electric Light and Power Company. The Association has just issued a printed list of membership up to August 1.

AMERICAN ELECTRIC AND AUTOMOBILE PATENTS MONTHLY.—The third issue of this important patent publication covers the month of March. Every patent issued during that month relating to electricity and automobiles is represented by all of the drawings, a brief of the specifications and all of the claims. A feature of particular value is an appendix, giving the number, name and date of references cited in examination of applications. As an example, we quote the following references to the transformer patent, granted March 18 to Thomson and Houston on an application filed Feb. 19, 1887. The numbers refer to patents cited: Zipernowski et al., 352,105, Nov. 2, 1888, and March 3, 1885, Austria; Gaulard & Gibbs, 351,589. Oct. 28, 1886; see article in *Engineering*, March 3, 1888, p. 205; Ripley, 347,642, August 17, 1886; 14,190, 1852, England. Interference with application of W. K. Freeman, Astoria, N. Y.; A. Bernstein, Boston, Mass.; R. M. Hunter, Philadelphia, Pa.; patent to Gaulard & Gibbs, Oct. 28, 1886, 351,589; E. Thomson, Lynn, Mass., and E. Thomson, Lynn, Mass.; decision unfavorable. Interference with application of W. K. Freeman, Brooklyn, N. Y.; Westinghouse Electric Company, Pittsburg, Pa., and J. D. Gibbs, Middlesex County, England; decision favorable to Freeman. Another patent granted to Alfred C. Gilmore on an automatic telegraph was the subject of 24 citations of patents, dating from 1868 to 1901.

MERCURY VAPOR LAMP.—In his experiments with mercury vapor lamps, Mr. Cooper-Hewitt established that a fixed relation should exist between the cross-sectional area of a tube and its surface. It has also been found that the highest efficiency is obtained with a small area of cross-section and a large section of surface. In a patent, issued August 26, to Henry Noel Potter, it is also stated to be advantageous to increase the radiating surface and decrease the cross-section of the luminous stream, for the specific reasons that the portions of gas or vapor lying near the surface of the luminous stream are somewhat opaque to the light rays given off by the more central portions of the gas, and that the vapor mercury has a temperature of maximum efficiency beyond which it is easily possible to heat it. To meet these several conditions a tube is described, the central portion of which is occupied by a glass rod or tube, thereby confining the vapor stream to a contracted annular passage; and to counteract the tendency of the mercury vapor to become heated to a temperature above that of maximum efficiency, the vapor tube is surrounded by a vacuum jacket of glass. Another detail consists in the use of a heating wire coiled about the vapor tube. The arrangement of circuits is such that in starting up, a current is passed about this heating coil in order to warm up the vapor of the lamp, and as soon as sufficient conductance has been thus obtained, the heating circuit is automatically interrupted and the tube operates normally.

LETTERS TO THE EDITORS.

Graphical Calculation of Synchronous Motors.

To the Editors of Electrical World and Engineer:

Sirs.—From Prof. Blondel's letter in your issue of August 16, it would appear that he considers that I made use without due credit of material published by him. In this connection I wish to say that I never read any of the articles to which Prof. Blondel refers, and that the method which I published in your columns of May 17, 1902, is an application of a general method of making alternating current calculations developed and published by me under the title of "An Alternating Current Calculating Device."

STANFORD UNIVERSITY, CAL. F. G. BAUM.

Humming of Telephone Wires.

To the Editors of Electrical World and Engineer:

Sirs.—On page 175 of your journal of August 2, 1902, it is stated that Mason Grover, of Bidwell, Ohio, has obtained a patent, dated

July 22 for a damper designed to prevent the humming of telephone wires I take the liberty of observing that this is a very old device. The German Reichs-Post has been using these rubber dampers for the past fifteen years. It is a well-known fact that in Germany all telephone wires are aerial and carried over the house-tops on iron poles fastened to the roofs and spaced about 150 feet apart. These iron poles are provided with iron cross arms, which are the points of attachment and support for the wires. In order to prevent the noise in the wires produced by vibrations of the air and which noise is transmitted through the entire house or houses used as a support for such wires, especially for the winter months, the German Reichs-Post uses these rubber dampers and by them deadens the singing of the wires. The rubber cylinder is about four inches long and one-half inch in diameter, and is split lengthwise. After the rubber cylinder is in place on the conductor it is bound spirally with very fine wire to keep it in place. Thus you see this so-called invention is as old as Methusalem.

New York City. Geo. D. Roedelsperger.

DIGEST
OF
Current Electrical Literature.

Dynamos, Motors and Transformers.

Rating of Motors and Generators.—Rasch.—His recent Internat. Tramway Union paper in full. It is a report on the question what basis should one adopt in estimating the power of motors and generators, taking into account the different elements which may enter into this calculation, such as output, speed, torque, heating, etc. In rating the power of a motor, a distinction should be made between the power received by the motor and that given out by it. He, therefore, recommends the German terminology, according to which mechanical power should always be given in horse-power, and electric power in watts. It follows that a motor of 25-hp is always a motor which gives out, and not one that receives, 25-hp. In giving the power of a motor there should always be added to it an indication of the kind of service—whether intermittent service or momentary service or continuous service and when dealing with a momentary or intermittent service there should also be given the number of hours corresponding to the length of the service. It is, in fact, evident that the same machine may for each of the three categories of service yield quite different powers. The German regulations determine as the normal power of a traction motor that which in the test room can be yielded during one hour without causing the temperature to rise above the admissible limits. The author thinks that the trial of one hour is insufficient. He gives a formula for determining the duration of the test, according to the conditions of the service. The number of hours during which the motor should be tested under full load is the excess of the temperature over that of the atmosphere, multiplied by the number of hours during which the motor is working in service, divided by the sum of the temperature excess and 28 times the number of hours during which the motor is not subjected to the electric current. Concerning overload, tramway engineers are, in general, of the opinion that an overload of 40 per cent. during three minutes should be regarded as insufficient. One company suggests an overload of 100 per cent. during some seconds, another one goes as far as even to require this overload for a period of five minutes, and requires at the same time that the limit of admissible heating shall be diminished by 20° C.; the author does not believe that this diminution is justified. Concerning the limit of temperature, he quotes the results obtained by Dettmar: a temperature of 95° C. may be considered as perfectly admissible for stationary windings; on the contrary, for the rotating coils this temperature of 95° C. should be regarded as an extreme one, and is not to be allowed in a well-adjusted machine. Besides, as an atmospheric temperature of 35° C. is in no way extraordinary, it results in the case of a cotton insulation that a limit of 60° C. overheating is permissible. The author suggests that a manufacturer should give for half-load, normal load, and 50 per cent. overload, the following: the current in amperes, the torque in kilogram meters, the number of revolutions per minute, and the efficiency. Concerning efficiency, it will be necessary to specify in every case if the efficiency of the motor alone is required or that of the whole car. This latter information will naturally be asked for, when the motors and car trucks are ordered from the same factory.—Lond. *Elec.*, August 8.

Definition of Armature.—Singer.—A communication in which he recommends defining the armature (anker) of an electric machine as "that part in which the lines of magnetic flux, produced by the primary excitation, are to be closed."—*Elek. Zeit.*, July 24.

Dettmar.—A communication in which he criticizes the recent suggestion of Ziegenberg (duly noticed in the Digest), and defends the definition of the committee of standardization of the Association of German Electrical Engineers. In an induction motor, both stator and rotor are armatures; the one is the primary armature, the other the secondary armature.—*Elek. Zeit.*, July 24.

REFERENCE.

Frame for Alternators.—Boehmlaender.—A brief paper, read before the Berlin Electrical Society, on a new frame construction for alternating-current machines, used by Siemens & Halske. The construction is well shown in several illustrations.—*Elek. Zeit.*, July 24.

Power.

Electric Hoisting Machines in Mines.—A profusely illustrated article on electrically-driven hoisting machines. The first machines described are installed at a mine in Dortmund for hauling from a depth of 2,296 feet, 100 tons of coal per hour. The machine is worked by a 2,000-volt, three-phase induction motor, the armature of which is keyed directly on the pulley shaft. The starting and speed regulation of the motor are effected by a liquid resistance in the rotor circuit. Each of the three phases of the rotor circuit is led to electrode plates; these are insulated and suspended in a tank, in which circulates a solution of soda. As usual, the resistance in the circuit decreases in proportion as the solution is made to rise in the tank, causing the motor to run at a higher speed; full speed is reached when the solution is at its highest level in the tank. The power-house contains three 550-kw, three-phase alternators, the frequency being 50; they supply, besides the hoisting machine, an electric mining pump and apparatus, both in the mine and at the surface. Another installation in a mine in Saxony is also described. Direct-current motors are used here. The starting of the motors and the speed regulations are carried out without the aid of resistance in the main line, and, therefore, without energy losses. Each motor is always supplied by the corresponding dynamo with the necessary current at the required pressure. The dynamo is separately excited by a small exciting dynamo, worked by belting from the steam engine shaft. The controller of the hoisting machine is inserted in the exciting dynamo circuit.—Lond. *Eng'ing*, August 1.

REFERENCES.

Steam Turbines and Engines for Large Generating Stations.—A detailed account of the discussion which followed Fedden and Day's Mun. Elec. Ass'n. papers, recently noticed in the Digest.—Lond. *Elec.*, August 1.

Swiss Power Station.—Perkins.—An illustrated description of the central station of Romanshorn, Switzerland. The 2,250-volt, three-phase generators are driven by gas engines, their total capacity being 250-hp.—*Elec. Rev.*, August 9.

Traction.

Polyphase Traction.—Ziehl.—A communication in which he criticizes a statement in a recent paper of Niethammer, that "under otherwise equal conditions" a three-phase induction motor absorbs considerably more power and heats up more than a direct-current series motor. The advantage of the latter is that at starting, when the current increases, the magnetic flux also increases; as the torque is proportional to the product of magnetic flux and current, if the torque is increased, the maximum current is not increased to the same degree, nor the heat loss which is proportional to the square of the current. In three-phase induction motors, on the other hand, the field decreases during starting, and this is a disadvantage. But

this disadvantage can be avoided, if the motor is excited by the three phases with 1.73 times the voltage, *i. e.*, the motor is changed from star connection to delta connection, or what is the same, the phases of the transformer supplying the motor are changed in reversed direction. The latter arrangement is used by Siemens & Halske on their experimental high-speed motor-car. He shows that with this arrangement the three-phase induction motor is superior to the direct-current motor during starting in regard to heating. He claims that the three-phase motor is most suitable for fulfilling the problem to get the maximum power from the smallest space, and the highest efficiency with the best conditions of cooling. At the conclusion of his communication, he suggests the following, "mechanical connection in cascade" of one or two motors. Both case and armature revolve around the axle of the motor-car, for instance the armature with the axle rotates in one direction, while the case rotates in the opposite direction; the latter acts on a second axle through a gearing, or it may be connected mechanically to one part of another motor. Both motors mounted on one axle, are suitably so coupled that the armature of each motor is rigidly mechanically connected with the case of the other motor. When rotor and stator revolve with equal speed, a 200-hp, 50-periods, 4-pole motor, directly mounted on the axle, would give about 750 revolutions. Both armature and case transmit each 100 hp, *i. e.*, together 200 hp.—*Elek. Zeit.*, July 17.

Youngstown and Sharon Railway and Light Company.—An illustrated description of this recently completed system. The company owns a large number of electric light companies, street railway companies, gas companies, etc., which were operated independently in the district, and has consolidated these various properties into a unified whole. The various electric power stations of the companies entering into the combination have been discarded, and one central power station has been built for the operation of the entire system. The new central station has a capacity of over 2,000 kw, generating two-phase current at 2,250 volts and 60 cycles. This is stepped-up to 10,000 volts, three-phase, and transmitted to three substations on the different divisions. Lighting circuits are supplied from the same station. The business of the company has so far exceeded the original estimates, that a 1,000-kw generating unit is in contemplation. There are two transmission circuits, so arranged that they may be operated independently or in parallel, as the conditions demand. At times of heavy load the railway, lighting and power business is operated in parallel; but at times, when the load is comparatively light, better results are obtained by operating the light separately from the railway and power circuits, and this method has been adopted. The substations contain 200-kw rotary converters, each station having two machines. Two of the substations contain storage batteries, one of 160 amp.-hours, and the other of 240 amp.-hours. The rail in the streets of the towns is of girder section, but where the track runs on the company's own right of way, T-rail is used. Copper bonds are placed under the plates of the rail joints, and cross-bonds are used every 500 feet. Double trolley wire is used throughout. It also has an electric locomotive equipped with air-brake apparatus and hose couplings, and can be attached to a number of standard steam railroad freight cars if desired. This locomotive has detachable noses, so that it can be used as a snow plow if desired.—*St. R'y Jour.*, August 2, and *Internat. Ed.*, August.

Municipal Ownership in England.—PORTER.—A brief history of the present movement, in England, in opposition to municipal ownership, and a summary of the effects which have been produced by the various municipal undertakings now in existence. The backward condition of electrical industries in England is in a very large measure due to the operation of the tramway act of 1870, which enables municipalities to come in at the end of 21 years of operation by private enterprise and practically confiscate the property and goodwill. With the expection of two or three exceptionally well-managed companies' plants, British municipal plants are never so well nor so economically operated as the private plants, nor do they serve the public so advantageously. Electric lighting is found to be in a similar condition. Public ownership of telegraph and telephone franchises has created a great stagnation, and the government lines have complete monopoly, which militates strongly against efficient service.—*St. R'y Jour.*, August 2, and *Internat. Ed.*, August.

Electrolysis in Water Pipes.—HUMPHREYS.—A paper read before the British Association of Waterworks Engineers. He gives a general review of the subject, but does not seem to give anything new. There is an appendix, containing the report of a special committee on this subject. In this report it is said that there is no known practical method by which owners of underground pipes can protect themselves against electrolytic injury from single trolley currents, but that there are two methods of operating electric railways by which the return currents are kept out of the ground; the conduit system and the double-trolley system. The conduit system is peculiarly adapted to the larger cities; the double-trolley system, it is claimed, "is entirely practical, possesses many advantages over the single trolley, is more economical in operation and maintenance, and completely stops the injury to the pipes." No connections should be made between pipes and rails or other return conductors.—Lond. *Elec. Eng.*, August 8.

REFERENCE.

Current Distribution on Railroad Networks.—PFORR.—An article in which he describes a graphical method for determining the current distribution in electric railroad lines. He first considers the case of several power houses situated along a single line, at a greater or smaller distance from the road. After that he considers the case in which the line branches into several roads. The method used by the author is a graphical one, and an extension of an older method described by him.—*Elek. Zeit.*, July 24.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Sparking in Switches.—RUSSELL.—A summary of an investigation of Paterson and himself, in which he reaches the following conclusions: The spark at break ought to be taken as a guide to the rating of a switch for use on direct-current circuits. The shape of the terminals does not make much difference in the length of the spark. The effect of increasing the speed of the break above that ordinary used is small. The effect of a double break is to make the length of the sparks the same as the length of a spark with the same current at half the voltage. The difference in the length of the spark when copper, steel or zinc is used is not great. In small double-break switches for use on circuits of 200 volts and upwards, when the trailing spark just fails to bridge the air-gap, the factor of safety is 2. In double-break switches for large currents under the same circumstances, the factor of safety is greater than 2.—Lond. *Elec. Times*, July 31.

REFERENCES.

German Central Station.—GASSNER.—An illustrated description of the central station of Ludwigshafen. It contains at present three 400-hp generating units, while space is available to increase the capacity to 6,000 hp. The three-phase current system is used, the voltage of transmission being 3,000; in transformer stations the voltage is reduced to 125, and from there the secondary network is supplied. The direct-current for traction is generated in the power house itself, the direct-current dynamos being mounted on the same axle with the three-phase generators.—*Elek. Zeit.*, July 24.

Earthing.—PROCTOR.—His Mun. Elec. Ass'n. paper in full, together with a detailed account of the discussion which followed, abstracts of which have been noticed recently in the Digest.—Lond. *Elec.*, August 1.

High-Tension Switches.—SCHUH.—An illustrated article on switches and circuit breakers of a Swiss company, in which the well-known horn arrangement is used.—*Elek. Zeit.*, July 24.

WIRES, WIRING AND CONDUITS.

Electric Resistance of Insulators.—ROOD.—An account of measurements of the internal resistance and of the surface resistance of glass, quartz, mica, ebonite and guttapercha. The following values of the internal resistance refer to a plate of one square cm. in area and a thickness of one mm.; quartz, 885,000 ohms; guttapercha, 18,-500,000 ohms; ebonite, 55,000,000; mica, 133,000,000. The following values of the surface resistance refer to "one surface of one sq. cm. between the terminals;" commercial window glass, 1,590,000 ohms; cobalt glass, 22,000,000 ohms; mica, 50,760,000; guttapercha, 432,000,-000; quartz, 521,000,000; ebonite, 2,000,000,000 ohms. These values are to be regarded only as first approximates.—*Am. Jour. Sc.*, August.

ELECTRO-PHYSICS AND MAGNETISM.

Cremieu's Experiments.—CREMIEU.—A description of some further experiments made to meet the objections raised against his results. He claims to have experimental certainty that in the electric convection experiment a charge is carried along with its ponderable support; that only this charge acts upon the magnetometer, and that no appre-

ciable loss of charge occurs during the movement. The convection apparatus consists of a horizontal [illegible] disc 24.4 cm. in diameter, with a sector of gilt micanite. The observations showed impulses upon the magnetic system whenever the sectors were charged or discharged, and usually in the sense in which a permanent deflection could be theoretically expected. Sometimes, also, there was a slight permanent deflection in the expected sense, but both impulses and deflection died away as the apparatus continued working. No quantitative relation between the amount of charge and the deviation could be detected. On reversing the disc with uncharged sectors, the deflections also occur occasionally, but in the opposite sense. The sectors were charged and discharged during every revolution.—*Comptes Rendus*, July 7; *L'Eclairage Elec.*, July 26; abstracted in Lond. *Elec.*, August 1.

Magnetic Effect of Electric Displacement.—WHITEHEAD.—An account of an experimental investigation. Maxwell assumes that the phenomenon of polarization in a dielectric consists of an actual propagation or displacement of charge in the direction of polarization, and that the "displacement current" has the same magnetic effect as a conduction current, so that in the case of a condenser the magnetic effect in the neighborhood, incident upon any change of charge, would be due to the combined influence of the current in the charging wires and the displacement current in the dielectric. Such a direct magnetic effect of the displacement has, however, never been satisfactorily observed. The author has made a long series of experiments. In principle his method is to subject a piece of a dielectric to an alternating electric field, and also to an alternating magnetic field, the directions of the two being at right angles in space; to adjust the phases of the two to give the maximum effect of the displacement-current reaction against the magnetic field, and to look for motion of the dielectric in a direction perpendicular to the plane including the directions of the electric and magnetic fields. He used four different forms of apparatus, in each of which a block of dielectric was hung rigidly at each end of a light beam which was suspended horizontally on a quartz fiber attached at its center. The phase of either the electric or the magnetic field on one block being 180 degrees from that on the other, the other field having the same phase for each block, the reaction of the displacement current on the magnetic field would be opposite at the two ends of the beam, causing a couple to act on the fiber suspension. He made a great many experiments, the results of which are different, but the mass of the evidence of his research is against the presence of the magnetic effect of electric displacement in an amount given by Maxwell's theory. He intends to continue his investigation.—*Am. Jour. Sc.*, August.

Luminous Gas Surrounding a Wire.—BORGMANN.—A description of the peculiar light effects observed in a vacuum tube traversed from end to end by a fused-in wire, one end of which is free, the other is attached to a secondary pole of an induction coil; the other pole of which is put to earth. By putting a condenser between the tube and the coil, the intensity of the luminosity can be varied. He describes in detail the various phenomena noticed when the tube is joined to the positive or negative pole, and when the poles of the coil are joined by a spark-gap or not. The tube being attached to the positive pole, and a spark-gap being inserted in parallel, the wire is surrounded by a series of luminous lenses, which are subject to magnetic deflection. Under the influence of a strong magnetic field at right angles to the wire, the lenses incline to the axis of the tube, and then begin to move slowly in the direction of inclination; after moving a short distance they disappear, but new ones appear in their original places, the process being repeated indefinitely.—*Phys. Zeit.*, July 1; abstracted in Lond. *Elec.*, August 1.

[illegible]

Terrestrial Magnetism.—The June number contains a brief mathematical paper by Nippoldt, on a theorem on the Fourier series and its application in geophysics; a note by Bauer on the magnetic disturbance during the eruption of Mount Pelee, Martinique; a note in German, by Hausmann, on a disturbing factor in suspension on points for measurements of declination; a note in German, by Hellmann, on Gilbert's De Magnets; an article, by Leyst, on Paul Passalkij and his last work on terrestrial magnetism; a biographical sketch of Christopher Hansteen; a sketch, by Cady, of the life and work of Max Eschenhagen, and an article, by Birkeland, on the proposed magnetic researches of the Norwegian polar station in 1902-3.—*Terr. Mag.*, June.

ELECTRO-CHEMISTRY AND BATTERIES.

The Financial Basis and Design of Electrolytic Metal Refineries.—PHILIP.—The first part of an article giving various statistical data and formulas. He has for many years collected and tabulated all the available details in order to elaborate a connected scheme, by means of which the task of designing an electrolytic refinery upon a sound financial basis might be successfully undertaken. The general method adopted has been to arrive at a formula for any given item of outlay, expressed in terms of all the variables involved, and then to insert in this a constant or constants obtained by calculation from all the available trustworthy figures hitherto published with regard to the particular item of outlay under consideration. He thus arrives at a formula stating that the cost of the power plant must be proportional to the product of the annual output of refined copper and the current density. The cost of offices in pounds sterling is given at 150 plus one-tenth the number of tons refined per year. The area of refinery buildings for a given yearly output is inversely proportional to the current density; the area in square feet is given as 30 times the ratio of the number of tons refined per year to the current density in amperes per square foot (the constant 30 is an average value, the value of this constant in six different plants varying between 21.9 and 31.5). The cost of works buildings in pounds sterling is given as 7.5 times the ratio of the output in tons per year to the current density in amperes per square foot. The power required varies directly as the output per year, and also directly as the current density employed. If gas engines and gas-producer plant is installed, and if the prime cost of supply and erection of this plant is $60 per horse-power installed, then the prime cost of the plant in pounds sterling including erection of gas engine and producer plant may be fairly given as 0.12 times the product of the output in tons per year and the current density in amperes per square foot.—Lond. *Elec.*, August 1.

Goldschmidt Process.—HOULLEVIGNE.—An account of experiments in which he prepared pure zinc with the Goldschmidt process in which iron oxides are reduced by means of aluminum. He recommends the use of at least 3 kgr. of substance, aluminum filings sifted, washed in petroleum essence and dried, and pure sequioxide of iron, free from sulphur and carefully dried, in excess of about 15 per cent. over the amount required for the chemical reaction, and crucibles lined with magnesia. If a less amount of the reagents is used, the iron remains suspended in the shape of separate globules, in a cavernous mass surrounded by small crystals of corundum. The addition of 20 per cent. of powdered cryolite to the mass increases the fusibility and raises the yield from 30 to 53 per cent. The best commercial ferric oxide contains 98.2 per cent of the oxide, but the slightest trace of sulphur is very obnoxious. There is even greater difficulty in obtaining pure aluminum free from fatty matter. The best way is to wash the filings with petroleum essence and then dry them in a sand-bath, at 150 degrees, for several days.—*Jour. de Phys.*, May; abstracted in Lond. *Elec.*, August 8.

A Thermochemical Constant.—F. W. CLARKE.—A brief abstract of an A. A. A. S. paper. He studied the heats of combination of organic compounds, and after reducing to the gaseous form throughout, under uniform conditions of temperature and pressure, he finds that by the application of a definite formula, nearly every equation yields a constant which is identical in value with the neutralization constant of strong acids and gases. The average in 66 cases is 13.773 small calories. The conclusion is reached that the absolute heat of formation, from gaseous, dissociated atoms, of the aliphatic hydrocarbons and their simpler derivatives, is proportional to the number of atomic linkings within the molecule. In this calculation every linking counts as one, and single, double or triple unions between carbon atoms become identical as regards their thermal value. The conclusion is revolutionary, but it satisfies the equations which are otherwise indeterminate. The preliminary paper contains 66 verifications of the new law.—*Science*, August 22.

Exactness of Faraday's Law.—T. W. RICHARDS.—A brief abstract of an A. A. A. S. paper. He showed that Faraday's law holds with great accuracy for aqueous solutions and ordinary temperatures. The weight of silver deposited in the "porous cup voltameter" of Richards and Heimrod, was compared with the weight deposited by the same amp.-hours from a solution of argentic nitrate in fused sodic and potassic nitrates at 300 degrees; it was found that the weights were identical within the limits of error of the experiment, about 0.005 per cent. This investigation places Faraday's law among the most exact and invariable of the laws of nature.—*Science*, August 22.

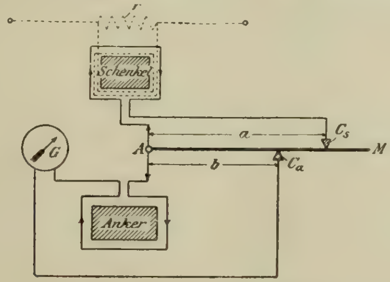
REFERENCES.

Purification of Water by Ozone.—An illustrated description of the Siemens & Halske experimental plant, for purifying water by ozone, near Berlin, which has been noticed before in the Digest.—*Sc. Am. Sup.*, August 23.

Electrolytic Production of Metals.—Koehler.—A paper read before the Canadian Mining Institute, on the electrolytic production of metals, with special reference to copper and nickel. A large number of processes are discussed.—*Sc. Am. Sup.*, August 23.

Units, Measurements and Instruments.

Zero Method for Magnetic Measurements.—Roth.—An illustrated description of a method which he has used for determining the stray field of direct-current dynamos. The arrangement is shown in the adjoining diagram for a shunt-wound dynamo; one winding is placed around one pole and another around the armature. G is a



MAGNETIC MEASUREMENTS.

galvanometer, Ca and Cs are contacts sliding along the wire AM; the resistances of this wire from A to the sliding contact points are a and b, respectively. A resistance, r, is connected in parallel with the exciting winding of the field poles, which is represented by dotted lines. When the machine has been excited, and the exciting current is suddenly interrupted, the disappearing magnetic flux, in the pole piece and the disappearing smaller flux in the armature, induce two e. m. fs. in their circuits. These two e. m. fs. are opposed to one another at the point A. If the rate of the decrease of the two fluxes is the same, the ratio of the two e. m. fs. is equal to the ratio of the two fluxes. For a certain relation between the positions of the two sliding contacts, there is no current, flowing through the galvanometer; this is the case when the ratio of the fluxes equals the ratio of $w + a$ to b, where w is the resistance of the winding around the polepiece together with the conductors to the wire AM. The resistance, w, may be eliminated if a position of the two sliding contacts is first found for which there is no current through G; the resistance of the wire AM from A to the two sliding contracts may be a and b respectively; then the position of both sliding contacts is changed, but in such a way that there is again no current through G, the resistances which were in the first case a and b, may now be A and B. Then the ratio of the two fluxes equals the ratio of $a - A$ to $b - B$. In reality, in making this test, the needle of the galvanometer in the first measurements is deflected to one side, and in the second to the other side; it cannot be made to remain at rest; this is because the coefficient of straying increases with increasing excitation. The measurement must be limited to a sufficiently short time interval.—*Elek. Zeit.*, July 24.

REFERENCE.

Testing the Magnetic Properties of Iron.—Epstein.—A rather sharp polemical answer to a recent communication of Benischke, on the regulations of the Association of German Electrical Engineers for testing the magnetic properties of iron.—*Elek. Zeit.*, July 24.

Telegraphy, Telephony and Signals.

REFERENCES.

Party Lines.—Zabel.—An illustrated article on the construction of party lines.—*Tel. Mag.*, July.

Wireless Telegraphy.—Collins.—The first part of an illustrated article, in which he gives a review of the theory of electric resonance and its relation to syntonic wireless telegraphy.—*Sc. Am.*, August 23.

Wireless Telegraphy.—Collins.—An illustrated description of Braun's system.—*Elec. Rev.*, August 16.

Miscellaneous.

REFERENCES.

Goldschmidt Process.—Goldschmidt.—A long, illustrated paper on his well-known process of getting high temperatures by means of aluminium, which has been repeatedly noticed in the Digest.—*Zeit. d. Oest. Ing. u. Arch. Ver.*, August 1.

Hospitalier.—A biographical sketch, with portrait, of Edouard Hospitalier, who will be the next president of the International Society of Electricians in Paris.—Lond. *Elec. Rev.*, August 8.

Dusseldorf Exhibition.—Hoffmann.—A profusely illustrated description of the exhibits of hauling and hoisting machines, tramways, elevators, etc., for mines. Also an illustrated description of an electric hoisting machine of Schuckert & Co.—*Glueckauf*, August 9.

New Books.

The Electrical Catechism. 533 Plain Answers to 533 Practical Questions About Electrical Apparatus. Compiled from the regular issues of *Power.* New York: Hill Publishing Company. 210 pages, 246 illustrations. Price, $2.00.

Text-books, arranged in catechism form, that is as a series of questions and answers, are especially attractive to some persons. While the present volume is not original in treatment nor particularly successful in exposition, readers of this class will find in it a great deal of useful information. Pains have evidently been taken to adapt the language to the understanding of the beginner, and the questions are as a rule well chosen. The subjects treated give an outline of the generation and distribution of electric light and power, including alternating currents. The general principles of dynamo and motor construction are given, and methods of wiring, measuring instruments and other apparatus are explained and illustrated.

The Electric Arc. By Hertha Ayrton, M. I. E. E. (London). New York: "The Electrician" Series, The D. Van Nostrand Company. 479 pages, 146 illustrations. Price, $5.00.

This book is so interesting that it reads like a novel. Yet it is a careful scientific story of experiment and deduction. It is probably the most complete scientific publication on the phenomena of the voltaic arc that has yet been published.

There are twelve chapters in the book. The first outlines the general appearance and phenomena of the arc. The second gives, in 77 pages, a short history of the arc and its laws. The bibliographic list of communications, extending over the nineteenth century, at the end of this chapter, include 111 references. The third chapter deals with the phenomena presented when the arc is first struck. The fourth chapter deals with the arc voltage as a function of the length and of the traversing current. The rule is enunciated that at constant current strength between solid carbons in the permanent state a straight-line law connects the voltage with the length.

Chapter V considers the crater, its area and other properties. The rule is stated that with silent constant-current arcs a straight-line law connects the voltage with crater area.

Chapter VI deals with the power of D. C. arcs employing solid carbons. Two very important conclusions are stated; viz.: (1) That at constant current and constant regime, a straight-line law connects the power with the length. (2) That at constant length and constant regime, a straight-line law connects the power with the current. As a consequence of these rules a rectangular hyperbole connects voltage with length when the current is variable, but after the permanent state has been attained.

Chapter VII discusses the P. D. between each carbon and the arc, and the results of experiments with inserted test electrodes.

The relations between the arc and its circuit, including the generator are ably discussed in Chapters VIII and IX.

Hissing arcs and their various phenomena are treated of in Chapter X. Much experimental evidence is adduced in support of the conclusion that the hissing of an arc is due to what might be described as its boiling over the edge of the crater and spilling over the sides beyond. There seems to be no escape from the conclusion, and it has important bearings upon all the phenomena of the arc.

Chapter XI considers the light emitted by the arc. It is stated that the light emitted in any direction is roughly proportional to the area of crater visible from that direction. It is also stated that owing to luminous absorption by the arc the most efficient arc would be obtained with infinitely thin carbons infinitely near together. For constant length of arc efficiency increases with the current.

The twelfth chapter is 60 pages in length and deals with the vexed question of the resistance of the arc versus its c. e. m. f. Most ob-

servers, have taken the position that nearly all the p. d. between the carbons of an arc is due to c. e. m. f., and only a relatively small residue is due to fall of potential due to resistance. A mass of experimental data are here adduced leading to the opposite conclusion; namely, that the arc has a relatively high resistance in its vapor and in its mist, and that the observed voltage at carbons is nearly all due to resistance, and only a small residue is attributable to an independent c. e. m. f. This seems to be a reasonable conclusion. There probably must be some thermo-electric e. m. f. in an arc; but this would be liberally estimated by allowing a volt for it. The remainder is reasonably accounted for by fall of potential through gas.

A supplementary biographical list of 35 references concludes the book, together with an index of 19 pages. Every page of the book bears evidence of careful work and an effort to preserve an unbiased attitude in a subject that is full of experimental difficulty and much debated.

There is room for a second volume on the phenomena of the alternating-current arc, which are treated at lesser length in this volume.

The writer is to be congratulated on the clearness of style and voluminous experimental data found in the book. It is an invaluable volume to the electrical engineer interested in arc lighting, and it is a very fascinating work to the general electrotechnician. Not the least interesting is the first page, with its beautiful dedication to Mme. Bodichon.

Die Elektrolyse des Wassers Ihre Durchfuhrung und Anwendung. By Viktor Engelhardt. Halle a. S.: Wilhelm Knapp. 117 pages, 90 illustrations. Price, 5 marks.

This publisher, the most important publisher of electrochemical works in Germany and probably in the world, is starting to print at regular intervals a series of monographs on applied electrochemistry, of which this is the first volume. These promise to be of considerable interest and value, as each is to be written entirely on one subject, by an authority on that subject. There is much valuable information lost to the world in patent literature and in the experience of those who have made special investigations in one subject. While the patents themselves are accessible, yet it frequently happens that in actual practice, processes are carried out slightly differently from the way they are described in the patents. In this series of volumes, each is to be a full, detailed report of the present state of that art, and of its development. It is not the intention to make them a general compilation of the present state of the arts as a whole, but they are intended rather as special reports, each complete in itself. It is intended that they shall include commercial data, costs and descriptions of installations, or in general they are to treat of applied or industrial electrochemistry as distinguished from the purely theoretical subject matter, but the latter is not to be excluded entirely, as the importance of theory in such applications is also recognized. The editor of the whole series is Mr. Engelhardt, who is at the same time the author of this first volume; he is the chief engineer and chief chemist of the Austrian branch of the Siemens & Hálske Company. We are pleased to add that like in most of Knapp's books, the usual type used by the rest of the world is to be employed in this series also, as distinguished from that objectionable, specifically German type, to which some of the less progressive German publishers still adhere. An effort is also being made to have these volumes translated into English.

The present volume, which is on the electrolysis of water, begins with a short historical introduction, followed by what he calls the constants, namely, the numerical data concerning oxygen and hydrogen and water, as used in its electrochemical decomposition. Then follows the main part of the book, which consists of illustrated descriptions of the various processes that have been patented or used in the industrial electrolysis of water. These are divided into those in which porous diaphragms of non-conducting material are used; then, those in which the diaphragms are entirely non-conducting and not porous, in which cases the current goes around them, the object of the diaphragms being to prevent the gases from mixing; and, lastly, those in which perforated conducting separators are used. Then comes a department in which are described the processes in which the mixed gases are gathered—that is, those in which no attempt is made to separate the components—and, lastly, a few processes in which the oxygen alone is gathered. The next chapter is on the applications, including the cost of installations, the operating costs, consumption of anodes and comparison of the electrolytic with the purely chemical or purely physical methods, the applications of the gases for producing high temperatures, lighting, soldering, power, blasting, ballooning, etc. The book is concluded with a number of tables, such as for the corrections for temperature and barometer, the tension and the conductivity of the electrolyte. Lastly, there is a short index of authors and inventors referred to in the book.

If all the subsequent volumes deal with their respective subjects as thoroughly as this one does, the series promises to become one of great value to the electrochemist, and it is to be hoped that arrangements for translating them into English will prove successful.

BOOKS RECEIVED.

Alternating-Current Machines. By Samuel Sheldon, Ph. D., and Hobart Mason, B. S. New York: D. Van Nostrand Company. 259 pages, 184 illustrations. Price, $2.50.

Lehrbuch der Praktischen Physik. By Dr. F. Kohlrausch. Leipzig: B. G. Teubner. 810 pages, illustrated. Price 8.60 marks.

Directory of Electrical Societies, Etc.

American Electrochemical Society, Secretary, C. J. Reed, Philadelphia, Pa. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

American Street Railway Association, Secretary, T. C. Penington, 2020 State Street, Chicago, Ill. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

The American Electro-Therapeutic Association. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa. Next meeting, Mount Washington Hotel, White Mountains, N. H., Sept. 9, 1902.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

Indiana Electrical Association, Secretary, Hal. C. Kimbrough, Muncie, Ind. Next meeting, Indianapolis, Sept. 17 and 18, 1902.

Intermational Association of Municipal Electricians, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Northwestern Electrical Association, Secretary, Thos. R. Mercein, Milwaukee, Wis.

The Old-Time Telegraphers' and Historical Association, Secretary, John Brant, 195 Broadway, New York. Next meeting, Salt Lake City, Utah, Sept. 10, 11 and 12, 1902.

Pennsylvania State Street Railway Association, Secretary, John Ruth. Next meeting, York, Pa., Sept. 10, 1902.

U. S. Military Telegraph Corps, Secretary J. E. Pettit, Postal Telegraph Company, Chicago, Ill. Next meeting, Salt Lake City, Utah, Sept., 10, 11 and 12, 1902.

Vermont Electrical Association, Secretary, C. C. Wells, Middlebury, Vt.

Carborundum Manufacture at Niagara.

With the prospect of more power in the near future, the Carborunudm Company, of Niagara Falls, New York, is soon to build a new three-story brick building which has been long contemplated. Cramped for room, a new office building was erected by them but a short time since. This company uses at present about two thousand electrical hp, and takes current from each of the two phases for its electric furnaces. When current is shut off from a furnace where it has been continuously applied for from twenty-four to thirty-six hours, it is applied to another furnace. The usual length of time the current is shut off is nine or ten minutes. The transformer attendant at the Carborundum works always notifies the electrician on the

switchboard at the power house when a load is to be taken off or put on. In putting on a new furnace, the load increases gradually until the mass comprising the furnace has become thoroughly heated and the load practically uniform.

One of the switchboard troubles was formerly due to leaking current, and was overcome by open work in the specially built board, to prevent "creeping."

When a furnace has been cooled off and its contents assorted, traces of graphite are often found. This fact led Mr. Acheson to experiment along that line, and finally to manufacture graphite on a large scale, in a large building adjoining the works of the Carborundum Co., on the upper Niagara, a short distance above the power house.

Power Plant of the Buffalo Forge Company.

The economy of electric power distribution is well illustrated in the plant of the Buffalo Forge Company. In the six shops comprising its plant, and occupying an entire block in the central part of the city, electric drive is employed exclusively. Formerly Niagara power alone was used on the drive, and the boilers used simply for testing and for heating the plant. The plant now installed is of sufficient size to enable it to utilize at all times the full steaming capacity of its boilers. The power thus developed is used in connection with that received from the Falls.

The boiler plant consists of a battery of two 125-hp return-tubular Erie City boilers, supplied with induced draft. Furnishing power to the shops, and supplementing the Niagara power are two 100-kw, direct-current General Electric dynamos, each direct-connected to a 12 and 20 by 14-inch horizontal tandem compound Buffalo engine, running non-condensing. A 30-hp air compressor, belted to a single vertical engine, drives the pneumatic hoists and small pneumatic tools throughout the shops. The 40-hp generator used in lighting the offices completes the equipment.

The offices and shops are heated by the hot blast system. By means of steam-driven fans the air is drawn through the steam coils of the heater and distributed through galvanized iron pipes or ducts to all parts of the various buildings. By this arrangement a uniform temperature of 60 degrees in the shops and 70 degrees in the offices is maintained with great economy. The heaters, except in extremely cold weather, require only the exhaust steam from the power plant and their own engines. The cost of running both power plant and heating plant together is thus practically no greater than running either one alone, since the engine is capable of converting only about 10 per cent. of the calorific value of the steam into work.

Besides providing for the above uses, considerable boiler power is required at times for the tests. These comprise running and power tests of engines, from the smallest fan engines to 300-hp, high-speed compound engines, tests of the various types of belted exhaust fans and blowers, and of electric and fan units direct connected to high-speed engines. The demand for power in these tests is very irregular. While on occasions it may reach as high as 300-hp, the usual peaks are about 150-hp, and the average load about 80-hp. The average load on the boilers is about 300 boiler hp, with peaks of about 450 boiler hp, or loads from 120 per cent. to nearly 200 per cent. of the rated boiler hp.

Of particular interest in this connection is the great increase in capacity and ultimate economy in operation of the boiler effected by the use of high intensities of draft. The induced draft plant consists of a special 90-inch full housing bottom, horizontal discharge exhaust fan exhausting from the smoke breeching, and discharging into a short stack. It has an overhung blast wheel driven by a 4½-in. x 5-in. direct-connected, single vertical engine, capable of running the fan at speeds varying from 300 to 600 r. p. m., and producing corresponding drafts of from one-half to two and one-fourth inches of water, with the flue gas at a temperature of approximately 500° F. A Foster regulator automatically governs the speed of the engine to produce the proper draft to maintain a constant steam pressure in the boilers.

By this arrangement demands for steam are readily met to double the rated capacities of the boiler, without noticeable decrease in pressure and with no other attention than to proper firing and water supply. Nor does this high rate of driving lower the efficiency of the boiler as one might naturally suppose. With a ratio of heating surface to grate surface of 45 to 1, which is usual in boilers made at the present time, the loss of heat in the flue gas at double the rated performance is only about 4 per cent. more of the total heat of the coal than at the rated capacity, while the radiation loss remains practically constant for all rates of driving, and is, therefore, reduced from about 12 per cent. to nearly 6 per cent. of the total heat of the coal. This shows the total efficiency of the boiler to be about the same. If the maximum capacity of the plant were increased by doubling the number of boilers instead of increasing the performance by increased rate of combustion, twice as much coal would be required in keeping up steam throughout the 24 hours a day. This, in plants having irregular loads for 10 hours a day, amounts to a considerable portion of the coal bill, which we see is greatly reduced by resorting to higher rates of driving at the peaks and employing fewer boilers.

In the instance of such a manufacturing establishment as the above, it is seen that the power developed by utilizing at all times the full capacity of the boiler plant will cost far less than central station power. Each additional electric horse-power within the capacity of the boiler will require but from two and one-half to three and one-half additional pounds of coal per hour. The additional cost of such power will, therefore, be only about \$.0044 per hp-hour for coal, or only about \$.0053, including cost of maintenance and interest on cost of engines, dynamos, power-house, etc. When generated in connection with the heating plant the cost of the additional power will be that of maintenance, etc., or \$.0008 to \$.0010 per hp-hour, plus \$.0005 for fuel.

Oil Switches.

The increasing use of high voltages has naturally led to many problems in switching, and in the solution of those the oil switch has come to the front. Of this type of switch we illustrate one of the latest forms made by the General Electric Company.

The form of switch shown is electrically opened and closed by hand. All of the live parts are supported from a single base or frame which constitutes the top of the switch, and the complete switch may be attached to any appropriate support as a single piece of apparatus. The mechanism consists of one or more metal contact pieces, depending upon whether the switch be single, or double, or triple pole. Each contact piece is carried upon a rod of specially treated wood. The rod or rods are connected to a crosshead, which, when operated by the system of levers, moves in a vertical plane. The clips with which the contact pieces make connection are supported from the frame by porcelain insulators thoroughly insulating all live parts. The switch is closed when the contact pieces are in their upper position,

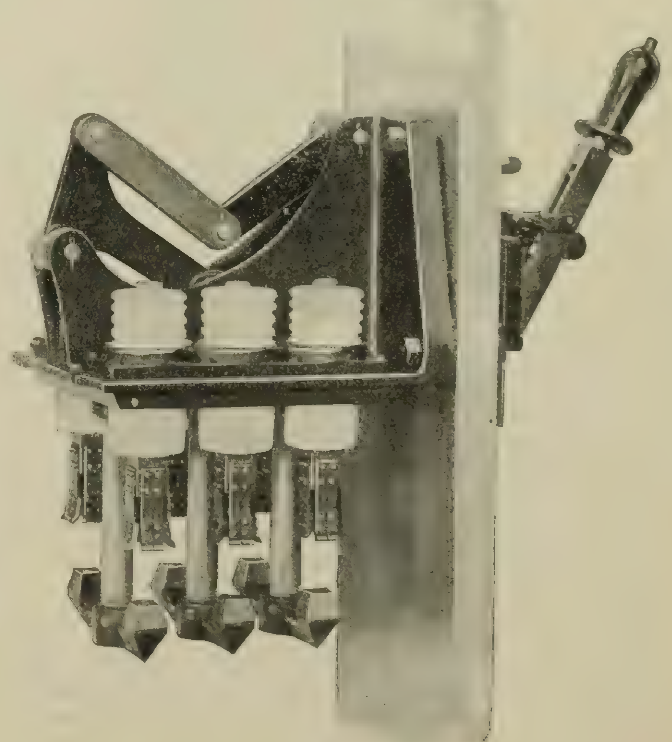


FIG. 1.—OIL SWITCH, ELECTRICALLY OPENED, CLOSED BY HAND.

and in opening the switch these contacts drop into the lower portion of the oil can. The clips, contact pieces, and all exposed live parts are completely submerged in oil when the can is in place. No leads are introduced through the oil can, therefore there is no opportunity for leakage and no difficulty in the removal of the can.

This switch is not designed to rupture loads under emergency conditions, such as a short circuit immediately beyond the switch on the load side, which can exceed 5,000 kw, single-phase, or 8,500 kw, three-phase. They should not be mounted directly upon the panel for use on circuits which under emergency conditions can exceed 2,500 kw, three-phase, or 1,500 kw, single-phase. Conditions may exist which will render the use of this type of switch mounted directly upon the panel permissible in connection with circuits which under emergency conditions may somewhat exceed 2,500 kw, but such use should not be attempted without inquiring as to the advisability of it under the conditions contemplated. For service in connection with circuits which under emergency conditions can exceed 2,500 kw, three-phase, or 1,500 kw, single-phase, single-pole switches are generally used, each pole being placed in a separate fireproof compartment. These are arranged in groups of two, three and four single-pole switches of the remote controlled type, operated by one handle and suitable for mounting in cells.

To make the switch automatic and to have it perform the functions

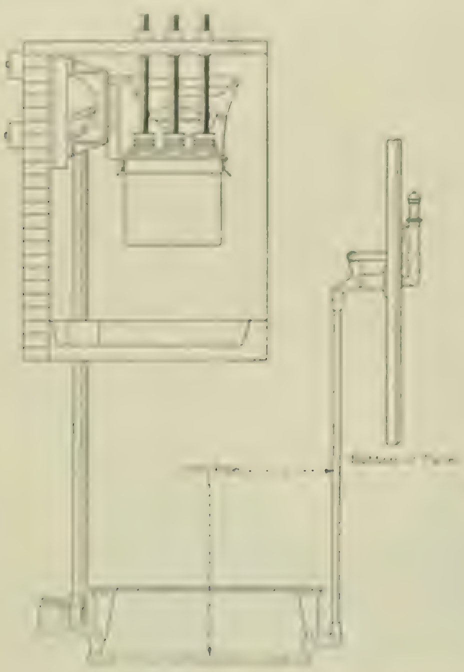


FIG. 2.—ARRANGEMENT OF SWITCH ON BACK OF OPERATING BOARD.

of an automatic circuit breaker, two forms of tripping mechanism are employed. The type selected depends upon whether the switch is installed directly upon the switchboard or in cells at a remote point. The first, or switchboard tripping mechanism, is shown in Fig. 1. It consists of a set of coils upon the face of the board (the edges of which are visible on the cut) operating armatures which actuate a release catch on the link connecting the switch and the handle. The tripping coils are energized from the secondaries of current transformers connected in series with the main circuit of the switch. When the switch is thrown open automatically by means of the tripping coils, the operating handle on the face of the board remains closed, the link moving forward through the handle. This movement serves to indicate that the switch has automatically opened. Fig. 2 shows diagrammatically the arrangement of this type of switch mounted on the back of operating panel.

Junction Box.

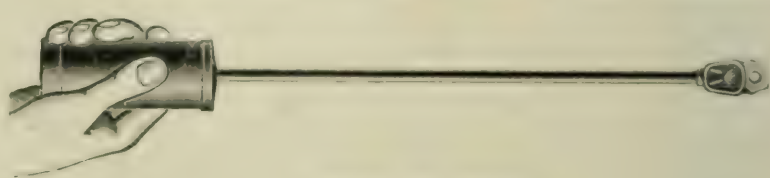
The accompanying illustration shows a new adaptation of a side-wall junction box that will be of interest to electrical contractors because of its great convenience in wiring. It is the usual type of sidewall box manufactured by the Sprague Electric Company for use with the flexible products of that company, in its well known line of interior conduit. The use of the lead bushings, furnished by the company, obviates the necessity of having different sizes of boxes for different sizes of conduit, as one box is thus able to take a variety of sizes of conduit, from

SIDE WALL JUNCTION BOX.

one-half inch down, or a variety of conduit, cable and cord. Reference to the illustration will give a clear idea as to how this is accomplished.

Gas Lighter.

The accompanying illustration shows a gas lighter manufactured by Mr. Wm. Roche, 42 Vesey Street, New York. It is made entirely of metal, is about 24 inches long, and weighs 1 lb. The dry cell enclosed in the handle is 4½ inches long and 1¾ inches in diameter. The current supplied by this cell is sufficient to render incandescent

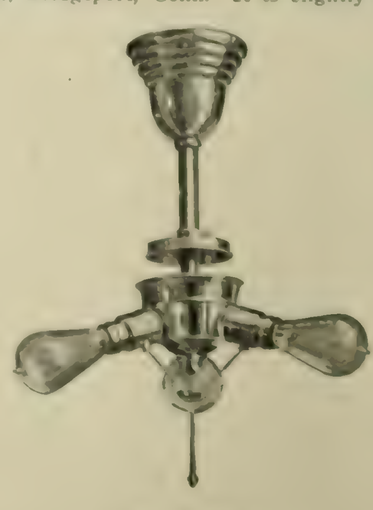


ELECTRIC GAS LIGHTER.

the small platinum coil at the upper end of the rod, and the gas coming in contact with the incandescent metal is immediately ignited. The platinum igniter is enclosed by a wire screen to prevent injury. It is stated that with ordinary use this lighter will give from 1,000 to 1,500 ignitions from one cell of battery.

A New Pull Cluster.

A new standard pull cluster has recently been introduced by Harvey Hubbell, Bridgeport, Conn. It is slightly different in de-



PULL CLUSTER.

sign from his old cluster, in that the socket cap is a part of the cluster center, which not only makes it more ornamental in appearance, but

more substantial and mechanically correct. The chain on each socket is about four or five inches long, connecting in the center with the coupling rosette. From the bottom of this rosette a single chain, about 3 feet long, is hung. One pull on this chain will turn on the lights, the next extinguishing them. A pull down will turn on all the lights; a pull to one side will turn on one or more.

All parts are carefully made and adjusted. The action is smooth and bright. The clusters are furnished with a shade holder only, or with a brass covering tube, shade holder and canopy, complete, or with a solid brass stem, shade holder and canopy. Mr. Hubbell is prepared to furnish different lengths of chain and stem to accommodate the different heights of ceiling. The cluster is made in two three, four, five and six-light, fitted in either Edison, Thomson-Houston or Westinghouse base, and of any finish desired.

This cluster is a decided improvement over the old, in which the socket was merely attached to the regular cluster. The idea of each individual light of the cluster being under separate and direct control is entirely new. The clusters and sockets combined are most convenient in this respect, and make the handiest arrangement possible. They are of perfect workmanship, and have stood the severest test.

New Universal Milling Machines.

The Becker-Brainard Milling Machine Company, of Hyde Park, Mass., have placed upon the market a new line of plain and universal milling machines from new designs and patterns. These machines embody many new features, special attention being given to strength, power and rigidity in order to meet the demands of modern milling machine practice. In the universal machines, the spindle is connected with the change-feed mechanism by a train of three-spur gears, thereby eliminating the usual feed pulleys and belt, giving positive gear drive necessary for heavy and rapid cuts.

The change-feed mechanism is a novel feature, and obviates loss of time in changing gears. The feed is obtained and driven by the

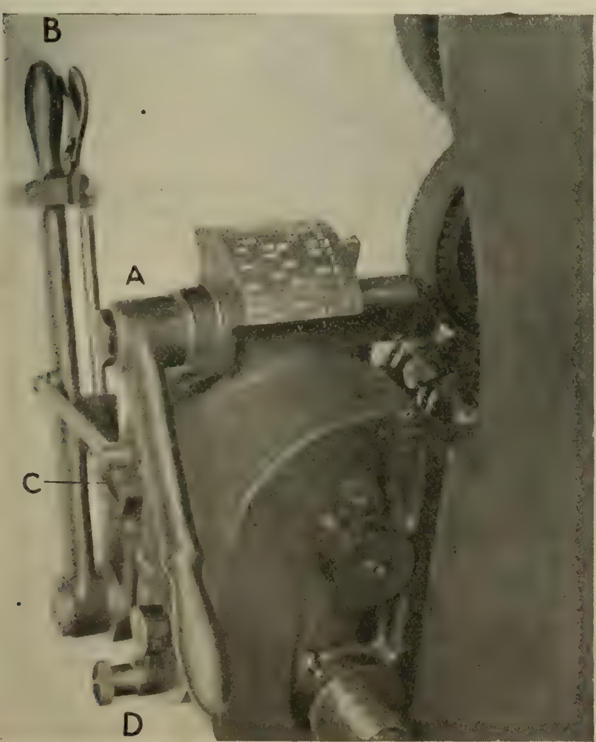


FIG. 1.—MILLING MACHINE.

main spindle through a train of three-spur gears on the back of the machine, which drive two nests of change-feed gears in the column. By compounding the gears in the upper nest, the various changes of feed are secured, giving, with the quick change in the gear case on the outside of the machine, 20 changes of feed for each spindle speed. Levers, operating the change-feed mechanism, are conveniently located on the side of the feed box, and all changes may be made by the operator without stopping the machine or changing his position. The changes are made by the simple movement of the levers, bringing them into position indicated on the index plate, which has each feed plainly marked on its surface, showing the exact position to which the levers must be brought to give a desired feed per revolution of the spindle. For example, suppose a feed at the rate of seventeen-thousandths per revolution of the cutter is to be obtained, the lever *B*, as shown by the cut, is placed in the notch marked 3 on

FIG. 2.—MILLING MACHINE.

the lower quadrant *C*, and then the lever, *A*, is brought to the line marked 3, opposite the space .017 on the index plate. The quick-change lever, *D*, on the lower side of the feed-box is then moved to the hole marked slow, and the desired speed is obtained. Should it be desired to increase the feed, move lever, *A*, so as to point to the line at 3 prime, marked with dash below, on the index plate, and .019 is obtained. If the feed is to be decreased, the lever *B* is moved to notch 4 on the quadrant *C*, and .013 is obtained. When the fast feeds are desired, the quick-change lever, *D*, is thrown into the hole marked "fast," and the same operation performed as described above.

The power is transmitted from the change-feed mechanism through the telescopic shaft connecting, by gears, the longitudinal, transverse and vertical feeds, which are reversed by a lever on the side of the knee within easy reach of the operator. Both transverse and vertical feeds are operated and controlled by a lever, located on the side of the knee, which, when central, disconnects both feeds; and when thrown into position for one feed, it is impossible to connect the other.

Another important feature is a clutch arrangement enclosed in the hubs of the hand wheels, which operate the vertical movement of the knee and cross movement of the carriage. When either the knee or carriage have been set to the required position, the clutch may be instantly disengaged by pressing in the knob on the front of the hand-wheel, thereby preventing any accidental change from their fixed position, and also preventing the hand-wheels from revolving when the automatic feeds are thrown in.

The knee, which is of the box type, provided with a telescopic elevating screw, makes holes in the floor unnecessary, and allows the machine to be placed regardless of beams or foundations. The thrust of the screw is taken by ball bearings.

In designing these machines, the greatest care has been taken to secure the highest efficiency, together with accuracy and simplicity. Nevertheless, the parts are so arranged that they are within easy reach of the operator, and of sufficient strength to prevent breakage from undue strain. Metal distribution has been properly proportioned, the base being very solid, thereby absorbing vibration. The arm is a straight steel bar, so that any of the regular attachments can be placed in position without the necessity of removing the arm.

NEWS OF THE WEEK.

Financial Intelligence.

Commercial Intelligence.

RECENT SALES OF TRIUMPH APPARATUS.—The Triumph Electric Company, of Cincinnati, O., notes the following recent sales of dynamos, motors, and complete plants: The Krell-French Piano Company, Newcastle, Ind., one 100-kw. engine type, direct connected generator and 38 motors from 5 to 40 hp. aggregating 590 hp in motors; The Missouri University, Missouri, O., two 100-kw. and one 50-kw. engine type, direct connected generators; the Kanawha Valley Traction Company, Charleston, W. Va., two 125-kw. belted type of generators; Eastern Kentucky Asylum for the Insane, Lexington, Ky., one 75-kw. engine type, direct connected generator and a 15 and 20 hp motor; U. S. Printing Company, Cincinnati, one 100-kw. engine type, direct connected generator; Nordberg Mfg. Company, Milwaukee, Wis., one 100-kw and a 60-kw belted generator; The Globe-Wernicke Company, for its Cincinnati plant, one 200-kw belted generator and fifteen motors in sizes of 5 to 30 hp, aggregating 380 hp in motors; for the same company at its Norwood plant, one 200-kw. engine type, direct connected generator and twelve motors of 5 to 65 hp. capacity aggregating 350 hp. in motors; The Armour Packing Company, for its New Orleans plant, one 75-kw. engine type, direct connected generator; The Water Works and Electric Light Company, Norwood, O., two 100-kw. engine type, direct connected generators; The Kennedy Dry Coal Company, Minneapolis, Minn., one 80-kw. belted generator; E. H. Hewins, Boston, Mass., two 50-kw. engine type, direct connected generators; The Gardner Electric Light and Power Company, Gardner, Mass., one 50-kw. engine type direct connected generator; F. Derby & Co., Gardner, Mass., one 50-kw. engine type, direct connected generator; The John A. Dunn Company, Gardner, Mass., one 50-kw. belted generator; Ralph S. Hopkins, Seattle, Wash., one 50-kw. belted generator; Northern Pacific Railway Company, at its St. Paul shops, one 50-kw. engine type, direct connected generator and one 15 hp, one 7½ and one 10 hp motor; The Calvert Lithographing Company, Detroit, Mich., one 75-kw. engine type, direct connected generator; The Beals & Selkirk Company, Detroit, Mich., one 50-kw. direct connected generator; The Brady Union Stock Yards Company, Atlanta, Ga., one 50-kw. engine type, direct connected generator; The Alexian Hospital, St. Louis, Mo., one 50-kw. engine type, direct connected generator; The Eclipse Electric Company, St. Louis, Mo., one 25-kw. engine type, direct connected generator; The James H. Curran Elevator Company, Cincinnati, 21 elevator motors; F. Woodlar & Co., Cleveland, O., one 25-kw. belted generator; W. F. Callahan & Co., Dayton, Ohio, 15 lighting machines of 7½ to 20 kw capacity; The Buckeye Iron and Brass Works, Dayton, O., twelve machines of 7½ to 22½ kw capacity; The Charter Oak Stove and Range Company, St. Louis, Mo., one 100-kw. engine type, direct connected generator, two 35 hp, one 25 hp, two 10 hp and two 5 hp motors.

EXIDE BATTERY DEPOTS.—The constantly increasing number of electric vehicles equipped with batteries of Exide accumulators, manufactured by the Electric Storage Battery Company, of Philadelphia, has prompted this company to anticipate the convenience of its customers by opening a number of "Exide battery depots" in different localities for the purpose of maintaining the batteries of its manufacture in the best possible manner, and securing to the owners the same care and supervision of their equipment they would receive at the company's main factory. These depots are fully equipped and are placed under the charge of experienced battery men, competent to advise in all matters pertaining to the operation of Exide batteries, and to generally supervise the treatment received in the way of charging, etc. The Exide battery depots already announced have been located in New York, at 148 West Eighteenth Street; Philadelphia, 250 North Broad Street; Buffalo, 200 Pearl Street; Chicago, 264 Michigan Boulevard; St. Louis, 3937 Olive Street and Detroit, 200 Woodward Avenue. Users of the Exide battery are requested to consult with the engineer in charge of the nearest station when desirous of securing advice or new parts for their equipment.

ENLARGING POWER PLANT.—The Oroville Gas Electric Light & Power Company, Clarence M. Smith president, will make an addition to its electric power plant. The same capitalists control both the light and power company and the local water company. The Engineering Offices, San Francisco, are doing the engineering work on the new plant. According to a contract between the two companies, the same water that later supplies the town of Oroville is used to produce power at Thompson's Flat under a head of 240 feet. The present plant consists of a 120-kw General Electric single-phase generator belted to a water wheel. The new plant which is now in course of construction will be equipped with a 200-kw. Stanley three-phase 2,200-volt generator which will be direct connected to Pelton water wheel.

STORE LIGHTING AT DULUTH, MINN.—A contract has just been completed at Duluth, Minn., for the installation of 5000 lights in one of the largest department stores in the Northwest. The show case and window lighting is of the latest and most efficient style. There will be a five-panel, white Italian marble switchboard and two Ideal engines, direct connected to General Electric machines; also one motor-generator, to be used as an auxiliary in case of any trouble in the plant. The motor-generator will be run by general street railway current. This work will be installed by the Northern Electrical Co., of Duluth.

THE FILTER MANUFACTURING COMPANY, builders of Corliss engines, etc., Milwaukee, Wis., has recently closed contracts with the following parties: Midland Rice Milling Company, Midland, Tex., 12 x 30 engine; Keller & Oberhardt, Chicago, Ill., 16 x 36 engine; Estate of Jessie Elgrod, Milwaukee, Wis., 16 x 30 engine; T. J. Gardner, Los Angeles, Cal., 10 x 18 x 30 tandem compound engine; Menasha Paper Co., Menasha, Wis., 16 x 36 engine; Menasha Paper Co., for Ladysmith, Wis., 20 x 42 engine; Saginaw Valley Traction Company, Saginaw, Mich., 30 x 60 engine; Wm. Holbrook & Co., Milwaukee, Wis., 8 x 24 engine.

THOS. POTTER, SONS & CO., of Philadelphia, manufacturers of oilcloth and linoleum, have adopted electric power distribution for the operation of their oilcloth and linoleum printing machines, the blowers used for drying oilcloth, elevators and other general work throughout their plant. They have recently purchased from the Westinghouse Electric & Mfg. Co. six induction motors, which will be added to their present equipment of one 100-kw. and one 150-kw. two-phase, 220-volt alternators and fifteen or twenty induction motors.

RIALTO BUILDING, SAN FRANCISCO.—Charles C. Moore & Co. will furnish the steam plant for the very complete electric system which is to be installed in the new Rialto Building at the corner of New Montgomery and Mission Streets, San Francisco. There will be two Babcock and Wilcox water tube boilers and two Ideal tandem-compound engines direct connected to Westinghouse generators. A high boiler pressure will be used which will be reduced at the engines by the use of Leslie's regulating valve.

DEMAND FOR CATALOGUES IN AMSTERDAM.—Consul Frank D. Hill, of Amsterdam, under date of July 24, 1902, writes that it would be advisable for exporters of iron, steel, coal, and electrical supplies to send catalogues to that consulate, as he intends to devote a room exclusively to circulars of American firms, folders of American railways, steamship lines, cable companies, etc. He has received many visits of late from people interested in the import trade, and they desire data in regard to United States industries.

NEW PLANT AT BOISE, IDA.—The new electrical power company at Boise is located one and three-fourths miles from the business centre. The equipment includes two double Leffel turbines, with two generators for lighting and two for power, of Fort Wayne and Westinghouse make; Lombard governors are used. The station building is 40 feet by 70, and up to 700 hp can now be developed. The pole line is about completed. H. G. Pope is president; H. D. Pope, vice-president; M. D. Dobson, secretary.

KEYSTONE DYNAMOS AND MOTORS.—For the past eight years the Keystone Electric Co. has been manufacturing a line of direct current dynamos and motors, and is now in a position to supply machines up to 750 kw at 90 revolutions direct connected to Corliss engines. As The Keystone Electric Company it takes now a much more prominent position than heretofore, and is pushing vigorously for business. Its general sales agents are H. B. Coho & Co., Inc., 114 Liberty street, New York City.

TROLLEY WIRE FOR ENGLAND.—The British electrical engineering and contracting firm of Mummery, McElroy & Company, 26 Cortlandt Street, has placed a contract with the John A. Roebling's Sons Company for sixteen miles of trolley wires to be utilized in the overhead construction of the Rotherham, England, electric traction system, the contract for which has been awarded to the British company.

BIG ENGINE FOR PHILADELPHIA.—Mr. A. J. DeCamp, general manager of the electric light consolidation of Philadelphia, informs us that the Southern Electric Light Company, of that city, has made a contract with the Allis-Chalmers Co. for an 8,000 hp nominal engine, which will develop 12,000 hp in an emergency. The date of delivery is approximately one year from date.

THE JESSOP STEEL CO., of England, is building a large steel plant at Washington, Pa., in which electrical power distribution will be employed. The company has recently purchased a considerable amount of direct current apparatus from the Westinghouse Electric & Mfg. Co.

PLANT FOR SANFORD, N. C.—A new electric lighting plant of a capacity of 1,000 lights is to be put in at Sanford, N. C. T. M. Campbell, proprietor; D. McMahon, manager. Catalogues of material of all kinds are requested by Mr. McMahon.

BALL ENGINE ORDER.—An engine built by the Ball Engine Co., Erie, Pa., is being installed in the tobacco factory of R. & W. Jenkinson, Pittsburg, and will be used for electric lighting.

[illegible] port of [illegible] material. [illegible] public—15 pkgs. material, [illegible] l—117 pkgs. material, $6.741; 6 pkgs. [illegible] 53 pkgs. material. $3.000; 25 pkgs. ma- [illegible] gs. material, $268; 10 pkgs. [illegible] chinery, $500. British West [illegible] machinery, $75. [illegible] aterial, $210. China—1 pkg. [illegible] pkgs. machinery, $300. Dutch [illegible] Ecuador—6 pkgs. material, $265. [illegible] material, $383. Hong Kong [illegible] Japan—768 pkgs. ma- [illegible] l. $10.734. Liverpool—308 pkgs. [illegible] $1.1222. Leicester—2 pkgs. ma- [illegible] don—34 pkgs. machinery. $1.120; 77 pkgs. material, [illegible] 1 pkg. material, $90. Marseilles—2 pkgs. material, [illegible] y, $1.512. Mexico—20 pkgs. ma- [illegible] $997. Neuss—11 pkgs. machinery, [illegible] al, $14. Port Talbot—1 pkg. material, $24. Peru [illegible] Rotterdam—2 pkgs. machinery. [illegible] machinery, $4.300. [illegible]

[illegible] T.—A project is on foot with a [illegible] rests of three fair-sized Mexican [illegible] of another. The principal [illegible] and is owned by the Tampico [illegible] city is about 500 hp. There [illegible] The equipment was mostly [illegible] ny. Another plant is situ- [illegible] f Linares, and lights 50 arcs and [illegible] mentioned plants [illegible] water and steam. [illegible] these plants, and [illegible]

[illegible] to Gen- eral Electric generators. Each engine will be thus connected to two [illegible] vidually set in asbestos-lined steel casing, bricks not being resorted to in view of the unsuitability of the soil and the question of space. The condensing apparatus will be supplied by the Wheeler Condenser and Engineering Company, of 120 Liberty Street. The heater [illegible] yet been let. Shipment will be made about Nov. 1.

ELECTRICITY IN GERMANY.—A cable dispatch from Berlin, of August 31, says: Nearly all industrials were strong last week. Irons advanced from two to six points, and coal shares advanced varyingly, some increasing 11 points or more. Electricals were irregular. Shares of the Schuckert Electrical Company, of Nuremberg, recovered strongly because the annual meeting of the stockholders of this company brought no further disappointments, and a group of Berlin banks is arranging to give the company financial assistance by taking the securities of its various undertakings, which are at present unsalable. This arrangement involves a partial alliance with the Berlin Allegemeine Elektricität Gesellschaft.

THE ELECTRIC SUPPLY AND CONSTRUCTION COMPANY, of Zanesville, Ohio, was recently incorporated with a capital stock of $10.000. The officers are as follows: Gilbert Snyder, president; J. B. Rhodes, vice-president; A. T. Brennan, secretary; A. W. Evans, treasurer; R. J. Moore, manager, and S. M. Winn, general counsel. The directors are Gilbert Snyder, J. B. Rhodes, A. T. Brennan, R. J. Moore and S. M. Winn. The company proposes to do contracting of all kinds of electrical construction, in addition to carrying a complete line of electric supplies to supply the wholesale as well as the retail trade.

ACTIVITY IN WEST VIRGINIA.—Mr. John L. Livers, Buckhannon, W. Va., has contracts to install and operate within the next 60 days the following Warren alternators, furnished by the Rumsey Electrical Manufacturing Company, of Philadelphia: One 120-kw, Grafton Gas and Electric Company, Grafton, W. Va.; one 120-kw, Keyser, W. Va., Electric Light Company; one 90-kw, Davis, W. Va., Electric Light Company; one 60-kw and complete plant at Parsons, W. Va.

THE AMERICAN INSULATING MACHINERY COMPANY, OF PHILADELPHIA, has recently completed and shipped some heavy-winding machinery to John A. Roebling's Sons, Trenton. The New Haven office of the American Insulating Machinery Company has been closed, and Mr. Thomas S. Reed, who was in charge of that office, is no longer connected with the company. All business will hereafter be handled through the Philadelphia office.

AMERICAN SUPPLIES FOR SOUTH AFRICA.—The British electrical engineering and contracting firm of Macartney, McElroy & Co., Havemeyer Building, has secured a contract for furnishing considerable supplies for the city of Durban, S. A., municipal electric traction system, which will be filled in the American market. The contract calls for a quantity of trolley cord and brake attachments for 30 cars, replacing devices for 50 cars, etc.

OTIS ELEVATOR IN ENGLAND.—It is announced by cable from London that the English branch of the Otis Elevator Company, Limited, has absorbed the business of R. Waygood & Co., Limited, the leading firm of elevator makers in England. The latter company acquires by its agreement with the Otis firm full rights to manufacture from the American patents and to use all licenses of the parent concern.

THE EUREKA ELECTRIC COMPANY, of Chicago, has just obtained a contract from the city of Chicago for furnishing telephone apparatus for the fire-alarm telephone service. This speaks well for Eureka apparatus, as this is the first independent telephone outfit to be used by the city of Chicago, which has previously used American Bell apparatus exclusively.

BRILL TRUCKS FOR JAPAN.—The J. G. Brill Company, of Philadelphia, has just secured a contract through the American Machinery and Export Company, of 120 Liberty Street, New York, for several car trucks for the Osaka, Japan, electric traction system. Another order for twenty-five is pending for the same road.

WESTINGHOUSE TURBINE ORDER.—Westinghouse, Church, Kerr & Company have secured a contract for the supply of a 400-kw Westinghouse steam turbine, which will be installed in the paper mills of the S. D. Warren Company, Cumberland, Me.

GENERATING PLANT BIDS WANTED.—Bids are asked until Sept. 3 for engines, generators, etc., at the New York Reformatory, Elmira. G. L. Heins is State Architect, Albany, N. Y., and Charles F. Howard is president of the board.

WESTINGHOUSE MOTORS FOR QUEENSLAND.—The Queensland Government railway shops are about to be equipped with several alternating-current motors, built at the East Pittsburg shops of the Westinghouse interests.

General News.

THE TELEPHONE.

SAN BERNARDINO, CALIF.—The City Trustees of San Bernardino have advertised the sale of the telephone franchise applied for by C. F. Guthridge, of Los Angeles.

LOS ANGELES, CALIF.—The new exchange of the Home Telephone Company in this city will be one of the largest ever installed in the United States. There will be switches for 18,000 subscribers or double the number now in operation with the Sunset Company.

SAN FRANCISCO, CALIF.—The Sunset Telephone Company is reducing its rates in competition with the new Pomona Valley Telephone Union. The price of individual telephones, which is now $4 per month, is to be reduced to $2.50 for business houses and $2 for residences. The 10-party rate, now $1.50 per month for private houses, will be reduced to $1.00.

TALLADEGA, GA.—The Home Telephone Company of Talladega has been sold to the Bell Company. The local exchange will be rebuilt.

VALDOSTA, GA.—The board of trade of Valdosta has decided to appoint a committee to endeavor to prevent the establishment of a second telephone system in the city unless the company shall absorb the old company. The new concern is the Bell Company. W. A. Bisbee, of Savannah, is principal owner of the independent company.

AUGUSTA, GA.—The Strowger Telephone Company of Augusta is making long distance connections towards the north and the south by special arrangement with the numerous independent lines in this section and expects to soon have connection with at least 1,000 miles of long distance lines.

VICTOR, IDA.—The Rocky Mountain Bell Telephone Company will extend its line from Teton City to Victor, a distance of 50 miles.

CHICAGO, ILL.—Within the next month the Illinois Central Railroad expects to have its new telephone circuit established between Chicago and Omaha

CHICAGO, ILL.—The Illinois Telephone and Telegraph Company has leased one of the Kerfoot buildings in the heart of the city for a central telephone exchange.

ATWOOD, ILL.—The Atwood Mutual Telephone Company, lately incorporated, will be ready for business in October. The switchboard has a capacity of 25 bell drops and 60 series drops. The company has 150 subscribers.

FLANAGAN, ILL.—The Flanagan & Dana Telephone Company has installed the Stromberg-Carlson system. A new switchboard is to be put in, and there will be about 15 party lines to provide for, besides some 30 village telephones.

CHICAGO, ILL.—The Automatic Electric Company has leased from the Lewis Institute directors the six-story brick structure at Van Buren and Morgan Streets, which it will maintain as an automatic telephone and switchboard factory in connection with its previously established factory on Washington Boulevard. Immediate steps are now being taken for the location of between 7,500 and 8,000 telephones of the secret service, automatic type in the business heart of the city.

ALEXANDRIA, IND.—The Central Union Telephone Company has decided to increase the size of its plant and the efficiency of its service in this city.

INDIANAPOLIS, IND.—The Modoc Telephone Company commenced business June, 1902. It operates a 100-drop board and is gaining subscribers rapidly. It has 16 miles of local circuit and 16 of toll line.

EVANSVILLE, IND.—The City Council passed an ordinance, Aug. 19, asking the Cumberland Telephone Company to quit doing business in the city on Aug. 25. The Board of Public Works will ask for new bids for a franchise.

INDIANAPOLIS, IND.—The Amboy Home Telephone Company, of Amboy, Miami County, capital stock $5,000, and the Cowan Rural Telephone Company, of Cowan, Delaware County, capital stock $4,000, have been incorporated.

NEW HAVEN, IND.—The New Haven Telephone Company has been placed in the hands of a receiver. W. L. Mallering being appointed receiver. The exchange is a small one and has not proved profitable from the start. The plant will be sold and then greatly improved.

MISHAWAKA, IND.—The local council has granted a franchise to the Home Telephone Company, an independent corporation, despite the strong opposition. The Bell Company at once announced a reduction in rates to residences of $3 and $5 a year. Business service is also to be reduced.

INDIANAPOLIS, IND.—S. P. Sheerin, of this city, was before the State tax board in the interest of the new local and long distance telephone companies asking that the assessments as fixed by the board be reduced to what he called a fair figure. The assessment of the local companies was fixed by the board at $550,000, which was an increase of $289,000, or 110 per cent. over last year. The assessment of the New Long Distance Company was fixed by the board at $193,000, an increase of $132,000, or 110 per cent. These were said to be exorbitant. Several other companies were heard from.

EVANSVILLE, IND.—The movement to establish a municipal telephone plant in this city is about to fail and the city administration is fearing a legal entanglement. The city wants to award a franchise to the best bidder, but the Cumberland Company, the present occupant of the field, asserts that its franchise can be successfully defended. The city must first free itself and establish a right to grant a franchise before other companies will bid. Bids thus far submitted provide that the city must dispossess the Cumberland Company. If this matter was settled the city could make a satisfactory contract. It is claimed that the Cumberland's franchise has expired and that it is the duty of the council to revoke it. To revoke it would be a recognition of its validity and the power to revoke might fail. The Cumberland is willing to enter into a new contract, but only with preferred terms, not nearly so favorable as other bids.

CEDAR FALLS, IA.—The farmers of this city are making a raid on the Cedar Valley Telephone Company and are ordering telephones faster than the company can supply them.

DENISON, IA.—The Crawford County Telephone Company has been incorporated recently with $50,000 capital. The Stromberg-Carlson system will be used, with switchboard capacity of 200 town and 20 farm lines.

SIOUX CITY, IA.—William Bowen, agent of the Stromberg-Carlson Company, whose application for a telephone franchise has been some time in abeyance, is again endeavoring to obtain it. The franchise, if granted according to the provisions of the ordinance introduced, will be given to William Bowen personally.

HOPKINSVILLE, KY.—The city of Hopkinsville has accepted a proposition from the Cumberland Telephone Company whereby this company will furnish long distance connections and reduce the price of the service. This settles the question of competition in this town, at least, for the present.

LOUISVILLE, KY.—The Home Telephone Company of Louisville has just secured a controlling interest in the New Albany, Ky., Home Telephone Company, which has been in operation since 1896. The New Albany company has a capital of $100,000. The Louisville company will build connections with the New Albany company.

SHELBYVILLE, KY.—The town of Shelbyville, Ky., will sell, during the month of September, a local telephone franchise. The Cumberland Company is already operating in the town. It is said that the Louisville Home Telephone Company is back of the movement. The new franchise will forbid consolidation with any other company on the part of the owners of the new franchise.

BALTIMORE, MD.—The International Telephone Company has recently purchased the charters of several concerns in Maryland, among them the Maryland Telegraph and Telephone Company. The International will begin the building of lines through the State and will make a maximum charge of two cents per call.

McINTOSH, MINN.—A local telephone system is to be put in by Mr. Anton Jenson and will be ready for business September 1. Stromberg-Carlson apparatus is installed.

JOPLIN, MO.—The Mineral Belt Telephone Company, which includes the exchanges in Carthage, Joplin, Webb City, Cartersville and Oronogo, with all connecting lines, has been sold to a company headed by Theodore Gary, of Macon, Mo., for $250,000. The company will be reorganized with a capital stock of $200,000 with 6 per cent. dividend guaranteed. The new company will also issue $150,000 ten-year bonds, bearing interest at 5½ per cent. This issue has been underwritten by a Macon syndicate. The new company will at once expend $75,000 in improvements.

NEW LISBON, N. J.—The Farmers' Telephone Company, H. M. Black, president, has 25 miles of toll line now being built and will use the Kellogg system.

SERGEANTSVILLE, N. J.—The Merchants' and Farmers' Telephone and Telegraph Company has been formed; capital $10,000. Incorporators: William Strouse and Wesley D. Bodine, Sergeantsville, N. J.; Charles M. Reading, Frenchtown, N. J., and William C. Gebhardt, Clinton, N. J.

TRENTON, N. J.—Nearly 200 telephones have been installed and connected by the new Interstate Telephone Company at Trenton, and it is expected that almost another hundred will be in operation early in September. The new building is expected to be ready for occupancy by October 1.

HOPEWELL JUNCTION, N. Y.—The East Fishkill Telephone Company has just started business with 50 subscribers, and about 25 miles of local circuit. The Hudson River Telephone Company will extend its lines to Hopewell Junction and connect with those of this company.

GASTONIA, N. C.—An effort is being made to construct rural telephones in Gaston County, N. C. Gus Shannon, of Gastonia, is interested.

SHELBY, N. C.—The Boiling Springs Telephone Company of Cleveland County, N. C., has been incorporated with $1,000 capital, with D. J. Hamrick and others as stockholders.

WILMINGTON, N. C.—The Columbus Telephone Company has a switchboard at Chadbourn and one at Whiteville. Forty-four telephones are now in operation and further extensions are planned. The capital stock is $5,000.

MANCHESTER, OHIO.—The Manchester Telephone Company, incorporated in May, 1902, has Western Electric apparatus—a drop board with 125 subscribers. The company is about putting in several miles of lines on both sides of the Ohio river.

PITTSBURG, PA.—The Postal Company is now preparing to construct new through trunk lines all along the Pennsylvania railroad system, from New York to Pittsburg and from Washington to Buffalo. Within the next month work will be started on the stringing of eighteen copper wires between Philadelphia and New York. Twelve wires will be strung from Philadelphia to Pittsburg, and four will be required on the line along the Northern Central and Philadelphia and Erie branches.

ST. MATTHEWS, S. C.—The St. Matthews Telephone Company has obtained its charter. The capital is placed at $1,500. L. M. Able is secretary and treasurer.

CHESTERFIELD, S. C.—The Chesterfield Telephone Company is ready to receive its charter. Officers have been elected as follows: president, J. A. Welsh; vice-president, Dr. D. T. Neal; secretary and treasurer, T. P. Mangum. Long distance lines will be erected.

NASHVILLE, TENN.—The new service of the Cumberland Telephone and Telegraph Company in this city has gone into effect.

CLARKSVILLE, TENN.—The city council of Clarksville has granted to R. B. Crane, of Toledo, Ohio, and others a franchise to build a competition telephone system.

NASHVILLE, TENN.—A charter has been granted to the District Telephone Company of Shelby County, Tenn., with a capital of $100,000. Those interested are E. Howard, J. Compton, W. T. Gentry and others of Shelby County.

[illegible] future.

[illegible] Idaho.

[illegible]

[illegible]

[illegible]

[illegible]

LEEDS, WIS.—The Leeds Farmers' Telephone Company, which commenced [illegible] have been used, but are to be changed to a larger one this fall. There are [illegible] 10 miles of toll line and extensions are projected.

[illegible]AWA, ONT.—The Canada Atlantic Railway has about completed a private [illegible] the Georgian Bay. The system will be one of the most complete and up-to-date private sys [illegible]n, about 534 miles of copper wire have been used. The object in inaugurating such a service is to relieve the telegraph lines and afford better communication with the elevators of the company, with which there is [illegible]

SALT LAKE CITY, UTAH.—The Telluride Power Company has been granted a franchise for 25 years to maintain a telephone system in Salt Lake County

ELECTRIC LIGHT AND POWER.

SKAGWAY, ALASKA.—The Northwest Light & Power Company, C. E. Shepard, of Seattle, Wash., president, has an electric light plant at Skagway, Alaska, and gas works at Everett, Wash.

MALVERN, ARK.—The Malvern Light & Power Company was formed in 1898 with $8,000 capital. The owner, C. W. Turner, operates T-H. and General Electric, arc and incandescent system of 580 lights.

[illegible], CALIF.—The [illegible] California Power Company, H. H. Noble, president, is building an extension of 50 miles to Willows. The com[illegible] apparatus.

SAN JOAQUIN, CALIF.—The San Joaquin Power Company has been incorporated with a capital of $300,000, by Alto Weiss, E. A. Beck, W. G. [illegible]

SAN JACINTO, CALIF.—Messrs. Roach and Chambers are the officers of [illegible] It was organized in 1897 [illegible] The Westinghouse system is used.

SANTA PAULA, CALIF.—[illegible] A General Electric alter[illegible] plant is to be put in. Mr. C. C. Teague is secretary.

[illegible]D, CALIF.—The Richmond Light and Water Company, H. E. [illegible] It has [illegible] lights, and uses [illegible]

OAKLAND, CALIF.—The Suburban Electric Light Company distributes cur[illegible] Mr. C. A. [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

ST. ANTHONY, IDA.—The new electric light company at St. Anthony has ordered another generator, which will double the capacity of the plant.

[illegible] Valley Power Company near Boise has started [illegible] Boise River. The dam will be 18 feet high and [illegible]

[illegible] voted to issue $40,000 in bonds for an electric plant and [illegible] for the latter. Thomas E. Kelly is mayor and Stewart H. Travis, city clerk.

CHRISMAN, ILL.—The Light and Water Company was formed early in the [illegible] Warren alternating-current apparatus furnishes [illegible] incandescents.

BLUE MOUND, ILL.—The Blue Mound Electric Light Company was formed in [illegible] The Thomson-Houston alternating system is used. Mr. H. L. Ferguson is manager.

BELLEVILLE, ILL.—The Belleville Gas Light & Coke Company was sold Aug. 18 [illegible] of Chicago and Cincinnati men. The purchase price is $240,000, but the purchasers assume an indebtedness of $60,000, making the actual consideration $300,000. The purchasers are represented by Mayor M. M. Stephens, W. S. Forman and L. D Turner, Jr., of East St. Louis. The present capital stock of the company is $150,000. The shareholders receive $80 net cash for the stock, which has a par value of $50. It is the announced intention to [illegible] the company and increase the capital stock to $350,000. It is [illegible] will be made and the gas mains and the electric wires will be extended towards East St. Louis.

BLOOMINGTON, IND.—The People's Gas, Electric and Heating Company uses "Wood" apparatus. It has 24 miles of circuit and a coal gas outfit.

ROCHESTER, IND.—The Rochester Electric Light & Power Company, of Rochester, has filed articles of incorporation. J. E. Beyer heads the board of directors.

JONESBORO, IND.—The Jonesboro Light & Water Company, formed January, 1902, is a municipal plant. L. M. Pemberton is superintendent. The Fort Wayne system is employed. There are 26 arcs, 450 commercial lights.

CARTHAGE, IND.—The Carthage Electric Light and Power Company has $7,500 capital. It operates a water power plant, 17½ miles transmission. It has 1 400-kw General Electric dynamo, and the station is laid out for two more. The secretary is S. M. Strickland.

SUMMITVILLE, IND.—The Summitville electric light and water plant is now under construction, and will be owned by the municipality. When ready for operation it will represent an investment of $35,000 to $40,000, including the purchase of the present private lighting plant.

DURANT, IND. TERR.—The Durant Ice & Light Company, organized May, 1901, has a paid-un capital of $20,000. It has two dynamos of 60-kw each, Westinghouse system, and furnishes 1,200 lights. A. S. Smith is secretary.

BURNSIDE, KY.—The Burnside Electric Light & Power Company uses Bul[illegible] and has a power service of 1 10-hp, 1 2-hp and 30 fan motors. R. M. McCracken is general manager. The capital stock is $4,500.

ST. FRANCISVILLE, LA.—The town of St. Francisville has voted $10,000 water and electric light bonds.

BRIDGTON, ME.—The Bridgton & Harrison Electric Company, J. R. Sanborn, president, capital $50,000, has Westihghouse machinery and about 1,500 16-cp lights furnished by one 135-kw dynamo. It runs two motors.

LIVERMORE FALLS, ME.—The Livermore Falls Light & Power Company has an authorized capital stock of $100,000. Mr. E. Riley is president. The Edison system is installed; there are 15 miles of circuit and 5 motors are running.

HOUGHTON, MICH.—The Houghton County Electric Light Company has been organized with a capital stock of $1,300,000.

GRAND RAPIDS, MICH.—The Edison Electric Light Company is erecting a new building for a storage battery plant. In it will be placed 166 cells of an improved form of storage battery, with a capacity of 3000 ampere-hours.

SHAKOPEE, MINN.—The electrical plant here furnishes light and a small amount of power. There are 600 incandescents, 42 Nernsts and 34 arcs. This place is a good location for a central heating station, also for water works.

WHEATON, MINN.—The Wheaton Electric Light Company of Wheaton, Traverse County, has filed articles of incorporation. The incorporators are W. I. Gray, W. W. Bardwell, E. Le Vesonti, of Minneapolis, and F. W. Murphy and M. J. Jacobson, of Wheaton. The capital stock is $25,000.

GREENVILLE, MISS.—F. J. Butler, of Greenville, has been awarded the contract for a $36,000 electric power house at Jackson.

[illegible] Light plant was organized in 1900 with $15,000 capital. This is a municipal plant, having between 1,400 and 1,500 lights, and using the Western Electric system. J. W. Hoyle is manager; E. W. Hawkins, superintendent.

[illegible] Street Railway Company has purchased the plant of the Natchez Light, Power and Transit Company, paying $7[illegible] for the same. The last-named company has the contract for public lighting, which has seven years to run before it expires.

NEOSHO, MO.—The Neosho Electric Light Company, J. C. Geye, president, was organized in 1897 with $6,000 capital. The system is alternating, and there are 8 miles of wire.

CLAYTON, MO.—Articles of association of the St. Louis County Electric Company have been field in Clayton. The capital stock of the company is $50,000, one half of which is paid up. The shareholders are A. C. Einstein, of St. Louis, Charles J. Schnaus, of St. Louis, and O. J. Mudd, of Kirkwood. The main office of the company will be in Webster Groves.

HOOPER, NEB.—The Hooper Electric Light plant of which Mr. W. T. Martin is proprietor has $7,000 capital. It operates the Thomson-Houston system [illegible]

SILVER CITY, NEB.—The New Mexico Light, Heat & Power Company was rmed in 1900 with $30,000 capital. It operates 2 direct-connected dynamos, miles of wire and 1,600 lights. E. L. Woods is president.

JERSEY CITY, N. J.—The United Electric Company of New Jersey has :en awarded a contract by the Jersey City Water Supply Company to furnish ght at the site of the new reservoir being built here.

ALBUQUERQUE, N. MEX.—J. J. Henery has been granted a franchise or the Electric Light, Power & Gas Company in Albuquerque. The new ompany will charge the following rates: Business houses, 15c. per kw-hour; esidences, 20c. per kw-hour; 16 cp, 10 o'clock closing, $1.00 each per month; 6cp, 12 o'clock closing, $1.50 each per month; 16cp, all night, $2.25 each per onth.

CHATEAUGAY, N. Y.—The Chasm Power Company, formed June 27, 1902, ias $20,000 capital. The company is now constructing a dam and has already :,500 lights.

BALDWINSVILLE, N. Y.—A light, heat and power company, with a capital of $100,000, has been organized at Baldwinsville, to do business in Baldwinsville, Lysander and Van Buren.

ROME, N. Y.—The Rome Gas, Electric Light & Power Company is one of the electric properties of which J. T. Lynch, of Detroit, Mich., is president. The company has three General Electric dynamos of 150-kw each.

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company, organized in March, 1902, employs General Electric system and has 2 500-kw and 2 200-kw dynamos. Regular power service is furnished. S. P. Hunt is superintendent.

JAMESTOWN, N. Y.—Jamestown Lighting & Power Company, of Jamestown, has been formed to do public lighting in this city, the villages of Falconer, Celaron and Lakewood and in the towns of Ellicott and Buste in Chatauqua County. Capital, $100,000. Directors: Robert T. Paine, 2d, of Brookline, Mass.; Ernest S. Carr, of Jamestown, N. Y., and William H. Whitney, of Boston, Mass.

ADA, OHIO.—The Ada Water, Heat & Light Company, formed July 1, 1902, has a capital stock of $75,000. C. S. Ames is president.

COALTON, OHIO.—Directors of the Coalton Light, Power & Heating Company have decided to commence the construction of a plant at once.

NORTH AMHERST, OHIO.—A council committee has been inspecting a number of lighting plants and has decided to spend $8,000 for a municipal lighting plant.

PORTSMOUTH, OHIO.—Philip Hughes, of this place, has the contract for installing an electric lighting plant for the Munroe furnace of the Hill Coal Company.

GALLIPOLIS, OHIO.—The Gallipolis Electric Light Company has been incorporated with $10,000 capital stock by A. Clendenin, J. W. Clendenin, S. H. Eagle, C. H. D. Summas and E. D. Davis.

COSHOCTON, OHIO.—The Coshocton Light & Heating Company has been incorporated with $250,000 capital stock under the laws of New Jersey, and has been admitted to do business in Ohio. W. A. Hinebaugh is at the head of the company.

SALINEVILLE, OHIO.—The Salineville Electric Light, Heat & Power Company was formed January, 1902, with $15,000 capital. Westinghouse and Western Electric apparatus are used, furnishing 48 arc and 1,000 incandescent lights. J. H. Dodds is secretary.

CINCINNATI, OHIO.—The Cincinnati-Newport-Covington Light and Traction Company has a capitalization of $10,000. The lighting and power system is General Electric; the railway system Westinghouse. The former has 25,000 16-cp lamps and 600 arcs; the latter 70 miles of track. E. Harrow is the chief engineer.

COLUMBUS, OHIO.—The Providence Engineering Company of Cleveland has submitted prices on three horizontal cross compound condensing engines at a cost of $29,250. The company was the only bidder for furnishing equipment for the proposed municipal plant. Legal proceedings are holding up the question of the lighting plant, and new proposals will be called for when the suits are settled.

EL RENO, OKLA.—The El Reno Light & Power Company was formed January, 1902, with $150,000 capital. H. Lassen is president and J. A. Masters, manager. It has 10 miles of arc circuit, 6 miles of incandescent and 50 alternating enclosed lamps. Three thousand lights are now wired in.

GOLD HILL, ORE.—The Condon Water & Power Company has been incorporated at Gold Hill, with a capital of $100,000, by C. R. Day, W. F. Hunter and F. S. Smith.

ROSEBERY, ORE.—The Douglas Electric Company has a water power plant and General Electric system. Three miles of circuit and about 100-hp of S, 16 and 32-cp lights. F. W. Benson is secretary.

CHARLESTON, S. C.—The Charleston Light and Water Company has filed notice of an increase of capital stock from $500,000 to $1,000,000.

GEORGETOWN, S. C.—The Georgetown Electric Company was organized October, 1891, with $50,000 capital. It is a light and power plant supplying 1,600 incandescent and 44 arc lights, besides 30 fans. There are 16 miles of copper wire. H. L. Chandler, of Philadelphia, is president.

FORT MILL, S. C.—The Catawba Power Company is constructing near Fort Mill what will be one of the largest dams in the South when completed. The estimated cost will be $1,000,000. Four thousand eight hundred horse-power is what the company expects to develop. Two cotton mills have already contracted for power with which to run their machinery.

HOUSTON, TEX.—The Houston Lighting and Power Company, organized December, 1901, has $275,000 capital stock and employs the General Electric system. The plant is three-phase alternating, managed by W. H. Chapman. There are 12,000 lights of 16-cp, 425 street arcs and 275 commercial arcs.

PARIS, TEX.—The Paris Light & Power Company was reorganized November, 1901, and the capital stock increased from $120,000 to $200,000. H. L. Baker is the secretary. The plant furnishes electricity, gas and steam heating, the General Electric system being installed throughout. The Paris Transit Company is owned by the same parties.

LOGAN, UTAH, has voted $65,000 in bonds for a municipal electric light plant.

SALT LAKE CITY, UTAH.—Engineer Hayward, of the Utah Light & Power Company of Salt Lake City, has been examining the waters of the Big Cottonwood canyon for the Great Western Mining Company, with a view to erecting a large power plant to furnish the Big Cottonwood mines with power. It is understood the plant will be built early next spring.

NORFOLK, VA.—The People's Light and Power Company of Norfolk has been granted a charter with a capital of $100,000.

RICHMOND, VA.—The Electrical Construction Company of Richmond, Va., has the contract for a $20,000 electric plant at Warrenton, Va.

FAIRMONT, W. VA.—A deal has been closed by the Fairmont Gas and Electric Company with the Fairmont and Grafton Gas Company, an old corporation, whereby the former becomes the owner of all the rights of the latter company in Fairmont.

EVANSTON, WYO.—The Edison Electric Company has been formed here. Directors: H. Fisher, J. B. Miller, H. H. Sinclare, F. B. Hinge and others. Capital stock, $10,000,000.

MONTREAL, QUE.—The Shawinigan Water & Power Company has made a proposition to the Dominion government for lighting the channel from Montreal to Quebec.

OTTAWA, ONT.—The town plant of Fort William, Ont., has been found insufficient to provide the necessary light and power. A proposition is now under consideration to develop the Ecarte Rapids power. Messrs T. Pringle & Sons, of Montreal, estimate the cost of developing 2,000 horse-hower there at $207,000.

OTTAWA, ONT.—The Ontario government has authorized the construction of a coffer dam at Dufferin Islands, on the Niagara river, by the Ontario Power Company, to be used in diverting water through the park to the company's outlet below the falls. Although the company's application has been opposed by the Canadian Niagara Power Company, which was first in the field, the government has decided to grant the Ontario Power Company's application, in order to stimulate competition in that district.

THE ELECTRIC RAILWAY.

HARRISON, ARK.—Toledo capitalists have entered into a project for connecting Harrison with Dodd City, by an electric railway. John J. Greghan, of Toledo, may be addressed.

HARTFORD, CONN.—The Hartford Street Railway Company is engaged in making an addition to its power equipment at the power house on Commerce Street, and is now installing a 1500-hp engine. The engine is from the Westinghouse, Church, Kerr & Co. works of Pittsburg, and is connected to a Westinghouse generator of 1050-kw. When the engine is installed the company will have a capacity of 5000-hp.

WARSAW, IND.—The directors of the Winona assembly have voted to construct an electric railway between this city and Winona.

INDIANAPOLIS, IND.—A trolley line from this city to Springfield, Ill., by way of Terre Haute and Paris, Ill., is projected. A. J. Hunter, of Paris, is chief promoter.

FRANKLIN, IND.—President Irwin announces that the contract has been let for the extension of the Indianapolis, Greenwood and Franklin electric line to Columbus, a distance of 20 miles.

INDIANAPOLIS, IND.—The Indianapolis Street Railway Company has interests at work with a view to organizing a company to construct an interurban line between Indianapolis and Cincinnati.

ELKHART, IND.—The Elkhart, South Bend & Chicago Railway Company, which proposes to connect Elkhart, South Bend and Mishawaka with an electric road, has been incorporated. Capital stock, $15,000.

KOKOMO, IND.—The Kokomo Street Railway and Traction Company has been reorganized and is now the Kokomo Railway & Light Company. Capital, $80,000. G. J. Marott, president. Extensions are projected.

NEW ALBANY, IND.—Interest has been revived in the contemplated electric road from Cincinnati to Louisville along the Indiana shore of the Ohio river. Colonel A. S. Berry and Engineer Lyman are looking after the two surveys now being made.

INDIANAPOLIS, IND.—The Richmond and Ohio Traction Company of Richmond has incorporated with $10,000 capital. The company will build an electric line from College Corner, through Liberty to Richmond and from Richmond to Connersville, aggregating 35 miles.

BUTTE, NEB.—Butte, Neb., has subscribed $40,000 for a new electric railway to connect the town with the new Elkhorn extension at Anoka.

ALBANY, N. Y.—The Mineola, Hempstead and Freeport Traction Company has changed its corporate name to the Long Island Traction Company.

OYSTER BAY, N.. Y.—It is now certain that a trolley line is to be built from this village through the chain of villages between here and Mineola, at which point it will connect with the existing cross island line.

NEW YORK, N. Y.—At a special meeting of the stockholders of the Interborough Rapid Transit Company it was voted to increase the capital stock of the company from $25,000,000 to $35,000,000. The purpose of the increase is to raise funds to defray the expense of building the projected tunnel from Manhattan to Brooklyn, connecting with the Manhattan underground system.

YOUNGSTOWN, OHIO.—The Sharon & New Castle Railway is now running cars regularly from Hubbard to New Castle.

JAMESTOWN, OHIO.—The Springfield & Washington Traction Company has selected a site for a power station in this place.

COLUMBUS, OHIO.—The Delaware, Berkshire and Sunbury Electric Railway Company has increased its capital from $10,000 to $150,000.

CINCINNATI, OHIO.—The Bullock Electric Manufacturing Company has just shipped a large generator to the Wheeling (W. Va.) Traction Company.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company will spend about $100,000 in improvements on the Cleveland & Eastern Division during the coming season.

LIMA, OHIO.—The Western Ohio Railway has commenced condemnation proceedings against a number of land owners to complete its right of way between Lima and Findlay.

CONNEAUT, OHIO.—J. H. McWirt, representing the bondholders of the Conneaut & Eastern Railway, has applied to the county commissioners for a franchise from Conneaut to the Pennsylvania State line.

PORTSMOUTH, OHIO.—The charter of the Portsmouth Street Railway will be changed to enable the company to build to Hanging Rock, where connection will be made with the lines of the Camden Interstate Railway.

CLEVELAND, OHIO.—The Osborn Engineering Company has completed the surveys for the Mansfield, Mt. Gilead & Defiance Railway. The power station will be at Cardington or Mt. Gilead and there will be three substations.

TOLEDO, OHIO.—The promoters of the Toledo & Bryan Air Line Railway assert that eastern capitalists have agreed to finance the project and that it will be bonded for $18,000 per mile; construction work to start this fall. The road is projected from Toledo to Ft. Wayne.

PROSPECT, OHIO.—The promoters of the Magnetic Springs, Green Camp & Prospect Railway, owning franchises and rights of way between the towns named, also a site for a park and power house, are prepared to turn over the rights and plans to a company which will guarantee the building of the road.

DAYTON, OHIO.—The Dayton, Springfield & Urbana Railway Company's power house at Medway is being enlarged to nearly three times its present capacity and when completed it will furnish power for nearly all of the Appleyard-syndicate system between Cincinnati and Columbus. The plant will be in operation in about three months.

STEUBENVILLE, OHIO.—Work has been started at Brilliant on the new power house of the Steubenville, Mingo & Ohio Valley Traction Company. The station will also furnish power for the Wheeling-Wellsburg Railway on the West Virginia side of the Ohio River and a submarine cable will be laid for the feed wires. The station will cost about $175,000.

CINCINNATI, OHIO.—The Cincinnati Traction Company is planning to introduce a parcel-delivery system with ten delivery stations in various portions of the city. The company will act only as carrier, the present delivery companies doing the collecting. Stamps will be sold, which, when pasted on a parcel, insures delivery to the proper distributing station.

BARBERTON, OHIO.—The Northern Ohio Traction Company has secured a lighting franchise in Barberton, and has closed a contract to furnish light to the town. The rate will be $75 per lamp per year on moonlight schedule. The rate for commercial lighting will be 10 and 12 cents per kw-hour. The council will buy 45 new arc lamps and other material.

SANDUSKY, OHIO.—A prospectus of the Sandusky, Clyde, Tiffin & Southern Railway shows that the road will be 37.16 miles long, touching Sandusky, Castalia, York, Clyde, Green Springs and Tiffin, drawing from a tributary population of 50,000. Bonds to the amount of $650,000 are to be issued. The officers are J. C. Parker, president; J. C. Hauser, secretary; F. P. Zollinger, treasurer. Others interested are Ira Comstock, W. W. Woodward, G. R Butler and W. H. Johnson.

DILLSBURG, PA.—A charter has been issued by the State department to the Dillsburg and Allen Electric Street Railway Company to build a line from Dillsburg to Churchtown, a distance of six miles; capital, $50,000; president Peter Sidle, Dillsburg.

PITTSBURG, PA.—The efficiency of the street railway service in the eastern portion of the city is to be still further increased by the Pittsburg Railways Company by the rejuvenation of the old Broad Street power station of the Allegheny County Light Company. Several street railway generators and a large number of storage batteries are to be installed there for the purpose of furnishing more power.

MARTINSBURG, W. VA.—The Charles Town, Berryville and Winchester Street Railway Company, of Charles Town, W. Va., has been incorporated for the purpose of constructing and operating a street railway in West Virginia and Maryland. Capital $500,000. The incorporators are S. M. Patterson, New York; George Eyster, F. S. Harrison, of Halltown, Va.; R. P. Chew and W. O. Morris, of Charles Town, W. Va.

THE AUTOMOBILE.

THE INTERURBAN MOTOR COMPANY has been incorporated at Auburn, Ind., with a capital of $[illegible]. It has already started regular trips with new automobiles between Auburn, Garrett and Waterloo. The company proposes to take the place of the long-talked-of electric railway between these points.

RECORD DISTANCE ON ONE CHARGE.—A. C. Newby, of Indianapolis, Ind., claims to hold the record for distance covered by an electric automobile on one charge of the battery. Mr. Newby completed on the streets of Indianapolis in the night time a run of 118 miles on one charge, in an Indianapolis machine.

THE PORTLAND TRANSIT COMPANY has been organized at Portland, Ind., with a capital of $[illegible], to run a line of automobiles between Portland and Camden, there connecting with the Dunkirk and Redkey automobile line. Eiler & Boyd, of Portland, have been selected to purchase the automobiles. They are open to correspondence from automobile firms.

THE LONG ISLAND HIGHWAY PROTECTIVE SOCIETY has filed its certificate of incorporation. The objects of the society are the protection of the interests and the rights of the people in the highways of Long Island, the co-operation with the authorities for the enforcement of laws governing motor vehicles, and of other riding and driving equipages and the general care of the highways on Long Island. The principal offices of the society are to be at Oyster Bay, Nassau County, and the directors for the first year are R. W. Gibson, Thomas S. Young, W. Emlen Roosevelt, William J. Young, Arthur D. Weeks, and C. W. Nelmore, of Oyster Bay; William F. Sheehan and George R. Sheldon, of New York City; William H. Baldwin, Jr., of Locust Valley, and William J. Matheson, of Cold Spring Harbor.

LEGAL.

DISCRIMINATION IN LIGHTING.—Because R. Snell did not have his residence wired for light by the Clinton (Ill.) Electric Light, Heat and Power Company, that corporation refused, when Snell applied to it for electric lighting, to install a transformer in his house without cost, although its practice was to furnish customers with such transformer free. The Supreme Court of Illinois has sustained Mr. Snell's appeal from the decision of a lower court refusing to grant him a mandamus against the company. The Court holds that the discrimination was an unjust one. The electric light company's contention was that it only considered itself under obligation to furnish the transformer free where it had been allowed to make a profit in wiring a house. Justice Carter, in giving the opinion of the Court, after stating that a transformer or reducer is just as necessary in lighting houses as the pole on which it is fastened or the wire that carries the electricity, says: "It is entirely immaterial who does the wiring of the house—the electric light company or some other party; the transformer is necessary in either case. If the company does the wiring, that is a business distinct from that of furnishing electricity for lighting purposes, just as the putting in of gas and water pipes into a house is a distinct business from furnishing the gas or water to flow through them. Appellee, being organized to do a business affected with a public interest, must treat all customers fairly and without unjust discrimination.

NEW INDUSTRIAL COMPANIES.

ELECTRO METALLIC ARCH COMPANY has been formed at Philadelphia, with a capital of $30,000, to carry on the business of electroplating.

CHICAGO TELEPHONE SUPPLY COMPANY, Augusta, to make and deal in telephone supplies of all kinds; capital, $500,000. President, F. I. Dutton; treasurer, W. L. Beedle, both of Augusta.

E. B. LATHAM & COMPANY, New York, have been incorporated to deal in machinery and electrical supplies; capital, $100,000. Directors: Ernest B. Latham, Charles A. Latham, John Lewis Owen, Brooklyn.

C. E. HEWITT & COMPANY, New York, have been incorporated to deal in electrical supplies and do construction work; capital, $10,000. Directors: Charles E. Hewitt, Newburg; Ernest B. Latham, Henri Pressprich, Brooklyn.

AMERICAN INSTRUMENT COMPANY, of New York, has been formed with a capital of $10,000, to make electrical and other apparatus. The directors are J. M. Boyle, N. T. Weitzel, both of New York, and G. T. Weitzel, of St. Louis.

THE MANHATTAN SMELTING AND REFINING COMPANY has been incorporated at Trenton, with a capital stock of $200,000, to produce metals and alloys by means of oxyhydrogen or electrical heat. The incorporators are Thomas S. Haight, Harry Brian Pearson and Edwin V. Machette, all of New York.

PERSONAL.

MR. T. A. EDISON denies the reports that he will enter his storage battery in the endurance run, New York to Boston, of the Automobile Club of America.

DR. F. A. C. PERRINE'S interesting paper on success in long distance power transmission, read before the Boston Society of Arts, has just been issued in pamphlet form.

MR. FRANK WRIGHT, the chief electrical engineering expert attached to the Monterey Steel Works now under construction in that Mexican city, is expected in New York early next week.

MR. FRANK V. BURTON, formerly with the Western Electric Company and Sanderson & Porter, New York City, is now with the Bryant Electric and Perkins Electric Switch Companies of Bridgeport, Conn.

MR. MAX HUELSENBECK, chief engineer of the Helios Electrical Company of Ehrenfeld, Cologne, Germany, is now on a visit to this country and is making a trip of inspection of its chief electrical plants and factories.

MR. L. A. FERGUSON, chief engineer of the New York Edison Company and president of the National Light and Edison Illuminating Associations, has been spending a week or two down East preparatory to the Edison convention in the White Mountains.

MR. M. A. HAYS, agent for the land and industrial department of the Southern Railway, has become secretary of the Chamber of Commerce of Sault Ste Marie, Mich., and is devoting his energies to the development of its hydro-electric resources, on which so much capital has been expended.

MR. A. B. PAINE has an interesting illustrated article in the September [illegible], detailing his experiences in making a trolley trip from New York City to Chicago. That is to say, a large part of it was made by trolley, and in a year or two he thinks the other links will be filled in.

MR. W. F. ZIMMERMAN, formerly of the Westinghouse Company, but for some years past prominent in the management of the St. Lawrence Power Company, of Massena, has resigned from that enterprise, and before taking up any other work will indulge in a long rest, the first in six years.

MESSRS. EDWARD NOYES and W. G. T. Goodman, of Noyes Brothers, of Sydney and Melbourne, sailed for England on the Lucania, August 30. Their visit to this country was made largely for the purpose of placing contracts for apparatus for the electric tramway system, for which they have been appointed the engineers.

MR. W. R. WRIGHT, the English electrical engineering expert, who has recently been retained by the municipality of Wellington, New Zealand, in connection with the proposed electric traction system to be constructed in that antipodean city, is expected to arrive in the United States very shortly for the purpose of studying American electric traction methods.

MR. H. H. VREELAND, president of the Metropolitan Street Railway Company of New York, receives from *Harper's Weekly* the deserved compliment of having his portrait printed on its front page as one of the leading "Americans of to-morrow," in the series of that name. But what an atrocious portrait it is! A "dying duck in a thunderstorm" never looked worse.

DR. M. I. PUPIN, of Columbia University, New York, has just returned from a trip abroad. He says that he believes that the Marconi Company will win the suits instituted by that company against other wireless telegraph companies, alleging infringements of the Marconi patents. He bases his opinion on the fact that the other companies are obliged to use Marconi's invention of two upright wires to receive and forward messages.

GRAND DUKE BORIS, of Russia, cousin of the Czar, has been in New York during the past week and when interviewed spoke specially of electricity in America. "It's nothing but electricity here, there, and everywhere. Your street cars move because of electricity, and you even illuminate your stores and places of amusement with letters made of many electric globes. Americans are coming to us with their many electrical appliances for transportation and manufacture. They are welcome."

MR. THOMAS B. WHITTED, manager of the sales department of the General Electric Company's Denver office, has resigned to assume the technical management of the J. J. Henry enterprises, which include gas, electrical and power plants in a dozen western cities. Mr. Whitted began his career in the Schenectady shops, became engineer of the Denver office three years ago, and a year later was promoted to the position he now gives up. He has won a wide circle of friends and acquaintances in the Far West.

SWARTLEY-ERNST.—A great many electrical people will be interested to learn of the wedding in Philadelphia last week of Miss Charlotte Ernst, niece of Mr. Luther Stieringer, to Mr. H. C. Swartley, of Philadelphia. The happy pair are spending their honeymoon in the mountains of Maryland. Miss Ernst has for some years past been in the habit of attending electrical conventions with her uncle, and has made a host of warm friends and admirers, some of whom had indeed counted upon her participation in meetings now about to take place.

MR. EMILIO DYSTERUD, chief engineer of the Monterey Electric Light & Power Company of Monterey, Mexico, is now in the United States. He will remain for some three weeks and inspect the various electrical plants, and it is anticipated that he will make arrangements with a view to the placing of considerable contracts for equipment, etc., to be installed in a proposed addition to the existing plant. Mr. Dysterud is making his headquarters at the office of the Federal Electric Company, Washington Building, 141 Broadway. Broadway.

MR. CHARLES J. GLIDDEN, of Lowell, Mass., and Mr. Dudley E. Waters, president of the Grand Rapids National Bank, of Grand Rapids, Mich., who, with Mrs. Glidden and Mrs. Waters, are making a four thousand mile drive on Mr. Glidden's 16-hp Napier automobile, have arrived at Lucerne, at last reports. They have covered 2,066 miles of their trip. They have traversed the A.berg, Brenner, Aprica and St. Gothard passes, the latter in a snowstorm. Mr. Gidden relates that the temperature there was so low that it froze the gasolene, so that it was necessary to come down to Andermatt without power.

MR. C. L. BUCKINGHAM, the well-known New York patent attorney who has for many years past had offices in the Western Union Building, has just secured larger and finer quarters in the Potter Building, in a suite looking out upon the City Hall Park. In addition to practice for the Western Union, General Electric and other large corporations, Mr. Buckingham has of late found time to develop and perfect the highly practical telegraph system bearing his name, in which, it will be remembered, using an ingenious alphabet system for mechanical transmission, the message is received and printed an a regular blank ready for delivery.

MR. FRANK JONES is reported from Hartford, Conn., to have returned from South America a millionaire and to have already negotiated the purchase of Bear Top Mountain as a summer home. Seeking fortune, he has traveled well over the world, and to-day, it is stated, he occupies a place as the financial leader of South America. He is president of the East Coast Telephone Company, which controls practically all of the telephone lines of South America. He has offices in Buenos Ayres and London, and he is about to open offices in New York. After considerable wandering about the world he brought up in Argentina. Being much interested in electricity he found employment with one of the telephone companies that was just starting. His ability and energy were quickly recognized, and it was not long before he was in a position to force his fortunes. He brought about the amalgamation of all of the telephone lines along the east coast of South America, and he is now practically the owner of the entire system.

MR. JAMES HOULEHAN, of Toledo, O., has found out how to turn the energy of a permanent magnet into the production of continuous or rotary motion—indeed, has patented "a form of permanent magnet in which there is no zero point or dead centre." He says: "A horseshoe-shaped piece of steel can be magnetized in a few seconds by an electric current of a few amperes from a battery or a dynamo. And the amount of electrical energy used is ridiculously small, but the magnet so made can lift many pounds of iron in contact or a less without contact; and, stranger still, the exercise of this power strengthens the magnet. This mystery of the magnet has never been solved. All that I claim is that I have discovered a method whereby its 'pull' on a piece of iron can be made to produce rotary motion. By this means it is possible to use the magnet's force in the driving of machinery or other application of power. It is not a storage or reacting device like a steel spring which, when it is wound up, gives back approximately the force required in winding, but no more. The magnet resembles a spring that when you wind it keeps wound up, giving out its force indefinitely."

OBITUARY.

MR. LEVI SPRAGUE, formerly president of the [illegible] Telephone and Telegraph Company, died at his home in Lowell, Mass., last week from heart disease. He was ninety-two years old.

MR. E. P. WHITFORD, one of the oldest telegraph operators in the country, died last week of heart failure in the Onwentsia Clubhouse at Lake Forest, Ill., where he was in charge of Postal Telegraph Company operators during the Western Women's Golf Championship Tournament.

Trade Notes.

THE PHOENIX GLASS COMPANY, New York, has just issued a neat little catalogue illustrating its various styles of shades, globes, etc.

SEEING STARS.—Both astronomers and amateur photographers are appealed to strongly in the article on "Celestial Photography" which *The Living Age* for August 23 reprints from *Blackwood's*.

THE BURT MFG. CO., of Akron, Ohio, has just received an order from the United States government for two of its Cross oil filters for one of the new torpedo boats, and also two filters for the Navy Yard at Bremerton, Wash.

TELEPHONE SUPPLIES.—The Vallee Bros. Electrical Company, 625 Arch Street, Philadelphia, Pa., in its catalogue No. 13 gives illustrations and price-lists of its full line of telephone and telegraph supplies, including fuses, lightning arresters, etc.

EL-BEND.—Mr. William W. Benson, inventor of the El-Bend, is a frequent visitor to New York. The El-Bend has attracted a great deal of attention, and orders have reached the firm manufacturing them in large quantities since the device has been put on the market.

MR. JAMES G. BIDDLE, 1023 Stephen Girard Building, Philadelphia, Pa., dealer in electrical instruments, reports that August has been a record-breaker. His sales for that month have been greater than in any previous month since he has been in business. While Mr. Biddle can furnish promptly any instrument that is made, he represents directly Morris E. Leeds & Co., Western Electrical Instrument Co., The Bristol Co., Kelvin & Jas. White, Ltd., and Société Generoise.

M. & O. COMPANY.—H. W. Morris, formerly engineer of the Gibbs Electric Company and recently secretary and engineer of the Milwaukee Electric Company, has associated himself with John Ohenberger, formerly general foreman of the Gibbs Electric Company, and recently superintendent of J. & J. Obenberger, under the name of the M. & O. Company. The firm will locate in Milwaukee, and, having acquired the machine shop of J. & J. Obenberger, will manufacture a line of dynamos and motors.

THE GORDON BATTERY COMPANY, 439 East 144th Street, New York, is having an excellent trade in its Gordon cell, particularly among telephone and gas engine manufacturers. It is pointed out that several prominent railway companies use Gordon cells exclusively in the operation of their signals. The company has a plant of large capacity and is in a position to promptly fill orders of any magnitude for immediate shipment. The company describes and illustrates its cell in a booklet, a copy of which it will be glad to send to anyone on request.

CORDS FOR ARC LAMPS.—Many managers of central stations have not given attention enough to the danger from broken arc lamps by falling. If a smooth, firmly-braided cord is used, the chances of loss of the lamp or loss of life from its falling are a minimum. There is much ordinary cheap sash cord purchased for this purpose and called "just as good." It is quite a different article from the best solid braided cord. The Samson Cordage Works, Boston, state that their trade mark, the colored "Spot," is used only on their extra quality cord. The "Samson Spot Cord," assures the buyer, they say, that he is getting the best thing that is made for the purpose.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, reports that it has been unusually successful with its Browning small motors and generators for which it is general sales agent. It states that this type of motor and dynamo, made in sizes of 1/40 to 10-hp and ⅛ to 8½-kw, has met with instantaneous success. The workmanship and material in these machines is the very best, and they are sold under the strongest guarantee. This apparatus is especially designed to be used where a high grade, strong and compact motor is necessary, and is adapted for all small power works, manufacturers, jewelers, hotels, clubs, restaurants, or small lighting plants. The company issues a very complete bulletin covering this apparatus, a copy of which will be mailed upon application.

THE CUTTER COMPANY, of Philadelphia, the well-known manufacturer of I-T-E circuit breakers and the selling agents of Keystone measuring instruments, has just brought out a handsome volume which undoubtedly will prove of value not alone to the consulting engineer, but to the contractor, switchboard builder and the engineer in charge of the large isolated plant. "I-T-E Switchboard Practice," is a volume of 243 pages, printed on the finest plate paper 9x11 and handsomely bound in cloth with colored edges. It is a supplement to "Modern Switchboards," which was published several years ago, and it brings that work, which has for some time been out of print, right down to date. As is quite natural, the subject of circuit breakers is treated with care and exactness, the Cutter Company, whose work in this line is so well known, having devoted several chapters to this important subject. Indeed, the question of circuit breakers appears to be one on which the last word is never said and a chapter on "Switchboards without Switches" appears suggestive. Other chapters are devoted to the question of the selection, use and care of measuring instruments. The scope of the work may be suggested by the following chapter headings: "Switchboard for Manufacturing Plant." "Switchboard for Street Railway Company." "Special Types of Circuit Breakers and Their Accessories." "Circuit Breakers and Their Use in Power Transmission." Model specifications which will be of service to many are also given and the whole volume is very fully illustrated with drawings, half-tones and diagrams. The price is $3.00, express paid.

Record of Electrical Patents.

[illegible]

[illegible]

[illegible] TELEGRAPHIC [illegible]; C. M. Davis, Chicago, Ill. App. [illegible] current from the line and causing [illegible]

[illegible] J. [illegible], Jersey City, N. J. [illegible] are used [illegible] the battery casing when the apparatus is not in use.

[illegible] UNDERGROUND TROLLEY SYSTEM; F. A. Howarth, Johnstown, N. Y. [illegible] is inclosed in a sectional flexible conduit and normally out of contact therewith. The pressure of the trolley against the conduit distorts and carries it against the conductor to establish the circuit.

[illegible] TROLLEY FOR USE IN ELECTRIC TRACTION; J. G. Lister, [illegible] the pole and forced towards the wire by an independent spring.

[illegible] PAGE PRINTING TELEGRAPH; G. Musso, S. Angelo Dei Lombardi, Italy. App. filed July 3, 1901. A solenoid is rotatably mounted and [illegible] to the intensity of the [illegible], to select the letters of a typewriting machine.

[illegible] SNAP PUSH BUTTON SWITCH; W. J. Newton, New York, N. Y. App. filed Oct. [illegible]

[illegible] ELECTRICAL SAFETY ALARM AND SIGNAL MECHANISM FOR RAILWAYS; J. L. Ricketts, Philadelphia, Pa. App. filed March 19, 1900. An electrically driven car having a normally closed circuit containing a magnet which, when in one position, closes the motor circuit and when in the other position, closes a circuit containing a signal lamp on the car, a track circuit adapted to be connected in series with the car circuit [illegible]

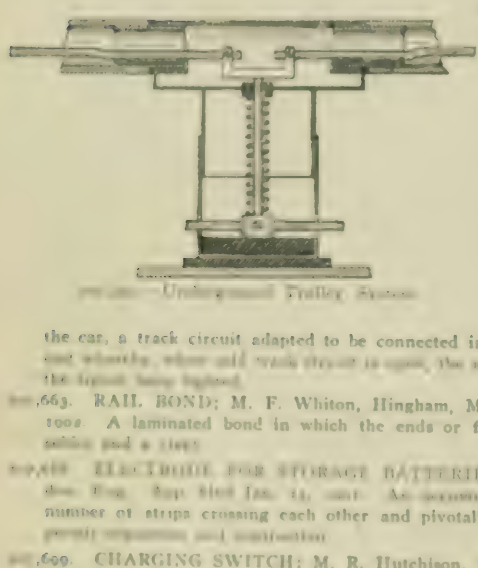
707,804. ELECTROLYTIC CELL; A. Sommer, Cambridge, Mass. App. filed Aug. 17, [illegible]

707,829. TELEGRAPHY; Albert C. Crehore, Tarrytown, N. Y. App. filed [illegible] superposed current telegraphy for way station work, in which the impedance of any inductance or condenser employed on either side of the system is removed from circuit when the key is [illegible]

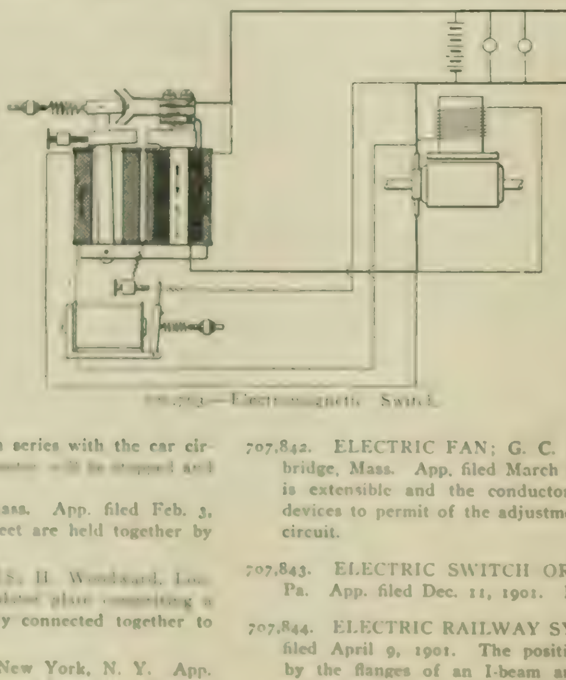
707,830. TELEGRAPHY; Albert C. Crehore, Tarrytown, N. Y. App. filed Oct. 21, 1901. Details relating to superposed current telegraphy, designed to increase the limit of the pulsatory current and make possible the use of smaller condensers.

707,835. MEANS FOR GENERATING COUNTER ELECTROMOTIVE FORCE; H. H. Dow, Midland, Mich. App. filed April 21, 1900. The polarizing capacity of the cell is increased by using granular material upon the surfaces of the electrode, such material being of the same kind as the electrode itself.

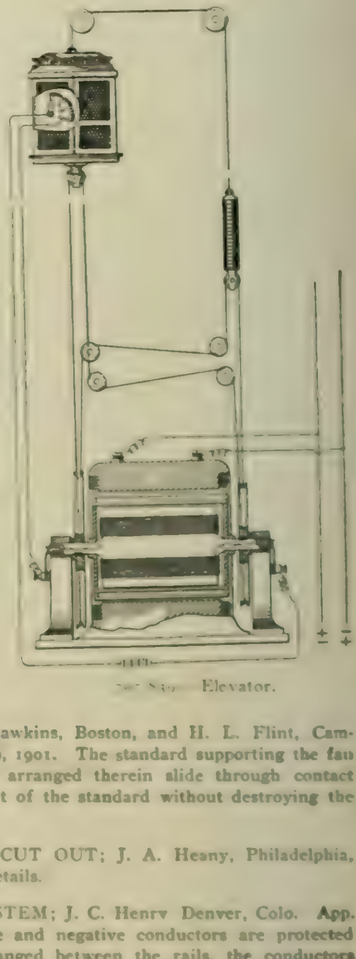
707,839. ELEVATOR; E. R. Gill, New York, N. Y. App. filed Dec. 16, 1899. An apparatus by which synchronous alternating current motors can be used to operate elevators.



[illegible]—Underground Trolley System.



[illegible]—Electromagnetic Switch.



[illegible]—Elevator.

[illegible],663. RAIL BOND; M. F. Whiton, Hingham, Mass. App. filed Feb. 3, 1902. A laminated bond in which the ends or feet are held together by [illegible]

[illegible] ELECTRODE FOR STORAGE BATTERIES; H. Woodward, London, Eng. [illegible] number of strips crossing each other and pivotally connected together to [illegible]

[illegible],699. CHARGING SWITCH; M. R. Hutchison, New York, N. Y. App. [illegible]

[illegible] ELECTRIC BATTERY; [illegible], Paris, France. App. filed April [illegible] is removably connected with the electrode with which it cooperates.

[illegible] BRUSH MECHANISM FOR DYNAMOS; [illegible], Brooklyn, N. Y. [illegible] ing position.

[illegible],761. CIRCUIT CLOSING DEVICE; A. B. Chance, Centralia, Mo. App. filed [illegible]

[illegible] ELECTROMAGNETIC SWITCH; [illegible], New York, N. Y. App. filed [illegible] generator [illegible]

[illegible] OSCILLATING ELECTRIC [illegible], La [illegible], France. [illegible]

[illegible],797. ROTARY APPARATUS FOR THE PRODUCTION OF DIFFUSED ELECTRIC DISCHARGES; M. [illegible], France. App. filed Nov. 12, [illegible]

707,842. ELECTRIC FAN; G. C. Hawkins, Boston, and H. L. Flint, Cambridge, Mass. App. filed March 29, 1901. The standard supporting the fan is extensible and the conductors arranged therein slide through contact devices to permit of the adjustment of the standard without destroying the circuit.

707,843. ELECTRIC SWITCH OR CUT OUT; J. A. Heany, Philadelphia, Pa. App. filed Dec. 11, 1901. Details.

707,844. ELECTRIC RAILWAY SYSTEM; J. C. Henry, Denver, Colo. App. filed April 9, 1901. The positive and negative conductors are protected by the flanges of an I-beam arranged between the rails, the conductors being set in an insulating cement filled into the space between said flanges.

707,886. PROCESS OF MANUFACTURING MANURE FROM APATITE OR SIMILAR MINERAL PHOSPHATE; J. G. Wiborgh and W. Palmaer, Stockholm, Sweden. App. filed Oct. 22, 1900. (See page 381.)

707,894. AUTOMATIC CUT OUT; G. E. Andrews, Providence, R. I. App. filed Nov. 1, 1901. A spring cut out switch released by the destruction of a fuse.

707,952. CIRCUIT BREAKER; F. Benziger, Union Hill, N. J. App. filed Jan. [illegible] An improvement in the latch for the switch lever described in patent No. 686,918.

707,959. TELEGRAPHY; Albert C. Crehore, Tarrytown, N. Y. App. filed Oct. 21, 1901. Details relating to superposed current telegraphy. Designed to avoid any disturbance in the receiving instrument due to the discharge of condensers or to the operation of any of the keys or transmitters in the system.

707,967. AUTOMATIC SWITCH FOR ELECTRIC PUMPS; A. C. Griscom, New York, N. Y. App. filed Nov. 12, 1901. The core of the solenoid enters spring contact jaws at each end of its stroke and an auxiliary core having a limited initial movement along the main core, imparts a driving movement to the latter to release it from the contact jaws.

707,975 and 707,976. MERCURY-VAPOR LAMP; H. N. Potter, Pittsburg, Pa. App. filed July [illegible] and Dec. 11, 1900. (See Current News and Notes.)

// Electrical World and Engineer

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NEW YORK, SATURDAY, SEPTEMBER 13, 1902.

CONTENTS.

NIAGARA MEETING OF THE AMERICAN ELECTROCHEMICAL SOCIETY.

It is appropriate that the newly-fledged American Electrochemical Society should hold its first meeting away from its birthplace at Niagara. The general meeting there next week calls attention to the swift strides with which the industry as represented by the works using Niagara power, and the profession as represented by the society, have been advancing. When the great project of the utilization of Niagara power was undertaken there was doubtless little thought that before its entire completion a new industry would arise which, nestling close to the seat of electrical generation, would entirely modify the original plans for the disposition of the electrical power transformed from the energy of the great falls. At present there is almost a score of separate electrochemical establishments settled at Niagara, some of which are already significant factors in our national industry, and several others give promise of developments revolutionary in their effect. Indeed, if some of the processes now in an experimental stage at Niagara work out successfully, the electrochemical industry as a whole will be given a new and wonderful impetus.

It is with regret that we learn that the Niagara plants upon the occasion of the visit of the society will only in a few cases depart from the practice that has obtained, of refusing admittance to their works. This practice was doubtless borrowed from the chemical industry, which itself imported it from abroad. Such a policy of seclusion is not only un-American, but it is futile so far as concealing the details of processes in regular commercial working. In every other line of electrical manufacture American works are open to properly accredited visitors, and there is usually competition for the privilege of a place on the programme of the American Institute of Electrical Engineers for a visit while the members are *en route* to or in attendance on the annual convention. And if any one thing has been thoroughly demonstrated in this wideawake country, it is the fact that competitors in the same line of work can always find means to know what their rivals are doing, particularly when the process is in commercial operation and known to employees who, when they quit the works, cannot be bound to secrecy as to what they have learned.

The Niagara programme of the American Electrochemical Society is of even higher quality in some respects than that of the Philadelphia meeting, which latter at once gave to the society a high rank among the professional bodies of the world. The papers as thus far announced are 23 in number and cover a wide range of subjects, practice and theory being well combined. The electric furnace is naturally well represented, and a paper by Prof. Richards on its efficiency deals with a subject of particular interest. Prof. Carhart will present another contribution on his paradoxical nickel concentration cell, and the subject of electro-metallurgy of iron and steel will be considered in a paper by Mr. Marcus Ruthenberg. Mr. Alfred H. Cowles will discuss the matter of a unit of quantity of electricity for use in electrochemical calculations, which we trust will not advocate any proposition at variance with the general system of electrical units. Among other subjects of special interest are, the electrolytic dissolution of soluable metallic anodes; cathodic production; some phenomena of electrolytic conduction, and a paper by Prof. R. S. Hutton, of Owens College, Manchester, Eng., on the fusion of quartz in the electric furnace. A paper by Mr. Arvid Reuterdahl on the electronic hypothesis will furnish an opportunity for a discussion on modern electrochemical theory, which doubtless will be taken advantage of. A

[illegible] will be read by Prof. [illegible] of [illegible], who will attend the meeting as the accredited delegate of the German Electrochemical Society.)

N. E. L. A. MEMBERSHIP.

The new spirit infused into the National Electric Light Association under the administrations of Presidents Cahoon and Doherty is illustrated by the statement that a membership of 117 at the Chicago meeting two years ago, has been increased to 266 at the present year. [illegible] new members have joined since the Cincinnati convention, their adhesion doubtless being largely due to the remarkable success of that meeting, from both the technical and managerial standpoints. If the progress of the past few years is continued—and there is no reason to believe that it will not be—there is every prospect that the association will eventually become in numbers more truly representative of the industry than it has been in the past. Though now including the greater number of large stations, there remains a vast possible constituency among the total of over 3,500 American central stations; and nothing could aid more in a successful canvass among these than the earliest possible announcement of a programme for the next convention which will vie with that of Cincinnati in live interest to the central-station man.

LOAD FACTOR IN POWER DISTRIBUTION.

In an article printed elsewhere in this issue descriptive of an electric power plant in a steam railroad shop, an analysis is given which shows that in this particular case the motor equipment is operated at only about 37 per cent. of its rated capacity. It is perhaps needless to say that this does not reflect on the motor equipment, being due to the infrequency at which the machines driven are employed in actual work. Moreover, in the case of a shop largely dealing in repair work, and consequently necessarily fitted with tools only occasionally in use, a considerable disparity between connected capacity and the actual load is inevitable. But the figure given is significant when we consider what it would mean if the shops were shaft-driven by a steam engine. In the present case a considerable part of the capacity is in direct-connected motors, and it is to be assumed that where shafting is employed full advantage has been taken of the economy in disposition incident to a motor drive. If, however, the shops were operated from a system of shafting driven by a steam engine, the low load factor of 37 per cent. would entail a distressing loss of energy in the shafting. In the case of a large shop, somewhat similar in character to that described in the article, the load with all the machines idle was found to be 57 per cent. of the normal load during the working hours; with an electrical distribution this perhaps would have been reduced to the odd 7 per cent. We have no doubt that the low load factor quoted had in itself much to do in the present case in influencing the railroad company in the adoption of electric power in the face of special circumstances, which, as pointed out in the article, militated against such action. As to the matter of the load factor itself, this is conditioned on the character of operation in any case, and very difficult of amelioration. Electric power, however, offers a means of reducing its untoward effect to a minimum.

ELECTRICITY AND SLUMBER.

In thought one is not apt to associate electricity with sleep, nor seek in it an agent for producing slumber—at least of the reposeful kind that has an awakening. In the Digest of this issue, however, will be found an account of some experiments which appear to indicate that insomnia may find in the electric current a dangerous foe; and as the authority for the statements is not a newspaper writer but a French physicist of authority, the matter takes on a real interest. It is true that the apparatus necessary is somewhat formidable, and that in the case of the animals experimented on, the first step consisted in producing apparent death, from which the subject was resuscitated to the intermediate stage of slumber. But even this condition would not deter one so afflicted with insomnia as to render any remedy however heroic the lesser evil. An insomnia is the result of a disturbance of the nerve centers, it appears reasonable that a titillation properly set up by an interrupted current at such centers should have some effect, and perhaps a tranquillizing one; but whether it could be one oft repeated or have a permanent curative power is a matter for physiologists rather than physicists to pass judgment upon, and the verdict of the former will be awaited with interest.

DETERIORATION OF STORAGE BATTERY PLATES.

It is a trite observation that the efficiency of dynamos is already so good that there is but little room left for improvement in this direction. While this is true, there is ample room for possible improvement in the size, weight and cost of dynamos for a given output. The demand for improvement in the dynamo is, however, not merely so great as the demand for improvement in the storage cell. When we consider that a lump of good coal is theoretically capable of lifting itself two thousand miles high against sea-level gravitation, by virtue of its contained potential energy, whereas a lump of storage battery can at best only lift itself about ten miles, the disparity between the storage of electrochemical energy, and the storage of chemical energy in carbon becomes painfully apparent. Nevertheless the low efficiency of the steam-engines commercially used on vehicles for the transmutation of coal energy into work goes a long distance towards placing coal and the storage-battery on a par as energy carriers. At least, until recently, the lead storage cell has held undisputed sway among commercial accumulators. It is an irony of fate that for the electrical propulsion of automobiles, batteries of the heaviest commercial metal must be used and carried about.

It is not so much a question, however, of the weight, or even of the efficiency of an automobile battery, as it is its reliability. If the storage battery runs the automobile 20 miles to-day, can it be relied upon to do so after recharge to-morrow or next week? It is the depreciation of batteries that has brought them into discredit far more than their weight. In an article on page 409 of this week's issue, Prof A. L. Marsh suggests that silver might be made to replace lead in a storage cell, were it not for the first cost. While it is true that the first cost of a silver battery would constitute an objection, yet if a silver battery could be made light, efficient and reliable, so as to have a small depreciation under commercial conditions, it might supersede lead for automobile traction. Tramps might occasionally run away with an automobile for the sake of its silver battery, but the value of a light and reliable accumulator would pay interest on a considerable first cost of battery. Of course, for stationary storage cells, silver has very little chance, and the leaden cell has every chance of surviving; but for automobile propulsion, the survival of the fittest means the survival of the lightest.

WIRELESS TELEGRAPHY AND MAXWELL'S THEORY.

An article on this subject appears in our columns this week, and is closely in line with our views on the subject. The full significance of Maxwell's theory of electric wave transmission required the development of wireless telegraphy to elucidate. Not only is modern wireless telegraphy in accordance with Maxwell's theory, but also, in a certain sense, a full knowledge and complete understanding of Maxwell's theory would entail a conception of modern wireless telegraphy. Unforunately, Maxwell was so pre-eminently a mathematician that his results remained for many years enshrouded in symbolic language, and appreciated only by the esoteric. Even at the present time but little progress has been made in enlightening the process of the propagation of light and other etheric waves.

It is a significant fact upon which the practical success of marine wireless telegraphy depends, that sea-water is opaque to electromagnetic waves of comparatively great wave length, although very fairly transparent, as we all know, to the shorter waves that we recognize as luminous. In other words, sea-water is a good conductor to waves executing several millions of cycles per second, but is a fairly good insulator to waves of some 500 trillions of cycles per second. If we had eyes that responded to the low frequencies or to the light colors which those frequencies accompanied, a layer of sea-water would be almost metallic in its opacity. Expressing the matter in still another way, if a marine fish carried coherers it would be impossible to operate the same at any considerable depth below the ocean level with the frequencies of wireless telegraphy; but with luminous frequencies, coherers in fairly deep-sea fish might be actuated.

An electromagnetic disturbance impinging upon the sea must either be reflected from it as from a mirror or else travel along the surface, provided that the frequency is not more than millions per second. The disturbance cannot penetrate very deeply. But if the frequency is reckoned in trillions per second, the disturbances may be all reflected or nearly all transmitted to a considerable depth before being destroyed, according to the conditions of the impact. But when a wireless wave travels along the surface of the ocean, oscillating currents flow on and near the surface; and if a current indicator could be made sufficiently delicate, such an indicator, floating on the surface of the sea, might serve as a detector of the electric waves running over it. The current in a long antenna terminating in the sea would, however, be probably much stronger than any local and superficial current on the ocean surface. An enormous amount of detail yet remains to be learned and explored concerning wireless waves, but their main outlines have been implicity contained in Maxwell's theory for many years, and may be said to be definitely known. As pointed out in the article, there is a common ground upon which nearly all theories of wireless telegraphy unite. The orthodox theory embraces each of these theories as one of its aspects, and all the contestants have at least a certain amount of the truth on their side.

THE SHADOW OF DISASTER.

Only a few weeks since we sounded a note of warning regarding a dangerous phase of electric railroading. To this the disaster of last week, which brought the President and the Governor of Massachusetts within a hair's breadth of death, serves as grim and dreadful confirmation. That they were spared to the Nation and State was due to no human interposition. It is a terrible and ghastly thing that such an accident could occur in broad daylight with full knowledge of the conditions, and in spite of such police protection as the city was able to furnish. It is not our place to sit in judgment on the men who may have been directly or indirectly at fault, for the courts will settle the matter of responsibility in so far as any tribunal has the power. Nor do we propose to discuss the details of the catastrophe—we cannot call it an accident—for until these are brought out under oath they must remain somewhat uncertain. But the broader aspects of the affair are as clear now as they ever can be, and the relation of these to the public weal is no light matter. It is not the particular manner of the occurrence, but that it could have taken place at all that is of the greatest moment.

Whatever may be the judicial decision as to the culpability of the parties to the horror, the fact remains that a car running under full control of the motorman and below the legal rate of speed could not have produced the results that are all too plainly in evidence. Whether the brakes were inadequate or out of order, the reversing gear cramped and inaccessible, or its use forbidden, the motorman reckless or demoralized, the conductor negligent or the management heedless in allowing the cars to be run at all, these are questions of fact to be decided later. That the President's carriage turned to cross the tracks and was immediately run down by the car admits of no dispute. Presumably the motorman did not expect the carriage to cross the track at that particular point, but it was no business of his to read the driver's mind. It was his business to keep his car under complete control, whether his rubber-necked passengers got a good view of the Presidential party or not. It was his business to keep his car under complete control whenever there was any chance that a carriage might get in the way, whether it contained the President of the United States or the humblest citizen. We know well the hard and nerve-racking duties of the motorman; we know that there are accidents that no human skill and prescience can avert; but running down from the rear a smartly driven carriage by an electric car at its legal limit of speed cannot be relegated to this class of occurrences. The truth is that with the modern fast and heavy electric cars there is little pretense of keeping the cars under control except in the most crowded part of the city. Even with the best automatic brakes it is hard to keep control unless the speed is low, and this particular car had only hand brakes. As to the legal limit of speed, it is a fact well known to every qualified observer that it is systematically and persistently exceeded almost everywhere and at all times. We know of no adequate legal provisions for enforcing such a limit, for violation in face of the uniform denial of conductors and motormen is very difficult to prove, and the penalties are utterly ineffective. The Pittsfield disaster, to speak frankly, is simply an exemplification of the insufficient grasp which the public has upon its servants.

We are far from being champions of municipal ownership and management of street railways and the like. On the contrary, we have over and over held up to scorn the fallacies of the municipal ownership enthusiasts. In the present state of American municipal politics even close public regulation of public utility is fraught with danger of degenerating to legalized blackmail. But a long line of trolley catastrophies has shown that however good the intentions of the managers may be, they too often fail of ensuring public safety. And they do not stand alone in their ineffectiveness, for less than 24 hours prior to the Pittsfield affair two trains on the Boston and Maine Railroad collided at a crossing and missed terrible loss of life only by the fraction of a second. It was the old story of trains hurrying to make up time and cutting too close at the crossing. The question of immediate public interest is not so much the details of any one accident as means for prevention of all accidents due to reckless running—that is, running with train or car under incomplete and inefficient control. Neither managers, engineers or motormen desire accidents—on the contrary, they suffer by them; but to put the matter in a nutshell, they sometimes imperil the public to meet the temporary exigencies of business. The control of this element of danger is no easy matter. A single reckless man can be landed in the penitentiary if life is lost by his carelessness and negligence; but you cannot get an adequate grip on a corporation. By a pleasant legal fiction it is a person as regards its rights, immunities, and privileges; but when it comes to civil and criminal responsibilities the corporation slips out from under. It cannot be imprisoned for felony or hanged for a wilful murder; it cannot be fined enough to exercise the slightest restraint upon its policy. A single agent may here and there be brought to punishment, but the real criminal escapes. The essential thing to public safety is not so much restrictive regulations as the power to enforce them against the elusive personality of a corporate policy. We pass no judgment upon the management of the Pittsfield road in saying this—it will meet its own vindication or condemnation later. But there is dire need for a firmer grip on quasi public corporations, a grip strong enough to ensure greater caution in operation.

A Memorial to Joseph Henry.

In [illegible] telegraphic societies in this country wrote recently that he had never heard of Joseph Henry or his work in the telegraph field, it would seem to be high time for the movement set on foot by the Albany Institute to secure a memorial in honor of that great physicist at Albany, the city of his birth. It has been proposed that the various electrical bodies should co-operate actively in this laudable work by appointing a committee and raising part of the necessary money. Mr Cuyler Reynolds, curator of the Albany Institute and Historical and Art Society, who is chairman of the committee at Albany pledged to undertake and carry through the plan, sends us the following as part of a formal resolution, which is so worded that all societies interested can adopt it as their utterance in regard to the matter:

"That this committee favors a memorial wherein the sciences shall be taught, in connection with the Albany Academy where he taught as a member of the faculty, and within which building he performed the experiment that demonstrated the correctness of his principle of the electric telegraph, believing that it will be more practical than any other type; and thereby holding in cherished remembrance the views and character of the one who has been long recognized as the leading American scientist, and who donated his discoveries to the advancement of knowledge and the world's industries.

"Considering the inestimable advantage that the inventions of Joseph Henry have been to the world, inasmuch as the sum of $4,000,000,000 is invested in this country alone in enterprises that his study and free gift made possible, which industries give employment to more than a million persons, and appreciating the honor of his labors in connection with the work of this organization, we take this step with a feeling that even when the efforts shall be crowned with success it will be but a slight token of the sincere esteem of the country."

Annual Meeting of the American Electro-Therapeutic Association.

The twelfth annual meeting of the American Electro-Therapeutic Association was held at the Hotel Kaaterskill, Kaaterskill, N. Y., September 2, 3 and 4. Forty members were present, and 24 new members were elected. Many papers were presented on Röntgen rays, which was by far the most frequent subject of discussion, occupying the attention of the members fiully half the time of the convention. Ample evidence was given in cases cited of its efficacy in skin diseases, particularly in carcinoma, lupus and rodent ulcers, its effect being first to remove all pai , and then to heal up granulations, and suppuration, diminishing the tumor in size, and finally curing it. It penetrates the tissue right down to the tumor, and supersedes the knife, which only too often auguments the trouble. It is of unquestioned service in diseases of the lymphatic system. The claims which have been made for it, however, in the cure of consumption were called into question, satisfactory proof of its value in this field being absent. The general feeling was that it would be wise to work and wait rather than promise too much for this new agency. The rest of the papers covered the somewhat limited area over which electrotherapy has been approximately standardized.

Among the matters considered by the convention was the place to be given to electro-therapeutics at the World's Fair of 1904. The subject was presented to the convention through the president by recommendation of the executive committee, and an animated discussion ensued. The trend of the discussion showed that the members were greatly interested in having a true picture of what is being accomplished in electro-therapeutics along strictly scientific lines presented for the criticism of the world. There was a strong feeling that too much light cannot be thrown upon electro-therapeutic methods; that no effort is too great which will stimulate the medical and electrical professions to earnest search after truth; that every effort must be made to [illegible] confidence in that which is good, and brand with its proper mark all charlatanism. At the close of the debate, by unanimous vote, a resolution was passed heartily commending and supporting the plans that have been inaugurated for organizing an electro-therapeutic exhibit commensurate with the dignity and importance of this branch of electricity.

There was a strong sentiment expressed in the discussion of this resolution in favor of the association being represented at the exposition by an appropriate exhibit of the work which it has accomplished, and to further the project and to lend such assistance as may be possible to the Department of Electricity in arranging for the general electro-therapeutic exhibit at the exposition, by vote of the convention, the president of the association was empowered to appoint a special committee of the association on electro-therapeutics at the Louisiana Purchase Exposition.

Prof. W. E. Goldsborough, chief of the Department of Electricity at the Exposition, was present at the convention and by invitation of the president explained the plan and scope of the Exposition. His address was received very warmly by the members, and a strong sentiment developed in favor of holding the 1904 meeting of the association in St. Louis.

Municipal Ownership.

At the convention of the League of American Municipalities, held at Grand Rapids, August 27 to 29, inclusive, Mayor Ashley, of New Bedford, Mass., in his presidential address, advocated in general the municipal ownership of public utilities, more particularly water and electric light plants. While the question of municipal ownership did not come out very strongly at the meeting, it was advocated by several members, especially the Hon. Ignatius Sullivan, the "Labor" Mayor of Hartford, Conn., who was, perhaps, the most pronounced municipal ownership man present at the meeting. Mr James B. Cahoon, the secretary of the National Electric Light Association, secured the floor at the end of the morning session on Friday, and almost following an address by Mayor Sullivan, made the following proposition to the league in behalf of the National Electric Light Association:

The Association would bear one-half of the expense of a competent engineer and public accountant to the extent of $5.000 for their services; such engineer and accountant, or engineers and accountans to be mutually agreed upon by the presidents of the two associations, to examine and report on the costs of any municipal operated plants that the presidents of the league might select, and to compare the costs of the same with the published costs of a private plant of similar size and operated as nearly as may be under similar conditions as regards cost of coal, etc., so that the comparisons could be made on the basis of cost per kilowatt-hour, delivered at the lamp.

In his address, Mr. Cahoon went into the subject somewhat fully, laying particular stress on the subject of uniform accounting, which he informed the league had been adopted by the National Electric Light Association, and which they were at perfect liberty to apply to their plants. At the conclusion, Mayor Smythe, of Charleston, S C., moved that the matter be referred to the executive committee The president modified it by suggesting that the National Electric Light Association submit their proposition in writing to the executive committee through the secretary of the league, and that the matter be taken up between now and the next convention, and a decision arrived at, whether they would accept or reject the proposition. The president explained that the reason he did this was because almost all of the members of the league there present were new to the workings of the league and to the proposition submitted and were entirely ignorant of what had gone on before at Syracuse and Charleston. He stated that this would give them a chance to study the subject over and act on it in an intelligent manner.

Mayor Smythe stated further that he had always understood that the league was against committing themselves in one way or another in favor of, or against, the question of municipal ownership. Mr Cahoon explained to him that the object of the National Electric Light Association was not to agitate this question as to the advisability or non-advisability of municipal ownership, but rather to look at it from a straight business point of view, as to whether a municipality could operate a plant cheaper than the members of the association could. If it was found that they could do so, then private plants must necessarily retire from business and seek investment for their capital in other directions; they were thus naturally anxious to arrive at the true costs of operation of municipal plants so as to know whether private plants could, or could not, operate cheaper than municipal plants, when the proper system of costs and a uniform system of accounting were applied to both propositions He stated further that the association believed private owners could operate this class of public utilities cheaper than municipalities possibly could, for the reason that the latter lacked the incentive to economy which was always present in the privately operated plant

The Mayor of Waco, Tex., who had a paper on municipal ownership, was not present at the meeting, and, therefore, the specific subject of municipal ownership did not come up for general discussion in such a way that the negative side could be heard from

Electric Power in Steam Railway Shops.

SINGULAR evidence of the economy of transmitted electric water power is found where a great railway adapts it to the disuse of an existing and extensive steam plant. When the railway in question hauls all the coal used at the point where the change is made, weight is added to the illustration. If the electric water power is purchased by the railway from an independent company that must sell at a profit, the triumph of water over coal is well nigh complete.

All three of these conditions exist as to the large shops of the Boston and Maine Railway, at Concord, N. H. These shops, where much of the roling stock of the railway is built or repaired, cover a ground area of some acres, and are a good exemplification of the advantages of electric power distribution instead of long, heavy shafting or radiating steam pipes and scattered engines. An electric power plant, driven by steam, was installed at these shops in 1897. This plant comprises two Westinghouse alternators of 150 kw each, at 440 volts and 60 cycles, two-phase, each belted to a tandem-compound engine of the Fitchburg make. From the switchboard near the generators, distribution circuits are run to the various buildings that make up the group, and these circuits supply motors with an aggregate capacity of 590 hp. All the motors are of the Westinghouse make, two-phase, induction type, at 60 cycles and 440 volts, and are composed of the following sizes and numbers of each.

Horse-power.	*Number.*	*Horse-power.*	*Number.*
10	1	30	6
15	6	40	2
20	3	100	1
25	2		

The total number of motors is thus 21.

About a year ago the railway company became convinced that, in spite of the advantage of their position as to fuel supply, electrical energy from water power could be substituted for steam with a saving in the cost of operation at their shops. The available water power is located at Sewall's Falls, on the Merrimac River, 5.5 miles from the railroad shops. This water power is owned by the Concord Electric Company, which uses the falls to drive its generating station there, and operate the electrical supply system in the city of Concord. A contract was made between the railway and the electric company, whereby energy from the water power of the latter was substituted for steam at the shops of the former, and the engines and generators at these shops were left to stand idle.

At the water power plant the generators operate at about 2,500 volts, 60 cycle, three-phase, and this energyy had to be transmitted to the railroad shops. For this purpose three transformers of 150-kw each were installed at the water-power station to raise the three-phase energy from 2,500 to 10,000 volts. Three No. 6 bare copper wires were run from the three transformers at the water power to the railroad shops, and there connected with two transformers of 200-kw each, which change the energy from three-phase at 10,000 volts to two-phase at 440 volts for the two-phase motors. At both ends of the line, the transformers are of General Electric make, and are cooled by air blast from motor-driven blowers. In the generator room at the railroad shops the two transformers just named were installed near the then existing switchboard, from which the motor circuits radiate, and were connected to this board through a smaller one at the left hand.

FIG. 1.—VIEW OF BOSTON & MAINE SHOPS POWER PLANT.

Recording wattmeters connected in each phase of the 440 secondaries from the two large transformers measure the energy delivered from the water-power system to the local distribution lines.

Throughout the shops the induction motors are applied in a variety of ways to the work in hand. One interesting unit is made up of a 100-hp motor, geared to an air compressor. In another case a large transfer table, used to move railway cars from one department of the works to another, is driven by a geared motor of 15 hp.

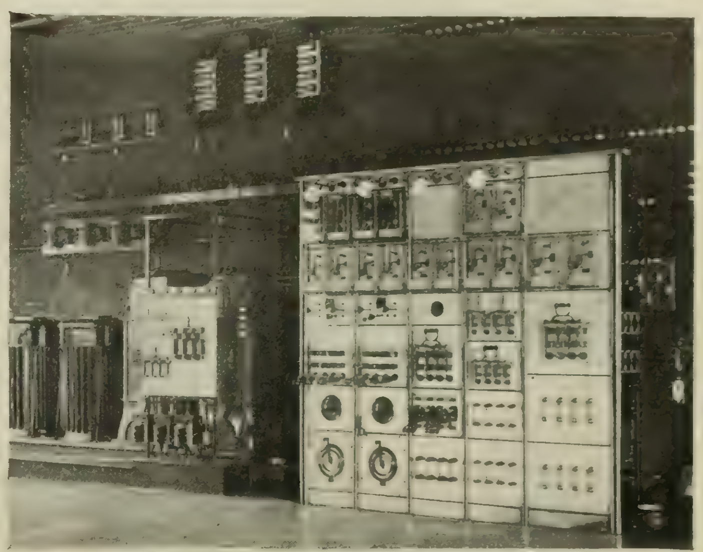


FIG. 2.—SWITCHBOARD AND TRANSFORMERS.

This motor is supplied with energy through an auto-converter, so as to be operated at variable speeds. A large set of plate rolls, used to bend boiler sheets, is driven by a geared motor of 15 hp, operated at variable speeds through an auto-converter. In the wood-working shop are seven motors; in the blacksmith shop, two motors, and in the cabinet and pipe shop, one motor, all driving by belts. A long shaft operates each of the two sides of the main machine shop, and one shaft is driven by a 30-hp, the other by a 40-hp motor, both belted. In this machine shop are two traveling cranes, each of 30-tons capacity and motor driven. Each crane is provided with three motors of 10, 15 and 30-hp capacity, respectively. All of these motors are connected through auto-converters to secure variable speed of operation in the three movements. The 10-hp motor on each crane moves the carriage lengthwise of it. The entire crane with its load is moved up and down the shop by the motor of 15 hp. In each case the 30-hp motor on the crane is used for lifting.

For all of these motors, except one of 40 hp, the nominal working time is ten hours every day except Sunday, when no work is done. Working time for the 40-hp motor is 20 hours on each week day, except Saturday, when the time is 16 hours. From May 31 to June 30, 1902, the above motors, all told, consumed energy to the amount

of 57,740 kw-hours. If the meter readings to determine this energy were taken after the close of work on the 31st of May, and after the close of work on the 30th of June, the kw-hours named would represent exactly the amount of energy used by the motors during June. The meter readings were probably taken at same times during the two days just mentioned, and the 57,740 kw-hours may be taken without material error to represent the consumption of the motors during June. There were five Sundays in June and 25 working days. The nominal hours of work for all motors except the 40-hp were 250 hours during the month. It may be fairly assumed

FIG. 3.—TRAIN OF MOTOR-DRIVEN ROLLS.

that these motors working at all stages of load have an average brake efficiency of 74.6 per cent., so that one kw-hour must be delivered to the motor for each hp-hour of work done by them.

The motors of 250 hours nominal working during June were rated at 550 hp. If these motors had been fully loaded during their entire working time, they would have delivered 137,500 hp-hours, and absorbed at the assumed efficiency 137,500 kw-hours. If the 40-hp motor had operated 20 hours per day during each of the 25 working days of June, its time of service would have been 500 hours, but 16 hours must be deducted from this time, leaving 484 hours of nominal work, because this motor works only 16 hours on Saturday, and there were four Saturdays in June. On the foregoing assumption as to efficiency, the 40-hp motor would have absorbed 19,360 kw-hours during June if constantly worked at full load. With all

FIG. 4.—MOTOR GEARED TO AIR COMPRESSOR.

motors operating at full capacity during the nominal working time, the energy absorbed by them during the month of June would thus have been 156,860 kw-hours. The actual energy used by these motors during the month being only 57,740 kw-hours, as above stated, it follows that the motors were operated at only 36.9 per cent of their total rated capacity for the entire number of nominal working hours on an average.

Here, then, is a complete and important illustration of the fact that electric motors in manufacturing plants consume energy at a rate much below their nominal capacities, on an average. The Boston and Maine shops may be taken as fairly typical of the power requirements in metal and wood working plants. It is probable that there are times when the demand for power is equal to the greater part of the normal rating of all the motors. The fact that generators of 300-kw total capacity were installed to operate the motors supports this view. In spite of occasional large demand for power, the motors show, as above, an average consumption of only 36.9 per cent. of the energy necessary to operate them at full capacity during their nominal working hours.

Wireless Telegraphy and Maxwell's Theory.

BY FREDERICK K. VREELAND.

THE mode of propagation of the electric waves employed in wireless telegraphy has been so freely discussed in these columns that one hesitates to prolong the argument. Yet the great diversity of the ideas submitted in explanation of the facts would indicate that the incident is not yet closed, and that the beautiful work of Maxwell and his followers still lacks appreciation. Several of these explanations are reviewed by Mr. A. Frederick Collins in the issue of August 2, and he in turn submits another which is not altogether in accord with the generally accepted views on the subject.

First, as regards the conductivity of sea water. If we accept the prevalent theory that electrolytic conduction is due to the motion of charged material particles or ions, it is quite conceivable that, where the alternations are sufficiently rapid, the inertia of the ions and the influence of neighboring molecules might prevent the ions from responding to the electromotive impulses, and the electrolyte would then become an insulator[1].

Whatever the explanation, it is evident that sea water is quite transparent to light, and even with waves a million times longer, such as are produced by the smaller Hertzian oscillators, it acts as a more or less perfect dielectric; but the waves used in wireless telegraphy, at a frequency of a million cycles per second, are several hundred times longer still, and it is a well established fact[2] that at these frequencies sea water is a good conductor, and hence quite opaque to such waves. So if we are to accept the "free wave" hypothesis we must find a way to get *around* the surface of the ocean, not through it.

Diffraction has been suggested, but we must remember that the amount of deviation depends upon the relation of the wave-length to the sharpness of the diffracting edge. M. Gouy, in his experiments on the diffraction of light by the edge of a very keen razor, obtained remarkable deviations; but here the thickness of the edge was comparable to the wave-length of light. If waves 1,000 feet long could go around the earth we might expect light to pass around a sphere one inch in diameter, whereas the keenest edge obtainable is none too sharp for wide deviations.

Mr. Collins refers to the twilight produced by diffuse reflection when the sun is below the horizon, but the sun's rays are reflected by material particles, large in proportion to the wave-length, and as the diameter of the particles approaches the wave-length the reflection becomes less and less perfect. The longer waves are naturally the first to be affected; hence on a perfectly clear day, when the suspended particles are very minute, the sky takes on its characteristic blue color due to the preponderance of the shorter waves.

Where are the material bodies in the upper air large enough to reflect waves 1000 feet long? Clouds will not do, for Marconi and others find a fog-bank quite transparent. Some think that the rarified upper strata of the air are sufficiently good conductors to reflect the waves, but this remains to be proved, and the idea has not gained general credence. However this may be, the fact remains that transmission by free waves has not been successful over long distances. Marconi and many others have tried it faithfully, using parabolic reflectors and other concentrating devices; but not until the grounded antenna was adopted did long distance signalling become possible.

What, then, is the real nature of the radiations?

To gain a proper understanding of the subject we must go back to the fundamental conceptions of Maxwell. His beautiful theory, the masterpiece of a master mind, conceived and developed twenty-five years before Hertz observed the first electric waves in space, has been expanded and amplified by such men as Heaviside, J. J. Thomson, and Poincaré until it gives a complete explanation, not only of

[1] See E. Cohn, Wied. Ann. 38, p. 217.
[2] See J. J. Thomson, Proc. Roy. Soc. 45, p. 269.

the subject we are now considering, but of nearly all the intricate phenomena of light as well. Such a complete corroboration of the theory is sufficient proof of the hypotheses on which it is based, and these principles are so important and far-reaching that we cannot afford to overlook them in this connection.

Imagine a condenser, composed of two plates of metal separated by an air space, and connected by a loop of wire containing a battery (Fig. 1). The moment the battery is put in circuit a current begins to flow, and continues until the condenser is charged to the potential of the battery. We would say, in the language of the old theory, that the current flows from the battery to the condenser, and there, being checked by the layer of insulating air, it spreads out over the surface of the plates, and stops. But Faraday discovered that if instead of air he placed a block of paraffin or glass between the plates, a much greater integral current would flow before the condition of equilibrium was reached. If the dielectric layer were simply an inert insulator, all dielectrics should behave alike; but this experiment shows that some electrical action must take place within the mass of the dielectric itself. But what is its nature?

Maxwell says *it is an electric current.* The current does not stop at the surface of the plates, but continues to flow through the dielectric, with this difference, however: When a current flows in a conductor, it encounters an ohmic resistance, which is analogous to friction, in that it continues unchanged in magnitude as long as the current flows, and the energy absorbed is converted into heat. In a dielectric, however, the reaction is of an elastic nature; it is as if the current had to compress a multitude of tiny springs, whose tension increases continuously as long as the current flows; until finally the elastic reaction equals the direct e. m. f. and the current ceases. The energy expended in overcoming this reaction is not converted into heat and dissipated, but is stored in the dielectric, and may be liberated again in the form of an electric current in the reverse direction as soon as the tension is removed and the "springs" are allowed to unbend.

The current which flows in a dielectric is thus a "displacement current." The elastic reaction or "electric force" is proportional to the degree of the displacement in the dielectric, and the direction of this displacement, if plotted continuously, gives the familiar system of "lines of electric force." Hence, according to Maxwell, there is no such thing as an "unclosed current"; but the circuit is always completed, as a conduction current in conductors, and as a displacement current in dielectrics.

Again, consider a straight wire carrying a current. If we explore the field surrounding the wire with a compass needle we find it to be permeated by a magnetic force which may be plotted as a system of closed circles, the "lines of magnetic force," surrounding the wire. This magnetic field, like the electrostatic field considered above, represents an accumulation of energy; but whereas the latter was a form of potential energy, due to the strained condition of the dielectric, this is kinetic energy, which Maxwell supposed to be due to the motion of the dielectric, or of the ether which permeates it. The self-induction of a circuit, which opposes an increasing current and assists a decreasing one, is due to the inertia of this moving medium which surrounds it.

This magnetic force, and the electric force considered above, are interconnected by well-known laws, which we may not discuss here[8]; but let us consider briefly what takes place when an oscillator is set in operation.

Take, for simplicity, a straight wire, interrupted in the middle by a spark gap. Suppose the two knobs which constitute the spark gap to be suddenly connected to a source of constant high potential, not quite sufficient to break down the air gap. A current flows from the knobs towards the ends of the apparatus, and continues until both conductors are completely "charged." While this is taking place, displacement currents are flowing back through the dielectric until, when the condition of equilibrium is reached, the whole surroundng medium is in a state of electrostatic stress which may be expressed by a system of lines of force such as is shown by iron filings around a bar magnet. (Fig. 2.) These lines, it should be remembered, show the direction of the electrical displacement in the medium.

Now suppose the air gap to break down. A current surges across the gap, the stress in the dielectric is relieved, and displacement currents begin to flow back along the lines of force.

It is well-known that a variable current in a conductor induces similar currents in neighboring parallel conductors. So also in the dielectric: the displacement currents suddenly set up by the discharge of the oscillator induce similar displacement currents in the adjoining portions of the dielectric, and so the disturbance is propagated outward from place to place in an ever-expanding wave.

At the moment when the conductors are completely discharged and the current flowing across the spark-gap is a maximum, the energy of the oscillation is entirely kinetic, *i. e.*, magnetic, and no lines of electric force proceed from the oscillator. As the conductors become charged again with the opposite polarities, this changes into potential energy, stored in the strained dielectrics, about the oscillator. And these alternations of potential and kinetic energy are transmitted outward in somewhat the same way as sound is transmitted from a vibrating tuning-fork—here a layer of moving air under normal pressure, next a layer of compressed air without motion, and so on; only in the case of electric waves the direction

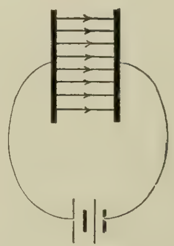


FIG. 1.—CONDENSER.

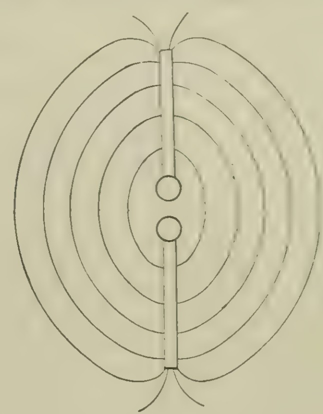


FIG. 2.—SPARK-GAP.

of the current and of the stress which alternates with it is perpendicular to the line of propagation, while in sound the action is in the direction of propagation. Indeed, the action in the ether may be compared to the motion of a series of incompressible plates, capable of sliding over each other, but bound together by an elastic connection which tends to make them slide back to the position of equilibrium after being displaced.

The form of the wave which proceeds from the oscillator has been worked out by Hertz[4], and more fully by J. J. Thomson in his supplement to Maxwell, but as the pith of the matter has been given by Mr. Lee De Forest in your columns of May 17, 1902, it is not necessary to repeat it here. His Fig. 3 (p. 859) shows the lines of electrical displacement at the moment when the two conductors are fully charged and the current is about to reverse; the closed loops at the right and left represent a wave that has detached itself from the oscillator and is beginning its outward journey. As the wave travels outward the loops expand vertically until at last we have practically a spherical wave front, and the lines of force are circles (at least in the equatorial region) whose common center is at the oscillator. The direction of propagation being perpendicular to the wave-front, the disturbance travels radially in straight lines, like light.

These are free waves in space, the peculiar discovery of Hertz. They show the phenomena of reflection, refraction, diffraction, polarization, total reflection, double refraction, etc.; indeed, when allowance is made for their long period and rapid damping, with long intervals of rest, they are quite the equivalent of polarized light.

When such a wave encounters a conducting body, the displacement currents in the dielectric induce conduction currents in the conductor, and these currents in their turn become a source of

[8] This relation for free ether is expressed by Maxwell's fundamental equations:

$$A\frac{dL}{dt} = \frac{dZ}{dy} - \frac{dY}{dz} \qquad A\frac{dX}{dt} = \frac{dM}{dz} - \frac{dN}{dy}$$

$$A\frac{dM}{dt} = \frac{dX}{dz} - \frac{dZ}{dx} \qquad A\frac{dY}{dt} = \frac{dN}{dx} - \frac{dL}{dz}$$

$$A\frac{dN}{dt} = \frac{dY}{dx} - \frac{dX}{dy} \qquad A\frac{dZ}{dt} = \frac{dL}{dy} - \frac{dM}{dx}$$

Where L, M, N, are the components of the magnetic force and X, Y, Z of the electric force at the point whose co-ordinates are x, y, z, and A the reciprocal of the velocity of light.

[4] "Electric Waves," trans. by D. E. Jones, pp. 144 et seq.

radiation—in other words, the wave is reflected, though leaving behind a part of its energy which is absorbed by the ohmic resistance of the conductor. Thus we see how conducting bodies intercept the waves, while non-conductors are transparent.

Now suppose the whole system to be divided into two symmetrical halves by an infinite sheet of conducting material passing through the center of the oscillator. All the lines of electrical force are perpendicular to this plane, so no currents are induced in it; the displacement currents complete their circuits as before, following the lines of force; indeed, everything goes on precisely as if it were not there.

Now let the lower half of the system be removed. The middle point of the oscillator was always a point of zero potential, at which the current simply surged back and forth. Now this point is grounded in a conductor of infinite capacity, and the currents from the remaining half of the oscillator surge in and out as before, losing themselves in the perfect conductor.

An acoustic analogy will illustrate. In a sonorous tube, closed at both ends, a disturbance started at one end is reflected at the other, returns to the starting point, is again reflected, etc. These reflected waves interfere with each other and the resultant is a standing wave, with nodes at each end, where the pressure varies but there is no motion; and with an antinode at the middle, where the air rushes back and forth with no variation of pressure. The wave-length is twice the length of the tube. If now we cut the tube in the middle, each half will vibrate as before, like an organ pipe, with a node at the closed end and antinode at the open one; the air rushing in and out of the open end. The wave length will be the same as before, *i. e.*, four times the length of the open tube.

The action of our oscillator with a single vertical antenna grounded in a conducting plane is quite similar, and the wave length is four times the length of the antenna. The displacement currents, instead of making their wide circuits through the air from end to end of the oscillator, now pass into the conducting plane, and the circuit is thus completed. So also with the waves that have detached themselves from the oscillator; the lines of force, which must terminate in opposite electrical charges, find these charges in the conducting plane; and the motion of the charges as the wave advances constitutes a series of conduction currents which complete the circuits of the displacement currents in the dielectric. Thus the half wave travels outward over the plane, precisely as if the other half were present.

Now suppose the conducting sheet to be curved. A perfect conductor is, by definition, one in which only vanishingly small electric forces can exist. Hence there can be no tangential component of the electric force, and the lines of force must always be perpendicular to the surface. If then the surface be curved, the lines of force must accommodate themselves to the curvature, and the wave, whose direction of propagation is perpendicular to the lines of force, will follow the surface.

Thus we see how the waves can follow the surface of the sea. Only in this case, the water is not a perfect conductor and the lines of force are somewhat distorted, the tangential component wasting itself in ohmic losses in the conductor.

Many of the perplexing questions in connection with wireless telegraphy now resolve themselves: The greater facility of transmission over sea than over land; the poor transmission over dry, sandy or frozen ground; the passing of the waves through or over hills while city buildings cut them off; the failure of symmetrical ungrounded oscillators; the value of high antennæ, etc., etc.

We also see that there is a measure of harmony in the various conflicting theories that have been proposed, for the radiators *are* "sliding waves" following the surface of the earth, but they are of essentially the same nature as "free waves in space," and they are accompanied by "oscillating currents" in the earth. So Maxwell's theory affords a meeting ground for the opposing parties in the dispute, and gives to each a firm scientific basis from which to work up his own ideas; for it is not the least remarkable feature of Maxwell's work that it is independent of any particular hypothesis regarding the ether. He makes no assumptions as to the nature of electricity or the character of the disturbances in the ether. Indeed we must guard against putting a too literal interpretation on the terms "current," "displacement," etc., which are only convenient words borrowed from the mechanics of ponderable matter to describe analogous actions in the ether. He simply formulates the laws which govern these actions and leaves to future investigators the task of determining their real nature.

The Alternating Current Arc.

By C. H. Bedell.

Recent articles on the alternating-current arc have brought out prominently that it has characteristics peculiarly its own, and to those already described should be added the very interesting behavior of this arc when in a magnetic field.

It is well known that any arc may be "blown out" by the approach of the poles of a magnet. The term "blown out," while it correctly describes the action, if the magnet be of the horseshoe type, does not do so if a bar magnet is used, for the arc is then forced out at right angles to the line of the magnet, and not directly away from it,

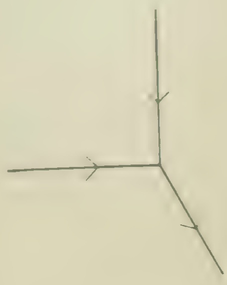


FIG. 1.—DIRECTION OF CURRENT FLOW.

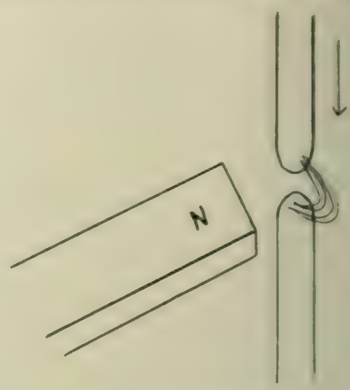


FIG. 2.—THRUST OF ARC TO RIGHT.

as the "blowing out" would lead one to suppose. This forcing to one side of an arc by a magnetic field is due to the same laws which govern the action on wires carrying current on the surface of a motor armature; that is, the direction of flow of the current, that of the lines of magnetic force, and direction of movement are all at right angles to each other, and may be illustrated by the arrows in Fig. 1.

If, therefore, the north pole of a bar magnet be presented to a direct-current arc and the current flows down, the thrust will be to

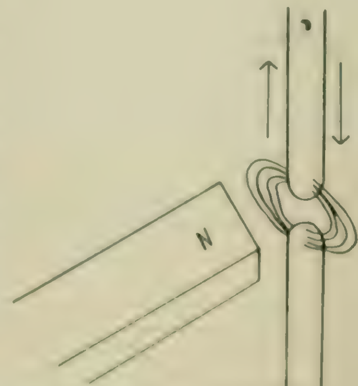


FIG. 3.—ARC WITH TWO WINGS.

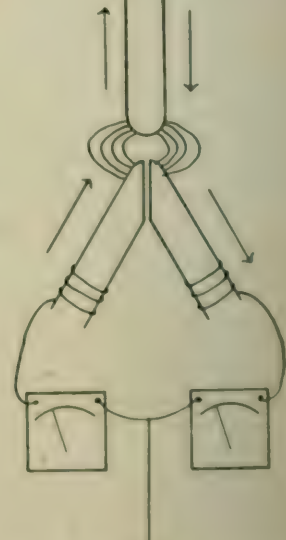


FIG. 4.—DIVISION OF CARBONS

the right, as in Fig. 2, and if the current flows up the thrust will be to the left. With an alternating-current arc the two above effects are combined, and the arc appears to have two wings, as shown in Fig. 3. Of course, these two wings do not exist at the same time though appearing continuous to the eye, but follow the alternations of the current; that is, when the current flows down, the lines of force from the north pole of the magnet force the arc to the right, and when the current flows up, the thrust is to the left.

This property of the alternating arc in a magnetic field of separating the currents of opposite direction into two paths, furnishes a means of extending the separation, and obtaining in one conductor the portions of the alternating current which flow in one direction, and in another conductor the portions which flow in the opposite

direction. By dividing one of the carbons, as illustrated in Fig. 4 (magnet not shown), wires may be connected to direct-current ammeters which will indicate the presence of direct or pulsating currents. Constructed in this manner, the ammeters will not read until the magnet is presented to the arc. As soon as the arc is divided into the two wings, the instruments read the average current flowing in each circuit, and also indicate that these two portions flow in opposite directions.

If the current curve followed the e. m. f. curve, it might be represented, as in Fig. 5, and after the separation by the magnet, by the two curves, as in Fig. 6, where the current is passing in one wire, when there is zero current in the other. The current curve, however, does not follow the e. m. f. curve, but remains at zero until the e. m. f. of the line equals the counter e. m. f. of the arc. This is shown by Fig. 9, which is from a photograph of an ordinary alternating arc, as seen in a revolving mirror (axis vertical). It will be noticed that the period of darkness nearly equals that of light, showing that the current does not flow until some time after the e. m. f. commences to rise.

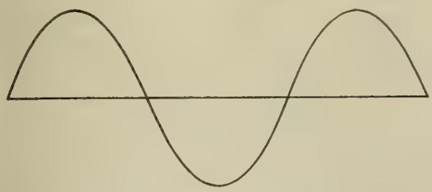


FIG. 5.—CURRENT CURVE.

The appearance of the arc under the influence of the magnet is interesting, as the wings may easily be made to have an extent of five inches from tip to tip, and with an upward curve due to the currents of heated air. An attempt to photograph such an arc was made, and it was found necessary to shield the lens from the strong violet rays of the arc proper, in order that sufficient exposure might be obtained on the wings. This photograph is shown in Fig. 7.

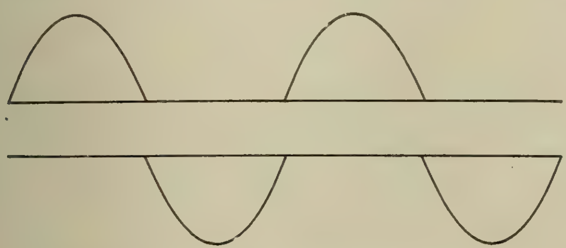
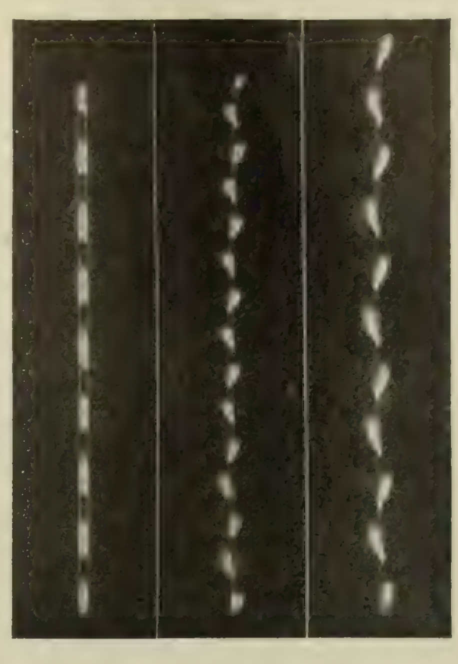


FIG. 6.—CURVES AFTER SEPARATION BY MAGNET.

Fig. 8 is from a photograph of the violet arc proper, extended sideways by the magnet. It will be noticed that the ends of the carbons, although brilliantly incandescent, do not appear to give out many chemical rays. The exposure was made short to suit the violet arc, and, therefore, it would seem that but little violet light was given out by the incandescent ends of the carbons. The question, therefore, arises, is not the curve of illumination for actinic rays for any arc lamp quite different from the curve of illumination for visual rays?

FIGS. 7 AND 8.—PHOTOGRAPHS OF ARC.

Probably the most interesting photographs taken of the alternating arc under the influence of the magnet are those shown in Figs. 10 and 11. These were taken of the arc as seen in a revolving mirror, having its axis horizontal, and show the separation produced by the magnet—the arc from currents in one direction being on one side of the central line, while that from currents in the opposite direction are on the other side of that line.



FIGS. 9, 10 AND 11.—ALTERNATING ARC UNDER INFLUENCE OF MAGNET.

Thanks are due to Prof. Geo. Hoadley and Mr. Arthur Collins for their valuable assistance in making the photographs.

Deterioration of Storage Battery Plates.

By A. L. Marsh.

In a previous article (Electrical World and Engineer, June 7), the possibilities for a light-weight storage battery were discussed. Lightness is an important factor in traction work, but not of such immediate importance as durability.

The greater part of the patents taken out on storage cells of the lead-lead type are based on minor improvements in mechanical construction. These improvements are generally intended to increase the life of the battery rather than to reduce its weight, although some are obviously designed to secure lightness at the expense of life. There is room for improvement in both directions in the lead cell, but the improvements will undoubtedly come from the chemical and physical study of the active materials and electrolyte rather than in a mechanical way.

From the properties of lead with respect to its equivalent weight, lack of rigidity, etc., and from the nature of the reactions of its compounds during charge and discharge, we are justified in the conclusion that attempts at reduction of the weight of lead cells are impractical, but that there is a profitable field of work in attempting to increase the durability of a cell from the chemical side of the problem.

What is wanted is not a battery which will show good results on a laboratory table, with a competent battery man in charge, but one which can successfully withstand the average treatment given it by inexperienced persons, and the necessarily great variations of current output and the constant jarring to which it is subjected in automobile or street-car propulsion.

It is the purpose of this article to bring out the principal defects which tend to shorten the life of a battery of the lead, and also of other types, and finally to suggest lines upon which improvements may be made.

Taking up first the lead-sulphuric acid-lead peroxide type, we find that in actual practice the negative plates, in a well-designed cell, will last during two or three renewals of the positives. To be sure, the negatives gradually lose their capacity, but ordinarily the depreciation is so slow that it is practical to use them with several sets of positives. It has been claimed by a battery man of con-

greater resistance than a negative plate can be made light and yet last during four or five years of constant service. Since the positive electrode is the weak point of the cell, I shall concern myself more particularly with it.

In discharging a lead storage cell, lead sulphate is formed on either plate. This sulphate being insoluble remains in its position and there is thus formed a mixture of lead peroxide and lead sulphate on the positive electrode, and spongy lead and lead sulphate on the negative. As the proportion of sulphate increases, the conductivity of the mixture decreases. In practice the proportion of the sulphate is not allowed to increase to more than 50 per cent., as at this point the electromotive force of the cell falls (and even before this point is reached), and further sulphation takes place rapidly if the cell is not at once recharged.

It is held by some that this mixture is in reality a complex compound; that the lead peroxide of a charged cell is not as represented by the simple formula PbO_2, but is an allotropic form in which many simple molecules are combined into the complex one $(PbO_2)x$, where x is an unknown number but assumed to be 50 for mere convenience. Then the discharge of the positive electrode will be represented by a series of changes in the molecules, as follows: $(PbO_2)_{50}$, $(PbO_2)_{49}$° $(PbSO_4)_1$, $(PbO_2)_{48}$ $(PbSO_4)_2$ . . . . to approximately $(PbO_2)_{20}$° $(PbSO_4)_{30}$, when the electrode has practically reached its discharge limit. Each molecule contains some lead peroxide throughout the discharge and keeps the mass conductive. The molecule becomes less stable as the percentage of peroxide decreases, and when the point represented by $(PbO_2)_{20}$° $(PbSO_4)_{30}$ is approximately reached, it readily breaks up with the formation of ordinary lead sulphate and simple molecules of lead peroxide, thus accounting for the rapid sulphation which is apt to take place if a cell is allowed to remain long uncharged. This structure of the molecule also accounts for the ease with which the discharged plate is reconverted to the peroxide condition, it being generally held that pure sulphate of lead is very slowly converted to the peroxide electrolytically, and only with a relatively large expenditure of energy.

This theory of the complex nature of the lead peroxide molecule was brought forward by Wade in a paper read before the British Institution of Electrical Engineers.

Theory is a thing to explain facts. Whatever the theory held, the fact remains that sulphate of lead does form rapidly if the cell is allowed to stand uncharged, and also forms under other conditions which are not well understood. Although sulphation can be controlled to a certain extent by exercising great care, it is still a serious drawback to the use of lead in batteries, and is in a large measure responsible for the rapid deterioration of the plates.

Another cause for deterioration is the lack of porosity in the active mass. The plate cannot absorb sufficient acid for its discharge, and so must depend upon diffusion. A heavy discharge will exhaust the acid in the interior of the active mass, and, as was shown by Gladstone and Tribe, the normal reactions do not take place in very dilute acid.

A rapid charge may loosen particles of the active material by the too rapid evolution of gas. This is known as scaling.

In pasted plates the peroxide mass softens when subjected to severe service in an automobile, and tends to wash away from the grid. This result takes place in a very short time if sediment is allowed to accumulate in the bottom of the cell until it touches the lower edges of the plates and thus causes a short-circuit. This sediment, consisting of lead sulphate, is continually forming and necessitates the frequent washing of the battery to avoid harm to the plates.

In order to prevent the falling away of active material, due to the softening of the mass and to dislodgment by escaping gas, and to prevent sediment from falling to the bottom of the cell, some battery makers wrap the plates with some porous substance, as specially treated cellulose, glass, wool, etc. I do not know to what extent this method is alleviating the trouble, but in my opinion it cannot stop the formation of sediment, which I believe is due to the following causes:

Lead sulphate is soluble in concentrated sulphuric acid, is practically insoluble in dilute acid, and is again slightly soluble in pure water. In charging a cell at a fairly rapid rate, sulphuric acid is liberated in the pores of the active masses faster than it can diffuse out. Therefore the interior of the plates must contain fairly concentrated acid, in which lead sulphate is slightly soluble. This strong acid, carrying lead sulphate, slowly diffuses out of the plates and is there diluted by the weaker acid. The sulphate being less soluble in the weaker acid, is precipitated and settles to the bottom of the cell. This action would take place through the porous envelope and so form a sediment the same as without it.

The way to prevent this action would seem from the foregoing to be by preparing the plates with greater porosity, so that the acid could diffuse more rapidly, and so avoid great changes in density of the electrolyte, or by preventing the formation of the white sulphate, assuming Wade's theory to be correct; preferably by both methods together.

Mr. G. H. Robertson thinks that the formation of sulphate might be checked by adding some substance to the electrolyte that will prevent the formation of oxidized bodies in it, and which at the same time will not injure the plates.

ZINC-COPPER OXIDE CELL.

This cell, which uses an alkaline hydroxide electrolyte, possesses certain advantages over the lead cell, but also introduces new difficulties, which have rendered it less useful than the lead type. In the alkaline cell there is no such thing as sulphating and buckling, and no harm is done to the plates even if charge does not immediately follow the discharge.

The zinc negative, however, is liable to local action, and great difficulty is experienced in plating the zinc in compact form available for the discharge. To charge the cell, the temperature should be about 54° Centrigrade, and the charge rate low and intermittent to produce the best results. These conditions cannot always be realized in practice, and since the life of the cell is rather short and its application somewhat limited, owing to the comparatively short time that it will retain its charge, this type has not been able to fulfil the expectations of its promoters.

NICKEL-IRON CELL.

The nickel-iron cell, invented by Mr. Edison, I think will be found subject to certain bad tendencies similar to those of the lead cell, but they may be found less difficult to control.

The material of the positive electrode is peroxide of nickel, probably having the formula NiO_2. In the discharge of the cell, the peroxide is reduced, according to one theory, to nickelous oxide (NiO). This compound (NiO) is difficult to oxidize electrolytically, while a reduced peroxide plate is not.

It seems likely that the reaction of discharge is in many respects analogous to that of lead peroxide, and that the capacity is only about half of the theoretical. In normal discharge, I believe that the lowest oxide formed is the sesquioxide Ni_2O_3 (sometimes called peroxide), but under certain conditions the nickelous oxide (NiO) might be formed, and would present difficulties similar to those due to the formation of lead sulphate in the lead cell were it not for the fact that the oxide is insoluble, so that it remains in place and is slowly brought back to the proper condition.

Overcharging does not harm the plates, because nickel is not readily attacked by the nascent oxygen if the electrolyte is a solution of pure potassium hydroxide. Chlorides, nitrates and tartrates should not be present, as nickel is more readily attacked in such solutions.

ZINC-CHLORINE CELL.

Cells of the zinc-chlorine type, with a carbon plate for the positive electrode, have the disadvantages of difficulty in obtaining good deposits of zinc, high internal resistance and difficulty of handling the gas. Cells of this type will probably not enter into competition with lead accumulators.

SILVER CELL.

Of all the storage cells having insoluble electrodes, those using silver oxide for the positive seem to be best adapted to maintain normal reactions under the severe conditions of service. Jungner uses this material in his work with storage cells.

As was mentioned earlier in this article, the negative plate of a lead cell is very durable when compared with the peroxide plate. The difference must be due to the metallic nature of the negative. In the discharge, only about half of the spongy lead is converted to the sulphate, so there is always some metal present and this is in the nature of sponge which holds the mass together. By obtaining a similar physical condition on the positive there should be realized an increase in the life of the battery, corresponding approximately to that of the negative electrode.

To obtain this condition, a depolarizer which reduces to the metallic state must be chosen and, moreover, this metal must have

the property of holding together when in a spongy state. Silver oxide is such a material.

Taking a silver-cadmium cell for illustration, we have spongy cadmium and silver oxide when the cell is in the charged state, and cadmium oxide and spongy silver when in the discharged state. In both these plates we have a condition very similar to that of a spongy lead electrode. There is this difference, the silver passes from an oxidized state to approximately half oxide and half meallic and half negative plates pass from the metallic state to half metallic and half oxide or sulphate, as the case may be. The positive is never entirely reduced, and the negative never entirely oxidized under normal conditions, but they are near enough alike so that we should expect them to be of approximately the same durability.

Silver presents the difficulty that its oxides are slightly soluble in the alkaline electrolyte in which they are used. It has a great advantage, however, in the nature of its reactions. A cell may be left in any state of charge, or completely discharged, without danger of harming the plates. There is no tendency to form compounds which cannot be brought back to the original charged state with ease. Spongy silver can be readily oxidized to the oxide (Ag_2O), or to the peroxide (AgO), and the oxide (Ag_2O) may be easily further oxidized or reduced. No other compounds are formed. Silver oxide may be made by chemical methods and applied to the electrode which can then be used immediately without any forming process. This is a good indication that the chemical reactions will not get out of order as long as they are confined to the electrode.

The slight solubility of silver oxide is the weak point in this cell, but this drawback can perhaps be largely overcome either by a method employed by Mr. Edison in the preparation of copper electrodes or by slight alterations in the electrolyte.

CONCLUSION.

The lead cell has not received enough attention from its chemical and physical side, most manufacturers having paid more attention to mechanical details, and this has given the battery a rather unbalanced development. However, the manufacturers are now giving more attention to the chemistry of batteries, and we may expect to see in the near future a considerable improvement in lead cells in the way of longer life and greater reliability.

I think the investigations should be directed to methods for securing greater porosity and firmness in the active material of the positive electrode and to improving the electrolyte so as to prevent the formation of lead sulphate, or at least to render it insoluble in all densities of the acid solution, so that it remains in place and can be restored to the proper condition.

Other metals will undoubtedly come into competition with, and may displace, lead in batteries for traction work, but as an auxiliary in electric light and power stations lead cells will probably hold their own for some time.

Nickel is a strong metal compared with lead. Its peroxide belongs to that class of depolarizers which adds electromotive force to the cell, and in this respect it is the best, so far, that it is practical to use in alkaline electrolytes. The electrolyte permits the use of steel for the grids and the containing vessel, and this gives a construction both light and strong. There seems to be no reason to believe that this cell will not do what Mr. Edison claims for it.

Silver would be a good metal to use in traction batteries if its cost were not so great. To be sure, the silver in a worn-out battery would go a long way toward paying for a new set, but the first cost would be rather great. Silver is a rather abundant metal, and ought to be produced for much less than it brings at present, if the demand for it should sufficiently increase.

In the lead cell the active material of the positive is only about half of the weight of the entire plate, so the weight of silver oxide required in the silver cell would correspond to the weight of lead peroxide, and not to the whole electrode. The other materials used would be inexpensive; nickel or steel for the positive grid, and probably iron for both negative grid and active material.

Experiments indicate that a silver battery, giving the same power as a lead automobile battery weighing about 550 pounds, would require only about 70 pounds of silver oxide, and perhaps less. It would not take a very extraordinary reduction in the price of silver nitrate to make the cell practical from a financial standpoint, and for the reasons given above such a cell could be made to have a comparatively long life and high efficiency, and would require but little attention to keep it in working order.

Electrogalvanizing.

By C. F. Burgess and Carl Hambuechen.

THE problems arising in the employment of iron as a structural material have been among the most important with which engineers have had to deal. Of hardly secondary importance, however, is the question of preservation, and this being realized to a greater and greater extent, engineers are devoting more attention to the matter of preventing or reducing the corrosion of iron structures.

Zinc is one of the most effective and most extensively employed commercial agents for limiting this corrosion, and while its use has been extensive for more than a century, it has not reached its highest degree of efficiency. Recent years have witnessed an improvement in the application of zinc for this purpose in employing electricity as a means of applying the protective coating.

The electrolytic deposition of zinc, while rapidly increasing in importance has not as yet replaced to any considerable extent the hot galvanizing process, though if the present rate of improvement in its application continues it will not be long before the older process will be largely superseded.

The difficulties encountered in hot galvanizing can be avoided or reduced by the employment of the electrolytic method, and the overcoming of the new difficulties thereby introduced has been the field of such successful research during recent years that the older processes now have a formidable rival.

The term galvanizing in its usual significance applies to the dipping of iron or other metal into a bath of molten zinc under such conditions that on withdrawal the article retains a thin adherent coating of metallic zinc. The term implies an electrical meaning, and the reason for using this term is variously stated. One of such statements in that the zinc coatings were originally applied by electro or galvanic deposition, and hence the application of this term to all zinc coatings. This is erroneous, however, inasmuch as electrogalvanizing is of comparatively recent origin. The implication of the use of electricity lies not in the method of applying the coating, but rather in the method by which the coating protects iron or other more electronegative elements from corrosion. This is illustrated in Sir Humphrey Davy's successful attempts, over a century ago, to prevent corrosion of iron and copper immersed in sea water by attaching strips of zinc at frequent intervals to the other metal. The protection is offered by the galvanic action which is set up between the zinc and the other metal, whereby current travels from the zinc to the solution, thence to the electronegative metal and back to the zinc. The flow of current from the solution to the metal prevents the corrosion of this metal, although at the expense of an equivalent amount of zinc. Zinc offers protection to iron by reason of the property of the metal in partially excluding the corroding influences of the atmosphere or of various solutions, but more especially utilizing the galvanic effect, as previously explained, and as further illustrated by the employment of the metallic zinc blocks placed in contact with the iron of steam boilers to prevent corrosion.

Zinc being more electropositive than iron, the natural inference would seem to be that it would become quickly dissolved and thus expose the iron, but this is prevented by the formation of an oxide, carbonate, or basic zinc compound, which in many cases completely coats the zinc and thus protects it from corrosion. Zinc has been aptly defined as a substance which in contact with air and moisture effectively paints itself with a protective layer. Any solution, such as various acids, which is a good solvent for such coating, naturally destroys this property.

Where the zinc forms an absolutely continuous layer over the metal to be protected the galvanic property is not utilized, but this is a condition very difficult to attain. To all appearances a coating may be continuous, but microscopical examination will reveal the fact that there is some porosity, which will allow the corroding influences to reach the iron. The electropositive property of the zinc, however, prevents such corrosion and is the cause of its superiority to other metals such as tin, lead, and nickel, sometimes employed for the same purpose. In the latter cases the porosity of the coating is shown by the rust spots which accumulate on the plated article exposed to influences such as salt water and air. The distance to which zinc will protect iron from corroding action depends upon the electrolyte which is present, and it is usually of some considerable value.

The term "galvanized iron" usually implies a product obtained by

dipping iron, in sheet or other form, which has previously been freed from scale and other foreign substances into a bath of molten zinc. A suitable flux, such as salammoniac, is used to facilitate the flow and adherence of the zinc. The iron is left in the bath long enough to reach the proper temperature, when it is removed and made readily for the market. The containing vessel is iron, usually of sheet iron with riveted or welded joints.

The following are some of the disadvantages of this process which the electrical process reduces or avoids. A considerable expense is involved in keeping the large quantity of zinc necessary in a molten condition, heat being lost by radiation from the surface and the sides of the tanks, not only when the bath is in operation but also while standing over night, and by heating up all the iron introduced in the tank to something near the temperature of melted zinc, about 430° C. This heating of the immersed iron is often disadvantageous in reducing the strength and distorting iron and steel of small sections. The maintaining of the metal at the proper temperature causes a loss of zinc by oxidation, and the alloy formed with the iron of the tank not only entails a consumption of zinc but results in the ultimate destruction of the tanks. The depreciation on such vessels may be estimated at from 50 per cent. to 100 per cent. per year. Loss of flux is another appreciable item of expense. Perhaps most important is the fact that the galvanizer has little control over the thickness of the deposits, which causes a waste of zinc in some cases and an insufficient amount in others.

The characteristics of electrogalvanizing may be summed up as follows:

Electrolytically deposited zinc forms a very uniform and dense coating on the surface, more uniform than is possible by the dipping process. The degree of protection offered by zinc is proportional to the thickness of the thinnest part of the coating, and consequently electrogalvanizing enables greater protection to be obtained with a given amount of zinc than does the hot process. Further, electrolytically deposited zinc may be made more adherent and dense than by the older method, still further increasing the durability. The greater purity of electrolytic zinc, together with its greater density, gives it for equal thickness of coating an efficiency in resisting corrosion of 50 to 100 per cent. greater than that of the hot process.

Electrogalvanizing gives to the operator a control through a very considerable range of thickness of the coating which it is desired to apply. It is possible to obtain a much thicker coating by this method than by the older process, where the thickness is regulated to a slight extent only by the temperature at which the dipping takes place. If the melted zinc is kept at a very high temperature and the article to be galvanized is immersed a sufficiently long time to attain the temperature of the bath, the coating may be thinner than when the process is worked at a lower temperature. The physical character of the coating may, however, be seriously interfered with if the process is conducted at too low a temperature.

Many articles which it would be impossible to submit to the hot process may be readily galvanized cold, especially such tempered articles as would be damaged by the heat. Springs may thus be galvanized and perfectly retain their elasticity.

Grooves or lines on metal surfaces are not obliterated by the electrolytic method as they are by dipping, and this is an important feature in certain artistic work and in the preservation of stamps, numbers, markings, graduations, etc. This property shows a very distinct difference between the two methods of galvanizing, the one tending to fill up and obliterate the surface irregularities or markings, and the other preserving or even accentuating them. In some cases this difference would be a disadvantage rather than an advantage for the electrical method, inasmuch as the former enables a smooth surface to be obtained upon iron or steel which shows the markings or scratches from grinding and filing.

Screws and fittings dipped in the molten metal usually require recutting, while if proper allowance be made for the thickness of electrolytically deposited metal no such extra labor is involved. In certain classes of work such as the galvanizing of iron insulator fittings the pieces may have to be carefully examined for the removal of any knobs or projections which are detrimental to the insulation while in the electrical process this labor is needless.

Advantage has been claimed for both processes as regards adherence of the coating. Suffice it to say, however, that zinc properly deposited by electrical methods upon a suitably prepared surface can be made to adhere as well as it is possible to make any metal adhere, the joining surface seeming to be a real alloy of iron and the zinc. Improper working of either process will result in improper adherence. The cold process is always ready for working, no time being necessary for the heating or cooling of the liquid, and idleness of the solution does not entail the expense that idleness of the molten zinc involves. The fact that the article to be galvanized does not need to be heated enables soldered parts or low melting metals to be treated.

As far as the economy of zinc is concerned, the advantage lies very decidedly with the cold process inasmuch as nearly 100 per cent. of the zinc employed can be deposited in suitable form, while it has been estimated that 20 per cent. of the spelter put into the bath is wasted in the form of oxide or iron alloy.

The much slower rate at which zinc is deposited electrolytically make the size of the plant greater than for the dipping process, and the first cost is, therefore, greater. It should be noted, however, that the cost of one cubic foot of electrolytic bath is only a small fraction of that of the galvanizing bath. One cubic foot of zinc, weighing 400 lbs., has a value of about $20, while one cubic foot of electrolyte can be supplied for 50 cents or less, and the cost of the zinc anodes to supply the metal to the solution may be estimated at from one to two dollars per cubic foot of solution.

The cost of electrical energy is more than compensated for by the saving in fuel necessary to keep zinc molten. The amount of labor and skill necessary is approximately the same for either process. In the matter of cleaning and preparing the surface to be galvanized, the advantage lies with the hot process, for any small spots which might remain after cleaning may become bridged over in dipping, while they will be more likely to show after the electroplating process. This is not as much of an advantage as might appear at first sight, inasmuch as it is a means of concealing rather than preventing defective work. As to the cost of materials, such as toning salts for keeping the solution in proper working condition, the amount is not greater than the cost of flux necessary in the other process. The zinc to be supplied to the galvanizing tanks is of a purer form, and costing perhaps two cents per pound more than the spelter used in dipping, but this results in a pure form of zinc coating. In the sulphate solutions usually employed, lead, which is the common impurity of commercial zinc, is insoluble, and the coating is consequently free from this substance.

The commercial processes by which electrogalvanizing is now being performed may be subdivided into two classes, according to whether use is made of *soluble* or *insoluble* anodes. The former is used almost exclusively in this country, and the latter in England. The well-known Cowper-Coles process employs a lead anode, which is practically unattacked by the sulphate solution which constitutes the electrolyte. The effect of using such an anode is to cause a continual change in the composition of the solution, free acid being liberated in direct proportion to the amount of zinc deposited. The objection frequently raised against the use of soluble anodes is that while theoretically such anodes should keep the bath at constant composition, which is very desirable, in practice such constancy cannot be maintained for reasons which will be discussed later. The use of insoluble anodes introduces a much more rapid change in composition, but a change which is easily taken care of by a circulation of the solution at such a rate that the percentage of the acidity is limited to a suitable value. The acidity of the solution which is drawn from the tanks is neutralized by bringing it into contact with finely divided zinc in contact with coke, the zinc being usually in the form of zinc dust. This zinc sulphate and the solution thus neutralized and regenerated is again ready for use. By proper circulation and operation of the solution, it is claimed that by this process most excellent results are attained.

The action taking place at the lead anode results in the liberation of SO_4 radical which unites with the water forming sulphuric acid and liberating oxygen, which in turn oxidizes the surface of the plate to lead peroxide. This, when formed to a certain thickness, prevents further action of the lead plate, and thus makes it very durable. The condition of the lead anode is practically the same as that of the positive plate of a lead storage cell when fully charged. This discharge potential at such anode during its operation is above two volts in opposition to the flow of current.

Measurements of single or discharge potentials were made at the electrodes of a commercial zinc plating solution under practical working conditions. The measurements were made by means of the normal electrode, mercury and mercurous chloride in contact with a normal solution of potassium chloride, the value of which is assumed to be —.56 volt. In the notation here used, the — sign is

attached to the single potentials in which the tendency is for the current to flow from the electrolyte to the electrode, and the + sign when the tendency is for current to flow from the electrode to the electrolyte.

Fig. 1 illustrates the condition existing when a lead anode is used in a zinc sulphate and aluminum sulphate solution, with a current density of about 15 amperes per square foot.

The applied pressure, E, which is necessary to cause the current I to flow is made up as follows:

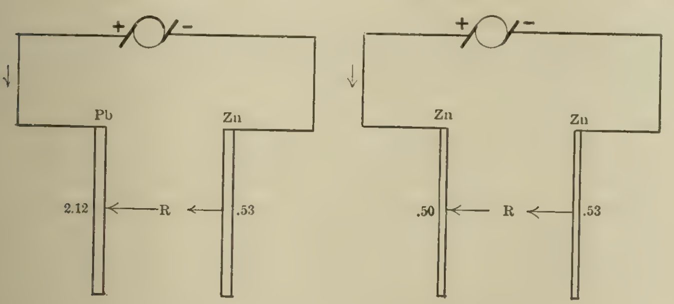
$$E = 2.12 + .53 + I\,R + I\,R_1,$$

where R is the resistance of the electrolyte and R_1 is the resistance of the electrodes and conductors. In this case it is seen that the counter electromotive force to be overcome is 2.65 volts.

Fig. 2 represents conditions when the lead anode is replaced by zinc, and where $E = .53 - .50 + I\,R + I\,R_1$. The counter pressure to be overcome in this case is only .03 volts, due probably to the difference of concentration of solution at the two electrodes.

The reason for desiring to use the soluble anode is that circulation and regeneration of the electrolyte is unnecessary, and the employment of auxiliary apparatus is done away with to a considerable extent. Further, but less important, the amount of power which is necessary is very much less with a soluble anode, as previously shown. In other words, the zinc supplied to the solution in the former case wastes its energy, while in the latter case its potential energy is changed into electrical energy to aid the dynamo.

There are two reasons why zinc anodes do not give the satisfactory results which might be expected. From analogy with the copper anodes used in copper refining, which dissolve away at a steady and uniform rate, zinc might be expected to act equally well, or possibly even better, by reason of the fact that it is a more electro-



FIGS. 1 AND 2.—ELECTROGALVANIZING.

positive element than copper, and consequently ought to go into solution more readily. During the operation of the zinc anodes, even those having a considerable degree of purity, there forms upon the surface of the zinc a scale or coating, usually black in color, which interferes with the solution of the zinc, and increases the resistance to the flow of current. This scale may be caused by the formation of a basic coating, especially if insufficient acid be present, but the principal cause is probably the presence of lead or other impurities which are found to an appreciable percentage in commercial zinc, and which remains undissolved by the action of the current.

The formation of this scale not only has the disadvantage of increasing the resistance and preventing uniform corrosion, but the scale becoming detached in large and small particles may by coming in contact with the cathode interfere seriously with the physical character of the deposited metal.

Another disadvantage in the use of zinc for anodes is that for satisfactory operation the solution must be kept at a certain degree of acidity. While the solution is not in operation this acidity will be neutralized by the zinc uniting with the acid by simple chemical action, and makes necessary the continual addition of free acid, which is subsequently changed to zinc sulphate. This causes a gradual increase in the density of the solution, which, if proceeding beyond a certain amount, produces an unworkable bath, and necessitates the removal of some of the solution and dilution of the remainder. This results in a waste product unless the solution removed be evaporated down and crystallized, which may be a troublesome operation, and gives a product of little or no commercial value, especially if organic substances are used in the operation of the bath.

An ideal process would then be one employing zinc anodes, in which the metal would remain unattacked while current is not flowing, and in which, while current is flowing, zinc will be uniformly corroded without the formation of the previously-mentioned scale. From the results of experimental work, it appears that such conditions may be realized.

The deposition of a good quality of zinc coating depends almost entirely upon the composition of the solution. Unless this is correctly chosen the coating will show the defects of non-adherence, or of spongy, tree, or wart-like character, poor color or pitted surface. The common zinc compounds, the chloride and sulphate, do not give satisfactory deposits when used alone. Of the two, the preference is decidedly with the sulphate, and this forms the basis of most practical zinc solutions. It is found that the coating is improved, as far as color and adherence to the iron is concerned, by the addition of a very small percentage of free sulphuric acid; still this does not prevent formation of rough deposits around the edges. The presence of the acid in the solution further aids in the corrosion of the anode, helping to prevent the formation of the basic salt, and keeping the electrolyte clear, whereas otherwise it would be clouded with a precipitate, which, coming in contact with the cathode, interferes with the quality of the coating.

It is very easy to get an excess of free acid, which would be detrimental in dissolving away the metal as it is deposited, and thus greatly reducing the current efficiency. In fact, with an excess of free acid, it may be impossible to obtain any zinc deposit whatever without the use of abnormally high current density. This is especially the case in depositing on cast iron. What might appear as a peculiarity in the operation of this solution is that with low current densities the current is expended entirely in the liberation of hydrogen, no zinc being deposited. As the current density is increased, the actual amount of hydrogen may decrease until at a sufficiently high density little or no hydrogen is evolved. This is due to the fact that hydrogen having a discharge potential from sulphuric acid of about —.2 volts, is more easily separated out of the solution than is zinc, having a discharge potential of + .5 volts. With low current densities there are sufficient hydrogen ions in the neighborhood of the cathode to take care of all the current. It is evident, however, that with increasing current density there may be insufficient hydrogen ions to take care of all the current, in which case the zinc must play its part and become deposited.

The number of chemical compounds which have been used in connection with zinc sulphate to improve the character of the deposit is very large, as shown by published processes and by solutions which are in operation. Among the most serviceable of such compounds is aluminum sulphate, the presence of which greatly increases the value of the deposit, and when used in the right proportion gives a coating which is entirely satisfactory. No suitable explanation as to why the presence of this substance exerts this beneficial influence has apparently been set forth. A galvanizing process, described quite extensively in the technical papers some time ago, claimed that with an electrolyte consisting of a solution of zinc sulphate and aluminum sulphates, an alloy of zinc and aluminum may be deposited, and the valuable properties of the resulting coating was attributed to the presence of the aluminum. There was probably an error in such conclusions, as no process which has been authenticated has ever been worked out whereby aluminum, either with or without other metals, can be deposited out of an aqueous solution. Further, it is a well-known fact that the presence of aluminum alloyed with zinc produces a metal which is more readily acted upon in solution than the aluminum itself, and such alloy when exposed to water for some length of time becomes brittle and powdery. The writers have made analyses on the deposits obtained from such solutions and they have been unable to find a trace of aluminum present.

To determine if possible to what causes the beneficial action of the aluminum salt in solution can be ascribed, the writers undertook some experimental work, and from the data obtained have arrived at the following conclusions:

It is a well-demonstrated fact that in the electrodeposition of metals for plating purposes, the physical character of the deposit is better in being more compact, uniform and non-crystalline when thrown out of solution by secondary rather than by primary action. That is, a metal deposited by throwing the ions of the metal out of solution directly by the action of the current is not as satisfactory as when some more electropositive ions are liberated, which in turn throw out the metal by a secondary or chemical action. This is illustrated in the ordinary nickel-plating solutions where the NH_4 is the principal electropositive ion which is first liberated directly,

and in turn throws out the metal by secondary reaction; also in the copper and silver cyanide solutions where the potassium is first liberated, and this in turn throwing out the metal by chemical action.

In the zinc solution under question, the aluminum is the more positive ion, which on liberation reacts with the zinc sulphate to deposit the zinc. While it does not prevent the liberation of zinc by primary action, such also is accompanied by metal which is deposited by secondary reaction and the physical character of the coating or deposit is thus improved. The question might naturally arise as to why aluminum sulphate is more satisfactory than the sulphates of the still more electropositive elements such as potassium and sodium. This is probably due to the fact that the discharge potential from an aluminum sulphate solution is only slightly higher than that of zinc, while that of solution or potassium is very much higher; consequently the sodium or potassium ions would not begin to take part in the reaction unless the current density be extremely high or the amount of zinc very low. It seems desirable, therefore, to choose a substance such that its cathode discharge potential shall be higher, although somewhat near that of zinc, which qualification aluminum sulphate fulfils quite desirably. Measurements which have been made show that the discharge potential at the cathode of zinc from a sulphate solution is very near + .5 of a volt. The discharge potential of aluminum from the sulphate is somewhere around + .59 of a volt. The cathode discharge potential of sodium and potassium is between .9 and 1.1 volts, depending upon current density and character of the cathode. These figures show, therefore, quantitatively why aluminum sulphate is a better substance to use than are potassium or sodium sulphates.

Alum, which is a double sulphate of aluminum and sodium or potassium, is very frequently used in plating solutions, and its value lies in its being a cheap source of aluminum sulphate. The presence of the sodium or potassium sulphate is not harmful, inasmuch as it is not decomposed by the current, and it may even be advantageous in reducing the ohmic resistance of the solution. Measurements showed that the discharge potential of NH_4 is about + .7 of a volt, somewhat higher than aluminum. This is not so high, however, as to prevent it from taking part in the electrolysis along with zinc, using reasonable current densities, and this fact accounts for the use of ammonium sulphate in place of or along with aluminum sulphate in increasing the value of the zinc coating. In fact, solutions consisting of zinc ammonia sulphates have been advertised as giving satisfactory results, and the writers have found that such solutions will give good deposits, although not such as can be obtained with aluminum sulphate.

The chemical action of the aluminum ions which takes part in the carrying of the current to the cathode is as follows:

$$2\,Al + 3ZnSO_4 = Al_2(SO_4)_3 + 3Zn$$

This is the reaction which takes place in the main, but the deposited aluminum also may unite with the water to a small extent in accordance with the following equation:

$$2\,Al + 6H_2O = Al_2(OH)_6 + 6H$$

The aluminum hydroxide which is thus formed is a precipitate, insoluble in the solution unless free sulphuric acid be present, forming with it aluminum sulphate. The presence of this precipitate which shows itself by a cloudiness of the solution is detrimental to a good deposit, inasmuch as particles may attach themselves to the cathode and thus destroy its uniformity. A good plating solution must be kept as clear as possible. The presence of a sufficient amount of free acid will prevent such cloudiness, but it is quite evident that under certain circumstances the amount of acid which might thus be necessary might be sufficient to be detrimental in obtaining a deposit of zinc of suitable nature, as previously pointed out. There is a sufficient range, however, in suitably prepared electrolytes to allow such an amount of acid to be used to avoid both difficulties.

An electrogalvanizing process, which has been patented and used extensively in this country, employs certain organic substances as an essential constituent of the solution, together with aluminum and zinc sulphates. Use is here made of the well-known fact that organic acids, such as tartaric acid, and other organic substances, such as glucose or grape sugar, prevent the formation of basic or insoluble precipitates from aqueous solutions of aluminum salts.

Such materials, while being efficient and cheap, have the decided disadvantage of complicating the solution and requiring that the plater shall be something of a chemist to keep it in the best working condition. During the electrolysis this material may become oxidized at the anode, or reduced at the cathode, forming other compounds and necessitating occasional addition of the organic material. There is no convenient way for testing the amount of such organic material present, and the plater must work rather blindly in keeping his solution at the proper composition. Experience has shown this to be a very decided disadvantage, and it frequently happens that if the plater cannot get his solution into working condition by the addition of such organic materials, he is forced to throw away the entire solution and start over with a new one.

The electrodeposition of zinc presents problems which are not noticeable in the deposition of other metals. One such problem is that the structure or the composition of the iron which is to be plated offers marked differences in the ease with which the surface will take a coating. A piece of clean wrought iron may be quickly and evenly covered with little or no evolution of the gas, while an equivalent piece of cast iron using the same current density will receive the coating slowly or not at all, accompanied by a copious evolution of hydrogen. This is especially marked if the cast iron has been cleaned by the pickling acid and then immersed in the plating solution. If, however, the surface be scratch-brushed or ground on an emery wheel after coming from the acid dip, the coating will "take" with less difficulty.

An explanation of this is found in the fact that difficulty is encountered in the deposition of zinc on graphite or carbon from an acidified solution, especially when the latter is in contact with iron. This is contrary to what would naturally be expected, inasmuch as the more electronegative materials are supposed to more readily receive a deposit than those higher up the scale, and the fact that carbon, an element more negative than iron, receives its deposit with great difficulty, is an anomaly, which for explanation requires a further knowledge than appears at the present time available. An experimental demonstration that such phenomenon actually exists was made by drilling holes in cast iron and in wrought iron, filling the same with plugs of graphitized carbon and immersing in the zinc-plating solution. The main portion of the surface quickly took its coating, while the graphite received no deposit for a considerable length of time, and, in fact, protected the iron in the immediate neighborhood of it from receiving a deposit.

When cast iron or iron containing a considerable amount of graphite is cleaned by acid, the graphite is unattacked, and, as the iron is dissolved away, more and more comes to the surface, which thus becomes an iron surface to which are attached innumerable small particles of graphite. Each particle not only refuses to receive a deposit, but protects the iron in this immediate vicinity from receiving it. This shows the necessity of employing some method other than the acid dip alone for preparatory cleaning of cast iron. No practical acid dip will dissolve the graphite as well as the iron, and it must, therefore, be removed by mechanical methods, such as the scratch-brush, grinding, the use of the tumbling barrel or sand blast. It is for this reason that a cast-iron surface prepared by the sand blast receives its deposit most readily. The relatively smaller content of graphite, which wrought iron and steel possess, make them much easier to galvanize than cast iron. An iron casting which has been pickled for a short time will receive a zinc coating more readily than cast iron which has been machined and pickled for some length of time. This may be explained by the fact that the chilled surface of the casting contains a smaller percentage of graphite than does the inner part of the iron.

Although with moderate current density the cast iron will refuse to take this coating, a high-current density applied for a considerable length of time will produce a suitable layer of zinc.

To determine the effect, if any, of materials other than carbon in contact with the iron, plugs of aluminum, amalgamated zinc, lead and copper were driven into cast and wrought iron, and they all, including the aluminum received a deposit quite readily and did not protect the surrounding iron as did the carbon. A possible exception appeared in some cases where the iron around the amalgamated zinc plug received a lighter coating than the iron some distance away. The silicon may have an effect similar to carbon, but this has not been investigated.

An experimental investigation which was made to determine the effect of the presence of graphite, produced some interesting results. The solution used was taken from an ordinary plating tank, and consisted of zinc sulphate and aluminum sulphate dissolved in

water, in which was present a small amount of free sulphuric acid.

By means of single potential or discharge potential measurements made at the cathode, it was shown that $+.5$ volt was necessary to cause deposition of zinc. The measurements were made by causing current to flow through the cell, and upon the instant of interrupting the current the potential reading was taken. By means of a specially constructed switch this measurement could be made with little error.

If no hydrogen ions were present in the zinc solution, it would require only a low-current density to bring the discharge potential up to the required value, but the free acid furnishing the hydrogen ions makes it necessary to employ current densities of considerable value, the amount depending upon the percentage of acid and to a marked degree upon the material of which the cathode is composed. This fact has been pointed out by Coehn (*Zeitschr. Elektrochem.*, July 13, 1899), and our measurements confirm his conclusions. With equal values of current density the discharge potential of the hydrogen from a dilute sulphuric acid solution was found to be: on zinc, $+.47$ volt; lead, $+.51$; copper, $+.49$, and graphite, $+.19$.

These figures show that it takes a much larger current density to raise the discharge potential high enough to deposit zinc on graphite than on the metals mentioned, thus giving a quantitative demonstration of the fact that iron in contact with numerous particles of graphite is difficult to plate upon.

A difficulty more noticeable in zinc deposition than in the use of most other metals for plating purposes is the failure of irregular shaped objects to receive a uniform deposit. Bodies which have cavities or recesses, hollow articles, or any, in fact, in which there is a considerable variation in the distance between various parts of the surface and the anode, become coated on the elevated or more exposed parts, and the deposit in the deeper or more removed parts is either very light or entirely absent. In such cases where zinc fails to be deposited a copious evolution of hydrogen may be observed. This is due to the fact that a certain definite cathode current density of a fairly high value is necessary in acidified solutions before zinc deposition ocurs, and while such suitable current density may be flowing on the outer or more exposed surfaces the portions of the surface further away from the anode or protected by the adjacent metal receives too low a current density. The resistance of the solution plays an important part in making this effect more noticeable. The better the conductivity of the solution, the more even is the deposition. As a consequence materials are frequently added to the solution whose sole rôle is to increase the conductivity, such materials not taking part in the electrolytic decomposition.

The shape of the anode is an important factor in electrogalvanizing. It should be designed so as to conform with the shape of the article to be plated, making the distance from the anode to each portion of the cathode as uniform as possible. Sheet plate cathodes require similarly shaped anodes; hollow articles such as pails require the anode to be inside as well as outside; wires are galvanized by passing them through circular anodes. As a general rule the anode current density should be of a lower value than the cathode density.

To increase the depth to which the coatings will strike or adhere and overcome the tendency which the graphite and other foreign materials influence the same factor, recourse is frequently had to what are known as "striking" solutions. By the use of such solutions the body to be plated almost instantly receives a coating which is distributed fairly uniformly over the entire surface, and after such coating has been formed, subsequent deposition may proceed upon two different principles; one of them is the use in the zinc plating solution of a metal salt, the metal of which is more electronegative than the zinc. The most commonly employed and the most satisfactory of such salts is tin chloride, which is added to the solution in small quantities from time to time. The tin which is thus held in solution is deposited with a lower discharge potential than is necessary for zinc, and even for hydrogen, and consequently a low-current density will throw out such metal. This will cause the entire surface to become coated with a layer of tin, striking into cavities quite satisfactorily. The properties of striking solutions are based to a considerable distance, and the subsequent coating by zinc will then take place more readily. The tin being in solution in a very small quantity, the electrolyte in the neighborhood of the cathode becomes exhausted of tin ions, and the zinc ions then become liberated exclusively. The tin layer seems to exert a beneficial action upon the color and appearance of the galvanized surface. The addition of this tin salt, which is necessitated from time to time, costing about 25 cents per pound, is an additional source of expense in electrogalvanizing, and this may be an especial disadvantage in view of the fact that the tin is deposited out not only at the cathode where it is made use of, but also at the anode where it is of no value. The deposition at the anode is caused by the fact that the zinc is much more electropositive than the tin and, therefore, throws out the latter metal by simple immersion. The tin which is thus thrown out accumulates as spongy masses of various sizes, which may sink to the bottom or by reason of the fine degree of subdivision float on the surface. This accumulation of tin is especially noticeable if the anodes are left in the solution while the tank is idle. The tin which is thus thrown out may, of course, be recovered, and by suitable chemical treatment be again changed into soluble salt, but the labor involved in such treatment would hardly result in any saving. It is, of course, evident that if a lead or other insoluble anode be used this abnormal consumption of the tin salt would be reduced. Nitrate of mercury has also been used as a "striking" material, its action being much the same as that of the tin salt. It is quite effective as a means of coating iron, but it has the disadvantage of making the subsequent zinc deposit brittle. Insoluble anodes would here be necessary.

The other principle utilized in the striking solution is the employment of an electrolyte in which the zinc does not exist to any appreciable extent as an electropositive ion, and in which it is, therefore, deposited out entirely by a secondary reaction. In this case the positive ion is a substance more electropositive than the zinc. Such solution is one composed of potassium zinc cyanide. In an experimental investigation by F. J. Newman, in the laboratory of Applied Electrochemistry, at the University of Wisconsin, over a hundred tests were made on solution of various compositions to determine which would give the best results. He found that a solution made up in the following manner wa most satisfactory: Four-tenths of a pound of potassium cyanide is dissolved in one gallon of distilled water, to which is added as much zinc carbonate as will be dissolved. This solution is then filtered and ready for use. A current density of 14 to 25 amperes per square foot produces an excellent deposit, the thickness of which depends to a considerable extent upon the length of time during which the article is left in the solution. The deposit thus obtained is very excellent as far as durability and appearance is concerned. The disadvantages, however, in employing such solution alone as the galvanizing solution are that the coating is formed very slowly, the thickness is not directly proportional to the amount of the current or the length of time which it has flowed and there is a consumption of potassium cyanide, a comparatively expensive ingredient. The fact that it is an extremely poisonous substance attaches considerable danger to its use, especially where the articles plated are such as may be used for culinary purposes.

In employing the former class of striking materials, the striking solution may be combined with the working solution, while in the latter case the article receives its preliminary coating in the striking solution and is then transferred to the working solution. During the transfer it is very essential that the article be thoroughly rinsed off to prevent any alkali which might otherwise adhere to it, causing a precipitate in the plating bath.

After determining upon a satisfactory solution for zinc deposition, the most important feature upon which successful operation is dependent is in the preparation of the surface to receive the deposit. The cost of labor and materials involved in the operation is the largest item of expense, and comprises about one-half the cost of electrogalvanizing. There is a great lack of uniformity of practice in this work, and it is here that the greatest opportunity for improvement lies.

A common method of procedure is to remove oil or grease by immersing the iron for one-half hour in a hot alkali solution containing about two to eight ounces of caustic soda per gallon of water. Scale and rust are removed by pickling in a 5 per cent. to 10 per cent. solution of sulphuric acid. Heating the solution increases its rapidity of action, but involves a complication of apparatus which is somewhat expensive on account of the difficulty of design, to avoid corrosive action of acid. Hydrochloric acid is frequently used and hydrofluoric acid is employed for removal of sand and scale from castings. As previously stated, the sand blast is a most effective method of cleaning, and its employment is steadily increasing.

Aside from improvement in the preparation of surfaces we may expect electrogalvanizing to become more extensively employed

[illegible] suspension in and removal from the baths, and in simplification of the maintenance of solutions. It is also probable that the rapidity with which zinc may be deposited will be increased, and thus remove the principal disadvantage which is attached to electrogalvanizing, as at present applied. These are problems which are suitable for investigation from the scientific as well as from the technical standpoints, and the solution of which will do much toward promoting the already important electrogalvanizing industry.

Parallel Operation of Direct-Connected Alternators.

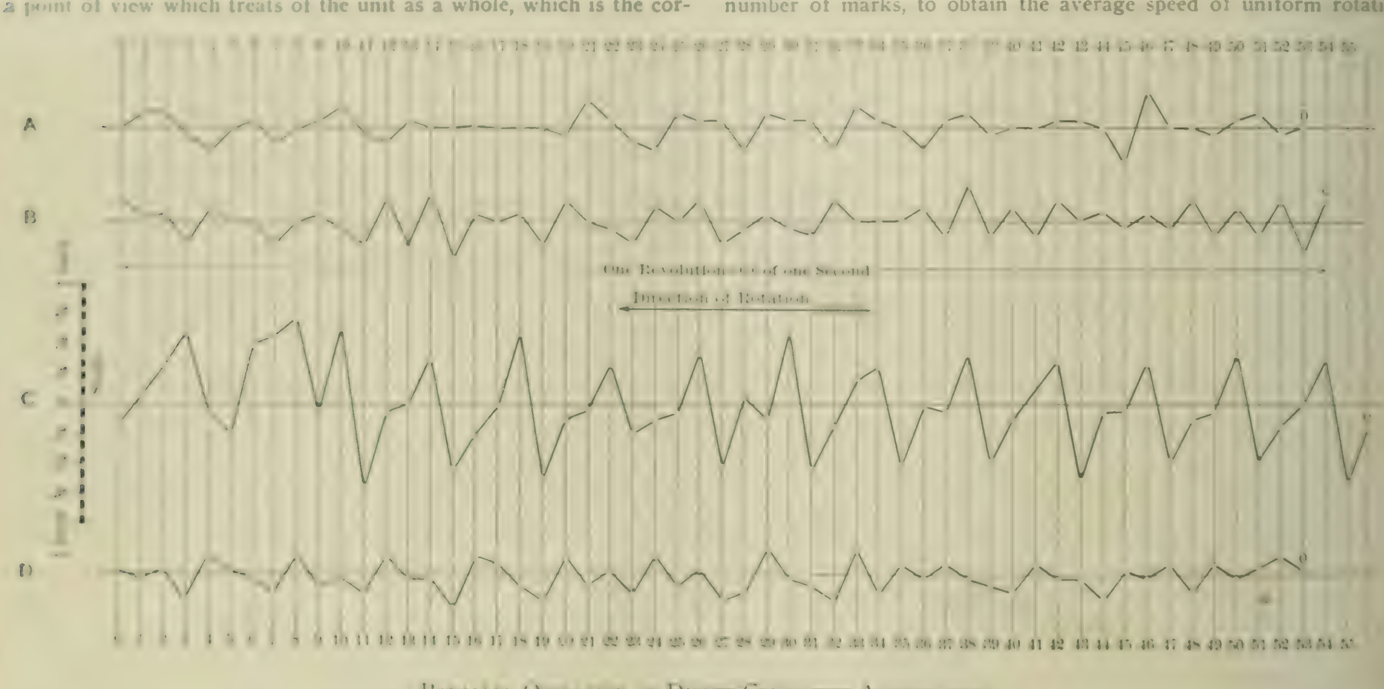
By [illegible]

THE numerous articles published relating to the operation in multiple of direct-connected alternators to Corliss engines, have been read by the writer with considerable interest, but generally have impressed him as being somewhat biased. The engine man deals with the subject from his point of view, and the generator man from his. The subject has been pretty well covered, and the requirements of engines for multiple operation have been duly set forth, as have also those of the generators. It seems to the writer, however, that the subject has not yet been dealt with from a point of view which treats of the unit as a whole, which is the correct point of view, inasmuch as the fundamental requirements for multiple operation of the generator are affected by the engine, and those of the engine are influenced by the generator. For instance, the generator requires that the engine to which it is connected shall have uniform rotation, which in a slow-speed Corliss engine, say of 100 r. p. m. or less, is a practical impossibility. On the other hand the rotation of the engine should be unaffected by the generators when in multiple, which is also an impossibility. Therefore, the solution of parallel operation lies not in the individual design of the engine or generator, but of the unit as a whole.

In operating alternators direct-connected to Corliss engines, we have an equilibrium to maintain, which may be considered analogous to a pendulum standing at rest in the theoretical condition of absolutely uniform rotation; but the engines being operated by pulsations of steam receive sudden impulses which destroy this equilibrium and start the pendulum to swinging. The generators, by virtue of their synchronizing power, instantly tend to draw the pendulum back to its normal position; if the synchronizing power be too great the pendulum will be drawn past the perpendicular, and in due time will receive another steam impulse, which, if it is imparted at a maximum point in the swing, will increase the pendulum action and so on, until the generators go out of step.

To demonstrate that this pendulum action is an actual fact and not a theory, the writer has devised an apparatus to measure and record the variation in angular velocity of fly wheels. This apparatus consists of a device which will mark on a moving object or strip of paper stretched around the periphery of a fly wheel, at regular intervals of time, at the rate of 80 marks per second. When it is desired to make a record a strip of paper is stretched around the wheel to be indicated, and the lap stuck with shellac. The unit is started and put into operation, operating without load, and the marking apparatus put in close proximity to the wheel; and at the desired moment the marks are made upon the strip of paper. The unit is then put in multiple and another record taken for comparison. When a record is made and the marks upon one section of the circumference of the wheel are found to be a greater distance apart than on the others, it shows that the rotation at that part of the revolution was accelerated. If the marks are found to be closer together, retardation from uniform rotation is indicated.

Curves plotted from records taken when units would not operate satisfactorily in multiple are shown in Fig. 1. These curves are plotted upon a horizontal line representing perfectly uniform rotation, being the time of one revolution, which in this case was six-tenths of a second. The vertical lines represent time, being one-eightieth of a second apart, and are the intervals of time at which the recording apparatus marked upon the record, being numbered from 1 to 55. The curves are plotted by measuring the distances between marks on a record, and the sum of their total divided by the number of marks, to obtain the average speed of uniform rotation.



PARALLEL OPERATION OF DIRECT-CONNECTED ALTERNATORS.

The marks on the record above the average, denoting acceleration, are placed above the horizontal line representing uniform rotation, and the marks below the average, denoting retardation, are placed below the line. The vertical scale in this illustration is multiplied four times, in order to facilitate comparisons of curves.

Curve *A* was taken on one of the units running idle. Curve *B* was made immediately after paralleling; curve *C* about five minutes after the unit was put in multiple, and curve *D* with the unit running singly under load. Comparing curve *B*, which was taken immediately after paralleling, with curve *A*, the effect of the synchronizing power of the generators upon the rotation of the engine, is clearly visible, and in curve *C*, taken five minutes later, the influence of the generators has affected the rotation of the engines to such an enormous degree, that the units are almost at the point of going out of step. That portion of curve *C* denoting extended acceleration, from numbers 1 to 10, is particularly interesting as it indicates the result of the pendulum action hereinabove mentioned, it being evident that a steam impulse has been imparted at a maximum point in the swing of the pendulum.

The result of this pendulum action may be observed on the indicating wattmeters of units that will not operate satisfactorily in multiple, and the beats counted. In cases observed by the writer, these beats have ranged from 97 to 216 beats in 300 r. p. m.; and units that would not operate with 168 beats in 300 r. p. m. would do so

perfectly with from 97 to about 125 beats. So it goes to show that success and failure in multiple operation are not far apart. That the frequency of the beat is partly due to the synchronizing power of the generators, may be demonstrated by increasing the self-induction of the armature by cutting down the field current, which results in a decrease in the frequency of the beats. That the frequency of the beat is also partly due to the engine, is demonstrated by the operation of two installations having identical generators, one installation having engines with heavy fly wheels, the other having light fly wheels. The frequency of the beat in the case of the installation with the heavy flywheels is 144 beats in 300 r. p. m.; whereas in the installation having the light flywheels, the frequency of the beat is 216 in 300 r. p. m.

Successful operation may, however, either depend upon the frequency of the beat or its amplitude. The frequency of the beat depends fundamentally upon the synchronizing power of the generators in combination with the moments of inertia of the units. The amplitude of the beats depend upon the dampening effect in the construction of the generator fields, together with the sensitiveness of the engine governors and the number of cylinders. The greater the dampening effect of the generator fields, the more sluggish the governor and the fewer the cylinders result in a beat of the smallest amplitude and the most satisfactory operation. The designer of the generator must take into consideration the design of the engine, and the designer of the engine must take into consideration the design of the generator in the construction of the unit; and the frequency and its amplitude should be predetermined, which is a simple matter of mathematical calculation. If the designer of the generator ignores the construction of the engine, or *vice versa*, satisfactory paralleling will be a matter of chance, which is hardly consistent with intelligent engineering.

Underground Work for Telephone Exchanges—III.

By ARTHUR V. ABBOTT, C. E.

2.—CEMENT DUCTS.

ONE of the earlier pieces of conduit construction is the system in New York installed by the Empire City Subway Company. In the commencement of this work the plan of embedding wrought-iron pipe in concrete was adopted, on the theory that while in time the pipe might, and probably would, rust away, a sufficient interval would elapse to permit the concrete to become perfectly hard, so that if the pipe did disappear a continuous concrete block pierced with a corresponding number of holes would remain. Experience has verified this expectation, and in many places at least the iron has vanished, but the concrete holes remain, forming a most excellent duct system. There are two objections to this plan: the iron pipe is exceedingly expensive, costing from 15 to 20 cents per foot (depending on the price of iron), exclusive of the cost of laying or street work. So long as the pipe is intact a serviceable tube is gained, and after oxidization has completely destroyed the metal the concrete tube is equally good, but an interval exists when the pipe is partially destroyed when the ducts may be filled with sharp jagged slivers of partially corroded iron that are likely to destroy the cable sheath in drawing in and out.

To minimize expense and avoid injury to the cable sheath many attempts were made to fashion a tube of some other material, but only two of these have survived the test of time and have gained any considerable vogue in the conduit field.

The first of these to appear was the so-called *"Cement-Lined Pipe."* The manufacture of this duct has been brought to a high state of perfection by the National Conduit and Cable Company. The process consists of first fashioning a tube about 4-in. in diameter by riveting up thin sheet-iron after the fashion of a stove pipe. A mandrel about 1 inch less in diameter than the tube is then inserted therein, the remaining space rammed full of hydraulic cement. After the cement is set the mandrel is withdrawn, leaving a composite pipe, consisting of a sheet-iron exterior and a lining of cement. The iron casing forms a mold to retain the cement in position during the process of hardening, and continues to protect it during the somewhat trying processes of shipping, handling, carting and laying in its concrete bed in the street. As with iron pipe, the idea is advanced that if the sheet casing rusts away after the pipe is laid, no harm can result, as by that time both the cement lining and the concrete matrix of the conduit will have the ample time to completely solidify. Further, it is argued that the casing being completely enclosed in cement and concrete it will not oxidize to destruction. Which of these theories is true matters little—probably both are—for in some cases the casing does entirely disappear, and in others it is preserved; but as far as the serviceability of the conduit is concerned no difference can be detected, and it is immaterial whether the iron rusts or not. Cement-lined pipe is usually made with a bore about 3 inches in diameter, in lengths of about 5 feet. Each piece is supplied with a male and female socket, somewhat similar to the pump log, so that successive lengths may be centered and fitted into the preceding ones. After the trench in the street has been excavated and the bottom graded, a layer of about 3 inches of concrete is carefully spread thereon and leveled. On this, as a bed, the first row of ducts are placed, spaced about 5-in. centers, lightly tamped in place. Then a concrete of fine stone or a very coarse mortar is spread over the ducts, filling completely all insterstices between them. A sufficient clearance is placed on top of the pipes so that the next row may be spaced about 5-in. vertically. As each piece is laid it is driven home on the preceding one, and mortar packed tightly about the joints. When a sufficient num-

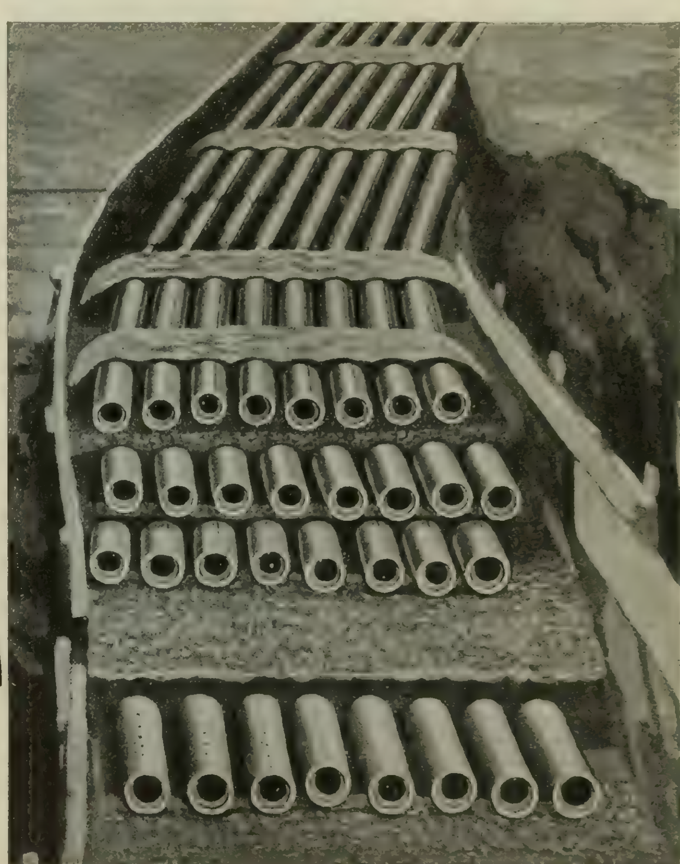


FIG. 6.—CEMENT-LINED PIPE SUBWAY.

ber of pipe have been laid to gain the desired cross-sectional number of ducts, 3 inches of concrete are packed about the sides and on top, and the street refilled and paved.

Fig. 6 gives a detailed view of cement-lined pipe construction, while Fig. 7 shows the general method, illustrating the flexibility of this form of duct in turning a curve. Cement-lined pipe meets a large number of specifications for ideal duct material, and so has deservedly won over many friends, hundreds of thousands of feet being in successful operation. It forms, with its concrete encasement, a strong and indestructible conduit, is easily and rapidly laid without skilled labor, and while by no means either moisture or gas-proof, it is as much so as most market forms. The duct surface is reasonably smooth and cables pull easily. It has as good insulation as any form of silicious duct material. Its chief handicap has been the price charged per duct foot by its manufacturers, which—notwithstanding the fact that the installation cost of cement-lined pipe is less than that of several other forms—has made the total expense per duct foot of conduit built of this material greater than that of some other kinds.

Within the past few years several attempts have been made to

[illegible] of manufacturing a concrete tube from a mixture of Portland or other [illegible] pressing the same into a tubular form, either in a mold or through a die. [illegible] Stone Conduit Construction Company are the best examples of these attempts. The pieces are made in lengths of five to six feet, but no socket joints are provided. Duct material is laid in conrete, exactly in the same manner as cement-lined pipe, excepting that the joints are simply butted, a tightly fitted rubber mandrel being placed at each joint, while the concrete is tamped around it, thus easily insuring good alignment. The advocates of this form of duct material claim that, owing to the absence of the metal casing, a much more perfect union between the encasing concrete is gained, and thus a stronger and more homogenous structure; that the absence of the socket joint does not in any way militate against its value as a duct material; as the pipe can be readily cut with an ordinary bucksaw; breaking is minimized, and no special short lengths are needed to complete sections. Theoretically, all these claims are probably true, but practically they are imperceptible in the actual working of the conduit in contrast with that built of other forms of duct material. Cement-pipe of this description is quite tough on the inside and cables pull hard, nor does the absence of the iron casing cause its manufacturers to quote prices that have as yet gained for it a widespread introduction. An example of the practice of the Western Stone Conduit Construction Company's work will be found in Fig. 8.

FIG. 7.—CEMENT-LINED PIPE CURVE.

FIG. 8.—LAYING CONDUITS.

[illegible]—VITRIFIED CLAY PIPES.

History is silent as to the inventor of the vitried clay duct—that very popular, and, on the whole, most valuable of duct material. Probably some ingenious but unassuming engineer pulled his cables through an old drain pipe, and lo! the tile manufacturers commenced flooding the country with vitrified pipe ducts of all descriptions. Some time in the early 80s the H. B. Camp Company placed on the market a particularly formed clay pipe. It was about 3 feet long and 10 inches square, hence in the vernacular it became known as "*ten by ten*." A partition running through the center of this clay box causes each piece to supply two rectangular holes about 4 ins. x 9 ins. inside. This form is shown at *A*, Fig. 9. The early conduits constructed of this material were made by carefully leveling the bottom of the proper street excavation and placing successive lengths of tile thereon. The joints between the several pieces were made by wrapping several layers of jute or burlap, previously dipped in hot asphalt, around the ends to be joined, and then painting the last wrap with a liberal coat of the melted hydrocarbon. This form of conduit was intended to carry three cables in each division of each piece, and there are many thousand feet that after more than a decade of severe service are doing good work, and seem likely to remain serviceable for a generation to come.

Experience developed two faults: It was found difficult to withdraw cables without injury when as many as three were allowed to remain exposed to the impacting influence of the dust and dirt that creeps into the best subway, and duct material laid with no foundation was prone to settle and fall a prey to the predatory pick. With a 10 in. x 10 in., the latter difficulty was easily cured by placing the duct material on a good 3-in. foundation of concrete, supplying the sides and top with a similar protection, supplemented with a strong piece of 1½-in. plank, but the difficulty of withdrawing the cables was not so easily cured. To meet this objection the Camp Company produced the "*hollow brick*." This form is illustrated in Fig. 10. It consists of the vitrified clay pipe, essentially circular in external section, with the corners chamfered, having a round hole about 3¼ ins. in diameter extending through it. Each piece is about 18 ins. long, 4¾ ins. in outside diameter. A subway of any desired magnitude is easily built by laying up, brick-wall fashion, on the proper concrete foundation, the desired number of hollow bricks to gain the required number of ducts. As each piece is laid it is covered with cement mortar and carefully tamped with a trowel to a proper bed, in exactly the same fashion as brick masonry. As the ends of successive pieces form but joints, a wooden mandrel, closely fitting the pipe hole and long enough to cover at least three joints, is placed in each line of duct and pulled along as fast as successive pieces are placed. This mandrel is shown in Fig. 11, and the method of using it in Fig. 12. At one end a ring enables the mason, who is supplied with a long hook to grasp, and pull the mandrel along, while at the

rear a leather or rubber disk that tightly fits the bore of the pipe scrapes away in its passage any superfluous mortar that may have entered through the joints.

In Fig. 13 a partially completed line of hollow brick conduit is shown. The trench is carefully leveled and supplied with the necessary three inches of concrete foundation. Then the hollow brick is

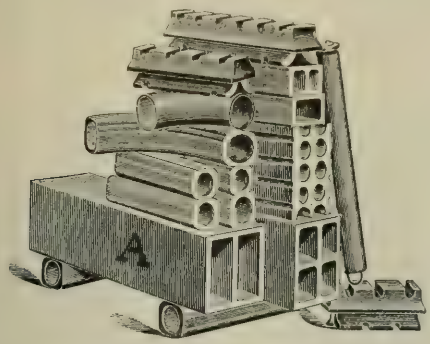


FIG. 9.—"TEN BY TEN."

piled up, the alignment being secured by a chalk line stretched through the center. As fast as successive pieces of tile are placed, the mandrels are pulled along, the rings of which will be noticed protruding from the ends of the ducts.

In Fig. 14 a finished conduit is shown, with the full concrete encasement ready for the refillment and repavement of the street. The

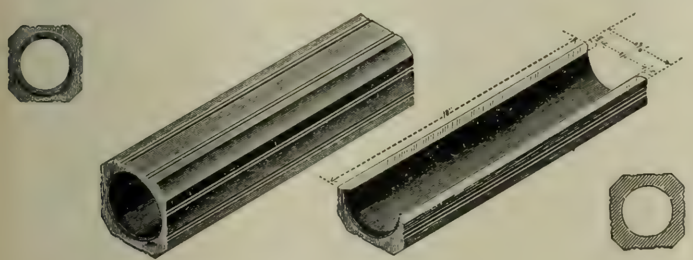


FIG. 10.—HOLLOW-BRICK DUCTS.

Camp hollow brick was a very distinct and very long stride in the art of duct material making, for it provided something that was indestructible, so far as the decomposing action of street soils were concerned, secured all of the advantages of the single duct space, was sufficiently flexible to lend itself to subways of any desired magnitude, possessed sufficient flexibility so that curves could be turned with ease, and intrinsically was a thoroughly good insulator; while the interior was smoother and easier on the cable than any

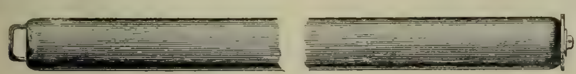


FIG. 11.—MANDREL FOR HOLLOW BRICK.

other form except the soft and greasy surfaces of creosoted wood. The hollow brick, however, labors under the disadvantage that it is impossible, without going to the most extraordinary labor and expense to build a conduit that is even remotely moisture and gasproof, and as it needs the use of a trowel in laying, trade unions have declared that only skilled masons shall be employed, thus saddling those who use this duct material with either the payment of

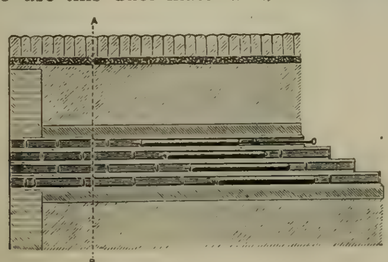


FIG. 12.—SHOWING USE OF MANDREL.

union rates of wages, or the prospect of a strike and a fight against the arbitrary tyranny that American trade unions always endeavor to inflict. Being laid in 18-in. lengths great flexibility is secured, handling is easy and rapid, and it is claimed breakage is reduced to a minimum. Contrawise, where conduits of a considerable number of ducts are to be installed, the labor in handling so many small pieces becomes excessive. With these manifest advantages, it is not surprising that hollow brick promptly captured and has held the bulk of subway construction for a number of years, and that many millions of duct feet have been placed and are now in operation.

The desirability of some form of duct material which could simultaneously preserve all the advantages of the hollow brick, minimize handling and obviate the necessity of skilled labor was early recognized, and the clay men atavistically returning to the old "10 x 10" idea tried to make clay shapes of long lengths containing several cable spaces, hence the so-called "Multiple Duct," of which the McRoy Clay Works were the pioneer exponents. The general type of the McRoy duct and simplest method of laying is shown in Fig.

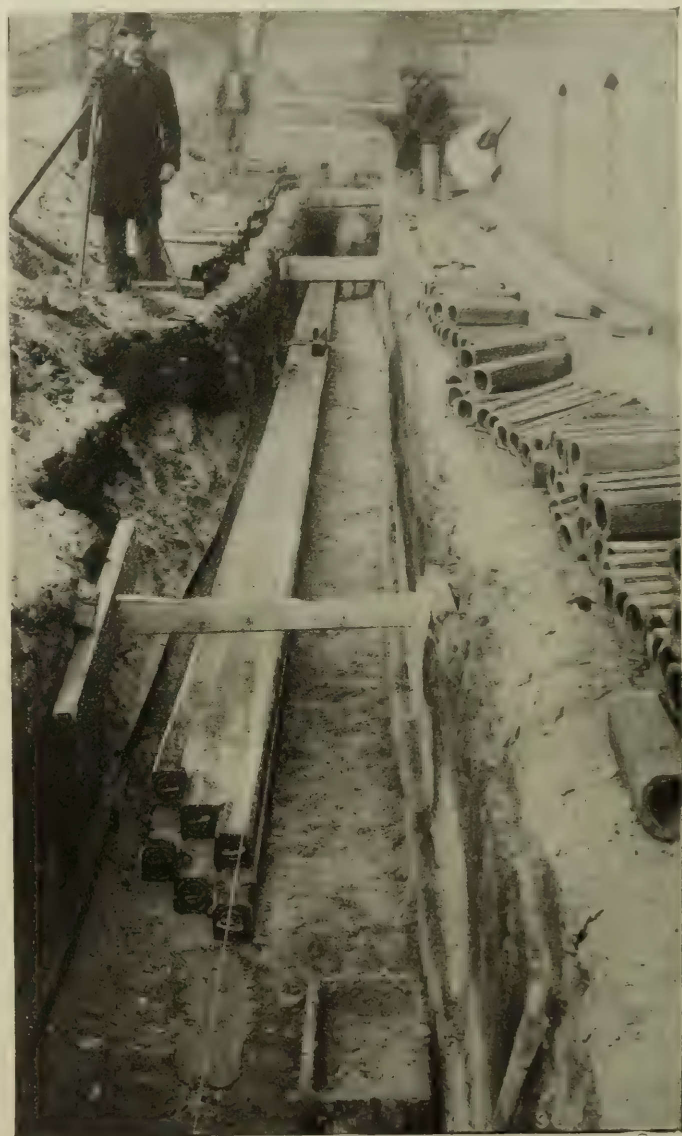


FIG. 13.—PARTIALLY COMPLETE HOLLOW-BRICK CONDUIT, SHOWING MANDRELS.

15. The clay sections are made in lengths of about 5 feet, and contain 2, 4, 6, 8 or more ducts, as the purchaser may desire. Each length is provided with one or more one-half inch holes molded in the clay partitions, into which iron pins forming dowels may be fastened, thus causing ducts in succeeding lengths to align with great accuracy. Joints are best made as indicated in Fig. 16, by wrapping tightly about each succeeding piece several layers of asphalted burlap. The simplest and cheapest method of laying is that shown in Fig. 15. The proper trench is excavated, leveled, and the requisite number of multiple sections piled up. To secure bearing, a thin layer of mortar is spread between each tier and the trench refilled. standard method is adequate where there is little to be feared from street excavation, but is insufficient in most street work, and the conduit is almost sure subsequently to suffer from settlement. The standard method of building is shown in Fig. 17. After the proper

FIG. 14.—COMPLETED CONDUIT TRENCH READY TO REFILL.

FIG. 15.—MULTIPLE DUCT

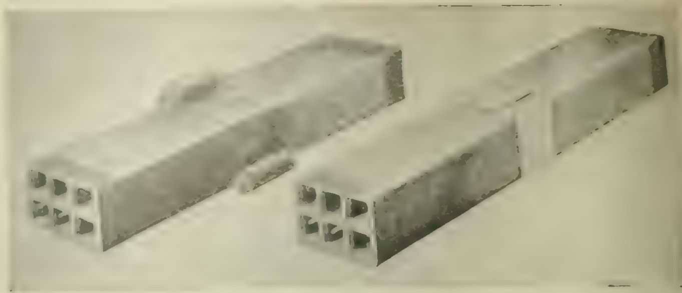


FIG. 16.—MAKING JOINTS ON MULTIPLE DUCT CONDUIT.

FIG. 17.—MULTIPLE DUCT CONDUIT.

FIG. 18.—MULTIPLE DUCT CONDUIT WITH TIMBER FOUNDATION.

INSTALLATION OF DUCTS FOR TELEPHONE SERVICE.

trench is excavated a three-inch concrete foundation is laid, and the sides lined with the cheapest lumber, so spaced as to make a trough 6 inches wider than is needed to receive the proper number of multiple sections. These are then joined and placed on a concrete bed, leaving three inches on each side between the planking. Just as each piece is placed a coating of thin mortar is applied to the clay surfaces in contact with each other. When all the duct material is in place the side spaces are tamped full of concrete and a three-inch

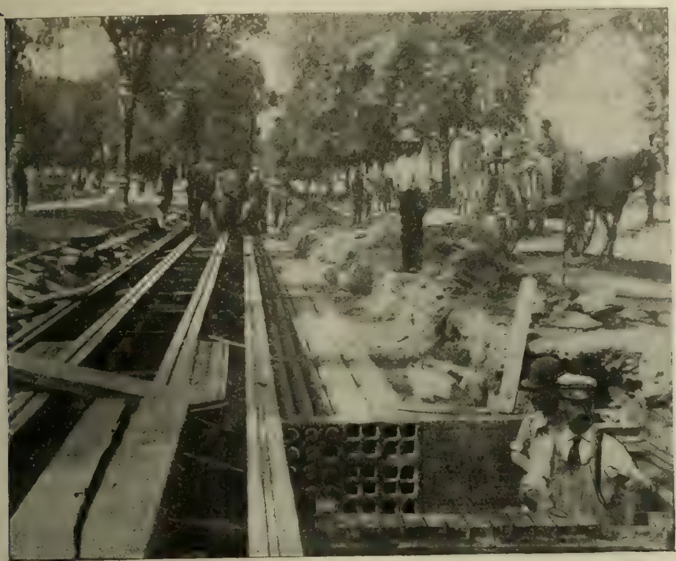


FIG. 19.—CEMENT PIPE AND DUCTS.

cover of the same material completes the work. In some instances the cheaper plan of using a lumber foundation has been adopted, as shown in Fig. 18, which is mentioned only to be avoided. Lumber in such a situation will sooner or later surely rot and allow the conduit to settle, thus ruining what would otherwise be a first-class piece of work.

In Fig. 19 an example is given of the McRoy ducts and cement-lined pipe comfortably and amicably occupying the same trench, utterly oblivious of the probable rivalry of their respective manu-

FIG. 20.—MULTIPLE DUCT CURVE.

facturers, while in Fig. 20 the practical, perfect flexibility of the multiple duct is shown in the ease with which a curve may be constructed.

The manufacture of multiple duct conduit struggled for a long time with indifferent success, as with every additional duct the difficulty both of molding the sections and of burning them without excessive wastage due to unequal shrinkage become very great, but with sufficient application of American perseverance these troubles were gradually surmounted, and following the lead of the McRoy Company many other tile manufacturers entered the conduit field until at present there are a number of firms, among which the engineer has ample opportunity for a wide selection.

Each of the various manufacturers produces a product which differs usually in unimportant details, from that of all others. Each maker claims some particular merit for little wrinkles which distinguish his output from that of others. A single example will, however, suffice to illustrate the forms of duct material from which the engineer is now able to select, and the line of duct material offered by the American Vitrified Conduit Company is large, diversified, excellent and thoroughly representative of the best present practice in the manufacture of duct material. The various single duct forms now put upon the market by this company are illustrated by Fig. 20. A slight analysis will reduce these to four types: The square form, in which each piece is a true rectangular parallelopipidon having full corners so that it may be laid up in a solid wall exactly after the fashion of brick work. At the other extreme is the cylindrical duct or pipe which precisely resembles an ordinary drain pipe minus the bell. Intermediate between these two is a hexagonal duct and a form with fluted or semi-circular corners. These respective types are marked *A*, *B*, *C* and *D* in Fig. 20.

Electrical Mining Plant for Nevada.

The famous Bamberger-De La Mar mines at De La Mar, Nevada, are installing at their properties the largest electrical plant of its kind in the west for mining purposes. The principal feature of this plant is the fact that De La Mar is located about 30 miles from the railroad, fuel is comparatively an expensive element in the handling of the ore, and the use of coal is prohibitive on account of the long, expensive haul. Heretofore, the company has been compelled to burn wood at a very large expense. This new plant will be about six miles from Calientes, on the new Short Line extension.

The purpose is to generate the power there and transmit it about 14 miles, at 30,000 volts, to De La Mar. The generator station will consist of two 600-hp generators, each having a maximum capacity of about 1,000 hp, driven by engines furnished by the Allis-Chalmers Company. This will supply power to the two mills at the Bamberger properties. One mill will work the ores as they come from the mines and the other mill will be used for working the tailings which have accumulated there for the past ten years, and which contain very high values.

Induction motors will be used, varying from 50 to 100 hp, distributed throughout the mills. In addition to this a 150-hp motor will be used in driving a compressor to supply power for drills. The April Fool and Magnolia properties which have been absorbed by the Bamberger interest will also use power from the same line for operating their mill and compressor. One 75-hp electric hoist will be installed at the De La Mar mines, and this will be driven by a 75-hp General Electric induction motor of the variable speed type, which has proven entirely successful for hoist work. The town of De La Mar will also be lighted with alternating current from the same line. The lighting conditions will be considerably improved there on this account.

The water supply for De La Mar and the mills is furnished by a pumping system from the Meadow Valley Wash, where the generator station will be located, supplied by a pipe line about 14 miles in length, with a total lift of over 1,000 feet. On account of the high pressure it is necessary to have three stations along the line where steam-driven pumps are at present used. These pumps will be driven by induction motors, which will receive their current from the transmission line. This will save considerable money on account of the high price of fuel, in addition to the pumps operating at high efficiency.

The work of installing this extensive and well-designed plant is in charge of Mr. F. G. Janney, engineer of the Bamberger Company, and M. D. Grosh, district engineer of the General Electric Company. Much credit is due the Bamberger Company for their good judgment in this pioneer movement, which is bound to result in great economy in the reduction of operating expenses, and will also bring them increased profits from these magnificent properties.

CURRENT NEWS AND NOTES.

WIRELESS TELEPHONY.—Experiments in wireless telephony were, according to a Berlin despatch, [illegible] successfully conducted on August 25, over a distance of [illegible] miles, between Sassnitz and Kolberg.

ITALIAN NAVY TO AID MARCONI.—A despatch from Rome states that King Victor Emmanuel has ordered that the battleship "Carlo Alberto" be placed at the disposal of Signor Marconi for experiments in wireless telegraphy between Europe and America. This compliment is significant in view of the warfare waged against Marconi in England [illegible].

A PRIZE FOR RADIUM.—In *The Cosmopolitan* for September a brief article is published under the title, "A New Field for Speculation," and announcement is made of a prize of $300 for the best paper on the subject of radium and the best way of securing a cheaper and larger supply of it.

DEGREES FROM NORWAY.—In connection with the centenary of the birth of Niels Henrik Abel, the Norwegian mathematician, which was celebrated September 4, at Christiania, Norway, honorary degrees of Doctor of Mathematics have been conferred on 29 foreign scientists, including Prof. Simon Newcomb, Prof. J. Willard Gibbs and Lords Kelvin and Rayliegh.

ELECTRICAL MANUFACTURE OF GLASS.—A patent issued September 2 to Jegor Bronn, of Cologne, Germany, describes a process for the electrical manufacture of glass, which is designed to avoid the difficulty experienced when working with powdered material. The raw material is supplied with a binding agent, kneaded and then caused to pass between heated rollers into the melting furnace in the form of a ribbon or sheet, which is there subjected to the action of an electric arc.

OCEAN WIRELESS TELEGRAPH STATION.—According to a London despatch, it is proposed to install a combined lightship and ocean wireless-telegraph station 100 miles west of the Lizard. It is suggested that a vessel provided with a powerful searchlight, whose beam shall be projected against the clouds, mark the position of the station at night. The wireless telegraph plant is to be powerful enough to command the fairway of the Channel and exchange news and orders with passing vessels.

DOCTORATES OF PHILOSOPHY.—In some statistics relating to Doctorates of Philosophy and their distribution, *Science* gives the total number of degrees conferred in this country during the past few years as 1,158, of which 568 were conferred in the sciences. The institutions considered do not include those that "have no right to confer the degree, giving it for work done *in absentia* or, perhaps, for the payment of a fee." Our contemporary recognizes 27 universities as qualified to confer the degree of Ph. D.

GERMAN SUBMARINE CABLES.—Although Germany has lately shown activity in developing her system of ocean cables, only [illegible] of the world's total mileage is hers. Consul J. F. Winter reports that, according to statistics just issued, the German cable system consists of [illegible] lines connecting different parts of the home territory, six with the colonies, and 10 with foreign countries, making a total of some 17,000 miles. One-third of all the German cables are [illegible].

FIRE INSURANCE TOPICS are to be discussed at the convention of the International Association of Fire Engineers, to be held in New York City on September 16, 17 and 18, including "How to Prevent Electrolysis," by Capt. William Brophy, of Boston; "The Fire Department of the Future in Large Cities," Chief George W. Horner, of Baltimore, and "Progress in Fire-Alarm Telegraphy," by J. W. Stover, president of the Gamewell Fire-Alarm Telegraph Company. The convention will be held at Grand Central Palace, where there will be also a complete exhibition of fire-fighting and life-saving apparatus. Some [illegible] exhibitors have already arranged for space.

A. I. E. E. MEETINGS.—The regular monthly meetings of the American Institute of Electricial Engineers will be recommenced at 12 West Thirty-first Street, New York, on Friday, September 26, 1902, when a paper will be presented by B. G. Lamme, of Pittsburg, on "The Washington, Baltimore and Annapolis Single-Phase Railway." This paper will be the first publication of the new Westinghouse single-phase railway system. At the following meeting, which will be held at the same place, on Friday, October 24, 1902, a paper will be presented by Prof. Charles P. Matthews, of Lafayette, Ind., on "An Integrating Photometer for Glow Lamps and Sources of Like Intensity."

TELEPHONIC DISTURBANCES FROM ELECTRIC RAILWAY.—A patent issued September 2 to Hermann Brockelt, of Berlin, Germany, describes an arrangement designed to obviate disturbances to telephone circuits from railway return currents. These disturbances are stated to be due to the fact that the counter e. m. f. in street railway motors is not absolutely constant, and can be resolved into a uniform e. m. f. and a relatively smaller alternating e. m. f. To counteract the effect of the latter, the current going to the rails passes through the primary of a transformer, the secondary of which is connected across the motor and its field. It is stated that the alternating e. m. f. in the secondary will exactly counterbalance the alternating e. m. f. of the motor so that the current going to ground will have no pulsations.

LETTER TO THE EDITORS.

The Second Law of Thermodynamics.

To the Editors of Electrical World and Engineer:

Sirs.—In your recent discussion of the second thermodynamic law the interesting question is raised whether it embodies a limitation in nature, or merely in man. The fact that the law has been employed by Clausins, Helmholtz, Van't Hoff and others for many broad generalizations in physics and chemistry which have been amply verified by experience would lead us to believe that the first named is the correct view, since it would be strange indeed if so many correct conclusions could be deduced from a false premise.

Your correspondent calls attention to the alleged limitation of the law embodied in Maxwell's conception of demons, who, by their discrimination between the velocities of molecules, could cause heat to flow from a cold to a warm body; but it should be noted that the power to perpetually reproduce a difference of temperature in a system of uniform temperature, depends upon that assumption of the kinetic theory which requires perfect elasticity of the molecules of a gas, and it is, therefore, of interest to inquire whether that assumption is essential to the theory.

The following considerations will illustrate one of several alternative hypotheses which seem to leave the kinetic theory very nearly where it is, without necessitating the abandonment of the second law as a true law of nature.

In speculations upon the mechanical conditions obtaining in a gas, attention has often been directed to the analogy presented by the stars and stellar systems of the visible universe, and I believe that in this case some light may be obtained by the consideration of such an analogy. If we replace the conception of impact of molecules by that of the deflection resulting from the combined influence of gravitation and inertia, such as is illustrated by the revolution of comets about the sun, we have introduced no new and unknown property of matter, such as "absolute" elasticity, and yet would seem to have accounted for the properties of gases as well as by the assumption of impact. The idea thus suggested admits of much further elaboration, which I shall not attempt here, and, indeed, ultimately reduces the three fundamental properties of matter to two by interpreting impenetrability as but a consequence of the possession by matter of gravitation and inertia; but one of the consequences of such a view is that the second law of thermodynamics remains intact.

Perhaps the simplest expression of the second law is embodied in the statement that "No isolated system is reversible," and in spite of the appearance of perpetual motion and complete reversibility in such an aggregate as the solar system, yet many considerations which need no mention here convince us that it is slowly running down, and that in time, its energy, both kinetic and potential, like that of all systems, will be dissipated into heat. Man corresponds to Maxwell's

dæmon in this magnified gaseous system, and does, in fact, utilize the energy of motion of the magnified molecules in tide mills; and we have merely to transfer the comparison to imaginary beings, operating with the molecules of gases to see that they would have no better reason than man to anticipate the complete reversal of an isolated system. In other words, if the law we are considering is true, and the kinetic conception of the constitution of matter is correct, then, whether or not we adopt the above view of molecular collision, heat must itself be dissipating into some other form or forms of energy as slowly, perhaps, as the mechanical energy of the heavenly bodies is dissipating into heat. Such a slow dissipation might be no more observable in the one case than in the other. Whatever position we may take on the matter however, even should strict mathematical investigation demonstrate that the above suggested view of the nature of impact is indefensible, the fact remains that the idea of absolute elasticity is incompatible with the second law of energy, and as one must be abandoned it seems to me that it should be the former.

Incidentally I would mention that your correspondent has cited no real violations of the second law (in practice). That law does not assert that heat may not be transformed into other forms of energy in a medium of uniform temperature. It does assert that it cannot be so transformed *reversibly*.

BOSTON, MASS. J. M. MACKAYE.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Direct-current Armatures.—DAVIES.—An article on the choice of the suitable core disc for the armature of a direct-current machine. He compares the relative advantages of the drum armature and ring armature, and seems to favor the former for pressures below 500 volts. For pressures over 500 volts he prefers the ring armature, owing to the greater facilities it offers for the insulation of the coils. The toothed core is said to have the following advantages over the plain core, especially in multipolar machines; the length of the air-gap may be considerably reduced; it offers better mechanical construction, the mechanical drag coming mainly on the iron core itself; there is almost an entire absence of eddy currents in the conductors, owing to their being in a very weak magnetic field. The iron-clad type of core possesses the same advantages, but should never be used for direct-current machines, on account of the high self and mutual-induction of coils wound on such a core, which prevent good commutation. He then discusses the dimensions of the core and gives some approximate formulas, in which the virtual external diameter means the actual outside diameter of the core in a plain apparatus and the diameter measured at the bottom of the teeth in a toothed armature, the virtual internal diameter means in unventilated drum cores, the inside diameter of the effective iron as measured over the ventilating aperture; the net length is the actual length of iron in the core; k is a constant. The formulas are as follows: The output in watts for a dynamo, or in horse-power for a motor, should be equal to k times the net length, times the square of the difference of the virtual external and internal diameters of the core, times the number of revolutions per minute, times the number of poles. For k, the following numerical values are given, the first figure always referring to a drum armature, the second to a ring armature: for a dynamo, 0.020 and 0.052; for an open-type motor, 0.000027 and 0.000070; for a protected type motor 0.000021 and 0.000056; for an enclosed type motor, 0.000018 and 0.000047. In toothed armatures the slots should be in radial depth about 0.125 times the difference of the virtual external and internal diameters of the core. He gives a curve, showing the suitable number of armature sections for various values of the virtual diameter of the armature. He recommends a width of slot which is about equal to the width of the tooth at the outer circumference of the core. The width of the slot at the circumference of the core should never exceed 1.5 times the length of one of the air-gaps. He recommends having the corners of the slots filled in with a small radius at the bottom, as this increases the section of the iron in the teeth where it is most needed, and reduces the hysteresis and eddy currents, besides imparting mechanical strength. The induction in the armature core should not be less than 60,000, nor much more than 80,000 lines per square inch. The mean average induction in the teeth will be somewhere between 100,000 and 130,000 lines per square inch, the heavier inductions being used most in generators for electric traction. For multipolar machines the induction in the armature core and teeth should be sligthly lower than in bipolar machines. While provision should be made for bolting up the discs fairly tight, in order to ensure a sound mechanical job, yet it is not advisable to subject the discs to any more pressure than is really essential, as the pressure increases the hysteresis loss. Preferably the bolts should not pass through holes in the discs at all, but through the center of the discs.—Lond. *Elec. Rev.*, August 22.

LIGHTS AND LIGHTING.

Enclosed Arc Lamp.—An illustrated description of an enclosed arc lamp made by a British company for single operation on 200 to 250 volt, direct-current circuits. It is said to be quite as efficient as the long arc-multiple lamp, and to give a perfectly white light, equal in quality to that from a standard 5-ampere, 80-volt arc. To obtain these advantages, it is necessary to divide the voltage equally between two arcs, and this is done in the "twin-carbon" lamp. The standard lamp takes 2¾ amperes, and the four arcs are in series, with 80 volts at each arc. The controlling mechanism is very simple, consisting of a steadying resistance and a pair of magnets connected in series with the two arcs across the 200 to 250-volt line. A single armature operates the clutches for both carbons, so that both feed together, and it is impossible for one arc to rob the other to an appreciable extent. The carbons are placed very close together, so that to the observer the effect is the same as if the light emanated from a single arc. Eleven mm. carbons are used, and with 12-inch upper and 5-inch lower the lamp will burn 130 to 150 hours with one trimming.—Lond. *Elec.*, August 22.

POWER.

Electric Power in Mines.—JACKSON AND COCHRAN.—An article on systems of electric power for soft coal mines. A system, using direct current for both haulage and other power; has the advantage of great simplicity, and is the most economical system for small lines. A second system is the use of direct current for haulage and polyphase alternating currents for other power and lighting. An example of this class is a large plant at Elkins, Va., where 500-volt direct current is used for haulage, while the power house also contains three-phase generators, the three-phase currents being transmitted at 2,000 volts into the mines, where the voltage is reduced by transformers at 250 for lighting and for supplying the induction motors which drive the coal cutters and pumps. A third system is to have a polyphase generating station transmission at 1,000 to 10,000 volts in the mines, with converter substations in the mines; direct current at 250 volts is then used for haulage; the other apparatus and the lighting can either be supplied in the form of direct current or of alternating currents, preferably the latter on account of the advantages of the induction motors. In order to avoid the converters, the power stations may contain double-current generators, generating both direct and alternating currents at the same time. This is done at the large plant at Ehrenfeld, Pa., which is described in some detail.—*Eng. and Min. Jour.*, August 16.

British Central-Power Station.—An illustrated description of the electric supply station at Neptune Bank, Newcastle-upon-Tyne, which is the first company supplying electric power in bulk in England. Three-phase currents, at 5,500 volts, and with a frequency of 40 cycles per second, are transmitted to the various substations, in which by means of transformers and synchronous motor-generators conversion is made to 480 direct current for power and lighting on the three-wire system, and to 440 volts alternating, three-phase currents for power alone. The alternators are driven by four 1,400-hp steam

[illegible] ator, running at [illegible] machinery, the steam [illegible] ion of steam consumption has [illegible]

[illegible] There [illegible] power house, for furnishing current to various machinery, interior lighting, outdoor arc lighting, etc. In the yard there are 450 switches, and of these the 120 switches along the "ladders of the classification tracks" are operated by pneumatic cylinders which are controlled electrically from the switch tower. The cylinders work under 60 pounds air pressure. The controlling apparatus in the tower comprises a set [illegible] controlling the movement of 12 switches. A battery of 14 accumulators is used for operating the switching system. Two motor-generators are used to charge the battery.—*West. Elec.*, August 30.

REFERENCES.

Canadian Power Transmission.—ADAMS.—An illustrated description of the power transmission to Hamilton, which is said to be the largest electrical transmission plant in Canada. The capacity is 6,000 kw.—*Elec. Rev.*, August 30.

TRACTION.

Electric Traction on Railways.—An editorial stating that an important step toward the "electrification" of the English main railway systems has been made in the determination of the North Eastern Railway Company to introduce electric traction on their Tyneside lines. There will be electrically equipped some 40 miles of double-track line, typical of the suburban railway. While it appears that the third-rail, direct-current system is favored, it is left to manufacturers to tender an alternative system if they can show that it would be beneficient. The specification to which contractors are invited to tender, is reprinted.—Lond. *Elec.*, August 22.

REFERENCES.

Yarmouth.—An illustrated description of the municipal tramways of Yarmouth. The system comprises six miles of single track. The trolley system is used. The generators give 360 amperes each, at 560 volts. The battery consists of 240 cells, of 360-amp.-hours capacity, and works in combination with a "reversible booster" of the Crompton type.—Lond. *Elec. Rev.*, August 8.

Interurban Railways.—GIBSON.—A well-illustrated article on high-speed electric interurban railways.—*The Eng. Mag.*, Sept.

Berlin.—MASON.—An illustrated article on the new electric underground and elevated lines in Berlin.—*Cassier's Mag.*, Sept.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Korea.—McLELLAN.—An illustrated description of the electric light and traction plant in Seoul, the capital of Korea. The power house contains two 120-kw, double-current generators, supplying 550-volt direct current for traction, and 385-volt two-phase alternating current. The latter is raised in tension to 2,000 volts and transmitted to the different transformers in the city, where it is reduced to 100 volts.—*Cassier's Mag.*, Sept.

REFERENCES.

Storage Batteries in Mills and Factories.—[illegible].—A long and well-illustrated paper read before the Civil Engineers' Club, of Cleveland. He says that in time the storage battery will be considered as essential a part of any electrical equipment as any other reservoir (of gas or water, etc.) in plants where the load is intermittent. He describes at length the construction of a storage battery and their installation and use in mills. He briefly mentions that a battery may be of great assistance [illegible] when used in conjunction with a gas engine.—*Jour. Ass. Eng. Soc.*, July.

Boston.—Nearly the whole issue is filled with illustrated descriptions of engineering features of Boston. There are articles on the new power stations of the Boston Elevated Railway, the lighting plants of Boston, the Massachusetts Institute of Technology, engineering at Harvard University, power plants of Keith's Theater, and the Tom River Ship and Engine Company, of Quincy.—*The Eng.*, Sept. 1.

Portable Electric Generating Plant.—A long and well-illustrated description of an electric light plant which can be readily transported from place to place in naval or military service. It consists of an engine coupled to a 105-volt, 600-ampere, six-pole dynamo, mounted on a transporting carriage.—Lond. *Eng'ing*, August 8.

Earthing of Middle Wire.—ABRAHAM.—An article on the reasons for, and the methods of earthing the middle conductor, and a description of a device which records all earths, both small and large, continuously with only one ammeter.—Lond. *Elec. Rev.*, August 22.

ELECTRO-PHYSICS AND MAGNETISM.

Electric Resistance of Steel and Pure Iron.—BENEDICKS.—An account of an extensive series of resistance measurements on eight specimens of Gysinge steel, with different percentages of carbon and other impurities, which gave the following results: First, equivalent portions of various substances dissolved in iron will augment its resistance by equal amounts, as experiments show for the case of *C*, *Si* and *Mn*, and as may be derived from Wedding's result for the case of *P*, one dissolved atom per 100 atoms of solution raising it by 5.9 microhms per cu. cm., in accord with Le Chatelier's measurements. Second, a definite carbide is not found to have any noticeable influence on the resistance of iron. He suggests, however, that other sorts of steel may exhibit a behavior somewhat different. Third, non-tempered steel with 0.45 to 1.7 per cent. C. holds 0.27 per cent C. in the dissolved state; such steels are, therefore, made up not of carbide and pure iron, as hitherto supposed, but of a carbide and a 0.27 per cent. solution of carbon in iron, this solution probably being identical with Ostwald's "sorbite." A formula for the resistance of steel is also given.—*Ofvers. Kon. Vet. Ak. Stockholm*, Feb. 12; abstracted in *Science Abstracts*, July.

Influence of Electrode Metal Upon Discharge.—STARK.—An article in which he points out that under certain conditions the material of the electrode may have a distinct influence upon the discharge potential of a spark-gap. If the electrode at which discharge first sets in, is an anode, the positive ions, as chief ionizing agents, shoot out from the anode, and the ionization they produce by their impact upon gaseous molecules is independent of the material of the anode. At the cathode, on the other hand, they produce ionization by impinging upon gaseous molecules attached to the cathode. Now, the proximity of a metal has the effect of reducing the "ionizing potential" of a molecule to an extent varying from one metal to another. Hence, in this case the material of the electrode is of importance. But it is marked if the cathode is in the least oxidized. Iron, nickel, silver and aluminum show a great variation of the negative discharge potential with their state of oxidation. Gold and platinum maintain a steady value.—*Phys. Zeit.*, August 1; abstracted in Lond. *Elec.*, August 15.

Mechanical Effect of Disruptive Discharge.—SEMENOV.—A description of certain mechanical effects of the electric spark, which shed some light upon the transportation of matter from one electrode to another. The experiments were conducted under ordinary atmospheric pressure, and he comes to the conclusion that, contrary to usual supposition, there is no transportation of the materials of either electrode though the transportation of the gas or vapor surrounding it is well marked, and gives rise to strong mechanical effects. The discharge from an induction coil was made to pass between a positive flame and a negative saline solution enclosed in a narrow tube, about 1 mm. in internal diameter. The matter transported by the positive discharge impinged violently upon the solution, and made it spurt out in a luminous jet several millimeters long, and in the direction in which rays would be reflected. The spurting consumes energy, and consequently the cathode is much less heated than would otherwise be the case. The projected liquid is not chemically altered. That the spurting was not due to impact of the material of the anode itself was proved by making the anode consist of a jet of copper sulphate solution. This produced the same spurting, but without any copper sulphate being transferred to the cathode, unless the jet was stopped and metallic vapor was formed by the heat then developed.—*Comptes Rendus*, July 21; abstracted in Lond. *Elec.*, August 8.

Dark Cathode Space.—WEHNELT.—Some results of measurements of free electric charges in the dark cathode space. The greatest amount of free positive electricity is found immediately at the cathode and at the outward limit of the dark cathode space. Between these there is a space having a surplus of negative ions. The cathode is concentrically surrounded by electric charges of different signs, but the algebraic sum of the whole free charges is always positive. This surplus of positive ions varies as the pressure of the gas and as the

current strength. Corresponding to the positive surplus in the gas is a negative charge on the cathode itself, whose discharge is facilitated by the ultraviolet light given out by the negative glow.—*Phys. Zeit.*, August 1; abstracted in Lond. *Elec.*, August 15.

Rotary Polarization.—LORD RAYLEIGH.—An investigation of the question whether the rotation of the plane of polarization of light propagated along the axis of a quartz crystal, is affected by the direction of this axis relatively to the earth's orbital motion. According to the theory of Lorentz, an effect of the first order might be looked for. According to Larmoor's theory, there should be no effect of the first order. Lord Rayleigh has found by experiments that the rotation is certainly not altered by the 1/100,000 part when the direction of propagation of the light is altered from that of the earth's motion to the opposite direction. This result supports the idea that the ether moves bodily with the earth, at least up to a certain height.—*Phil. Mag.*, August; abstracted in Lond. *Elec.*, August 15.

Zeeman Effect in Absorption Bands.—SCHMAUSS.—An account of some further measurements of the magnetic rotation of the plane of polarization within an absorption band, mainly in order to clear up some theoretical points raised by Voigt. He succeeded in verifying two of Voigt's theoretical conclusions, the first being that the maximum rotation in a field of absorption is nearly independent of the strength of field, and the other that the negative rotation in the interior of an absorption band diminishes with an increasing field. This diminution is convincing in the case of litmus and aniline blue, but not so marked as it is in didymium glass.—*Ann. d. Phys.*, No. 8; abstracted in Lond. *Elec.*, August 15.

Ionization by Ionic Shock.—STARK.—A theoretical discussion of the work of several investigations of the current in a gas and its dependence upon the e. m. f. His theory of ionization by ionic shock maintains that, in ionized gas, the current at first increases with the e. m. f. until all the ions generated in the gas, whether by Röntgen rays, ultraviolet light, incandescence, or other artificial means, are used up by the current as fast as they are generated. When this is the case, an increase of e. m. f. does not produce any further increase of current. But on further increasing the e. m. f. a point is reached at which the ions, traversing their mean free path, acquire a sufficient velocity to ionize neutral molecules by their impact. The current then becomes "independent," and rises again with increased e. m. f. The curve with the e. m. f., as abscissa, and the current, as ordinate, has, therefore, an ascending branch, a horizontal portion, and another ascending branch. Such curves may be obtained from the data provided by several investigators. In some cases the curves are not complete, as the point at which the independent current sets in depends upon the pressure, temperature and imparted ionization of the gas. "The positive ionizing potential is about 240 volts in air, with an aluminum electrode, and 270 volts with a copper electrode."—*Ann. d. Phys.*, No. 8; abstracted in Lond. *Elec.*, August 8.

Demagnetizing Effects of Electromagnetically Compensated Alternating Currents.—CROOK.—An account of an experimental investigation, the results of which are given in diagrams and tables. The "alternating current as magnetically compensated, has an effect on the magnetic induction in iron." For low-current densities (below 7.5 amperes per sq. mm.) the reduction by the residual magnetism in iron, or the reduction of the area of the hysteresis cycle, is proportional to the strength of the current. The effects of the alternating current on the residual magnetism in iron are different for different frequencies, that for the lower frequency being the greater. The total reducing effect is approximately proportional to the strength of the current.—*Am. Jour. Sc.*, August.

Radium.—MDE. CURIE.—An account of experiments in which she has succeeded in obtaining pure chloride of radium and has taken the opportunity for determining the atomic weight of radium. She is enabled to state definitely that it is 225 within a unit.—*Comptes Rendus*, July 21; abstracted in Lond. *Elec.*, August 8.

REFERENCES.

Magneto-Optic Effects.—VOIGT.—A review of recent discoveries of magneto-optic effects, with reference to his own theory. The investigations of Corbino, Zeeman and Majorann are dealt with.—*Ann. d. Phys.*, No. 8; abstracted in Lond. *Elec.*, August 8.

Magnetic Double Refraction.—MAJORANA.—A description of experiments, in which he has discovered an effect in magnetism, analogous to the Kerr effect in electrostatics. The particular effect described is a magnetic double refraction in solutions of ferric chloride and in colloidal iron oxide.—*Comptes Rendus*, July 24; abstracted in Lond. *Elec.*, August 8.

Screening Effect.—LEVI-CIVITA.—A highly mathematical paper on the screening effect of a conductor in a parallel alternating current.—*Accad. Lincei*, Feb. 16, March 2, 16; abstracted in *Science Abstracts*, July.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Alkali Salt Vapors.—WILSON.—An account of an experimental investigation of the passage of electricity through flames containing salt vapors. Former experiments have shown conclusively that conduction through salt-vapors is accomplished by means of ions of some kind and is, therefore, to this extent at least analogous to conductions through solutions. The experiments described in the present paper show conclusively that above 1,300° C. there is a very close analogy between salt vapors and liquid electrolytes; Faraday's laws of electrolysis are strictly applicable to salt vapors, just as to salt solutions. He shows that a salt in the state of vapor gives rise to the same number of ions carrying the same charges as a salt in an aqueous solution. He describes in detail the arrangement of his experiments, and gives in a diagram curves showing how the current with a constant e. m. f. (840 volts) varies with the temperature when solutions of one gram in a litre are sprayed. The nearly constant value of the current above 1,300 degrees seems to represent the maximum current which the amount of salt passing through the tube can carry, for it is affected very little by increasing either the temperature or e. m. f. This current he calls the "saturation" current for the particular salt used. The values of this maximum current are given for various salts in a table. From this table he proves that Faraday's laws of electrolysis apply also to the saturation current carried by a salt vapor. The amount of salt per second of electrochemical equivalent unity which would correspond to a current of 1 ampere is 0.0101 milligram. Now, 1 ampere-second liberates in electrolysis 0.0104 milligram of hydrogen, so that it appears that the factor of proportionality is nearly the same for salt vapors as for electrolytes.—*Phil. Mag.*, August.

REFERENCE.

Unipolar Currents.—CHRISTIANSEN.—A paper on a peculiar apparent departure from Ohm's law, observed in certain electrolytes. He applies the term unipolar current to the current through mercurous nitrate in nitric acid, with mercury electrodes, because this current greatly depends upon the size of the cathode, and not on the size of the anode. The irregularity observed is that under certain conditions the current is independent of the e. m. f. It varies, however, directly as the surface of the cathode and as the percentage of mercurous nitrate.—*Ann. d. Phys.*, No. 8; abstracted in Lond. *Elec.*, August 8.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Speed Indicator.—An illustrated description of an electric speed indicator, brought out by an English company to comply with the Board of Trade regulation that every electric tramcar shall be fitted with a speed indicator. It consists essentially of a small magneto-generator, attached direct to the motor-frame, and two indicating instrument, one on each platform. These instruments are small voltmeters, and are calibrated in revolutions per minute, the voltage of the small generator being directly proportional to the speed. The recorders are placed on a special "anti-vibration" frame.—Lond. *Elec.*, August 22.

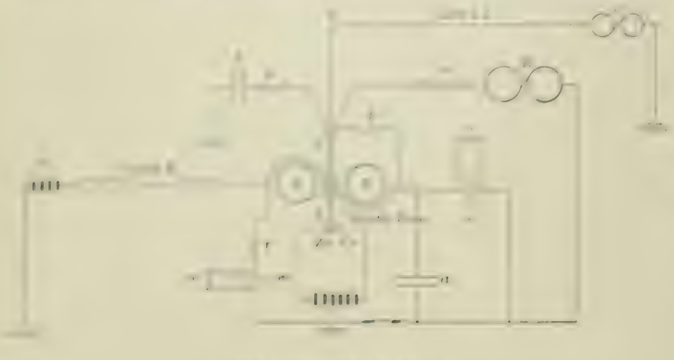
REFERENCE.

Galvanometer.—WRIGHT.—An illustrated article on the development of the principle present types of galvanometers, with a general outline of their various constructional principles.—*Cassier's Mag.*, September.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Vibrating Cable Relay.—GULSTAD.—The first part of an illustrated article on his cable relay, which is said to have been used for years in connection with some of the cables of the Great Northern Telegraph Company, and to have given most favorable results. It is not so much the specially constructed polarized relay for Morse signalling, but more especially an arrangement of condensers and resistances in connection with it, which is said to be the feature of the system. The adjoining diagram shows the essential parts of the relay arrangement used in connection with the cables from England to

[illegible] *A* is the cable-end [illegible] *B* the translating station, and *C* the receiving station. At the translating station there are, *E* the electromagnets of the relay, [illegible] of the relay, *T* the tongue of the relay, *Zn* and *Cu* the [illegible] poles of the relay, [illegible] a condenser, *s* a resistance belonging to the cable circuit through one relay winding, *a* and *m* condensers belonging to the local relay circuit, *r*, *n* and *p* resistances belonging to the local relay circuit, *t* a condenser, *u* a resistance in connection with the tongue, *R* the [illegible] in the leak circuit, and *d* the resistance in the leak circuit. It will be seen that the armature and tongue will move



ARRANGEMENT OF RELAY.

toward the *Cu* or *Zn* pole when a positive or negative current passes from *A* through the cable, and further that a current in the local circuit always tends to drive the tongue away from the contacts between which it is moving. The natural attraction between one or another of the pole-pieces and the relay-armature, may, when the relay is symmetrically adjusted, be easily and completely neutralized by giving *p* a proper size, *i. e.*, the relay can thereby be made as sensitive as required when acted upon by any current from the cable through the other winding. By further decreasing *p*, the tongue begins to vibrate, and the relay is preferably used in this condition. The rate of vibrations or dots may be regulated at will by variation of condensers and resistances in the local circuit, and the working rate generally is made equal, or almost equal, to the rate of dots emitted by the transmitter at *A*. Sparking, due to induction from the line between *B* and *C*, is avoided by the condenser *t*, connected with the tongue; but this very condenser may sometimes cause sparking and considerable contact-stickings; this drawback can, however, be completely overcome by the introduction of a small resistance, *u*. To make good contacts, the condenser *a* is important; for this purpose it is also necessary that the poles of the electromagnets should be very much closer to the armature than usual; and that the resistance, *p*, should be introduced. The current charging condenser, *a*, will then immediately cause the tongue to be pressed against the contact screw with which it has just made contact, and from which [illegible]—Lond. *Elec. Rev.*, August 22.

Telephone Receiver for Wireless Telegraphy.—BIECKHOFF.—A description of a very simple arrangement which is said to give excellent results. He fixes two parallel pieces of carbon, as used in an ordinary arc lamp, having a length of 5 cm., on a square piece of wood and makes with it a circuit including a couple of dry cells and a telephone; the circuit is completed by placing three or four common sewing needles loosely in transversal direction on the carbon rods. The apparatus is ready for use when the insulated wires of the signal mast is joined to one carbon, and the other is connected to the earth conductor. The letters from the Morse alphabet are very distinctly heard as shorter or longer taps in the telephone, and the telegrams are easily read by sound by a trained operator. He believes that such a receiver may prove very useful for temporary installations of wireless telegraphy, as anyone may carry it with all its accessories of his pocket and put it at once in action when an insulated wire can be fixed to some elevated post. He also investigated whether this arrangement is really anti-decohering; with the telephone no tapping is required, while a slight tapping is necessary when a sensible aperiodic galvanometer was substituted for the telephone. It may be that the self-induction of the coil of the telephone is sufficient for decohering, which factor is not as active when a galvanometer is substituted.—*Nature*; Lond. *Elec.*, August 15.

Telephony.—An editorial on recent developments in telephony. Reference is made to the recently published financial reports of the two British pioneer municipal telephone systems at Glasgow and Tunbridge Wells. In Glasgow the conditions were extremely favorable; but while it is not surprising that in the first year the undertaking was practically working at a loss, it is doubtful whether it will pay in the future. People in favor of municipal telephony are urged "to study carefully the Glasgow and also the Tunbridge Wells accounts before risking their taxpayers' money on the experiment of competitive telephony." The suitability of the call-wire system at Glasgow is doubted. For the common battery system it is claimed that for quick, efficient and economical working it is second to none, but its first cost must not be forgotten; and it is doubted whether it is suitable for small exchanges.—Lond. *Elec.*, August 15.

REFERENCE.

Common-Battery System.—GRACE.—An illustrated article on the common-battery system for small exchanges.—*Telephony*, August.

MISCELLANEOUS.

Electric Production of Sleep.—LEDUC.—A description of a method of producing sleep and local anæsthesia by means of electric currents. Continuous current is used, from an accumulator, with a small resistance in the circuit. A non-inductive interrupter, giving 150 to 200 breaks per second, is inserted in the circuit. A moist electrode is placed on the animal's shaven head and another on the back near the tail. The e. m. f. is rapidly increased till the animal shows generalized contraction, and respiration is stopped. The current is then reduced to about 5 milliamperes, with 12 to 30 volts. Respiration then sets in again and the animal sleeps a profound and tranquil sleep. It lasts as long as the current is continued. "As soon as it stops, the animal wakes up and jumps about with every sign of delight, and no evil consequences appear to result." If the current is not first brought to the point at which respiration stops, some agitation is displayed, such as seen in the administration of chloroform. A smiliar current applied to the root of a human nerve, such as the median of the wrist, gives rise to complete anæsthesia of the region innervated, accompanied by a prickling sensation, which is not painful.—*Comptes Rendus*, July 21; abstracted in Lond. *Elec.*, August 15.

India.—An article on India as a field for electrical enterprise. Madras has an electric tramway but no public lighting system. In Bombay there is a large scheme for spending $5,000,000 in both tramways and lighting. The two principal power schemes are those on the Cauvery Falls and at the Coonoor Cordite Factory. Neither has yet started work, but the first one will start soon; the whole of its electrical plant is of American manufacture; its prospects are exceptionally good, as it will have a continuous load 24 hours a day and 365 days of the year, supplying the Mysore Gold Fields with power, and working continuously without intermission. There is said to be a field in India for installing isolated electrical plants in clubs, mills and factories.—Lond. *Elec. Rev.*, August 15.

REFERENCES.

British Manufacturing Plant.—An illustrated description of the "Arc" Works, Chelmsford, with description and results of tests of an 800-kw multipolar generator.—Lond. *Elec.*, August 15.

Influence Machine.—ALLEN.—An article on a large influence machine of the Winshurst type, built for the Royal Infirmary, at Glasgow. Its construction is described and illustrated.—Lond. *Elec. Rev.*, August 15.

Modern Machine Methods.—ORCUTT.—The first part of an illustrated paper, read before the Brit. Inst. of Mech. Eng. In this part he discusses gauges, light milling, circular milling, heavy milling, planing, grinding, chucking, turning and polishing.—Lond. *Elec.*, August 15.

New Books.

SUBMARINE WARFARE. By Herbert C. Fyfe. New York: E. P. Dutton & Co. Cloth, octavo. 1902. 332 pages, 50 illustrations. Price, $3.00 net.

Submarine warfare is rapidly accumulating a literature of its own, but as pointed out by the author of this interesting volume there has hitherto existed no popular work in the English language on submarine warfare, and only one which deals exclusively with submarine boats. Indeed, the subject is still so new in many of its aspects that no hesitation is exhibited in this volume in devoting several chapters to the morality, the romance and the picturesqueness of warfare waged under the waves; and hence we have the sociological and metaphysical sides of the art discussed with a good deal

of animation. Mr. Fyfe seems, indeed, to take umbrage, more or less openly expressed, at the general indifference of his countrymen to submarine boats, as contrasted with the lively interest of the gallant nation on the south side of the English Channel. It is true that the fogs and the rough seas around the tight little island have long done much to stand off any possible invader, and it may, of course, be equally true that the murky dirtiness of the water also may in time be effective in preventing any submarine vessel from finding its unseen way through the palpable obscure—as Milton once put it. In America we have been rather more alert in the matter, and wisely so, with no fleet in particular, worthless forts, and a long, lone coastline.

Mr. Fyfe does ample justice, indeed, to American invention and enterprise in this field, going back to Fulton and Bushnell, giving the history of notable efforts in the civil war, and including the latest work of Holland and of Lake. While cast intentionally and avowedly in popular form, the book is full of technical data, is admirably illustrated, and excellently got up on the whole. We believe it will find many readers in America.

HANDBOOK OF ELECTRICAL MACHINERY AND APPARATUS. By Geo. L. Anderson, A. M. New York: D. Van Nostrand Company. 161 pages, 214 illustrations. Price, $3.00.

The title of this book as above set forth is somewhat misleading, as it is not intended to be of general application. On the title page the inscription reads, "A Hand Book for the Use of Electricians in the Operation and Care of Electrical Machinery and Apparatus of the U. S. Coast Defenses," which more correctly defines its scope.

It is evidently a compilation of the instructions issued to the civilian and enlisted attendants of the electrical apparatus used by the Army Department in the various fortifications, and is rich in illustrations, a particularly commendable feature being the various diagrams showing the connection of switchboards, rheostats, searchlights, telephone apparatus, etc., of the standard types employed.

The apparent bodily abstraction of directions has resulted in useless reiteration at several points, notably in the direction for the erection and care of storage batteries, and has resulted in making the book hard to read, the sentences being entirely disconnected.

The various chapters into which the book is divided treat of the handling and care of boilers, of steam engines, the Hornsby-Akroyd oil engine that the army uses so extensively, switchboards, storage batteries, motors, projectors, the Ardois night signals, telegraphy and telephony. There is also a chapter on simple testing and one giving the requirements on which the standard specifications are based.

It is rather surprising to note that the Ward Leonard system of motor control which is finding great favor in the sister branch of the service, and which bids fair to come into extensive use by the army also, should have alloted to it less than one-fourth page. It would seem to be of sufficient importance to receive more extended mention.

While it is, of course, easy to find points open to adverse criticism, such as the directions that a motor should be stopped by first cutting in the starting rheostat and then opening the main switch, and that a bar-to-bar test of an armature should be made with a portable voltmeter, the work taken as a whole is thoroughly good. As an example there might be mentioned the brief paragraph setting forth the derangements to which telephonic apparatus is subject, a list which while not perfect is one with whose aid any electrician of ordinary intelligence should be able to promptly put in order or at least locate the point of trouble in ninety-nine out of a hundred faulty telephones.

While the work is primarily intended to apply to government apparatus and installations, it is one which every owner of an isolated plant, particularly one in which storage batteries are present, could place in the hands of his electrician to their great mutual advantage. Those following correspondence school instruction would likewise find it an undoubted aid, particularly because of the numerous practical hints that it gives.

BOOKS RECEIVED.

ELEMENTARE VORLESUNGEN UBER TELEGRAPHIE UND TELEPHONIE. By Richard Heilbrun. Berlin: Georg Siemens. 64 pages, 44 illustrations.

DIE GEWINNUN DES ALUMINIUMS. By Adolphe Minet. Halle: Wilhelm Knapp. 130 pages, 57 illustrations, 15 tables. Price, 7 marks.

Directory of Electrical Societies, Etc.

AMERICAN ELECTROCHEMICAL SOCIETY, Secretary, C. J. Reed, Philadelphia, Pa. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Next meeting, Sept. 26. Paper by B. G. Lamme, "The Washington, Baltimore and Annapolis Single-Phase Railway." Oct. 24, paper by C. P. Matthews on "An Integrating Photometer for Glow Lamp and Sources of Like Intensity."

AMERICAN STREET RAILWAY ASSOCIATION, Secretary, T. C. Penington, 2020 State Street, Chicago, Ill. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

INDIANA ELECTRICAL ASSOCIATION, Secretary, Hal. C. Kimbrough, Muncie, Ind. Next meeting, Indianapolis, Sept. 17 and 18, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, Thos. R. Mercein, Milwaukee, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION, Secretary, J. H. Perkins, Youngstown, Ohio. Next meeting, Columbus, Oct. 14, 15 and 16, 1902.

OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION, Secretary, John Brant, 195 Broadway, New York.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION, Secretary, John Ruth.

U. S. MILITARY TELEGRAPH CORPS, Secretary J. E. Pettit, Postal Telegraph Company, Chicago, Ill.

VERMONT ELECTRICAL ASSOCIATION, Secretary, C. C. Wells, Middlebury, Vt.

De Forest Wireless Telegraph System in the War Manoeuvres.

Whatever may be the ultimate outcome of the recent Army and Navy manœuvres, so far as the relative efficiency of the two branches of the service is concerned, they have very clearly demonstrated the great utility of wireless telegraphy. The Army appears to have thoroughly appreciated the important role that wireless telegraphy could be made to play, for it made arrangements for the use of three different systems, the Marconi, the De Forest and the Fessenden. Should the decision of the umpires be in favor of the Army, there is little doubt it will be largely due to the assistance which the Army derived from wireless communications. By its means on several occasions the shore defences were kept informed of the movements of the attacking fleet long before it could have been sighted; and doubtless the strategy on the part of the Navy was circumscribed through the lack of wireless communication with the different portions of the fleet.

The U. S. Signal Corps installed two sets of De Forest apparatus, one at Ft. Mansfield and the other on board the scout-boat, "Unique." These two sets were in working order a week before the manœuvres began, and continued to give uninterrupted service up to Saturday noon, September 6, the end of the manœuvres. During this time the distance varied from five to fifty miles, but throughout, and under all conditions of weather, the system was in complete operation.

During the week of the manœuvres 72 official messages were transmitted from boat to shore, beginning at midnight, Sunday, August 31; from that time on the "Unique" kept in constant touch with the movements of the enemy's fleet, and the De Forest operators at Ft. Mansfield were continually in touch with them. These scout messages were transmitted by telephone to Col. Davis, at the headquarters of the firing district at Ft. Wright; to General Greely,

[illegible] New London, and the operation of the batteries at the different forts was [illegible]

All in all, 95 per cent. of the messages transmitted were perfectly [illegible] was on Thursday, September 4, when one of the operators in charge [illegible] Bay sent the following message, at the rate of 40 words per minute: "Now is the time for all good men to come to the support of their party."

Though unexpected this was received perfectly by the operator with the De Forest apparatus at Ft. Mansfield, and later verified by comparison with the Fessenden operators. The distance was between 50 and 60 miles, and, inasmuch as the tug-boat's mast was but 40 feet in height, the performance was a most remarkable one, both for distance and speed.

The apparatus at Ft. Mansfield and on board the scout-boat "Unique" was identical; the sending apparatus included a small kerosene engine belted to an alternating-current generator, transformer, condenser and key. The antenna on board the boat consisted of three parallel stranded wires, 65 feet in height. That at Ft. Mansfield was similar, and was hung from an 80-foot mast. The average speed of word transmission throughout the manœuvres was 20 words per minute, no code or abbreviations being used.

The De Forest operators on board the scout-boat "Unique" had a most exciting week of it. On three separate occasions the boat was constructively captured, sunk or completely destroyed by broadsides from the battleships. The Navy soon learned that this innocent [illegible] of a nature most damaging to their plans, and were continually on the lookout for her. On Wednesday night, during a dense fog, the battleship "Brooklyn," showing no lights, suddenly loomed up not 100 yards away from the tug. The "Unique" instantly showed her heels and began to send forth "Aerograms" announcing the discovery of the fleet and the pursuit. The "Brooklyn" turned and gave her her full broadside at point-blank range, nearly knocking the "Unique" out of the water with the concussion. Not content with this the big battleship gave chase, and, turning, delivered her starboard broadside into the scout-boat. The captain, however, did not regard the [illegible] throughout the night to inform the Army officers of the movements of the fleet.

[illegible] very nearly foundered. The topmast holding the aerial wires was [illegible] was drenched with sea water, which put the wireless outfit *hors de combat* [illegible]

SCOUT-BOAT "UNIQUE."

So well pleased with the service are the Signal Corps officers that the station at Ft. Mansfield is to be permanently established there, and the set from the scout-boat will be stationed at some Army post in the neighborhood, probably at Ft. Wetherill. This will mean a range of some 50 miles, mostly over land, and will be the first of a number of wireless installations at the various artillery districts of the United States Army.

The service altogether was so satisfactory as to leave no doubt in the minds of the Army officials as to the necessity of wireless telegraphy in war manœuvres, at least where conducted near the seacoast. In all other nations the Navy has been first to adopt wireless telegraphy, and it is significant of the enterprise and progressive spirit of our Army, and notably of the efficient Signal Corps, that it has remained for them to demonstrate to the Navy the usefulness of this new adjunct in warfare. It will be remembered that only last week Admiral Higginson put in an urgent appeal for wireless telegraphy for the Navy, and in view of the remarkable success of the De Forest system during the manœuvres, it is to be expected that the naval officers will give this system a thorough trial in the near future.

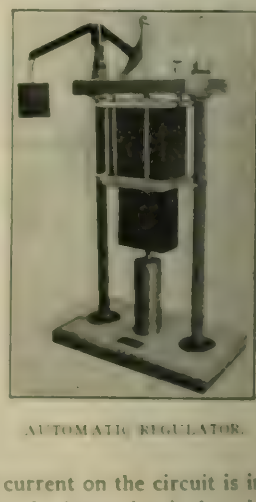
The accompanying cut shows the U. S. Signal Corps' scout-boat "Unique," equipped with a high mast with three pendant wires, which was used by the De Forest system throughout the manœuvres.

G. I. Series Alternating Current Lighting System.

The accompanying illustration shows the automatic regulator used in the alternating constant-current series system of the General Incandescent Arc Light Company. A pair of reactive coils is mounted in a metal frame and supported by spiral springs from a heavy marble top. This top is supported by an iron frame which is secured to a similar marble base. A laminated iron core is suspended under the reactive coils in such a way that it can play up and down in the magnetic field of the coils.

To the lower part of the core is fastened a metal strip, which is attached to the upper face of the arc on one end of the lever which carries the adjustable counter-weight at its other end. Below the core, and fastened to it, is a large air-dash pot which prevents "pumping" of the system and aids the starting of the lamps. Suitable binding posts are mounted on the marble top, allowing the regulator coils to be connected in series with the lamp circuits.

When not in operation only a small portion of the legs of the laminated iron core are surrounded by the windings of the reactive coils. If the outside line is short-circuited and current turned on, the core is immediately drawn into coils, which then react against the line potential and keep the current constant at the value for which the regulator is adjusted. When the short-circuit is removed, causing the current on the circuit to fall, the core drops down; this decreases the reactance of the regulator, and sufficient of the line potential is allowed on the lamp circuit to start and operate the lamps. If one or more of the lamps are switched off or cut out, causing the current on the circuit to increase, the regulator coils attract the core, which when entering the coils, further increases the reactance of the regulator, and the current will again be brought to its given value.



AUTOMATIC REGULATOR.

From the above it will be seen that the current on the circuit is inclined to vary with the changes of load on the lamp circuit, but the regulator coils being in series with the circuit of lamps and the core moving up or down with the slightest change of current, the automatically changing reactance of the regulator coils will always give the proper voltage and current to the lamps, no matter how many may be burning, as long as the voltage at the terminals of the constant potential alternating circuit furnishes not less than the required voltage (83) per lamp.

The regulator has no moving wires or coils, and therefore all trouble due to broken leads and loose connections is obviated. The efficiency of a 50-light regulator is about 98.6 per cent., and the current regulation from no load to full load is within .2 ampere. The current adjustment is by means of counter-weight, from 6 to 7 amperes.

In this alternating system for arc and incandescent lamps the series circuit may be connected either directly to the primary constant-potential circuit, or to the secondary of a constant-potential transformer. If the supply is direct from the current, the lamp circuit is connected, through suitable safety devices, to the primary bus-bars which are supplied direct from the generator, in which case the potential of the generator must allow not less than 83 volts per lamp, including regulator and line. The usual potential of alternators for ordinary city lighting is from 1,000 to 2,200 volts, on which the size of each arc-light circuit would be comparatively small. The higher voltage named would limit the lamps in a series to 26.

If the desired number of lamps to be operated in series on each circuit is greater than 25 or 26, it then becomes necessary to use a secondary source of supply. This is obtained from the secondary winding of constant-potential, step-up transformer, which is connected between the primary supply and the arc circuit. The application of a step-up transformer permits of transforming a low primary pressure to the necessary pressure for a large number of lamps in series. A further advantage of using a transformer between the generator and each lamp circuit is that it prevents any disturbance in the primary part of the system if one of the arc circuits should become grounded. If, however, the construction of the arc circuits is first-class, and care is taken to prevent their grounding, the installation of transformers between the generator and each lamp circuit is not absolutely necessary, where the primary voltage is sufficient for the number of lamps desired in a series.

Carriage-Call Annunciator.

A new electric carriage-call annunciator, for both day and night use, has been brought out by Messrs. Edwards & Company, New York. The apparatus is designed to set on brackets attached to the side of a building or in any other proper location, and is constructed so as to show numbers on both sides. It consists of 6 five-sided lanterns, three on each side of the case. The lanterns can be made with a greater number of sides or a greater number of lanterns may be used to give as many numbers as desired. The numbers on each of the faces of the lanterns are of opal glass so as to be plainly visible in the day time, while for night use, a 32-cp lamp is suspended in each lantern, thus illuminating the figures.

FIG. 1.—CARRIAGE-CALL ANNUNCIATOR.

The annunciator is operated by a 15-section switchboard of simple construction, there being three divisions of five numbers each, 5 for units, 5 for tens and 5 for hundreds, corresponding with the numbers 0, 1, 2, 3 and 4 on each lantern. From these 125 combinations can be made. The switchboard contains a switch for each number on each lantern, so that there are as many switches as there are numbers. By throwing in any switch, the corresponding number appears on the proper lantern. The switchboard is arranged with three rows of four switches each, one row for each of the three pairs of lanterns. If, for instance, the number 234 is displayed, the No. 2 switch in the first row, No. 3 switch in the second row, and No. 4 switch in the third row are closed. If, now, it should be desired to display the number 423, the No. 4 switch in the first row, No. 2 in the second

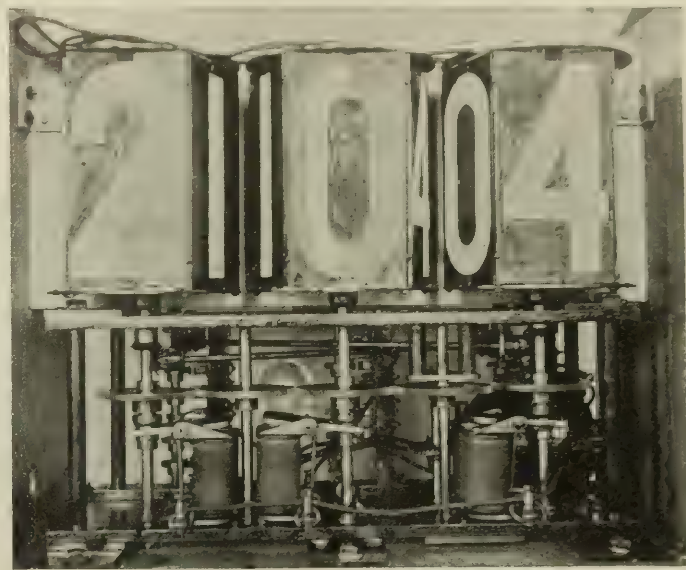


FIG. 2.—GEARS AND MAGNETIC CLUTCHES.

and No. 3 in the third would be thrown in, and the other switches that were last in would be opened.

The operation of the instrument is as follows: When the desired combination of numbers is switched in, the lanterns of both sides revolve to the desired numbers, and are automatically cut out in the instrument, the movement being given by a $^1/_{16}$-hp electric motor. Each section is provided with an electromagnetic clutch, which engages the lanterns the instant the circuit is established, and releases them when the circuit is broken. The lanterns are connected by mitre gear, so that each side will operate in unison with the other. The switchboard is provided with a main annunciator-switch, also one for the lights.

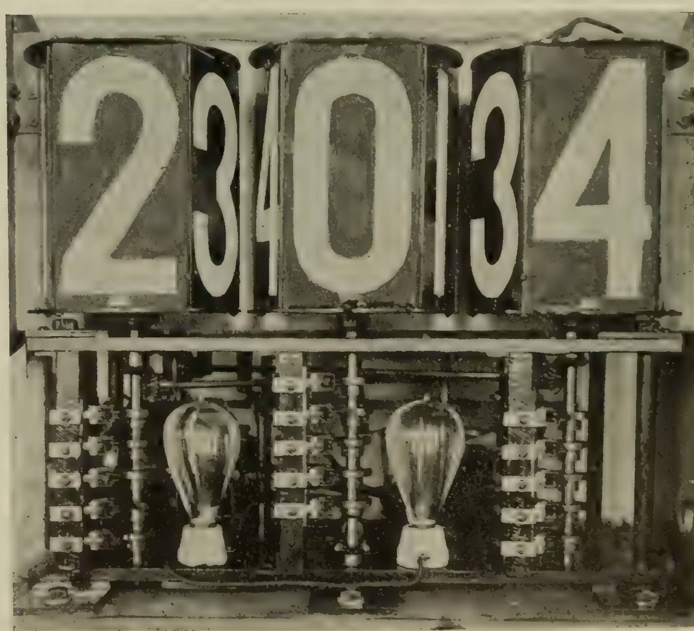


FIG. 3.—SHUNT LAMPS AND SWITCHES.

In the accompanying illustrations, Fig. 1 shows the annunciator complete, encased in an ornamental box; Fig. 2 shows the arrangement of gears and magnetic clutches, and Fig. 3 the arrangement of shunt lamps and automatic switches. One of these annunciators is in practical operation at the store of Stern Brothers, on Twenty-third Street, New York, and is said to be working satisfactorily.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was in small supply and quoted at 5 per cent. for all periods. Commercial paper was very dull. Higher rates for call money checked the tendency of the speculative stock market to expand, and the consequence was that the principal stocks receded. The United States Steel stocks were stronger on interested support and favorable news as to earnings. The Gould stocks were active and strong, Manhattan being favorably influenced by the increase of $700,000 in the net earnings for the year ending June 30. Amalgamated Copper showed some strength and rose to 70 on favorable reports as to copper trade conditions. Brooklyn Rapid Transit showed more activity, reaching 71⅛ and closing at 70¾, a net gain of 3 points; the lowest figure being 68. Met. St. Ry. fluctuated between narrow limits on small trading; the range of prices being 147, the lowest, and 149½ the highest, closing at 148. General Electric closed weak at 193½, being 4 points below the highest quotation of the week, and only ½ point above the lowest; the closing price representing a net loss of 2½ points. Western Union closed at 94¾, a net loss of ¾ point; Westinghouse common, 226, the lowest quotation of the week, 230 being the highest, the net loss being 2 points. Westinghouse 1st preferred kept steady at 230¼, being ¼ of a point net increase. The closing prices of other stocks were: American District Telegraph, 36¾, being a net loss of 2¼ points, and American Telephone and Telegraph, 172, a net loss of ½ point. Outside securities were generally higher, but with many recessions from the top figures. More attention was given to copper stocks. Following are the closing quotations of September 9:

NEW YORK.

	Sept. 2.	Sept. 9.		Sept. 2.	Sept. 9.
American Tel. & Cable	94	—	General Electric	196½	195
American Tel. & Tel.	—	171½	Hudson River Tel.	—	—
American Dist. Tel.	—	—	Metropolitan St. Ry.	147½	147½
Brooklyn Rapid Transit	68¾	71	N. E. Elec. Veh. Trns.	¾	1
Commercial Cable	—	174½	N. Y. & N. J. Tel.	—	—
Electric Boat	25	25	N. Y. E. V. T. Co.	—	11½
Electric Boat pfd.	45	45½*	Tel. & Tel. Co. Am.	—	—
Electric Lead Reduc'n	2½	2¼	Western Union Tel.	95½	96½
Electric Vehicle	5½	5¾	West. E. & M. Co.	229½	—
Electric Vehicle pfd.	14½	15¼	West. E. & M. Co. pfd.	230¼	—

BOSTON.

	Sept. 2.	Sept. 9.		Sept. 2.	Sept. 9.
American Tel. & Tel.	171½	171	Western Tel. & Tel. pfd.	100½	100½
Cumberland Telephone	—	—	Mexican Telephone	2¼	2¼
Edison Elec. Illum.	—	—	New Eng. Telephone	143½	142
Erie Telephone	—	—	Westinghouse Elec.	113½	—
Western Tel. & Tel.	—	29¼	Westinghouse Elec. pfd.	115	—

PHILADELPHIA.

	Sept. 2.	Sept. 9.		Sept. 2.	Sept. 9.
American Railways	51⅛	51	Phila. Traction	100	100
Elec. Storage Battery	88	89¼	Phila. Electric	8⅝	9 1/16
Elec. Storage Bat'y pfd.	—	88½	Pa. Elec. Vehicle	—	—
Elec. Co. of America	9¼	9⅛	Pa. Elec. Vehicle pfd.	—	—

CHICAGO.

	Sept. 2.	Sept. 9.		Sept. 2.	Sept. 9.
Central Union Tel.	—	—	National Carbon pfd.	99½	100
Chicago Edison	173	—	Northwest. Elev. com.	36½	—
Chicago City Ry.	—	222*	Union Traction	—	18½
Chicago Tel. Co.	175	—	Union Traction pfd.	—	50
National Carbon	32½	34*			

* Asked.

LIGHTING CONSOLIDATION AT WASHINGTON.—The United States Electric Lighting Company, of Washington, is to be absorbed by the Potomac Electric Power Company. At a meeting last week of the stockholders of the two companies the deal for the purchase of the United States Electric Lighting Company by the Potomac Electric Power Company was consummated. The sale will take effect September 30. The charter of the United States Electric Lighting Company, under the laws of West Virginia, will expire on October 1, the transfer being, therefore, on the last day of the corporate existence of the company. The interests which control the company are identical with those controlling the Potomac Company, and the companies have practically been one since the merger of electric lighting and street railway interests. The debenture bonds and certificates of indebtedness of the United States Electric Lighting Company are secured by mortgage upon the property of the United States Company. The floating debt and contracts of the United States Company are assumed by the Potomac Company, which will fund all floating debt. To do this, a mortgage of $[illegible] will be had, according to the plans of the company, and the present debt of $650,000 be retired. The consideration paid for the United States Company's property is $3,250,000 of the stock of the Potomac Electric Power Company. The Potomac Electric Power Company has filed with the recorder of deeds a certificate of reorganization. The paid-in capital stock is increased from $1,000,000 to $5,000,000, divided into shares of $100 each. It is stated that the liabilities of the company are $886,671.

OTIS ELEVATOR STOCK INCREASE.—At a special meeting of the Otis Elevator stockholders, held at East Orange, N. J., last week, it was voted to increase the preferred stock $2,000,000. About 85 per cent. of each class of stock voted in favor of the proposition. Of the new stock there will be offered to stockholders $1,090,000. Both preferred and common stockholders shall have the right to purchase at par an amount equal to 10 per cent. of their respective holdings. The balance will remain in the treasury to be issued as necessities may require. It is probable that both the preferred and common books will close September 25, and stockholders of record on that date will have the privilege of subscribing for the new stock.

DIVIDENDS.—The Manhattan Elevated directors have declared the regular quarterly dividend of 1 per cent., payable October 1. The Western Union executive committee has recommended the declaration of the regular quarterly dividend of 1¼ per cent. Otis Elevator directors have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable October 15. West Jersey and Seashore directors have declared the regular semi-annual dividend of 2½ per cent., payable September 15. A dividend of 2½ per cent. will be paid on the preferred stock of Union Traction of Indiana October 1.

BELL TELEPHONE RIGHTS.—It is generally the rule with corporations which issue new stock from time to time, that, if stockholders neglect to take advantage of any rights in connection with their stockholdings the company benefits by such neglect. The American Telephone and Telegraph Company has, however, just sent a letter to stockholders who neglected to subscribe to the stock issue of June, or sell their rights, to the effect that the directors had authorized a payment of $15 per share to such stockholders, and checks were enclosed.

NEW ENGLAND ELECTRIC VEHICLE.—Trustees of the New England Electric Vehicle Transportation Company have declared a dividend in dissolution of $1 per share, calling for the payment of $223,550, payable September 15.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports received by the mercantile agencies indicate that the past week was essentially one of active buying in distributive trade. Reports as to August trade have been almost uniformly favorable, while the business failures have been confined to a low summer minimum. Jobbing activity is undiminished at the West, Northwest and Southwest, and is of satisfactory volume at the East. The fuel shortage is pressing on the iron furnaces, and now the scarcity of cars and motive power is affecting the movement of ore from the lake ports to the Pittsburg district. Heavy imports of foreign iron and steel have cut down the premium on immediate-delivery business, but in the scarcity of supplies of domestic no particular interest is taken in this. Sales of foreign-made material are very large. In finished products, business in rails, bars and sheets is fair, and mills are heavily sold ahead. The business failures for the week ending September 4, as reported by *Bradstreet's*, aggregated 133, as against 140 the week previous, and 169 the same week last year. Copper continues weak, and prices have declined. Lake is quoted at 11.30 to 11.60c. for spot to September delivery; 11.25 to 11.55c. for October to December; electrolytic and casting, spot to December, 11.20 to 11.35c., and standard, spot to December, 10.70 to 11.15c., on 'change. Statistics compiled by Mr. C. Mayer, secretary of the New York Metal Exchange, show a total importation of 11,469 tons of copper during the month of August.

ELECTRIC TRACTION FOR MONTEREY.—A project is now under way, according to Mexican advices just received, with a view to the conversion of the two principal horse tramways in the city of Monterey, and the construction of a new electric line for which a concession has been acquired by the American engineering and contracting firm of MacKin & Dillon, of Monterey. The horse lines referred to are about 12 miles in length. The new electric line will be about 20 miles long. The scheme will in all probability be financed by a Wall Street banking house.

MEXICAN PLANT TO BE ENLARGED.—The Monterey Electric Light and Power Company, of Monterey, Mexico, is to considerably enlarge its plant. The existing equipment has a capacity of 800 hp. The generators are of General Electric, old Thomson-Houston, Stanley and Warren-Medbery build. The engines were furnished by McIntosh, Seymour & Co., Ide, and Armington & Sims. The boilers are from the Trenton Boiler Works and the Springfield Boiler Manufacturing Company. It is now proposed to increase the plant up to 2,000 hp, while eventually the capacity of the plant will reach 4,000 hp. It is expected that a producer gas plant will be installed, the units to be 500 hp each. Steam turbines may also be utilized. M. Emilio Dysterud, the electrical engineer of the company, as mentioned in our personal column last issue, is now in the United States regarding the matter, and is making his headquarters at the offices in the Washington Life Building of the Federal Electric Company. He will visit Boston. He will also visit Montreal, Niagara Falls, Chicago, St. Louis, Pittsburg, Schenectady and Hartford, and will be in this country about two months. The Monterey company is chiefly controlled by two Philadelphians, Joseph R. Livesey, Girard Building, and William Hopple, of the same address.

PNEUMATIC TUBE SERVICE.—The Post Office Department has closed a contract with the New York Mail and Newspaper Transportation Company for pneumatic tube service for postal matter over the old lines that were in operation from 1897 to 1900, when they were discontinued owing to the failure of Congress to appropriate for them. The mileage covered by this contract will embrace the line from the New York General Post Office to Branch P, .77 of a mile from the General Post Office, via Branch D, the Madison Square Station, to Station F, a distance of 4.41 miles, and from the New York General Post Office to the Brooklyn General Post Office, a distance of 1.65 miles. The price paid by the department is $15,799 per mile per annum. The service is to begin October 1, but may be put in operation a little earlier. The price is pro rata on the general bid made by the company recently for the whole general system proposed to be introduced as soon as Congress can be persuaded, from the efficiency of the service, to authorize it. The contract runs for one year, and contains a provision that either party to it may on a month's notice withdraw. The whole system will be planned for 8-inch carriers, as the old tubes are of this diameter.

BERRY ELECTRIC AND MANUFACTURING COMPANY has been formed at St. Joseph, Mo., under the laws of Missouri, with a capital stock of $10,000. Mr. G. D. Berry is the president and Mr. F. C. Uhlman is the secretary and treasurer. The company will do a general jobbing business, construct private lighting and telephone lines and plants, and also push the dynamo and motor trade in the St. Joseph territory, the city itself having a population of 102,987. Mr. G. D. Berry, who is the manager, was for 15 years purchasing agent for the St. Joseph and G. I. Railway. Mr. D. D. Berry, electrician, was in the Westinghouse factory for three years as a student, etc., and worked for about a year with the Geo. A. Fuller Construction Company. Mr. F. W. Mackey, formerly local manager for the Bell Telephone Company, has charge of the telephone department, which will push the undeveloped business of inter-communicating systems and rural lines.

ELECTRIC CARRIAGE-CALL SYSTEM.—Several contracts have recently been made by the Electric Carriage-Call Co., of 1402 Broadway, New York, which is now installing its system at the Metropolitan Opera House, New York, six boxes; Wallack's Theatre, New York, two; Providence, R. I., Opera House, one; Star Theatre, Buffalo, N. Y., one; Williswood Theatre, Kansas City, Mo., one; Garrick's Theatre, Philadelphia, one; San Francisco, Calif., one; and one for the exhibition room of the Boston Edison Company. The system was thoroughly investigated by the directors of the Metropolitan Opera House, who saw it in operation at the Herald Square and Criterion Theatres. A recent order is from Belasco's new theatre on Forty-second Street, New York City; and the system will be used this winter at Madison Square Garden for the Horse Show and other events. The company is looking for agents in the various unrepresented cities.

THE UNIVERSITY OF ILLINOIS has taken advantage of the perfection of the 220-volt incandescent lamp and the recent revision of the National Electrical Code of the Fire Underwriters, permitting the use of 500-volt distribution within buildings, by installing a 440-volt plant for the lighting of the five new buildings at Champaign. Two-phase alternating current will be used, and each phase will be treated as a single-phase circuit, operated on the three-wire system, the neutral wire being supplied with current from an auto-transformer. The exhaust from the steam engine plant operating the generators is to be used in heating the buildings. The generating station contains two-belted, two-phase generators, one of 50 kw and one of 75 kw, operated at 440 volts, to which will shortly be added an engine-type, revolving field, 120-kw alternator, purchased from the Westinghouse Electric and Manufacturing Company.

BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has begun work on four direct-current generators for the Pittsburg Reduction Company, at Massena, N. Y., in connection with the work on which an article appeared in these columns last week. These generators will be of 2,200 kw each, 500 volts, 140 r. p. m., with double commutators; two generators on one water-wheel set. The present equipment at the St. Lawrence Power Company's plant is alternating current, but the Pittsburg Reduction Company uses direct current, and is, therefore, putting in this apparatus to avoid the conversion which would otherwise be necessary, as at Niagara.

WATER-POWER PLANT FOR RUSSIAN MINES.—The Caucasus Copper Company, of South Russia, through its engineer, J. Stanley James, who came to the United States for the purpose, has placed a contract for a 500-hp hydraulic plant, which will be utilized for operating the company's extensive mines. The General Electric Company will furnish two 150-kw generators. The water-wheels, two units of 250 hp each, will be supplied through the New York office of the Pelton Water-Wheel Company, 143 Liberty Street. Shipment by steamer to Batoum will be made in about 15 days. The plant will, it is anticipated, be considerably increased in the near future.

MAXWELL M. MAYER ELECTRIC COMPANY is a new incorporation under the laws of New Jersey, with a capital stock of $100,000; the business taken over being that started by Mr. M. M. Mayer under his own name some eight years ago, and made into a company about four years ago. It now contemplates doing business on a larger scale by increasing its productive and selling capacity. The officers are: Maxwell M. Mayer, president; F. Dehrenberger, secretary, and Frank Skidmore, treasurer. The concern has its dynamos and motors in use all over the world.

THE INDIA RUBBER AND GUTTA PERCHA INSULATING COMPANY, of Yonkers, N. Y., is installing alternating-current motors to replace a number of small isolated steam engines formerly used for driving the carpenter shops and the winding and braiding departments. A recent purchase from the Westinghouse Electric and Manufacturing Company includes motors of the following sizes: 1-hp, 5-hp, 10-hp and 15-hp. The manager of the company states that the motors are very satisfactory in the work, and that he is very much pleased with them.

ELECTRICAL PLANT FOR MEXICO.—The Descubridora Mining and Smelting Company, of Descubridora, Mexico, is about to add to its electrical plant, which was recently designed with a view to considerable extensions by Albert A. Cary, 95 Liberty Street. David Gough, the company's general manager, is now in the United States for the purpose of placing contracts. He is a guest at the Holland House. Thomas H. Watkins is president of the company. The New York offices are at 68 William Street.

THE STANLEY RULE AND LEVEL COMPANY, of New Britain, Conn., is about to adopt electric driving throughout its works. It has recently purchased from the Westinghouse Electric and Manufacturing Company a 375-kw, 500-volt, direct-current, engine-type generator, to be operated in connection with a marine-type engine, running at 200 r. p. m., furnished by Westinghouse, Church Kerr & Co.

TO BUILD TRANSMISSION LINE.—The Kern River Company, which recently let contracts for electric generators and water-wheels for a 10,000-kw transmission plant, to be located 12 miles below Kernville, Calif., will soon let contracts for the building of the transmission line. The distance from the station to Los Angeles will be from 110 to 125 miles.

LIGHTING GOULD'S PRIVATE CAR.—Mr. George Gould's private car "Atlanta," now being completed at the car works at St. Charles, Mo., and which, it is stated, will be a veritable rolling palace, costing $150,000, is being equipped with the Consolidated "Axle Light" system of electric lights and fans.

BRAZILIAN LIGHTING AND TRACTION SCHEME.—It is proposed to light the City of Maranhao, Brazil, electrically, and to construct an electric traction system there. Two engineers, James Robert Hislop and Edmund Clayton Barker, are interested in the project.

THE PENNSYLVANIA SALT MANUFACTURING CO., of Wyandotte, Mich., has recently purchased a number of direct-current motors from the Westinghouse Electric and Manufacturing Company, for installation in its plant at Wyandotte.

BIDS WANTED.—The Department of the Interior, Washington, is inviting bids until October 1, on the erection of an electric light and power plant, etc., for the Government Hospital for the Insane, Washington, D. C.

THE MANSFIELD ENGINEERING COMPANY, Mansfield, Ohio, has prepared plans for the installation of a power plant at the Sawyer Sanitarium, at Marion, Ohio. Considerable new machinery will be purchased.

General News.

THE TELEPHONE.

[illegible], ALA.—The Southern Construction & Telephone Company of Toledo, Ohio, has applied for a telephone franchise in this place.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company has filed an answer, through its attorneys, to the suit brought by the City of San Francisco to compel the payment of [illegible] delinquent taxes accruing from Oct. 8, 1898. These are license taxes imposed by the Board of Supervisors in the sum of $[illegible] per year on each of the company's nickel-in-the-slot pay stations. It is denied that these boxes are slot machines, within the meaning of the ordinance, which requires a tax of $[illegible] on all apparatus having the coin attachment. It is claimed by the company that the license tax is a double taxation, as there is paid in annually at least $36,753 on the assessment of its properties. The tax ordinance was passed some years ago, but no attempt was made to enforce it with reference to telephone boxes until 1898, when an ordinance was passed directing the Tax Collector to begin legal proceedings against the telephone company for the delinquent boxes.

COLORADO SPRINGS, COLO.—The El Paso County Telephone Company has been incorporated with a capital stock of $200,000 by R. J. Belles, H. P. Lillibridge, J. F. Sanger and others.

MODE, ILL.—The Holland Township Telephone Company, capital $1,500, has been incorporated by W. B. Lantz, J. E. Gallagher and S. A. Egan.

ALTON, ILL.—The Kinloch Telephone Company has begun work stringing cables in every street in this city and upper Alton. An additional cable was found necessary to accommodate increasing business.

JERSEYVILLE, ILL.—The Jerseyville Telephone Company has extended its suburban service by running direct wires into Otterville, McClusky, Dow, Newburn, Fidelity, Medora and Kane. No toll is charged subscribers for this extra service.

ALTON, ILL.—The Calhoun Telephone Company, incorporated to construct a telephone line from Grafton, in Jersey County, through Calhoun County to Pike County, has started construction work. The new line will connect at Grafton with the long distance system, and an exchange will be established at Grafton.

UPLAND, IND.—There is talk of building a telephone line from this place to Jadden and Dundel.

MICHIGAN CITY, IND.—A short time before Lewis Russell was to be taken to the scaffold and executed for murder, Warden Reid, of the Northern Indiana Prison, received a telephone message from Governor Durbin respiting the doomed man for thirty days. This is the first instance of use of the telephone by an executive for such a purpose in this State.

INDIANAPOLIS, IND.—In the suit of the Western Electric Company against the United Telephone Company, of Marion, and Hugh Dougherty, as president, in the United States Court, asking that the Marion Company be restrained from the use of a certain multiple switchboard in its telephone exchange, the defendant has filed an answer which denies this exclusive right of the plaintiff company to this form of board.

INDIANAPOLIS, IND.—The Western Union Telegraph Company has asked the United States Court to perpetually enjoin the tax board from certifying the valuation made of its property this year. The board fixed the valuation of its property in this State at $2,242,722, while the company insists that it should not have exceeded $1,164,622. The board reduced the valuation from $63 to $57 a mile on account of the alleged reduction of local service by reason of the popular use of telephones, but this reduction was insufficient to satisfy the company, hence the suit.

EVANSVILLE, IND.—Mayor Covert and the city attorney still insist that the municipal telephone system will be a reality, and that the municipal telephone question is further from being a dead issue now than ever before. They say officers of banks and other capitalists have subscribed liberally for stock, showing the faith they have in the plan. Mayor Covert claims that when the council revoked the franchise of the Cumberland Company and ordered it to quit business within twenty days, it opened up the way for the municipal plant, and that capitalists no longer hesitate to put their money in the scheme. The mayor says that within the next few days there will be material developments in the municipal telephone question and that he is confident the success of the plan is assured.

INDIANAPOLIS, IND.—During the closing session of the State Tax Board, the valuations of telephone companies were reduced in many instances. It was shown, by arguments made by the appellant companies, that many of them were not doing well, and a few actually operating at a loss. Many of the larger companies have not paid dividends for years, and while future prospects are good, they are not in a condition at the present time to stand increased taxation. Telephone men before the board testified that the low rates with which the public is furnished telephone service make it impossible for the companies at the present time to reap substantial profits from the business. It was brought out that a great many companies, in order to obtain franchises, had agreed to furnish telephone rates that are too low. The total assessment on telephones will be [illegible] higher this year than last.

JEFFERSON, IA.—A mutual telephone company was organized here recently for the farmers in the vicinity and toward Jackson.

HINDMAN, KY.—The business men of this place are talking of building a telephone line to Hazard, Perry County.

BOWLING GREEN, KY.—The city has sold at public auction the franchise for an independent telephone exchange. The right was purchased by J. F. Mott. Wires are to be placed underground.

BALTIMORE, MD.—The Maryland Telephone Company, an independent line, is completing many extensions. The most important is a long distance line to Wilmington, Del., and Philadelphia. The line between Baltimore and Philadelphia will be opened in about two weeks. In ten days still another important long distance connection will be opened. This is the line to York, Pa. It will connect with the Baltimore company 10,000 telephones in the southern part of Pennsylvania, western part of Maryland, and in several towns in Virginia and West Virginia.

JACKSON, MISS.—The railroad commission has increased the valuation of the Cumberland Telephone Company's lines in Jackson and four other leading towns from $75 to $200 and from $10 to $40 for side lines.

ST. CHARLES, MO.—A telephone cable has been laid across the river, connecting the power house of the St. Louis, St. Charles and Western Railway at the foot of Adams Street, in this city, with the stations on the line in St. Louis County.

ST. LOUIS, MO.—The assessed valuation of some corporations has been materially decreased by the State board of equalization. This has partially made up by an increase in the valuation of others. The assessed valuation for 1902 of the property in St. Louis of each corporation is as follows: Western Union Telegraph Company, $83,926.99; Missouri District Telegraph Company, $15,175.48; Pacific Mutual, $6,353.91; American Telephone and Telegraph Company, $2,353.91; Bell Telephone Company, $823,134.72; Kinloch Telephone Company, $750,000.

JEFFERSON CITY, MO.—The State board of equalization has completed its work of fixing the assessment on the telegraph, railroad and telephone properties in Missouri for taxes for 1902. The telephone companies were assessed this year for the first time, their assessments being as follows: Bell lines, $900,000; Kinloch, $750,000; Missouri & Kansas, in Kansas City, $450,000. The local assessors also assessed these properties and the State board allowed their assessments to stand except in the cases of the big companies in the cities The principal increases are as follows: Western Union Telegraph Company, $200,000; Postal Telegraph Company, $60,000.

LE ROY, N. Y.—The Bell Telephone Company has been granted a franchise to do business in this place.

TUXEDO PARK, N. Y.—The telephone exchange at Tuxedo Park was destroyed by fire on the night of Aug. 29.

JAMESTOWN, N. Y.—At a recent meeting of the Home Telephone Company, of Jamestown, arrangements were made to secure long distance service with the Inter-Ocean Long Distance Telephone Company.

EASTON, N. Y.—A telephone company has been organized here with F. O. Ives, president; E. H. Borden, secretary; and E. J. Skiff, treasurer.

WILLISTON, N. D.—The Williston Telephone Exchange has been incorporated with a capital stock of $25,000 for the purpose of establishing and maintaining a telephone system at Williston and to extend it in time through Minnesota, Wisconsin, Montana and North Dakota. Incorporators: D. F. Collins, S. Dow and Geo. Dow, Jr., of Madison, Wis.

MIDDLETOWN, OHIO.—Representatives of the Dayton Home Telephone Company have asked for a franchise to install their system here.

MARION, OHIO.—The Central Union Telephone Company is making numerous improvements to its system at this point as well as at LaRue.

SALEM, OHIO.—The North Georgetown Telephone Company has extended its lines to Westville and will probably further extend them to Beloit.

KENTON, OHIO.—The Grocers' Association has decided to use only one telephone system, but which one is a question not yet settled. It will be decided by vote.

DELAWARE, OHIO.—The Stromberg-Carlson Telephone Manufacturing Company of Chicago has the contract for installing a new switchboard for the Delaware Citizens' Telephone Company.

SALEM, OHIO.—Exchange operators employed at the Salem exchange of the Columbiana County Telephone Company went on strike recently. They ask for a 33 per cent. increase in wages.

PAULDING, OHIO.—The Paulding Home Telephone Company is making numerous improvements at Payne and vicinity. Several small towns in the vicinity of Payne are being connected up.

TOLEDO, OHIO.—Manager Hamlin, of the Toledo Home Telephone Company, announces that his company has 3,000 telephones in operation. The company began charging for service on Sept. 1.

YOUNGSTOWN, OHIO.—Mr. W. W. Johnson, formerly manager for the Central Union Telephone Company at Youngstown, has accepted the position of superintendent of the American Telephone & Telegraph Company at Atlanta, Ga.

SPRINGFIELD, OHIO.—The Springfield & Xenia Telephone Company will commence work at once on the erection of poles. The company will build a fine block for an exchange building. An effort will be made to have the exchange in operation this winter.

TOLEDO, OHIO.—The Northern Ohio Construction Company has been incorporated with $10,000 by R. C. Packard, Alfred W. Allen, C. B. Lloyd, Wm. H. Golden and I. H. Packard. It will construct telephone and telegraph lines. The company will construct a telephone exchange at Ottawa, Ill., where a franchise has been secured.

CLEVELAND, OHIO.—The Cleveland Telephone Company (Bell) has adopted a new plan of advertising its service. For $1 it offers to install for a period of six months an unlimited residence telephone equipped for outgoing service only. It is expected that by the end of six months the user will become so attached to the telephone that he will subscribe for some other class of service. If he does not, the telephone will be taken out at the end of six months. A large number of new subscribers have been obtained for the service, and it is estimated that at least one half will become permanent subscribers.

CLEVELAND, OHIO.—The Everett-Moore syndicate announces that the Federal Telephone Company is to be dissolved, and that the remaining constituent companies are to be sold. The syndicate will retain its interests in the United States Telephone Company (the long distance company) and in the Cuyahoga Telephone Company (the Cleveland Company), but these will be handled as separate enterprises. Eleven of the subsidiary companies have been sold, leaving twelve for sale. H. A. Everett is quoted as saying that the syndicate in these sales is not clearing anything above its equity, hence there is little possibility that when the final clearing up takes place, there will be much left for the stockholders of the Federal Telephone Company.

YORK, PA.—By the consummation of a deal of the independent telephone companies of Maryland and Pennsylvania, York will soon have direct communication with Baltimore, Philadelphia, Wilmington, Charleston and other cities in Maryland, Pennsylvania, Delaware, Virginia and West Virginia. The lines of the combined company will meet at the Maryland and Pennsylvania border. It is expected that the Maryland and other extensions will be completed within a fortnight.

DENTON, TEX.—The Southwestern Telegraph and Telephone Company has been granted a franchise at this place.

CLEBURNE, TEX.—The City Council has granted a franchise to Messrs. F. B. McElroy, of Ft. Worth, and J. H. Keith, of this city, for the construction of a new telephone system here.

RICHMOND, VA.—The new Bell telephone system has been completed. Over 3,400 lines are now installed and the switchboard will accommodate 3,800 additional lines, giving a capacity of over 28,000 telephones.

LA CROSSE, WIS.—The operators of the La Crosse Independent Telephone Company struck recently because Miss Jennie Irwin, the chief-operator, it is alleged, was "stuck-up." The girls have no other grievance, but at last accounts a settlement of the trouble was not in sight. The service is crippled and 150 business men have petitioned the company to listen to the girls' demand. The petition has, however, been ignored.

ELECTRIC LIGHT AND POWER.

JUNEAU, ALASKA.—The Juneau Power Company has been incorporated for the purpose of installing a 10,000-hp electric power plant to supply Juneau and vicinity.

BISBEE, ARIZ.—The Douglas Improvement Company, Bisbee, will construct an electric lighting plant and an ice plant.

CORONA, CALIF., is to have a municipal electric lighting plant. The City Trustees have authorized F. A. Worthley to draw up specifications for the initial installation of at least 100-hp.

YREKA, CALIF.—A. H. Barr has filed water rights on 3,000 inches of water of Aetna Creek near Yreka for the purpose of developing power in connection with an electric plant.

LOS ANGELES, CALIF.—The Pacific Light & Power Company of Los Angeles is the merger company into whose system the Kern River plant will feed. It is owned by the Huntington-Hellman syndicate.

SAN FRANCISCO, CALIF.—The Northern California Power Company has completed a new substation in Redding, Calif. A ten-mile transmission line is being constructed to Horsetown, on Upper Clear Creek, where power will be furnished for gold dredging. A branch line will supply power for motor pumping for irrigating land. The new extension to Willows has just been completed. Other extensions will be made and the transmission line from Red Bluff to Corning will be rebuilt this year. It is expected that the company will furnish electric power to operate a projected electric railway from Willows to the Sacramento river.

SAN FRANCISCO, CALIF.—It is reported that the Bay Counties Power Company has made an offer to build a power house and substation for the Oakland Transit Consolidated, in Oakland, Calif. When the Transit Company placed its large bond issue, provision was made for the sum of $300,000 for the construction of an electric power house at Emeryville. This is to be built whenever the directors consider it necessary. At present a large amount of current for the operation of the Transit Company's street railway system is purchased from the Bay Counties Power Company. The supposition is that by providing for the installing of a reserve power plant the Transit Company would insure the securing of low rates for electric power from the companies having transmission lines. By offering to build a plant in Oakland the Bay Counties Power Company would make sure of retaining the business of the street railways.

LOS ANGELES, CALIF.—The Edison Electric Company of Wyoming, which was incorporated recently, proves to be the Los Angeles Edison Company, a copy of the articles having been forwarded to Los Angeles for filing with the County Clerk. The capital stock is $6,000,000. The trustees are Henry Fisher, John B. Miller, H. H. Sinclair, F. H. Rindge, John S. Cravens, James C. Drake, William R. Staats, J. S. Torrence and Walter S. Wright. It amounts to a formal consolidation of the Edison Electric Company, of Los Angeles, the Redlands Electric Light and Power Company, the Southern California Power Company and the California Power Company. The Redlands Company is completing a large electric transmission plant known as Mill Creek No. 3. The Southern California Power Company built the 80-mile electric transmission line from the Santa Ana river to Los Angeles. The California Power Company has made preparations to install a 15,000-kw plant, which will be located on the Kern River and will transmit current 116 miles to Los Angeles. Additional plants will be installed as the business grows and other cities will be supplied with electric power.

WASHINGTON, D. C.—The Potomac Electric Power Company and the United States Electric Light Company Company of this city have been merged under the name of the former company, and the capital stock of the Potomac Electric Power Company increased from $1,000,000 to $3,000,000. By the deed of reorganization the Potomac Company purchased the United States Company, paying $3,250,000 in stock of the Potomac Company. All the floating debt and contracts of the United States Company will be assumed by the Potomac Company and to this end $6,500,000 mortgage bonds will be issued.

BELLEVILLE, ILL.—The Belleville Gas Light and Coke Company has increased its capital stock from $150,000 to $300,000.

PANA, ILL.—The city has awarded a contract for the erection of a municipal electric light plant to T. C. Reid, of St. Louis. Mr. Reid proposes to erect a plant with a capacity of 82 arc lamps of 2,000 candle power each for $16,000, the Council to pay for it in installments. Before the work is begun a majority of the property-holders must sign a petition for it, after which the erection of the plant will be begun at once. For the last month the city has been in darkness, the Council being unable to reach an agreement with the Pana Modern Electric Light Company. The city will accept the last proposition of $5 a month per light until the municipal plant has been completed.

SIOUX CITY, IA.—The Sioux City Gas & Electric Company is spending $25,000 in rewiring the entire city and equipping the electric light system with new poles.

PLAQUEMINE, LA.—The town of Plaquemine has granted a franchise to Dr. W. A. Holloway and associates for an electric and power plant.

ST. LOUIS, MO.—A bill authorizing the creation of a sinking fund with which to install and operate a municipal lighting plant has been prepared by the president of the Board of Public Improvements. A certain per cent. of municipal revenues, the bill provides, shall be set aside each year for six years for the construction of the plant.

HUNTINGTON, N. Y.—The Town of Huntington Light and Power Company of Huntington, Suffolk County, has been formed; capital, $75,000. Directors: W. N. Baylis, H. S. Brush, and Douglas Conklin, of this place.

GENEVA, OHIO.—C. W. Goodrich, of this place, has bought the material and equipment of the old electric lighting plant.

GALION, OHIO.—The Galion Gas Light Company has submitted a proposition for the purchase of the municipal lighting plant. The company proposes to improve the plant.

EUGENE, ORE.—An offer has been made for the purchase of the electric lighting plant in Eugene by representatives of Eastern capitalists. It is represented that a system of electric railways will be built through the Willamette Valley, which will be operated from water power electric plants to be established at various points. It is also claimed that a number of electric power plants will be constructed and operated through the territory extending from San Francisco to Portland, Ore. It is not known who are the backers of the proposed enterprise.

WINNSBORO, S. C.—The city lighting bonds have been sold to a Northern firm and W. B. Smith-Whaley, of Columbia, S. C., has been selected to engineer the installing of the electric plant.

OTTAWA, ONT.—The new stone power house of the Consumers Electric Company, of Ottawa, which is affiliated with the Hull & Ottawa Power Company, has just completed, and the machinery has all been installed with the exception of the switchboard. The temporary frame structure will be abandoned shortly. About 10,000 horse power has been developed for heat, light and power, which can be furnished in large quantities. Over $500,000 has been expended on this work. An idea of its magnitude may be gained when it is said that over 125,000 cubic feet of solid rock has been excavated. The company is now in a position to furnish about 12,500 horse power of electrical energy.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—Solicitors are at work in Nevada County, Calif., seeking to secure rights of way for the construction of an electric railway from Marysville to Newcastle, Auburn and other points.

SAN FRANCISCO, CALIF.—The United Gas & Electric Company, which distributes the current of the Standard Electric Company in the counties south of San Francisco, has been negotiating for some time with the owners of the San Jose & Santa Clara Railroad Company for the purchase of the electric railway lines. This deal, which is likely to be consummated, would give the Gas & Electric Company control of all the lighting and power enterprises in San Jose. The Standard Electric current was recently turned into the lighting circuits of the city for the first time and the local electric lighting plant was shut down. A large steam-power reserve station is kept ready for emergencies.

HONOLULU, HAWAII.—The Honolulu Rapid Transit Company, Honolulu, has been granted a franchise by the Superintendent of Public Works for the construction and operation of an electric railway line on the Waikiki road.

NEWCASTLE, IND.—Chas. Hernley has been granted a street railway franchise in this city.

ELKHART, IND.—The Elkhart, South Bend & Chicago Railway Company, which proposes to connect Elkhart, South Bend and Mishawaka, has filed articles of incorporation. The capital stock is placed at $15,000.

INDIANAPOLIS, IND.—The Fort Wayne, Logansport & Lafayette Traction Company, with a capital stock of $1,000,000, has been incorporated by the Union Traction Company syndicate to construct a line from Fort Wayne to Lafayette by the way of Logansport.

SOUTH BEND, IND.—The South Bend Northern Railway has been incorporated with a capital stock of $10,000. Clyde Smith and E. T. Gaffney are members of the board of directors. The road will constitute a connecting link between the South Bend local system and the South Bend & Southern Michigan electric railway.

MADISONVILLE, KY.—An electric railway is projected to run from Morganfield to Sebree.

LEXINGTON, KY.—[illegible] secretary of the Bluegrass [illegible] Traction Company, announces that arrangements have been completed for the building of an interurban road. Work has been started on the line to Versailles.

JACKSON, MISS.—[illegible] are threatening and working for separate street cars for whites and blacks, and if the matter is not adjusted [illegible] it will be carried before the State Legislature.

DURHAM, N. C.—Mr. Wright has proposed [illegible] for a twelve-mile electric railway to Chapel Hill if the citizens will secure a similar amount.

LANCASTER, OHIO.—The Lancaster Traction Company is planning a number of improvements. New [illegible] will be [illegible] and a portion of the line will be double tracked.

SPRINGFIELD, OHIO.—Bids have been called for for the construction of a road over the route desired by the Springfield, Piqua & Sidney Traction Company for its entrance to Springfield.

CINCINNATI, OHIO.—The Tennis Electric Railway Company, of this city, has secured a contract for building the electric railway between Jefferson and New Albany, Ind., a distance of ten miles.

WARREN, OHIO.—Citizens of Mesopotamia, Bloomfield, Greene, Gustavus and [illegible] have subscribed [illegible] to the bond issue of the proposed Kinsman-Warren branch of the Cleveland & Sharon Railway.

SANDUSKY, OHIO.—With the completion of the proposed Sandusky, Clyde, Tiffin & [illegible] Railway, and of the Urbana, Bellefontaine Northern, now building, there will be an unbroken line of electric railways from Sandusky to Cincinnati, a distance of 225 miles.

COLUMBUS OHIO.—Several municipalities will endeavor to induce the Legislature to repeal the Thompson Bill, passed last summer. The bill provides that railway crossings and bridges shall be lighted with arc lamps. It is claimed the law works a hardship on the lighting departments of many towns.

HAMILTON, OHIO.—The Miami & Erie Canal Transportation Company has brought up all the canal boats operating on the canal between Cincinnati and Dayton. Construction boats are now operating between Cincinnati and Hamilton, using direct-current motors and transmission, but as soon as the Dayton section is completed, alternating current equipment will be used throughout.

YOUNGSTOWN, OHIO.—Stockholders of the Mill Creek Valley Railway Company and the Hamilton, Glendale & Cincinnati Traction Company voted unanimously to consolidate the two lines into the Cincinnati & Hamilton Traction Company, preparatory to a lease to a new company of which President Schoepf, of the Cincinnati Traction Company, is at the head. The new company will have $2,200,000 capital stock divided equally into preferred and common. It is announced that the officers will be H. H. Hoffman, president; Bayard Kilgour, vice-president; Henry Burkhold, secretary-treasurer; A. C. Hecht, assistant secretary-treasurer, and C. H. Kilgour, O. B. Brown and F. T. Homer the remaining directors.

AUSTIN, TEX.—The Union Traction Company, of Saginaw, Mich., is in correspondence with the municipal officers of Waco and Dallas, Tex., in regard to building an electric railway to connect those two cities. The distance is more than one hundred miles, but such a road would traverse a thickly populated section of the State and pass through a number of thriving towns.

NEW INDUSTRIAL COMPANIES.

THE DICKEY-SUTTON CARBON COMPANY has been formed at Lancaster, Ohio, and will soon be incorporated. It will build a factory for the manufacture of carbons.

THE ELECTRIC CONSTRUCTION AND MACHINERY COMPANY, Rock Island, Ill., has been incorporated; capital, $25,000. Incorporators: John T. Marron, William H. Dichman and Herman T. Schmidt.

THE NEW YORK ELECTRIC HEADLIGHT AND TRAIN LIGHTING COMPANY, of Yonkers, has been formed; capital $1,000. Directors: H. D. Crippen and W. J. Huston, of New York City, and F. A. Curtiss, of Nutley, N. J.

THE ELLIOTT BROTHERS ELECTRIC COMPANY has been incorporated at Cleveland, Ohio, with $25,000 capital, by J. E. Elliott, W. H. Elliott, E. E. Elliott, J. H. Colwell and K. L. Palmer. They have opened a factory on Hamilton Street and will do all kinds of electrical repairing, making a specialty of street railway work.

LEGAL.

LIQUIDATED DAMAGES.—The stipulated amount to be paid by an electric light company to a city, under a bond requiring it to complete the installation of its plant, for which the city has granted the use of its streets, within a specified time, is held in the case of [illegible] against Anson, to be properly regarded as liquidated damages, so that the whole amount must be paid in case of failure to meet the requirement, although the city proves no actual damage.

PERSONAL.

MR. H. A. ORR, superintendent of the Water, Light and Power Company, Anderson, S. C., has accepted the position of general Southern agent for the Stanley Electric Company.

MR. HAYDN T. HARRISON, an English electrical engineer who has been in this country for a short time studying electric light conditions, sailed for home at the end of last week.

MR. PAUL SCHUELER, of Magdeburg, Germany, an engineer in the railway service of the Imperial Government, is now visiting this country to study our steam and electrical methods of transportation.

MR. ANDREW PINKERTON, Electrical Engineer of the American Sheet Steel Company, Vandergrift, Pa., was married Aug. 30, at Apollo, Pa., to Miss Elizabeth M[illegible], daughter of Dr. A. McCauley, of that city.

MR. J. STEWART THOMSON, who is well known in machinery and electrical circles in New York City from his connection with the New York Safety Steam Power Company, was married on Sept. 3, at Cleveland, Ohio, to Miss L. C. Thomson, of that city.

MR. L. A. FERGUSON.—In the note in last week's issue regarding Mr. Ferguson's attendance at the Edison Convention this week it was stated that he was chief engineer of the New York Edison Company. This was an obvious error, the word "New York" having become substituted for "Chicago." Mr. Ferguson has not left the Western metropolis, as might be inferred from the original item.

PROF. H. HABER, of the Karlsruhe Technician Hochschule has arrived in the United States, where he will make a study of the American electro-chemical industry, as a representative of the German Bunsen Society, to which he will render a report of the results of his visit. Dr. Haber is also accredited as an official delegate to the coming meeting of the American Electrochemical Society, at which he will read a paper.

MR. EUGENE LEWIS, the well-known leader of New York's "electrical bar," has just carried through at Greenwich, Conn., some very successful theatricals for the benefit of a local church fund. His wife, formerly Miss Amy Busby, of the American stage, participated, and Mr. Charles P. Geddes, as well as Miss Jessie Moore, daughter of Mr. Charles A. Moore, also were active and clever participants

MR. A. H. KOEBIG, a civil engineer in the service of the Edison Electric Company of Los Angeles, Calif., who has been at work for that company in Fresno County, has just located there the biggest sequoia tree, which has a circumference of 109 feet, or a diameter of 32 feet. It is surrounded by other magnificent specimens. The Los Angeles Company is carrying out some extensive plans of power transmission.

MR. CHARLES E. HEWITT, who has been the senior partner in the firm of Hewitt & Warden, Newburgh, N. Y., has disposed of his interest in the above-named firm and is now the president of a new company, incorporated under the laws of New York, under the name of C. E. Hewitt & Co. The work of the new company will be mainly constructing central stations, and it will make a specialty of marine electrical construction.

MR. ALEX. C. HUMPHREYS.—The Trustees of Stevens Institute, Hoboken, have received a cable dispatch from Alexander C. Humphreys, now in Europe, accepting the position of president of the Institute, to succeed the late Henry Morton. Mr. Humphreys graduated from the Institute and is now senior member of the firm of Humphreys & Glasgow, gas engineers, of New York and London. He was elected president of the Institute in June last, but being then about to sail for Europe, declined to accept the position at once.

THE DUKE OF MARLBOROUGH, who has taken up automobiling, believes in keeping the machine under his own control, even though he is not driving himself. To accomplish this result the Duke has fitted his fifteen-horse power Mors with an ingenious arrangement, designed by himself, which takes the form of an indicator on the dashboard similar to the telegraph used on board ship. On the dial are directions to stop, go on, turn to the left or right, go slower or faster, turn right around, etc. By means of an electric button the Duke, serenely seated in the shelter of the limousine body, is able to direct the driver without exposing the occupants of the automobile to the weather.

MR. FRANK W. BEEVAN, chairman of the board of directors of the Anglo-American Telegraph Company, London, now on a trip through Canada and the United States, when asked his opinion of the Marconi researches from a practical standpoint, said: "While no doubt Marconi has made some wonderful discoveries, I do not think there is any reason at present to fear competition from his system. For instance, his system is not sufficiently perfected to be able to transmit accurately the intricate figures of brokers' quotations. So far as the Anglo-American Telegraph company is concerned, we recently sent upwards of 1,063 messages between London and New York in two hours, and so long as we are able to give such a rapid service at the present reasonable rates, I think the public requirements are being well met." In answer to a question whether there were any new cable schemes in view, Mr. Beevan replied that he knew of none excepting that the German Company intends laying another cable to America.

MR. M. R. HUTCHISON returned to New York Aug. 29 from a stay of several months in Europe which was passed in bringing to the attention of the public his instruments to assist the hearing of the deaf. While in England Queen Alexandra became very much interested in the system of Mr. Hutchison, though the statement that has appeared in the papers to the effect that he treated the Queen is incorrect, as it appears that Her Majesty is nowise in need of treatment for deafness. The first time Mr. Hutchison was summoned before the Queen there were present at a test, in addition to Her Majesty, Princess Victoria, the Duchess of Manchester and Leeds, several other members of the court, and a distinguished aurist before whom this instrument was first demonstrated in London. This seance lasted for an hour and a half, and some weeks later Mr. Hutchison was summoned aboard the royal yacht "Victoria and Albert," where he spent the day and before leaving Her Majesty handed him a handsome gold medal, saying: "Presented to Murray R. Hutchison by Alexandra, Queen, as a token of friendship and reward of merit for scientific invention and investigation." While in London Mr. Hutchison was requested by the Duke of Cambridge to call on him at the Gloucester House to show his system, and later was asked to dine there with the Duchess of Kent, the Lord Mayor of London, and many other titled personages. The Duke of Cambridge called on Mr. Hutchison several times at the Hotel Cecil and investigated the system very closely. At a seance given in honor of the Duke of Cambridge by Mr. Hutchison at Hotel Cecil, Mr. David Bispham, of the Metropolitan Opera Company, sang to the deaf mutes present. The company on this occasion included, besides a number of the nobility, a considerable party of Americans. While in Paris an exhibition was given before the Grand Duke and Duchess Vladimir and a party of other distinguished people. On Aug. 4 the instruments

were demonstrated before the British Medical Association, at Manchester, Eng. The Queen took a particular interest in Mr. Hutchison's invention, and during his stay in London he was summoned a number of times before Her Majesty at Buckingham palace, and from her received an invitation to attend the Coronation ceremony at Westminster Abbey, as well as being accorded permission to take a party of Americans through Westminster Abbey the Monday after the Saturday on which the King was crowned, and before the Abbey had been opened to the public.

Trade Notes.

THE BOSWORTH-HOLDING COMPANY, of Cleveland, dealers in new and second-hand electrical equipment, has opened a new establishment at 22 South Water Street, that city.

THE H. B. CAMP COMPANY, reports sales as exceedingly good at present for its underground conduit products. The company has largely increased its facilities to enable it to fill all contracts promptly.

THE BURT MFG. CO., of Akron, Ohio, reports that ten governments are now using its Cross oil filters. It has just made an important shipment of these filters and its Burt exhaust heads to Buenos Ayres for the Argentine government.

LANE & BODLEY COMPANY, engine builders, Cincinnati, Ohio., is planning a new foundry for its own Corliss engines and for jobbing foundry work, and invites the submission of new plans, ideas or apparatus, for inclusion in it. Blue prints can be had on application.

THE FROST CROSS ARM AND LUMBER COMPANY, of Cleveland, Ohio, has been incorporated under the laws of Delaware. Mr. A. S. French is at the head of the company, and has offices in the Century Building, Cleveland. The company will make cross arms for telephone and telegraph lines.

THE NATIONAL INCANDESCENT LAMP COMPANY, Cleveland, Ohio, which some time ago purchased the plant of the old Brush Electric Light Company, has moved its general offices from the Electric Building to the office building formerly occupied by the Brush Company at the corner of Mason and Belden Streets.

THE CLIFTON MANUFACTURING COMPANY has removed from 511 Washington Street to 308 West Street, New York, where much larger space is available for the carrying of a large stock of fire proof insulating conduit, electrical tapes and splicing compounds. The New York agents of the company are Messrs. F. H. Willmont and F. W. Smith, formerly with the Western Electric Company.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agent for Packard incandescent lamps, lately asked its customers for their opinion regarding the lamp. The hundreds of testimonials that have resulted from this request have been numbered, and are being exhibited as a chain of evidence as to the excellence of Packard lamps. It makes an exhibit of which both the manufacturers and the selling agents have a right to be proud.

BRAZING CAST IRON has, it is said, at last been accomplished by a German who has secured patents in thirteen countries. Companies have been organized in each of the thirteen countries including the United States, and in this country the company has, it is alleged, been making so much money from the brazing plants it has in operation, that others are to be placed as speedily as possible in every large town in the country. The American Brazing Company of Philadelphia, 136 South Fourth Street, has secured the American rights. We know nothing personally of the merits of the process.

IDEAL STEAM ENGINES.—A very handsome pamphlet has just been issued by A. L. Ide & Sons, Springfield, Ill., giving a very complete description of their automatic cut-off steam engines. The construction of these engines is very fully gone over and illustrations show the constructional details in a very clear manner. Views are also given of the various styles of "Ideal" engines, many of which are directly connected to electric generators. This engine has become well-known and is widely used in the electrical industries on account of its close regulation and especial fitness for driving dynamos and generators.

WATERBURY BRASS COMPANY, 122 Centre Street, New York City, has now ready for mailing its new stock catalogue, classifying brass, copper, bronze and German silver in sheets, rods and wire, also brass and copper seamless drawn tubing which it is carrying in its New York warehouse. This catalogue also illustrates stair treads and mouldings, brass ferrules and checks. They have also compiled a complete table of weights and measures bearing on brass and copper sheets, rods, wire and tubing. This catalogue has been prepared at considerable expense and is one of the most complete catalogues that has been issued for the hardware trade, electrical manufacturers, and buyers in general of brass and copper. It can be had for the asking and this enormous stock is ready for shipment on receipt of order.

AN EMPLOYMENT BUREAU.—The Chicago & Alton Railway has established an employment bureau, the purpose of which is to recruit employes from among the people living along the line of the Alton road. The head of the "Alton" employment bureau meets citizens living in towns upon and adjacent to the line of the Alton railway for the purpose of getting in touch with young men of good habits and high character who would like to become employes. Students in telegraph offices, clerks in various departments, operators, brakemen, firemen, etc., are recruited from persons whose record is kept by the bureau; the selections being made from those who are best suited and qualified after having passed mental and physical examinations which have been made a part of the requirements for employment by the company.

CEMENT BUTTS.—The "Durable Cement Butts," manufactured by the Durable Cement Post Company, Battle Creek, Mich., embodies a novel idea in the manufacture of poles for telephone, telegraph and electric railway trolley lines. The use of these cement butts permits of the use of short poles, which are often considered worthless for that reason, and poles which have become rotted at the butt may be saved and the part above ground utilized by placing them on cement butts. The butts are octagonal in form, of various lengths, and are placed in the ground in the usual manner, the top of the butt projecting above the surface a few inches. The bottom of the pole is set on the top and fastened thereto by stout iron straps, which are firmly bolted to the pole and the butt. These butts possess many advantages, which are well described and illustrated in a pamphlet issued by the company.

ELECTRIC AND COMBINATION FIXTURES.—A catalogue of electric and combination fixtures of extreme excellence and splendid detail has been issued by the Dale Company, 20 Thames Street, New York, as No. 11 of its series. Practically everything in the nature of an electrical fixture is shown in this catalogue, which covers 136 pages; is printed on good paper; contains well-made intelligible illustrations and is strongly and handsomely bound. The book illustrates portable fixtures of all sorts, some of which are very handsome designs; brackets, bracket tubes, canopies, ceiling fixtures and pendents, electroliers and column lights and some very ornamental designs for newell posts. In addition a line of canopies, receptacles, shade holders and shades are shown, giving a fitting finish to the catalogue which is a very complete publication and should be in the hands of every electrical man interested in fixture work.

"GOOD STOCK NEEDS GOOD LIGHTING," is a truth realized this season as never before by the leading merchants throughout the country, as evidenced by their orders for reflectors to the well-known house of I. P. Frink, 551 Pearl Street, New York. Among the many contracts for Frink's special patent window reflector and show case lighting in hand or recently filled we are advised of the following: Gimbel Bros., Philadelphia; also their Milwaukee store; Bloomingdale Bros., N. Y. City; Siegel-Cooper Co., N. Y. City; the handsome new buildings of Saks & Co., and R. H. Macy & Co., N. Y. City, two stores which because of their location have attracted general attention; Derby Desk Co., Boston; Washington Arcade, Detroit; Kennedy Furniture Co., Butte; L. Hammill & Co., Mobile, Ala.. who are conceded to have one of the finest store buildings in the South; J. N. Mockett, Toledo, Ohio; Hannifin Dry Goods Co., Milwaukee; and "The Leader," Minneapolis, Minn. It might be mentioned that in addition to their special line of reflectors for window and case lighting this concern manufactures a full line of cluster reflectors, mirror shades, etc. The former are well adapted to the lighting of store interiors being preferred by many to the enclosed arc. The Wadleigh High School, N. Y. City, about completed, has some 800 "Frink" clusters which are the standard type of the N. Y. Board of Education. The additional fixtures in this building, consisting of ceiling coronas with bent glass domes, and arch reflectors, were all furnished by this firm. Their catalogue fully illustrates and describes their fixtures and is intended to reach every central station, electrical engineer, contractor and supply dealer. A copy will be sent on request.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 2, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

708,006. ELECTRIC SWITCH; H. P. Ball, New York, N. Y. App. filed March 21, 1901. Solenoids mounted in line with each other carry the circuit closing bar on their joined cores. The solenoids are ironclad, the magnetic circuit being formed partially by the bracket in which they are mounted.

708,007. TIME LIMIT DEVICE FOR CIRCUIT BREAKERS; H. P. Ball, New York, N. Y. App. filed Jan. 29, 1902. Means provide for adjusting the time-limit between the energizing of the overload device and the circuit breaker, whereby several time limit devices can be incorporated in a distribution system and adjusted to operate independent circuit breakers at different times.

708,008. REVERSE CURRENT DEVICE FOR CIRCUIT BREAKERS; H. P. Ball, New York, N. Y. App. filed Jan. 29, 1902. A device adapted for use in connection with any type of circuit breaker to open the same should the direction of current be reversed.

708,016. REGULATING SOCKET; L. F. Bogia, Philadelphia, Pa. App. filed Sept. 20, 1901. A key-socket containing a variable resistance adapted to be inserted at the point where a branch circuit leads off from the main.

708,024. COUPLING FOR ELECTRIC MOTORS; F. E. Case, Schenectady, N. Y. App. filed Feb. 15, 1901. A coupling for use in conductors between cars of a train; one section carries a pair of brushes which bears against a plug held in the other section.

708,025. ROTARY TRANSFORMER; Alexander Churchward, Chicago, Ill. App. filed June 12, 1899. The converter armature is provided with two circuit windings in the case of a two-phase machine, or three separate windings in the case of a three-phase machine, each of which has its own commutator.

708,026. ELECTRIC CONTROLLER; W. H. Clarke, New York, N. Y. App. filed Oct. 11, 1901. An electro-magnet in the shunt circuit of the dynamo controls a steam valve which co-operates with a differential piston to control the supply of steam admitted to the engine which drives the dynamo.

708,032. ELECTRIC ARC LAMP; E. A. Edwards, Cincinnati, O. App. filed Nov. 25, 1901. Improvements in the details of construction for the purpose of securing a regular and uniform feed of the carbon.

708,036. MOUNTING FOR ELECTRIC HEATERS; E. E. Gold, New York, N. Y. App. filed Oct. 16, 1901. The heater is adapted to be placed under twin movable car seats and partakes of a motion in conformity with that of the seat.

708,[illegible]. TROLLEY HARP OR FORK; [illegible] Johnson and F. P. Crockett, [illegible], Mich. App. filed April [illegible]. Improvements in the strap spring which conveys the current from the wheel to the harp.

[illegible]. ELECTRIC CONTROLLER; [illegible], Schenectady, N. Y. App. filed Feb. 15, [illegible]. The [illegible] of the current switch are so constructed and arranged that [illegible] of the motors of a two-motor equipment are cut out of circuit, the controller cylinder is automatically prevented from passing to the parallel position.

708,070. COHERER; G. W. Pickard, Boston, Mass. App. filed Oct. 18, 1901. The plugs of the coherer have concave inner faces, thus furnishing a uniform V-shaped space for the particles, regardless of the side upon which the coherer rests.

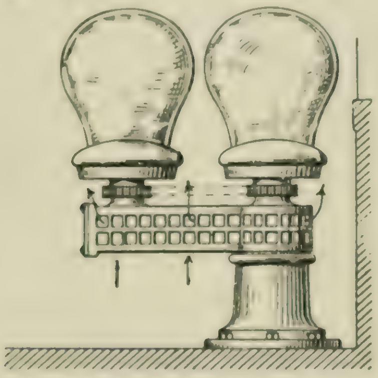
708,071. WIRELESS TELEGRAPH SYSTEM; G. W. Pickard, Boston, Mass. App. filed Oct. [illegible]. The [illegible] in the receiving apparatus of a [illegible] device which has its power of tapping regulated according to the low or high resistance of the coherer.

708,072. WIRELESS TELEGRAPHY; G. W. Pickard, Boston, Mass. App. filed Nov. 4, 1901. A terminal station in which is provided a means for automatically disconnecting and connecting a wave-responsive device in operative position as the air wire is disconnected from or connected to the receiver of the terminal station.

708,093. ELECTRICALLY PROTECTED STRUCTURE; H. M. Sutton, W. L. Steele, and M. Coerver, Dallas, Texas. App. filed May 25, 1901. Conductors arranged in crossing and recrossing grooves in the wall of a structure.

708,096. CONTROLLER FOR ELECTRIC MOTORS; L. A. Tirrill, Lynn, Mass. App. filed Feb. 14, 1901. The controller provides for cutting off the power and short circuiting the armature to cause the motor to operate as a braking generator, in case of an overload or the opening of a hand switch by an attendant, the result in either case being to open the circuit of an electro-magnetic unlocking device and permit a spring to throw the controller cylinder back to braking position.

708,105. CASE FOR FAN MOTORS; H. R. Wellman, New York, N. Y. App. filed Nov. 16, 1901. The case is formed of two parts which when united serve to support the armature of the motor, one part which is removable, also supporting the brushes.



708,036.—Mounting for Electric Heaters.

708,112. ELECTRIC CLOCK; H. E. Andersson, Stockholm, Sweden. App. filed Dec. 1, 1900. Details.

708,121. DEVICE FOR OVERCOMING ALTERNATING CURRENTS IN DIRECT CURRENT CIRCUITS; H. Brockelt, Berlin, Germany. App. filed March 28, 1902. (See Current News and Notes.)

708,1[illegible]. ELECTRIC ARC LAMP; R. Fleming, Swampscott, Mass. App. filed Dec. 6, 1900. The reactance coil is inclosed in a magnetic cage with a central core provided with an air gap to avoid placing the coil at a distance from the lamp mechanism.

708,155. ELECTRIC ATTACHMENT; J. C. Meloon, Providence, R. I. App. filed March 1, 1898. The actuating device of a switch lever is connected with a diaphragm which is moved by fluid pressure.

708,157. CONTROLLER FOR ELECTRIC MOTORS; F. A. Merrick and E. W. Stull, Johnstown, Pa. App. filed Jan. 2, 1902. By means of compound locking devices the series-parallel switch normally held at its series position, cannot be operated to connect the motors in multiple until the latter has been brought to a sufficient degree of speed by the operation of the [illegible] switch.

708,158. CONTROLLER FOR ELECTRIC MOTORS; F. A. Merrick and E. W. Stull, Johnstown, Pa. App. filed Jan. 2, 1902. Electro-magnetic means of improved character for "blowing out" arcs at the controller contacts.

708,159. INCANDESCENT LAMP; H. E. Meyers, Butte, Mont. App. filed Aug. 19, 1901. Filaments of different candle power are switched into and out of circuit by twisting the lamp in the socket.

708,18[illegible]. CIRCUIT INTERRUPTER; [illegible] Walker, Chicago, Ill. App. filed Nov. 6, 1899. Relates to means for regulating the action of a circuit interrupter of the Caldwell type.

708,185. MAGNETIC SEPARATOR; J. P. Wetherill, South Bethlehem, Pa. App filed Aug. 26, 1901. The main feature of the invention consists in supplying the material to be separated to [illegible] spaces formed between opposing magnet poles immersed in a suitable water tank, whereupon the heads are detained in said spaces until the accompanying tailings have been washed away.

708,186. MAGNETIC SEPARATOR; J. W. Wetherill, South Bethlehem, Pa. App. filed Aug. 26, 1901. Modification of 708,185.

708,187. MAGNETIC SEPARATOR; J. P. Wetherill, South Bethlehem, Pa. App. filed Aug. 26, 1901. A further modification of 708,185.

708,188. LIGHTNING ROD; J. O. Wilson, Canton, Mo. App. filed Jan. 5, 1902. The ground plates are electro-opposite and maintain a current through the lightning rod, to render it more sensitive to electrically charged clouds.

708,195. CONTROLLING DEVICE FOR ELECTRIC GENERATING SYSTEMS; J. H. Backford, Salem, Mass. App. filed Dec. 18, 1900. The invention consists of a starting device adapted to be manipulated by the operator to perform a number of successive acts, whereby the system is started.

708,198. TROLLEY; J. W. Brooks, Indianapolis, Ind. App. filed Jan. 16, 1901. An anti-friction knuckled joint is formed in the harp to permit the wheel to readily follow the wire.

708,070.—Coherer.

708,211. ELECTRIC SNAP SWITCH; L. W. Downes, Providence, R. I. App. filed May 3, 1902. Details.

708,216. ELECTROMEDICAL APPLIANCE; J. O. Fowler, Jr., New York, N. Y. App. filed March 30, 1901. A battery cell is located inside of a massage roller and an induction coil in the handle is connected in circuit with a circuit breaker and with the cell and the surface of the roller.

708,220. MEANS FOR WINDING CONVERTERS OR LIKE ARTICLES; E. R. Gill, New York, N. Y. App. filed March 30, 1899. Two half portions of a spool are secured together around the core by fastening devices and the heads of the spool are grooved to receive a belt for rotating it.

708,253. ELECTRIC CLOCK; A. F. Poole, Wheeling, W. Va. App. filed Sept. 7, 1901. Improvements in details of a master and secondary clock system.

708,309. MANUFACTURE OF GLASS BY MEANS OF ELECTRICITY; J. Bronn, Cologne, Germany. App. filed Sept. 21, 1901. (See Current News and Notes.)

708,329. LIGHTNING ARRESTER; C. E. Egan, Durham, N. C. App. filed March 11, 1901. Details.

708,334. ELECTRIC ACCUMULATOR PLATE; A. Fischer, Berlin, Germany. App. filed June 21, 1902. A serpentine-folded plate having tongues cut in the apex of each fold and bent outward to receive the active mass.

708,349. INSULATED RAIL JOINT; G. L. Hall, Brooklyn, N. Y. App. filed March 6, 1902. Blocks of wood are inserted between the fish plates and the rail end.

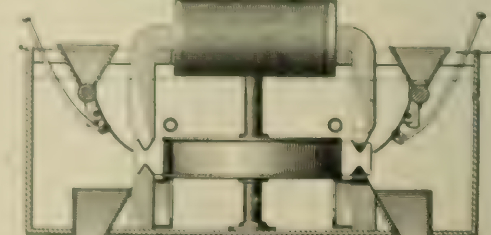
708,350. INSULATED RAIL JOINT; G. L. Hall, Brooklyn, N. Y. App. filed April 8, 1902. A modification of the preceding patent.

708,372. AUTOMATIC ENGINE STOP; N. C. Locke, Salem, Mass. App. filed Jan. 2, 1902. Circuit closers are placed adjacent to the fly wheel and cylinder head so that in case of rupture the circuit will be closed and steam cut off.

708,398. ELECTRICAL GAS LIGHTER; J. G. Poppert, Milwaukee, Wis. App. filed Jan. 7, 1902. Details.

708,432. INCANDESCENT ELECTRIC LAMP; Glenn Cannon Webster, Warren, Ohio. App. filed Dec. 30, 1901. In order to produce a symmetrical distribution of light a double spiral filament has its bottom loop attached to an anchor and the convolutions symmetrically arranged opposite each other and at different distances from the anchor.

708,462. VEHICLE TO BE USED IN ELECTRIC TRACTION ON RAILWAYS; G. Cawley, Westminster, England. App. filed June 3, 1902. Construction of a vehicle adapted to carry boiler, engine, dynamo and motor for electric traction.



708,185.—Magnetic Separator.

708,478. ELECTRICAL POSITION INDICATOR; A. S. Hubbard, Greenwich, Conn. App. filed Feb. 20, 1902. The invention comprises a movable index armature device having a magnetically polarized part and a fixed field magnet having a series of magnetizing coil sections whereby its field or line or axis of polarization may be varied or shifted so as to cause the armature to move, electrical contacts controlled by the movement of the object whose position is to be indicated, and connections from said contacts to said coil sections whereby the direction of the field axis and the position of the armature are determined by the position of said object.

708,496. BURGLAR ALARM; F. C. Robinson and J. E. Green, Council Bluffs, Iowa. App. filed Nov. 26, 1901. Details.

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THE WORRISOME FUEL QUESTION.

What is the average small central station going to show on its balance sheet if the price of fuel keeps on the rise? To be sure, at the present time it is the amateur stoker who runs his hot-air furnace that is worrying over the coal situation, but as anthracite goes up so does every other kind of fuel, and an inspection of the coal prices for the past few years is not a pleasant matter for any class of consumers. There is a bad time coming, if one may judge from the signs of the situation now visible; and although the coal supply is very far from showing signs of impending exhaustion in our own day, it makes little difference to the unhappy consumer whether prices go up from one cause or from another. In this exigency it is well to stop and consider the gas-engine situation far more seriously than ever before. It is a well-known fact that abroad "producer" and other gas has shown itself able to give very cheap power indeed even against rather cheap coal. Gas can be economically obtained from fuel that is not over well adapted for direct use, and at all events for power purposes it can be put in the holders at a surprisingly low price. The gas engine is best known at present in very small sizes, which give a very incomplete idea of its economical possibilities. With a fair grade of gas in the holder, at 20 cents or so per thousand feet, a big gas engine can turn off power at a figure that demands very respectful consideration indeed. Of course, if all fuel keeps on rising in price, gas itself must become somewhat dearer, but the more the grades of fuel that can be economically used for power purposes, the more the general situation is likely to be relieved; for not only is the demand for particular grades lessened, but it is rendered far more difficult to corner the market to any considerable extent. Coal in general is very widely distributed, even if some special coal in particular, to wit, anthracite, is scarce.

STATISTICS OF THE INDUSTRY.

Elsewhere in the pages of this issue will be found an abstract of the report published by the U. S. Census Office, on the manufacture of electrical apparatus and supplies during the census year, 1900. In view of the fact that the report is the first attempt in this direction, and had been preceded in other censuses by sporadic efforts, the difficulty of the task is obvious; but a study of the report, occupying some 54 pages, shows that the census authorities were very successful not only in eliciting the data in bulk but in securing detail in large variety. In 1880 and 1890 the figures of electrical manufacturing were loosely collated, without any attempt to give precision beyond the round totals; but it was recognized that the growth in the art during the past ten years called for a more respectful and elaborate treatment. Aside from inquiries into electrical manufacturing, the Census Office has hitherto attempted little in the electrical field. A cursory investigation was made of telephony in 1880, and ten years later there was an interesting study of street railways, as well as a report on electric lighting in the State of New York; but for telegraphy, we have had of late years to look wholly to the Western Union management for data of any value. The permanent census office, constituted recently by Congress, is fortunately now in shape to prosecute inquiries into all these fields of "public supply" that concern social welfare so deeply; and in the meantime an excellent start has now been made in regard to the manufacturing industry that has to furnish the apparatus required in the local plants or for general consumption.

As will be noted from the returns, 580 establishments, with a capital of $83,130,943, some 5,000 officials and 40,890 wage-earners, produced

apparatus and supplies in the census year, valued at $91,348.889. There were, [illegible] considered from 113 other establishments making apparatus of an electrical character as part of their business, and, all told, these 712 concerns turned out product to the value of $104.738,719. Nor was this in reality the limit, for it is pointed out in the report that many companies, within and outside the electrical field, build a great deal of their own apparatus for themselves, but not for sale. No account, moreover, is taken of electric launches, automobiles or locomotives, these being accounted for in the respective branches of ship building, carriage building and locomotive building; while they would obviously include and duplicate some apparatus already reported otherwise by electrical manufacturers. There is also no inclusion of any electrochemical or electrometallurgical products, although well nigh all our copper is refined electrically, and all our aluminum, carborundum, calcium carbide, etc., is the product of electricity. However, these exclusions are evidently directed by an intelligent policy, which at once strengthens confidence in the work of the Census Office as a whole, and illustrates the care with which the general plan was laid out at the beginning. It is to be added that the figures given are those derived directly from the manufacturers themselves; have been carefully sifted, and, therefore, involve a minimum possibility of error. It would, indeed, hardly be feasible to get nearer the truth, for no one else possesses the mechanism and authority of the government for prosecuting such an inquiry or for punishing misstatements made in the returns. As a matter of fact, throughout the expert work on the Twelfth Census, the manufacturers in all lines of industry have in general done all they could to render assistance.

The activity revealed by this report in electrical production has certainly not fallen off in the last two years, but has been maintained and intensified. An average increase of 20 per cent. each year would bring the total output for 1902 up to about $150,000,000; and there is no reason for doubting the approximate validity of that figure. The largest concerns have enjoyed a bigger growth even than that, in many instances, and the area to be supplied is ever increasing both at home and abroad. The American people in the census year, it is stated in the report, were spending at least as much on electricity as on daily bread, and it would not be easy to find any one fact more typical of the temperament and progressiveness of the nation.

While electrical manufacturing is shown to be chiefly concentrated in some six eastern and two middle or western States, the industry is fairly widespread, its data being furnished by no fewer than 19 States. It is a little surprising to see Pennsylvania head the list of States, with a total of nearly twenty-one millions, but New York had nearly eighteen millions, and Illinois nearly twelve. It is hard to tell just what conditions determine locality for the plants, but three causes at least are influential, viz., nearness of steel and iron; cheapness of lumber, and abundance of skilled labor. One point which emerges is the tremendous increase in the production of electric motors and their use in general manufacturing. But, after all, such motors are still only 4 per cent. of the power employed in the manufacturing industries of the country. It had seemed to reach a good deal more than that, but there are many outlets for motors; and in reality the figure is full of encouragement, for it shows how infinite is the work that lies ahead for electricity in one direction alone. Indeed, but a single field is seen from this report to be relatively restricted or narrowing, namely, the telegraph; but we refuse to believe that it is any less lacking to-day in opportunities of growth and improvement than it ever was.

Private Plants.

The electrical supply companies in most large cities have in the last few years adopted the wise policy of keeping prices down to a basis that renders isolated lighting plants far less attractive economically than they have been in the past. In a surprisingly large number of cases, the investigation of the possibilities of isolated plants in large buildings shows that supply from public plants is either actually cheaper or so near to the same cost as to make investment in a private plant inadvisable. Yet in spite of this there is a large field for private lighting plants, especially in places which have no public supply. Residence lighting, while becoming more and more common in this country, has not yet been exploited with anything like the thoroughness that it deserves—and this is the day of large country seats and summer homes. The advent of automobiles, if it had done nothing else, would mark an epoch in the construction of light and easily-operated prime movers of types well adapted for domestic use. Along this line there ought to be great progress in small isolated electric plants, and while something has been done already, the business has not yet been exploited to anything like the proper extent. In the present state of the art, it should be possible to make a 2 or 3-hp direct-connected oil engine and dynamo that would be pretty nearly fool-proof, and that would require hardly any attention. Such a plant with or even without a storage battery forms a very beautiful and economical means of lighting country houses. It is a fact that from such a plant properly handled one can get more and better light per gallon of oil than by its direct combustion—to say nothing of the other advantages. In spite of the number of small isolated plants now in operation, there has been little done in the production of generating sets specially designed for such work, and it is certainly a branch of the art that deserves encouragement. In some of the coming expositions it would be worth the while to make a separate class for such combination plants and to give them thus such a standing by themselves as they deserve.

The Coming of the Turbine.

We are watching and noting with the keenest interest the performance of the steam turbine plants installed in increasing numbers. Thus far the reports received have been of a highly encouraging character. but lacking in that detail which is necessary for reaching final conclusions. While the tests as a rule show a degree of economy fully up to the standard of the compound-condensing engine, few installations have been in operation long enough to show what difficulties. if any, will crop out after extended trial. So far as electrical uses go. the turbine has the advantage of high rotative speed, thus giving to the dynamo relatively low cost and high efficiency, since speed is certainly the cheapest way of getting electromotive force. A test based on steam per kw-hour at the bus-bars shows the turbine in a particularly favorable light, and whatever its place in general manufacturing may prove to be, it has a strong claim for favor in electrical power stations. Some of the economic results reported are of a most startling character for machines of moderate capacity. Much of the future of the turbine, however, depends on its performance in rather small and in very large sizes, and here the data are as yet rather incomplete. What, for instance, can be expected from a 10-kw turbo-generator and from a 2,500-kw one in fair comparison with the best reciprocating engines of similar capacity? As to the former case, the turbine ought by good rights to have a material advantage, since small engines, even the best of them, are notoriously uneconomical; but the latter condition is less to the turbine's advantage. And since the work of the future will include plants of truly gigantic dimensions, the performance of big turbines is of the greatest importance. It may be that in turbine practice the effect of linear dimensions upon economy may show some interesting peculiarities. Just at the present time the public are rather in the dark about turbine performances, as they are going through the stage of exploitation which is conducive to secretiveness—a policy often necessarily adopted by the manufacture., but a bit vexatious to the would-be buyer.

A. I. E. E. PRIZES.

Elsewhere we make note of the award by the British Institution of Electrical Engineers of no less than twelve annual premiums for papers, aggregating in money value $500, and also two annual scholarships of $250 each. Of the premiums, eleven were provided from the funds of the institution, the remaining one being the Fahie premium of $50, offered annually. One scholarship is endowed by Sir David Salomons, and the other is a legacy from the late distinguished Anglo-American, Prof. David Hughes, the capital fund in each case being about $10,000. It is perhaps unnecessary to add that the American Institute of Electrical Engineers has thus far made no provision from its funds for premiums, nor received any endowments to be applied to the encouragement of the science and the art for which it stands. To supply this lack would indeed be a gracious act on the part of friends of the Institute, thereby relieving that body of its present invidious status with respect to many other professional bodies—though this is a minor consideration in view of the intrinsic and continuing benefit the application of such funds would have through coming ages.

Granting the desirability of prizes and anticipating their foundation, it may not be inappropriate to refer now to several questions apt to arise in matters of detail connected therewith. Two of these are with respect to the relative merits of money and medal prizes, and the frequency of award of a prize instituted for a given subject. In all but exceptional cases we believe in this country a medal would be more highly appreciated, as it would constitute a permanent and tangible record and possession, and being divorced from direct association with lucre would in the end be apt to be of more material benefit to the recipient. As to the frequency of awards, there is no doubt that a prize conferred annually in connection with a subject which does not permit of great progress during that period—and very few subjects do—is greatly cheapened, as has been demonstrated in more than one instance. Which tends also to reflect upon the awarding body. A prize conferred once in, say, five years, would undoubtedly represent very much more to the public and thus be of greater value to the recipient. A practical advantage is the smaller endowment for such a foundation, which in the case of a medal containing $100 in gold and including provision for striking, inscription and case, and the making of the die, would, we find, not be over $1,000, neglecting any cost there may be for a design.

Another question concerns the relative benefit of students' scholarships and endowments for research. It can be said in favor of the latter that any expenditure will be for a definite end, and the recipient will likely always be one who has developed special aptitude for research. In the case of a scholarship on the other hand, the precocity that singles a student from among his fellows may not be realized at maturity; and even if it should be, the subsequent career would not necessarily be one involving special benefit to the world at large. Taking the figure of the English scholarships, namely, $10,000, this amount should produce during, say, five years, about $1,500. While this sum is not large, yet expended on one object something might be accomplished of value, whereas if doled out in driblets little could be expected. Another consideration is that the award of the fund only once in five years would go far toward insuring that the object selected would be a creditable one. Finally, there is little doubt that after the first medal and first research fund had been established others would be provided for; and if each were devoted to a specific purpose, there might in time be annual awards by the Institute, but with a probability in that case of much more fruitful results than if numerous small awards were made each year. With such great names as Morse, Bell and Edison for commemoration—as well as others —and with a laudable desire on the part of many to connect their names indelibly with the profession which they cherish, the endowment of Institute prizes offers a dignified means to worthy objects.

ELECTRIC HEATING.

If our public-spirited Christian potentates, the coal barons, keep up their philanthropic endeavors, there will soon be an open question as to the economic possibilities of electric heating. With anthracite at its normal price the cost of current for sustained heating is practically prohibitive, however it may be with temporary work like cooking. But save in street cars, electric heating on a considerable scale has never been seriously tried. And street cars are particularly difficult spaces to heat, as they are in rapid motion through the cold air, have many rather draughty windows, and front and back doors generally ajar and constantly being opened and shut. In case of electric heating the energy employed is very inefficiently produced, save in case of water-power plants, but it is utilized without any of the incidental losses which are so severe in ordinary cases of domestic heating. The heat can be obtained when and where it is wanted, and can immediately be shut off when it is not wanted. In an ordinary house a very small number of rooms need to be actively heated all day and all night, provided one has the power of heating quickly a room in which heat is needed. This power is conferred in a remarkable degree by electric heaters, as is also the power of exact and prompt regulation.

We Americans are hardened sinners in the matter of overheated houses, and the customary furnace is not thought to be doing its duty unless it keeps the entire house at 75 degrees, or thereabouts, in the coldest weather. Perhaps the present coal prices will be a blessing in heavy disguise if they teach by experience the art of judicious and efficient heating. We are more than half inclined to think that wherever water-power plants are able to furnish energy at a low figure, electric radiators with a groundwork of steady heat from fuel will prove reasonably economical and convenient to a very unusual degree. Let us look at the matter a little in detail. With electric energy for heating purposes supplied at, say, 2 cents per kw-hour, except during the peak of the load, one can do pretty well at electric heating on a restricted scale save in very cold regions. Such spaces as bedrooms need active heat scarcely more than two or three hours per day, unless in case of sickness. Four or five kilowatt-hours per room would on an average be ample for such rooms, except on some very cold days, provided the exposure does not unduly chill the walls. Of other rooms only two or three require continuous heat through the day, and can be allowed to go without it during the night provided it can be applied promptly in the morning when it is needed. In spite of the cost of electrical energy one could, therefore, get in a moderate degree all the heat really needed without an unreasonable expenditure; and in case there should prove to be considerable demand for heating not a few hydraulic plants could afford to make very reasonable terms for power taken at other times than during the peak of the load. We should really like to see a careful trial made at some favorable point during the coming winter, to show what the economic possibilities of the process really are, and if coal holds up to its present prices we are inclined to think that electric heating will have a chance to make some material headway. It certainly can give high-priced coal a pretty hard rub for cooking, even at far higher prices than would rule if general heating began to come into vogue. A considerable portion of ordinary domestic heating apparatus in general is poorly designed for efficiency, for heretofore high efficiency has seemed needless, but with coal a half a cent a pound it is high time to look after waste. At such a figure it does not take long to burn up ten dollars, which at our hypothetical price would mean five hundred kilowatt-hours. The subject is certainly one which will repay careful investigation on the part of supply companies in favorable locations.

Opening Institute Meeting.

The first meeting of the American Institute of Electrical Engineers will be held at the Mechanical Engineers' Rooms, on Friday, Sept. 26, when Mr. B. G. Lamme, engineer of the Westinghouse Electric & Manufacturing Company, will read an important paper on "The Washington, Baltimore and Annapolis Single-Phase Railway." It will be remembered that note of this road was made in these pages some weeks ago. Mr. Lamme now proposes to enter into a detailed description of the system, which marks a new departure in electric railway work in America. It is also understood that Mr. C. F. Scott, who has recently returned from Europe, will make a presidential address.

International Mining Congress.

The International Mining Congress—hereafter to be known as the American Mining Congress—met at Butte, Mont, September 1-5, Mr. E. L. Shafner, of Cleveland, Ohio, presiding. The meeting was probably the largest and most important one ever held in the interest of mines and mining—at least in this country.

Strenuous efforts were made to assist the movement for a new governmental department of mines and mining, with a cabinet officer at its head. President Shafner urged it in his opening address, and addresses in favor of the project were made by several members. Resolutions were also adopted to the same effect. A bill, introduced in Congress last spring by Mr. Kearns, was discussed at length, nd almost unanimously condemned. It limits the location of claims to one for each individual; also forbids mining along a vein when the vein runs farther than the surface location of the claim.

The meeting next year is to be held at Deadwood, S. Dak., in September, but at a date to be more accurately fixed hereafter.

The exhibition of mineral products of Montana and other states under the direction of Mr. J. R. Wharton, manager of the Electric street railway service, of Butte, and also of the Columbia Gardens, was an important feature of the congress. Besides Montana, Idaho, Oregon, Wyoming, Colorado and Kansas, as well as other states, were represented. The exhibition is to be kept permanently at Butte, and will probably be shown at the St. Louis Exposition in 1904.

A full line of papers was read, of which the only one on an electrical subject was by Mr. E. D. Owen, on the location of minerals by electrical means. He said that by the apparatus of his invention, one electrode current entered the earth at one point and another at another point, thus establishing a ground circuit which would cause the path of least resistance, as in reaching the ledge it would have to metallic streak, by changing the location of the electrodes he could determine very nearly exactly the width of the vein. He could also determine how deep the surface of the ledge was. If a 100-foot wire was used, the current would probably not dip to the ledge to find the path of least resistance, as in reaching the ledge it would have to go through the ground 100 feet, the distance between the electrodes. If, however, the rods were 300 feet apart, the current would go to the depth of 50 feet. After locating the ledge and figuring the relative resistance of the ground and the ledge, the depth could be accurately determined by calculation and by setting the rods at varying distances.

It had been suggested that water offering little resistance would interfere with the work, but experiments along this line had shown that such was not the case, as the conductivity of water does not compare with the conductivity of a metal streak. In the Calumet and Hecla, the vein was known to run under a horseshoe strip of water. The electrodes had been set up on the edges of the water, and the resistance had been found to be 1,100 ohms. They had been swung a distance to the side, and the resistance was 550. When moved directly over the ledge, the resistance was 125.

Mr. Owens stated that the normal resistance of the earth was between 16,000 and 20,000 ohms. In the State of Montana he had found it as high as 56,000. In Idaho it was between 7,000 and 9,000, and it declined only 60 ohms over the vein. One peculiar fact was that the lowest readings were nearly always over the foot walls. He told an experience he had in Mexico. Some of the gentlemen who had seen the working of the apparatus said that it would work over large or rich ledges, but they doubted if it would work over ledges that only carried a small quantity of metal. To test the apparatus, it was taken to a known ledge whose values consisted of one-half ounce of gold and one-half ounce of silver and no other metals. The ledge had been located as easily as any others.

Upon the conclusion of the paper, a resolution was passed, accepting an offer to submit the system to a practical test, to be made free of all expense to the congress, in the presence and under the direction of a committee of experts to be appointed by the congress, and the executive committee was directed to appoint a committee of five electrical and mining experts, who shall act for the congress in making these tests, and report the result to the chairman of the executive committee for publication at the next session of the American Mining Congress.

A Discussion of Municipal Ownership.

At the Belfast meeting, last week, of the British Association for the Advancement of Science, Robert P. Porter, director of the Eleventh United States Census, read a paper in the Economic Section, on "Municipal Trading." In the course of his address, Mr. Porter said that the broadest objections to municipal ownership or trading appeared to be six in number—the injurious effect upon the work strictly within the municipal sphere of operation; the fact that in giving attention to trading operations the "unproductive" work was almost certain to be neglected; the tendency to discourage improvement or development; the engendering of ill feeling when the taxpayer found himself obliged to defray the cost of competing with himself; the difficulty of putting the burden of a trading undertaking on the right shoulders, and the impossibility of drawing a line as to which industries should be taken up by municipalities and which should be left to individual enterprises.

Mr. Porter called attention to the fact that in the early part of the last century the various State Governments of the United States entered into financial partnership with the promoters of canals, and later, when steam railways were introduced, States, cities and counties were alike appealed to for assistance in building railways. Mr. Porter said that there had been an epidemic in the forties and fifties, similar to the present fever in England, which swept over the country and ended in bankruptcy and ruin not only of cities and towns, but of important States. Bonds issued by the State and local authorities for the promotion of railways went in default.

These kindred experiences, Mr. Porter explained, taught Americans the useful lesson that there was a limit to State and municipal credit. The taxpayers of those times, who saw their property practically confiscated to pay for enterprises which should have been left to individual endeavor or private speculators, invented a device known as "the debt limit clause," and this clause, in some form or other, was inserted in nearly every State constitution drawn and adopted since those days of financial disaster and destruction of State and local credit.

Partially because of the debt limitation and partially because private enterprise had been allowed a freer headway in such undertakings as the supply of gas, electric lighting, tramways, and telephones, Mr. Porter pointed out that in the United States no city owned and operated its own tramways and street railways, probably less than half a dozen manufactured gas, a very few engaged in supplying electric light, and not one was in the telephone business.

Mr. Porter said that municipal trading was rapidly increasing municipal debt in England, and that serious complaints were heard on all sides in consequence of the increase of local taxation. In regard to the answer that the debt is "productive," and that the profits of these industrial undertakings will be used to reduce the taxes, Mr. Porter called attention to Sir Henry Fowler's statistical classication of indebtedness showing that the so-called "productive" debt is only about half of 1 per cent. beyond the danger line; that is, the dividend or profit from this debit averages half of 1 per cent.

If, in consequence of the anxiety in financial circles at the steady increase of local debt, the rate of interest should rise a half per cent on all local securities, what would become of the "productive" debt? Mr. Porter asked. Then he stated that, assuming that the trading debt represented one-third of the total local debt, a rise of a quarter per cent. would extinguish the "productive" properties of these loans, and, in a sense, throw them on the rates.

Without suggesting any remedy for municipal trading, the speaker said, an alternative plan would be the leasing system, which, when the contracts were wisely drawn, secured the revenue for the city treasury, and good, cheap service for the public. On the other hand, this would shift the financial risk from the ratepayers' shoulders. This, with some form of debt limitation, would gradually modify existing conditions, especially if backed by a strong public opinion in opposition to further use of public funds in this manner. It was a case for gradual readjustment, not violent change. With the facts fully understood, the people would by degrees curtail these unwise and dangerous economic experiments, and bring cities back to a sphere of work strictly their own.

The Largest Electric Water Power Station in New England.

Lewiston and Auburn, Maine, occupy opposite banks of Androscoggin River at a point where its fall of fifty feet develops a great water power. Large industries have been built up by the use of this power, the most important of which, the manufacture of cotton cloth, has made the cities famous. Notwithstanding the 18,000-hp which these falls are said to develop at times of only moderate flow, it has been found necessary to resort to steam in some of the mills, as the demand for water power exceeds the supply. This situation is shortly to be relieved by means of electrical transmission.

Just below the falls of the main river and within the city limits of Auburn, the Little Androscoggin, a tributary stream, passes over three falls of several hundred horse power each. At two points on the larger and two on the smaller river, all four within the limits of the cities, the Lewiston and Auburn Electric Light Company operate stations by water power. These four plants have come down from the days of independent, competing companies, and present the usual variety of generating equipment and systems of distribution common to old stations.

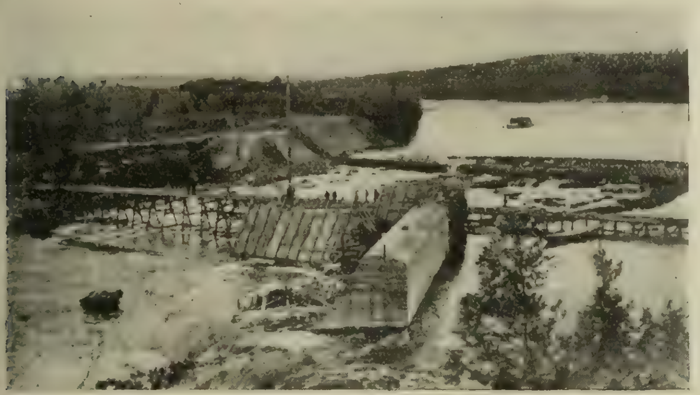


FIG. 1.—PART OF DAM AND CRIB.

By improvements now under way these generating plants will be displaced. At present the two-wire, direct current system at 110 volts, the three-wire at 220 volts, constant current open arcs, 500-volt distribution for direct current motors, and two-phase circuits at 2,200 volts are all represented. Among the equipment is one of the original bi-polar, Edison dynamos with three magnet cores per pole, which carries its daily load of about 250 amperes in a satisfactory way. The generating equipment at these four stations includes five 2,500-volt, 10-ampere arc dynamos, 125-volt dynamos of 90-kw total capacity, 500-volt generators of 350-kw, and two-phase alternators of 690-kw, a total of 1255-kw capacity. All the alternators operate at 60 cycles per second.

The connected load of these four stations is as follows. Open arcs of nominal 2,000-cp each, to the number of 110, are operated on city streets. Commercial arcs number 180, of which 30 are open and 150 enclosed. The enclosed arcs include 65 of the direct and 85 of the alternating type. Twenty-two Nernst lamps of the 1, 2 and 3 glower types are in use for interior lighting. Approximately 15,000 incandescent lamps are connected to the system. Motors make up an important part of the load with a total rated capacity of 484 hp. Nine of these motors, including one of 75-hp, are the two-phase induction type with a total rating of 300 hp. The remaining 184 hp is made up of 37 direct current motors. At present the lines of this system are confined to the two cities, because even there the available loads are greater than they can operate.

The management of the Lewiston and Auburn Company has planned and begun to execute extensions that will carry it far beyond its present moderate loads and limited service area. For some time the company has been unable to operate motor loads that could readily be secured in connection with the manufacturing industries. Within a radius of twenty miles from the cities on the Androscoggin are dozens of towns and villages that would welcome a supply of electric light and power. Within the next few months the Lewiston system will be in a position to supply thousands of horse power to manufacturers and a much wider service area.

Three miles up stream from the great falls of the Androscoggin at Lewiston are Deep Rips, where thousands of horse power, developed by the river at an abrupt descent in its rocky bed, have gone to waste as useless heat for centuries. The management of the Lewiston company have secured this water privilege and are now developing a power to drive an electric station that will have a capacity greater than any of its kind in New England. At this point the bed and sides of the river are solid rock, covered at intervals with a little earth. By a system of crib work successive portions of the river bed are shut off from the water, cleaned of earth and bowlders and sections of the dam built thereon.

This dam is located just above the natural waterfall, so that the head of water obtained will be greater by some feet than the height of the dam. From shore to shore of the river, a distance of 800 feet, this dam will form, when completed, a continuous mass of concrete. A great timber form or bin is built for each section of the dam, and into this bin is dumped the soft concrete as fast as it can be brought to the desired point over a tramway that extends entirely across the river just above the line of the dam.

After one section of the dam has been completed the timbering about it is removed and a new section next to it is started. In this way about 300 cubic yards of dam are being built each 24 hours, as the work goes on day and night. Rock for the concrete is blasted from the site of the canal on one bank of the river as fast as wanted, and is there reduced in a crusher so that the largest pieces pass through a two-inch ring. Concrete for the dam is composed of one part high grade cement, two parts coarse, sharp sand and three parts of the crushed rock. All work on the dam is being done by the day, the owners furnishing the materials.

At its top the dam has a uniform width of six feet, but it varies in height owing to the uneven bed of the river, being 26 feet where this bed is the lowest. Water behind the dam will be raised about twenty feet above its old level and a road along one bank is to be moved to higher ground in consequence.

A pond about three miles long will be formed by the water behind the dam and a valuable storage capacity thus secured. From one end of the dam to a point 600 feet down stream a canal is being blasted out of the solid rock. This canal is twenty feet wide and will be faced with stone. In order to furnish power for the stone crusher, light for night work, and to pump water from that portion of the river bed where work is going on, energy at 2200 volts is transmitted from the old water power plants to the site of the new dam over the line that will eventually serve for transmission in the opposite direction. This energy is reduced by transformers to 440 volts at the dam, and there operates a 50-hp motor for the rock crusher and a 5 and 20-hp motor for pumping, besides a number of enclosed arc lamps. Blasting is also carried on with the 440-volt current, 56 holes containing 300 pounds of 75 per cent. dynamite having

FIG. 2.—A SOLID FOUNDATION.

recently been fired at once, a result not possible with the equipment previously used.

At the lower end of the canal comes the power house, a brick building, 40 by 300 feet [illegible] and finished at one story with a steel truss roof. Along one long side of this building will be chambers for ten pairs of horizontal turbine wheels, which are to operate under a head of 32 feet. Each pair of these wheels is rated at 1200 horse power and 180 r. p. m., giving a total of 12,000-hp capacity. An alternator of 750-kw will be direct connected to each pair of turbines, giving a generator capacity of 7500-kw or 10,000 electrical hp.

All of these alternators are of the revolving magnet type and will operate at 10,000 volts, 60 cycles per second, three-phase. A contract for two of these 750-kw. generators has already been made with the General Electric Company. For each alternator the switchboard, located in a gallery above the wheel chambers, will contain one generator and one feeder panel. The output of all the generators will be recorded by wattmeters. Energy passes directly from the alternators and switchboard to the line at 10,000 volts, no raising transformers being used. From the water power plant to the sub-station in Lewiston, a distance of 3.5 miles, the transmission line has been erected on 40 and 45-foot chestnut poles. These poles are set six feet in the ground and 125 feet apart. For the greater part of its length the line follows the public highway, but the portion nearest the sub-station is over a private right of way which makes it possible to use overhead circuits exclusively.

The transmission line consists of two independent circuits of three conductors each, so arranged that the conductors of each circuit are eighteen inches apart. This arrangement is obtained by means of a four-pin cross arm near the top of each pole and

FIG. 3.—MAKING CONCRETE.

a shorter two-pin cross arm just under it. Two conductors of a circuit are mounted at one end of the top cross arm, and the third conductor beneath these two and on the lower cross arm. The other circuit is arranged in a similar manner on the opposite end of the cross arms. All six of these conductors are bare aluminum and each is made up of seven strands, each strand being number 8 B. & S. gauge. These conductors are erected in mile lengths and joints are made by twisting the conductors after each is passed through a McIntire aluminum sleeve ten inches long. No solder is used at the joints. Most important among the considerations that influenced the erection of two instead of a single circuit was the desire to avoid the effect of large and fluctuating motor loads on circuits that supply the lighting service. One circuit will therefore be used exclusively for power and the other for lamps. Wooden pins treated with parafine are employed for the entire line, and the conductors are mounted on Knowles H. G. glass insulators, each 6¼ inches in diameter at the largest point.

At the sub-station, an existing brick building in Lewiston, transformers of 500-kw each to the number of fifteen are to change the 10,000-volt, three-phase energy to 2200-volt, two-phase for general distribution. The present constant current arc dynamos will eventually be replaced by constant current transformers located at the sub-station, and feeding enclosed arc lamps. No rotary converters are to be installed, but it is the purpose to continue the operation of a 500-volt generator at one of the water powers in Lewiston indefinitely in order to carry the existing load of direct-current motors. Future contracts for power, however, are to be based on the use of induction motors.

When its great water power station is in operation the Lewiston Company will make attractive rates to large users of electric power, and it is believed that this policy will materially increase the importance of the two cities as centers of manufacturing industry. Thanks are due to Mr. H. S. Sands, superintendent of the Lewiston and Auburn Company for the facts here presented concerning this notable water power system.

All of the work on the dam is being done by the day under the personal supervision of Mr. W. S. Libbey, treasurer of the company.

Scientific Industry in England.

An important report has just been issued respecting the recent inquiry of a special sub-committee of the Technical Education Board of the London County Council, on "The Application of Science to Industry." The committee has arrived at the conclusion that "various branches of industry have during the past 20 or 30 years been lost to this country, owing to the competition of foreign countries; that in many others our manufacturers have fallen seriously behind their foreign rivals; and that these losses are to be attributed in no small degree to the superior scientific education provided in foreign countries."

In this connection, reference is made to the transfer from England to Germany of numerous departments of manufacturing chemistry, the best-known instance of loss being the manufacture of aniline dyes and many other valuable products from coal tar. Whereas the original investigations and discoveries on which this industry is based were made almost entirely in England, there are not now a thousand work-people employed in the industry in the Kingdom. On the other hand, it is a most lucrative and flourishing business in Germany. Then the manufacture of high-class lenses for photographic cameras, microscopes, telescopes and field-glasses, as well as of thermometer-glass tube for making thermometers for accurate physical measurements, has practically been lost to the country. Thirdly, the committee points to the rapid development in the United States, Germany and Switzerland of the various branches of the manufacture of electrical machinery, as compared with the relatively slow progress made in the United Kingdom. In 1890 the imports of electrical appliances and scientific apparatus were too insignificant to be separately scheduled. In 1900 they amounted to £1,174,000 and £522,000, respectively.

While some of the witnesses examined attributed the relative backwardness of England in scientific industries partly to other causes, they were practically all agreed in considering it due, in the main, to the deficiencies of the British educational system. It did not appear that the training of the workmen was at fault. It is believed that the opportunities now open to the London workman for obtaining technical education in his trade are actually superior to those enjoyed by the German or American workman. Summing up all the evidence, the committee is convinced that the main causes of British failure in the chemical, optical and electrical industries are the following: (a) The lack of scientific training of the manufacturers themselves, and their consequent inability to recognize the importance of scientific assistance; (b) the defective condition of secondary education, and the consequent lack of sufficiently prepared recruits for advanced technological training; (c) the lack of a sufficient supply of young men who have been trained, not only in scientific principles and method, but also in the application of science to particular industrial processes; (d) the lack of any institution providing advanced technological training which is sufficiently equipped and endowed to enable it to give adequate attention to post-graduate or advance work. There is a concensus of opinion that the highest grade of technical education must be carried on in an institution of university rank during the day. The few hours which can be given in the evening by those who are engaged in business during the day are insufficient for training in research.

U. S. Census Report on Electrical Manufactures.

THE United States Census Office has just issued a report of 53 pages on the manufacture of electrical apparatus and supplies, compiled by Mr. T. C. Martin, as special expert agent, and based on the returns obtained by the Census Office enumerators in 1900, with a subsequent analysis of the figures in as full detail as could be obtained. It is the first separate report made at any census on the subject, and the work was, therefore, without precedent to guide it. While reference is naturally made to the industries of electric lighting, electric railways, telegraphy, telephony, etc., and statistics are given as to their development, the only figures tabulated in Bulletin No. 245, are those which relate specifically to electrical manufactures; while as regards the figures of power employed in all the manufacturing industries of the country, they are included in another elaborate and voluminous bulletin of which Mr. E. H. Sanborn and Mr. Martin are the joint authors. The whole of this interesting and difficult work has been done under the initiative and judicious guidance of Mr. S. N. D. North, the able Chief Statistician for Manufactures of the Twelfth Census, and the success of the entire compilation of manufacturing statistics, on a scale and with a completeness never before attained, is due to the executive energy of General Merriam, head of the Census Department. When it is stated that 512,721 manufacturing establishments of all kinds had to be dealt with, some dim idea of the work in manufactures alone, can be formed.

The total product in the "electrical industries," and the product under the various divisions will be found in the tables presented herewith, all of which, it will be borne in mind, are based upon the signed statements of the manufacturers themselves, and have therefore a weight and value that could not possibly attach to an estimate, however careful. Even thus many difficulties arose in consequence of the endeavor to prevent "duplication" of figures, but it is made clear that the electrical industry is to be credited with much more than is actually assigned to it.

TABLE I.—ELECTRICAL APPARATUS AND SUPPLIES: COMPARATIVE SUMMARY, 1880, 1890 AND 1900, WITH PER CENT. OF INCREASE FOR EACH DECADE.

	DATE OF CENSUS.			PER CENT OF INCREASE.	
	1900	1890	1880	1890 to 1900.	1880 to 1890.
Number of establishments	580	189	[1] 76	206.9	148.7
Capital	$83,130,943	$18,997,337	$1,509,758	337.6	1,158.3
Salaried officials, clerks, etc., number	4,987	[2] 683	(3)	630.2	....
Salaries	$4,563,112	[2] $849,138	(3)	437.4	....
Wage-earners, average number	40,890	8,802	1,270	364.6	592.5
Total wages	$20,190,344	$4,517,050	$683,164	347.0	561.2
Men, 16 years and over	34,150	7,289	1,132	368.5	543.9
Wages	$18,369,228	$4,082,847	(3)	349.9	....
Women, 16 years and over	6,158	1,469	72	319.2	1,940.3
Wages	$1,701,110	$426,660	(3)	298.7	....
Children, under 16 years	582	44	67	1,222.7	[4] 34.3
Wages	$120,006	$7,543	(3)	1,491.0	....
Miscellaneous expenses	$6,788,314	$1,154,462	(5)	488.0	....
Cost of materials used	$48,916,440	$8,819,498	$1,116,470	454.6	689.9
Value of products, including custom work and repairing	$91,348,889	$19,114,714	$2,655,036	377.9	619.9

[1] Includes 36 establishments reported as "electrical apparatus and supplies," and 40 reported as "telegraph and telephone apparatus."

[2] Includes proprietors and firm members, with their salaries; number only reported in 1900, but not included in this table. (See Table 26.)

[3] Not reported separately.

[4] Decrease.

[5] Not reported.

For instance, it is pointed, there is probably no more conspicuous object in the average American landscape than the ubiquitous pole employed for the telegraph and telephone line, for the arc-light circuit, or for the trolley car. No poles, whether of wood, iron, or steel, are included in the statistics, it being considered that even if specifically made for such work, they are already embraced in the totals of the lumber and metal industries. There are some concerns, however, that make a feature of wooden cross-arms for poles, and insulator pins, and these, when reporting such product separately, have been included as being legitimately and undeniably electrical. In the same manner a large amount of glass and porcelain is used for electrical purposes—for battery jars, globes, tubes, knobs, insulators, etc., but only those products have been recognized that were reported by concerns with whom this is a distinct branch of business.

TABLE 2.—DYNAMOS: NUMBER, HORSEPOWER, AND VALUE BY STATES, 1900.

STATES.	Number.	Horse-power.	Value.
United States	10,527	770,832	$10,472,576
California	57	1,925	33,297
Colorado	40	875	18,000
Connecticut	408	13,182	263,590
Georgia	23	155	5,210
Illinois	1,102	59,696	868,640
Indiana	521	22,827	355,759
Kentucky	38	566	8,901
Maine	81	925	16,516
Massachusetts	711	53,930	757,486
Michigan	20	772	13,030
Minnesota	135	1,950	30,500
Missouri	25	2,500	35,000
New Hampshire	13	400	5,700
New Jersey	1,147	37,090	612,459
New York	1,220	269,708	8,280,871
Ohio	3,292	38,096	771,164
Pennsylvania	1,236	255,285	8,126,453
Rhode Island	10	400	8,000
Texas	15	600	15,000
Wisconsin	433	9,950	247,000
Direct current	9,182	428,601	6,297,925
Alternating current	1,345	342,231	4,174,651

Under the same generic rule the statistics include neither steel rails employed only for the construction of trolley systems nor bare iron and copper wire of any kind or size. It is a notorious fact that the annual consumption of bare iron and copper wire in the electrical arts runs into millions of pounds, most of it being of such diameters that outside of electrical applications it has no use whatever. Equally true is it that in electric railway work heavy steel rail is often used unknown to steam railway work, associated with special frogs and switches built for each case. But so far as can be determined none of this material has now been brought to account, and the only bare copper wire of which the value is given is that worked up into the form of "rail bonds" manufactured and used solely with the object of increasing at rail joints the conductivity of trolley tracks when serving as part of the return circuit.

It is true, of course, that some part of the total value shown is counted twice, but that is unavoidable. The duplication would appear to occur chiefly in regard to insulated wire. The item is set apart by itself, but owing to the enormous range of size of wire covered, as well as the fact that much of it is also laid up in cables, the value is not accompanied by any length in feet or weight in pounds. It would have been very interesting to know the actual consumption of copper by the electrical industries, but there are no data available as to the wire drawn for that purpose, and if there were, the figures would still be very incomplete, owing to the large electrical use of copper rods, bars, drop forgings, commutator segments, strips, leaf, etc. On the other hand, anticipating another part of this report, it is noted that virtually the whole American industry of copper refining is a branch of electrical manufacture. The production of copper in the United States is placed at 275,000 metric tons in 1900. According to the best authorities, in 1899 no less than 198,600 short tons was produced electrolytically. Mr. Charles Kirchhoff, expert special agent of the Census for copper refining and smelting, states that so far as the employment of the electrolytic refining process is concerned it is now applied practically to all copper produced in the United States outside of that

[illegible] from Lake Superior [illegible] a part of this is also electrolytically treated at the Buffalo works of the Calumet & Hecla Company.

Offsetting and far outweighing any possible reduction of the total here given for American electrical manufactures, on the score of duplication, is the vast and incalculable amount of work done by many large industrial concerns for themselves. To what an extent this may be carried is evidenced by the figures of the Union Iron Works, of San Francisco, Calif., builders of the battleship "Oregon" and other men-of-war. In 1896 this works began the manufacture of electrical apparatus required in every line of its work with the result that at times no fewer than 300 hands have been employed in its electrical department, and that at the present time all that is required in the line of generators, motors, switchboards, steering gear, ammunition hoists, turret turning, ventilating apparatus, bells, annunciators, signals, telltales, etc., is designed and built in the yards. Nor is this all, for the supersession of steam in the operations of shipbuilding has been attended by the introduction of electric cranes, etc., all of which also have been designed and built on the spot. An establishment of this kind is quite outside the electrical field in public estimation, but it is obvious that if it were not thus self-centred a corresponding product from regular electrical manufacturing concerns would have been demanded and would, to that extent, have swollen the figures for California and other States. Within the electrical field the public-service companies are numerous that do their own "custom and repair work," and from the Western Union Telegraph Company, the New York Edison Company, the Boston Elevated Railroad Company, the Pacific States Telephone Company, down through thousands of local lighting, trolley, telephone, and power companies, it would be difficult to find one of any magnitude that does not maintain its own shop, with an invisible line of demarcation between new custom work and repairs.

TABLE 3.—DYNAMOTORS, MOTOR GENERATORS, AND BOOSTERS: NUMBER, HORSE-POWER, AND VALUE BY STATES, 1900.

STATES.	Total value.	Establishments reporting quantities and values.			Establishments reporting values only.
		Number.	Horse-power.	Value.	
United States	$379,747	649	14,397½	$354,747	$25,000
Connecticut	50	1	½	50	....
Illinois	18,037	194	325	18,037	....
Indiana	1,287	7	43	1,287	....
Massachusetts	2,112	36	50	2,112	....
Missouri	2,000	20	100	2,000	....
New Jersey	82,091	245	3,450	82,091	....
New York	201,665	39	8,584	201,665	....
Ohio	20,850	11	1,054	20,850	....
Pennsylvania	51,655	96	791	26,655	25,000

TABLE 4.—TRANSFORMERS: NUMBER, HORSE-POWER, AND VALUE, BY STATES, 1900.

STATES.	Total value.	Establishments reporting quantities and values.			Establishments reporting values only.
		Number.	Horse-power.	Value.	
United States	$2,962,871	36,513	407,451	$2,960,171	$2,700
Illinois	37,516	1,234	5,185	37,166	350
Indiana	94,730	2,400	12,250	94,730	....
Massachusetts	951,014	23,799	120,190	951,014	....
Missouri	270,600	3,775	37,600	270,600	....
New Hampshire	600	2	60	600	....
New York	723,908	436	103,366	723,908	....
Ohio	100,850	2,[illegible]	12,900	98,500	2,350
Pennsylvania	783,658	2,362	115,900	783,658	....

While certain leading lines of American manufacture are subject to limitations imposed by the demand for or competition of foreign goods, it cannot be said that the electrical industries are conscious of any check of this kind. On the contrary, there has grown up a steady export trade which would be very much larger, but for the fact that the American apparatus sent abroad having at once proved popular and attractive, the patent rights for its manufacture in Europe have been purchased or arrangements made for drawings and patterns. Hence, American electrical factories are now located all over Europe, under one name or another, in Paris, Berlin, Havre, London, Antwerp, and other cities, and their product embodies American ideas, or capital, or direction or labor, sometimes all four. These factories employ thousands of men, and it is only fair to point out that the increase in the export of American electrical manufactures would be enormous but for this natural and inevitable restriction. The export of electrical apparatus in the census year 1900, amounting to $5,000,000 might easily have been five times as much but for the facts just noted. On the other hand, the electrical importations have been checked by corresponding conditions in the United States, though in much lesser degree, and are confined to but one or two specialties.

TABLE 5.—SWITCHBOARDS FOR LIGHT AND POWER: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Switchboards.	
	Number.	Value.
United States	6,422	$1,846,624
California	20	10,000
Colorado	60	8,000
Connecticut	15	3,700
Delaware	1	1,500
Illinois	180	75,367
Indiana	30	14,944
Louisiana	2	50
Massachusetts	143	230,[illegible]
Michigan	3	580
Minnesota	10	500
Missouri	35	67,500
New Jersey	12	1,890
New York	2,506	1,055,288
Ohio	46	21,660
Pennsylvania	3,354	353,043
Rhode Island	1	200
Wisconsin	4	2,000

As to electrochemistry and electrometallurgy Mr. Martin notes a very large class of products which are essentially electrical manufacturing, but of which no figures at all are included. The reasons for their exclusion are generally of the same nature as those applying to the exclusion of electrolytically refined copper, which has been shown to mean most of the copper refined in the United States. But this branch of the electrical art can not be overlooked, and a few figures in regard to it have been collated during the course of the inquiry. Already at Niagara Falls alone about 35,000 hp is used electrically in some twenty different processes for reducing metals or chemicals; all of this work growing up in the period between the Eleventh and Twelfth censuses. Among these industries may be mentioned the production of aluminum, which, owing to its electrical manufacture, has become so cheapened that it competes with copper as a conductor, and has found its way into a great many arts. The production of aluminum by electricity in America in the census year 1899-1900 is placed at 6,500,000 pounds, valued at $2,112,500. Another article is calcium carbide, from which acetylene gas is obtained, and which was first made commercially about 1895, in the United States. The quantity of this manufactured in the census year at Niagara was, it is stated, at the rate of about 12,000 tons per annum. Another notable product is that known as carborundum, in which silicon and carbon are doubly united by the

TABLE 6.—SWITCHES: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Switches.	
	Number.	Value.
United States	1,723,387	$1,129,891
California	700	1,125
Colorado	42,000	[illegible]
Connecticut	1,415,000	382,810
Illinois	2,000	3,000
Massachusetts	20,000	237,762
Missouri	108	1,380
New Jersey	31,200	21,932
New York	7,435	191,027
Ohio	1,286	7,515
Pennsylvania	203,458	254,340
Rhode Island	200	500

TABLE 7.—MOTORS: NUMBER, HORSE-POWER, AND VALUE OF VARIOUS KINDS, BY STATES, 1900.

STATES.	Aggregate value.	DIRECT AND ALTERNATING CURRENT.			FOR RAILWAYS.			FOR AUTOMOBILES.		
		Number.	Horse-power.	Value.	Number.	Horse-power.	Value.	Number.	Horse-power.	Value.
United States	$19,505,504	35,604	515,705	$7,551,480	15,284	666,669	$7,568,841	3,017	8,220	$192,030
California	56,500	...	...	...	...	...	...	...	...	...
Colorado	12,000	...	...	...	...	...	...	...	...	...
Connecticut	97,597	455	4,328	86,560	...	...	...	290	638	11,037
Georgia	6,000	30	200	6,000	...	...	...	...	...	...
Illinois	970,701	1,688	7,780	167,638	...	...	...	1,440	2,870	156,823
Indiana	105,904	643	4,613	96,364	...	...	...	...	...	...
Iowa	750	6	50	750	...	...	...	...	...	...
Kentucky	18,060	98	655	15,620	...	...	...	...	...	...
Louisiana	60	...	...	...	...	...	...	...	...	...
Maine	40,174	121	2,200	35,910	...	...	...	3	15	375
Massachusetts	1,892,500	6,393	23,754	410,176	4,078	94,791	1,095,069	2	2	200
Michigan	318,304	114	584	9,796	...	...	...	...	...	...
Minnesota	13,500	64	700	13,500	...	...	...	...	...	...
Missouri	175,180	598	6,110	91,705	...	...	...	...	...	...
Nebraska	23,200	110	1,100	19,600	...	...	...	...	...	...
New Hampshire	13,149	...	...	...	...	...	...	...	...	...
New Jersey	2,073,555	9,268	86,873	1,501,755	...	...	...	...	...	...
New York	4,470,881	3,996	80,990	1,222,255	4,746	214,749	2,120,000	52	120	12,000
Ohio	1,370,412	1,414	21,279	366,766	1,100	35,629	432,051	1,230	4,575	11,595
Pennsylvania	7,503,791	9,067	263,202	3,204,058	5,360	321,500	3,921,721	...	...	...
Wisconsin	343,286	1,539	11,287	303,027	...	...	...	...	...	...
Direct current	...	29,615	378,329	5,786,052	...	...	...	...	...	...
Alternating current	...	5,989	137,376	1,765,428	...	...	...	...	...	...

TABLE 7.—MOTORS: NUMBER, HORSE-POWER, AND VALUE OF VARIOUS KINDS, BY STATES, 1900.—*Continued.*

STATES.	FOR FANS.			FOR ELECTRIC ELEVATORS.					MISCELLANEOUS.		
	Number.	Horse-power.	Value.	Total value.	Establishments reporting quantities and values.			Establishments reporting values only.	Number.	Horse-power.	Value.
					Number.	Horse-power.	Value.				
United States	97,577	12,766	$1,055,369	$2,523,901	385	6,730	$515,446	$2,008,455	7,913	11,392	$613,883
California	...	...	...	35,000	30	1,500	35,000	...	270	1,085	21,500
Colorado	150	2,005	2,000	...	...	...	...	...	100	570	10,000
Illinois	15,046	755	130,281	506,359	153	1,500	40,000	466,359	480	450	9,600
Indiana	15	65	1,300	...	...	...	...	...	206	103	8,240
Kentucky	90	100	900	...	...	...	...	...	20	16	1,540
Louisiana	3	(1)	60	...	...	...	...	...	...	...	...
Maine	...	...	...	3,889	7	115	3,889	...	...	...	...
Massachusetts	18,330	1,760	183,120	152,335	120	3,240	152,335	...	172	1,474	51,600
Michigan	131	178	12,508	296,000	...	...	...	296,000	...	...	...
Missouri	5,195	(1)	82,500	...	...	...	...	...	200	20	975
Nebraska	...	...	...	...	...	...	...	...	80	8	3,600
New Hampshire	1,200	100	10,449	...	...	...	...	...	45	36	2,700
New Jersey	22,857	2,525	251,208	300,592	...	...	...	300,592	2,000	100	20,000
New York	14,560	2,333	152,051	945,504	...	...	...	945,504	212	571	19,071
Ohio	13,200	1,595	153,000	...	...	...	...	...	2,960	6,050	407,000
Pennsylvania	6,800	1,350	75,992	261,722	60	(1)	261,722	...	697	884	40,298
Wisconsin	...	...	...	22,500	15	375	22,500	...	471	25	17,759

[1] Horsepower not reported.

TABLE 8.—BATTERIES, STORAGE AND PRIMARY: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Aggregate value.	STORAGE.				PRIMARY.							
		Total value.	Establishments reporting quantities and values.		Establishments reporting values only.	Total value.	Liquid.				Dry.		Value of parts.
			Number.	Value.			Total value.	Establishments reporting quantities and values.		Establishments reporting values only.	Number.	Value.	
								Number.	Value.				
United States	$3,679,045	$2,559,601	11,012,035	$2,482,228	$77,373	$1,119,444	$571,370	708,077	$569,870	$1,500	1,946,688	$316,013	$232,061
Connecticut	500	...	...	...	...	500	...	...	...	...	...	...	500
Illinois	425,479	97,538	200,400	21,000	76,538	327,941	247,588	214,135	247,588	...	41,500	7,875	72,478
Indiana	41,252	...	...	...	...	41,252	39,552	133,561	39,552	...	5,000	700	1,000
Iowa	12,000	...	...	...	...	12,000	12,000	15,000	12,000	...	...	...	...
Maryland	47,969	1,200	600	1,200	...	46,769	...	...	...	...	10,000	46,769	128,125
Massachusetts	134,461	835	...	...	835	133,626	5,501	2,887	4,001	1,500	...	...	...
Missouri	61,610	5,610	323	5,610	...	56,000	56,000	40,000	56,000	...	...	...	...
New Jersey	116,524	...	...	...	...	116,524	5,000	50,000	5,000	...	1,100,000	100,000	11,524
New York	432,692	104,848	6,619	104,848	...	327,844	195,010	241,700	195,010	...	451,000	116,000	16,834
Ohio	280,330	225,311	7,563	225,311	...	55,019	10,350	[1]10,200	[1]10,350	...	339,188	44,669	...
Pennsylvania	2,126,228	2,124,259	10,796,530	2,124,259	...	1,969	369	594	369	...	...	...	1,600

electric current, an artificial abrasive resulting that vies with the diamond in cutting power. Carborundum is now being sold in all the civilized countries of the world, and in 1900-1901 the American production was not less than 3,800,000 pounds, at 10 cents per pound. Incidental to this process has been that of producing graphite electrically, and one plant at Niagara, in 1900-1901, turned out over 1,400,000 pounds.

In the report of the chemical industry, by Professor Munroe, cited by Mr. Martin, it is stated that by means of electricity, sodium and other metals, caustic soda, bleaching powder and other bleaching agents, bromine and potassium bromide, potassium chlorate, litharge, graphite, calcium carbide, carborundum, carbon disulphide, and phosphorus were being produced in the census year to a value of $2,045,535 at 14 establishments with a capital of $9,173,000 and employing 739 wage earners. These figures are exclusive of those relating to aluminum.

The amount of money spent each year by each member of the community for the necessities of life and its luxuries affords a measure of the extent to which the various arts and industries rank in importance in promoting the comfort and welfare of the public. It would seem, from the investigation that the average annual expenditure on electricity in the United States for every individual of a population not far from 75,000,000 was $7 per head. Of this amount about $1.25 per head would represent the demand for electric apparatus and supplies; the income of the electric traction companies would reach not less than $3 per head, while that from electric lighting would reach about $1.50. The returns available would also indicate that not less than 75 cents would represent the expenditure on telephone service, and 50 cents per head the outlay for telegraph, fire alarms, and kindred work. These values, which are conservatively put, are, however, rapidly increasing. At least one explanation of the rapid rise of the United States to its present position in international affairs and among the manufacturing nations may be found in this manifest willingness of its people to pay as much for electricity as for bread.

Up to the period of dynamo development and utilization, electrical manufacture depended for its resources of current upon primary batteries. With the perfection of the dynamo and its production as an ordinary piece of manufactured apparatus, great new arts at once sprang into being, the transition being so sharp and sensational that in the figures of the present report, covering $100,000,000 of apparatus, at least 75 per cent of the manufactured goods belong in classes that were unavailable to the public in the days of the primary battery, and would still be inaccessible if it were still the sole source of current supply.

In 1900, it appears, there were 580 establishments, with a capital invested of $83,130,943, and with a total output, including custom work and repairing, of $91,348,889. It has been pointed out by Mr. Martin how these gross figures are susceptible of enlargement for various reasons; and he states that in the course of the investigation the returns of 712 establishments were considered, all of which embraced some product of an electrical nature, bringing the value of such product up to an apparent total of $104,738,719. The supplementary concerns thus noted have not, however, been included, nor their output, as there would be serious difficulty in apportioning to electricity the part of capital, labor, charges, etc., that might be fairly due that item as compared with other items of output from the same factory. It is indeed essential to point out that of the material used in electrical manufacturing establishments, very little is purchased in "raw" or crude form. The returns show that materials valued at no less than $46,272,533 were purchased in partially manufactured form.

The 580 establishments report 384 proprietors and firm members, but do not give the number of stockholders. There were 516 officers of various corporations and 4,471 superintendents, managers, clerks, and salesmen. All these are salaried employees, as distinguished from wage-earners. In the latter category the greatest number employed at any one time during the census year was 50,389, and the least number 32,582. To avoid misconception it should be stated distinctly that these statistics do not include management or workers in the fields of telegraphy, electric railways, electric lighting, etc., in which the ap-

TABLE 9.—CARBONS: NUMBER, KIND AND VALUE, BY STATES, 1900.

STATES.	Aggregate value.	LIGHTING.				BATTERY.		BRUSHES.		FURNACE.		MISCELLANEOUS.			
		Total value.	Establishments reporting quantities and values. Number.	Establishments reporting quantities and values. Value.	Establishments reporting values only.	Number.	Value.	Number.	Value.	Number.	Value.	Total value.	Establishments reporting quantities and values. Number.	Establishments reporting quantities and values. Value.	Establishments reporting values only.
United States	$1,731,248	$1,263,732	172,955,922	$1,262,623	$1,109	355,583	$30,777	5,701,143	$136,679	41,749	$10,974	$289,086	12,176,522	$283,625	$5,461
Illinois	170	....	....	....	....	....	....	....	....	....	....	170	20,000	170	....
Indiana	182,000	182,000	28,000,000	182,000	....	....	....	....	....	....	....	....	....	....	....
New Jersey	43,067	....	....	....	....	319,583	27,864	373,294	9,742	....	....	5,461	....	....	5,461
New York	17,667	2,713	65,118	1,604	1,109	36,000	2,913	120,228	12,041	....	....	....	....	....	....
Ohio	1,311,560	970,202	132,414,866	970,202	....	....	....	3,959,285	90,129	36,749	8,974	242,255	12,000,000	242,255	....
Pennsylvania	176,784	108,817	12,475,938	108,817	....	....	....	1,248,326	24,767	5,000	2,000	41,200	156,522	41,200	....

TABLE 10.—ARC LAMPS, OPEN AND INCLOSED: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Total value.	OPEN. Number.	OPEN. Value.	INCLOSED. Number.	INCLOSED. Value.
United States	$1,827,771	[illegible]	$276,481	184,531	$1,551,290
Connecticut	18,093	1,391	18,093	....	....
Illinois	120,361	6,297	57,307	6,025	63,054
Indiana	91,980	2,193	30,696	5,322	61,284
Massachusetts	729,815	8,291	100,000	56,874	629,815
New Jersey	126,705	272	1,880	8,180	124,825
New York	231,367	2,612	39,605	18,655	191,762
Ohio	311,500	990	12,200	26,100	299,300
Pennsylvania	195,950	1,500	14,700	13,375	181,250
Rhode Island	2,000	200	2,000	....	....

TABLE 11.—SEARCHLIGHTS AND PROJECTORS: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Number.	Value.
United States	8,283	$225,635
Illinois	475	46,060
Louisiana	1	30
Michigan	4	400
New Jersey	30	6,500
New York	7,689	162,655
Ohio	80	8,000
Wisconsin	4	2,000

TABLE 12.—DECORATIVE MINIATURE LAMPS, X-RAY BULBS, VACUUM TUBES, ETC.: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Number.	Value.
United States	397,432	$72,935
California	4,825	2,800
Connecticut	10,450	3,800
Illinois	125	285
Maryland	200	50
Massachusetts	250	1,000
New Jersey	214,082	12,500
New York	150,000	46,000
Ohio	7,500	1,500
Rhode Island	10,000	5,000

TABLE 12.—INCANDESCENT LAMPS: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Aggregate value.	16 CANDLEPOWER. Number.	16 CANDLEPOWER. Value.	BELOW 16 CANDLEPOWER FOR LIGHTING SERVICE. Number.	BELOW 16 CANDLEPOWER FOR LIGHTING SERVICE. Value.	ABOVE 16 CANDLEPOWER. Number.	ABOVE 16 CANDLEPOWER. Value.	SOCKETS, BASES, ETC. Total value.	SOCKETS, BASES, ETC. Establishments reporting quantities and values. Number.	SOCKETS, BASES, ETC. Establishments reporting quantities and values. Value.	SOCKETS, BASES, ETC. Establishments reporting values only.
United States	$4,036,112	21,191,131	$2,910,023	2,906,817	$308,626	1,222,250	$223,534	$593,929	12,099,400	$468,279	$125,650
Colorado	32,000	196,200	29,500	6,750	1,000	4,050	1,500				
Connecticut	428,357	395,980	63,357					365,000	8,876,400	365,000	
Illinois	101,850	571,919	94,850	10,000	2,500	9,000	4,500				
Kentucky	20,400	120,000	20,400								
Massachusetts	663,278	8,269,615	491,415	2,000	200	90,000	61,663	110,000	15,000	10,000	100,000
Missouri	159,280	796,403	159,280								
New Jersey	1,130,803	8,019,787	813,067	2,176,951	200,510	872,420	91,576	25,650			25,650
New York	46,956	220,000	31,956			30,000	15,000				
Ohio	1,034,580	5,738,044	880,869	711,116	104,416	216,780	49,295				
Pennsylvania	325,329	1,863.183	325,329								
Rhode Island	93,279							93,279	3,208,000	93,279	

TABLE 14.—ELECTRIC LIGHT FIXTURES: VALUE, BY STATES, 1900.

STATES.	Value.	STATES.	Value.
United States	$2,665,124	Minnesota	$6,625
		Missouri	21,350
California	60,000	New Jersey	34,327
Connecticut	14,986	New York	1,551,051
Illinois	254,362	Ohio	193,795
Massachusetts	79,081	Pennsylvania	426,297
Michigan	9,500	Rhode Island	13,750

TABLE 16.—PHONOGRAPHS AND GRAPHOPHONES: SUMMARY FOR 1900.

	1900.
Number of establishments	11
Capital	$3,348,282
Salaried officials, clerks, etc., number	144
Salaries	$179,145
Wage-earners, average number	1,267
Total wages	$608,490
Men, 16 years and over	1,114
Wages	$565,076
Women, 16 years and over	146
Wages	$42,914
Children, under 16 years	7
Wages	$500
Miscellaneous expenses	$215,401
Cost of materials used	$827,529
Value of products, including custom work and repairing	$2,246,274

TABLE 15.—TELEPHONES: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Aggregate value.	RECEIVER AND TRANSMITTER SETS. Number.	RECEIVER AND TRANSMITTER SETS. Value.	INTERIOR SYSTEMS. Number.	INTERIOR SYSTEMS. Value.	CENTRAL SWITCHBOARDS. Total value.	CENTRAL SWITCHBOARDS. Establishments reporting quantities and values. Number.	CENTRAL SWITCHBOARDS. Establishments reporting quantities and values. Value.	CENTRAL SWITCHBOARDS. Establishments reporting values only.	SUPPLIES. Value.
United States	$10,512,412	797,246	$3,570,616	217,188	$1,837,266	$3,779,794	1,002	$2,650,396	$1,129,398	$1,324,736
California	296,016					150,301	5	150,301		145,715
Connecticut	105,161	5,000	40,800	8,406	57,161	7,200	5	7,200		
Delaware	3,000			200	2,000	1,000	1	1,000		
Illinois	5,418,528	142,202	1,142,504	203,610	1,687,212	2,282,645	534	2,282,645		306,167
Indiana	189,550	2,000	19,800			62,750	175	62,750		107,000
Iowa	375					375	5	375		
Maryland	120,567	11,000	108,487	400	10,080	2,000	5	2,000		
Massachusetts	503,734	77,511	157,780	554	5,288					340,666
Michigan	270,110	15,000	90,000			35,000	26	35,000		145,110
Minnesota	23,136	3,750	19,536			3,600	20	3,600		
Missouri	89,070	8,000	83,650			5,420	42	5,420		
New Jersey	21,700	21,000	21,700							
New York	2,765,994	460,500	1,523,246	575	52,000	1,159,898	26	30,500	1,129,398	30,850
North Carolina	82,403	5,714	55,000							27,403
Ohio	272,667	22,038	94,578	1,044	6,770	28,600	66	28,600		142,719
Pennsylvania	197,396	10,931	89,790	2,314	15,500	13,000	42	13,000		79,106
Wisconsin	153,005	12,600	123,745	85	1,255	28,005	50	28,005		

TABLE 17.—TELEGRAPH INSTRUMENTS: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Aggregate value.	INTELLIGENCE (KEY, SOUNDER, ETC.). Total value.	INTELLIGENCE. Establishments reporting quantities and values. Number.	INTELLIGENCE. Establishments reporting quantities and values. Value.	INTELLIGENCE. Establishments reporting values only.	POLICE, FIRE, DISTRICT, AND MISCELLANEOUS. Total value.	POLICE, FIRE, ETC. Establishments reporting quantities and values. Number.	POLICE, FIRE, ETC. Establishments reporting quantities and values. Value.	POLICE, FIRE, ETC. Establishments reporting values only.	SWITCHBOARDS. Total value.	SWITCHBOARDS. Establishments reporting quantities and values. Number.	SWITCHBOARDS. Establishments reporting quantities and values. Value.	SWITCHBOARDS. Establishments reporting values only.
United States	$1,642,266	$354,212	199,410	$348,912	$5,300	$1,231,167	40,264	$436,756	$794,411	$56,887	9,101	$53,517	$3,370
California	1,000					1,000			1,000				
Connecticut	61,048					61,048			61,048				
Illinois	52,958	5,320	20	20	5,300	41,268	10,000	30,000	11,268	6,370	1,000	3,000	3,370
Kentucky	62,204					62,204	1,200	62,204					
Maryland	85,000					85,000	6,000	85,000					
Massachusetts	215,004					214,904			214,904	100	1	100	
Missouri	14,400					14,400	1,000	14,400					
New Jersey	366,500	25,000	20,000	25,000		336,500			336,500	5,000	1,000	5,000	
New York	634,261	323,892	179,390	323,892		264,952	22,064	245,152	19,800	45,417	7,100	45,417	
Ohio	6,000					6,000			6,000				
Pennsylvania	143,891					143,891			143,891				

[illegible]. Of the factory wage-earners thus employed the largest number of men, 16 years and over, was 37,298; of women, 16 years and over, 6,975; and of children, under 16 years, 679. The last two months of the year appear to be the most active in the factories, although very steady work the year round is indicated, the growing variety of electrical apparatus tending to equalize the output throughout all seasons, although outdoor construction of lines and connections ceases in many States during the winter. While the demand for lighting may fall off in the summer months, that for fan motors comes in, for example, and while factories equipped with electrical power make a lesser use of current when the days are long, the trolley car has then its heaviest burden of excursion travel.

It is noted that 19 States are separately enumerated in the general returns, New York leading the list with 134 establishments,

TABLE 18.—INSULATED WIRE AND CABLE: VALUE, BY STATES, 1900.

STATES.	Value.	STATES.	Value.
United States	$21,292,001	New Hampshire	$96,793
California	65,905	New Jersey	4,701,574
Connecticut	938,075	New York	6,119,878
Illinois	722,069	Ohio	15,512
Indiana	330,000	Pennsylvania	2,696,155
Massachusetts	692,456	Rhode Island	3,912,584

Illinois coming second with 82, and Ohio and Pennsylvania closely contesting third place with 64 and 63, while Massachusetts has no fewer than 54. On the other hand, in gross value of output Pennsylvania heads the list with $20,967,587, as compared with $17,697,352 for New York, $11,641,177 for Illinois, and $8,259,612 for Massachusetts. New Jersey has also an excellent standing as a producer of electrical apparatus, with 35 establishments showing a value of $7,380,139, or more than Ohio, with $7,036,103. The preponderance of the Eastern States in the field of electrical manufacturing is shown by the fact that the six States—Pennsylvania, New York, New Jersey, Massachusetts, Rhode Island, and Connecticut—with 316 establishments, produced goods to the value of $59,470,637. The industry, however, is apparently not undergoing any process of consolidation so far as plants are concerned, for while control and management center chiefly in New York, Philadelphia, Boston and Chicago, there are only six establishments reported of over 1,000 hands, while 322 employ between 5 and 50, widely scattered all over the Union.

The general figures do not reveal any tendency to excessive capitalization, for the capital of $83,130,943 is actively employed in producing a yearly product greater than itself in the census period by $8,000,000. This may be explained in part by the fact that the largest producing company had reduced its capital by about one half not long prior to the census year, but has since restored to the present stockholders the amount thus mulcted, on account of the reparation of losses and the steady earning of a profitable income. It has been asserted in economic circles that

TABLE 19.—ELECTRICAL CONDUITS: NUMBER OF FEET AND VALUE, BY STATES, 1900.

STATES.	Total value.	Establishments reporting quantities and values.		Establishments reporting values only.
		Number of feet.	Value.	
United States	$1,066,163	14,875,386	$545,835	$520,328
California	14,160	200,000	14,160	....
District of Columbia	21,562	....	....	21,562
Massachusetts	353,424	9,936,378	353,424	....
New York	521,185	4,739,008	178,251	342,934
Ohio	42,381	....	....	42,381
Pennsylvania	113,451	....	....	113,451

electrical development has done its share in the creation of "securities" and "values" as a result of the combination and consolidation tendencies of the time, but the statistics of electrical manufacturing, Mr. Martin remarks, would appear to be quite clear from such criticism.

Each of the accompanying tables is accompanied by a brief review of development in the census decade. Some of the branches, such as electric lighting, telegraphy, electric railways, and telephony, have had historical consideration in a greater or less degree in the previous censuses; but in most cases, it is wholly new ground from the manufacturing standpoint; and Mr. Martin, with the aid of many of the makers, inventors and others, has tried to set forth briefly the industrial growth of the specific

TABLE 20.—RHEOSTATS AND RESISTANCES, ELECTRIC HEATING AND COOKING APPARATUS, WELDING, ETC.: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Total value.	Establishments reporting quantities and values.		Establishments reporting values only.
		Number.	Value.	
United States	$1,186,878	94,147	$1,011,997	$174,881
Illinois	29,342	1,410	16,356	12,986
Indiana	60,156	....	....	60,156
Louisiana	60	5	60	....
Maryland	13,200	1,050	13,200	....
Massachusetts	97,400	....	....	97,400
Michigan	32,269	6,200	32,269	....
Minnesota	4,000	320	4,000	....
New Jersey	147,349	5,758	147,349	....
New York	465,836	63,800	465,382	454
Ohio	163,849	1,050	163,849	....
Pennsylvania	55,210	12,204	51,325	3,885
Wisconsin	118,207	2,350	118,207	....

electrical arts—so briefly in fact as to show that a good deal of electrical history has still to be written.

With regard to electric motors, figures are quoted from the Sanborn-Martin power report as to their use in factories. It appears that of the total horse-power in manufacturing establishments was 11,300,081, only 311,016 horse-power owned, represented by 16,923 motors, and 183,682 horse-power rented was

TABLE 21.—ANNUNCIATORS, ETC.: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Total value.	Establishments reporting quantities and values.		Establishments reporting values only.
		Number.	Value.	
United States	$224,885	57,022	$199,565	$25,320
California	5,000	500	5,000	....
Illinois	30,233	750	4,913	25,320
Massachusetts	20,856	22,748	20,856	....
Michigan	2,426	4,044	2,426	....
New Jersey	20,000	10,000	20,000	....
New York	125,760	14,461	125,760	....
Pennsylvania	20,610	4,519	20,610	....

electrical. In other words, 4.4 per cent. of manufacturing power was electrical. It is, however, to be observed that the increase in electrical power plant owned, from 1890 to 1900, was not less than 1,897 per cent., the amount in the earlier year being only 15,569 horse-power. This is an enormous increase, but the regime of electric power in factories had barely begun before 1900;

TABLE 22.—ELECTRIC CLOCKS: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Total value.	Establishments reporting quantities and values.		Establishments reporting values only.
		Number.	Value.	
United States	$132,149	9,180	$132,039	$110
Illinois	10,000	4,200	10,000	....
Maine	800	75	800	....
Massachusetts	39,453	313	39,343	110
Michigan	2,750	1,000	2,750	....
Minnesota	600	50	600	....
New York	78,546	3,542	78,546	....

while every increase in the number and capacity of motors will be generally represented by a corresponding capacity in the steam or hydraulic generating plant, as the motor does not displace these, but is adopted as a better means of distributing their energy than long lines of shafting, belts, and pulleys. Moreover, there is an illimitable use of electric motors outside manufacturing plants, as, for instance, in operating the auxiliary appar-

atus of large steam plants, in mines, in waterworks, on docks, in warehouses, on steamships, in office buildings, etc. As to electric power transmission, this is also discussed at length in the power report referred to. An effect of the improvement in electrical manufacturing and a better grasp of its underlying principles is seen in the notable results as to the development

TABLE 23.—LIGHTNING ARRESTERS, FUSES, ETC.: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Total value.	ESTABLISHMENTS REPORTING QUANTITIES AND VALUES.		Establishments reporting values only.
		Number.	Value.	
United States	$595,497	11,264,570	$515,636	$79,861
Illinois	88,400	4,053,150	88,400	....
Indiana	60,157	....	....	60,157
Iowa	30,700	8,325	30,700	....
Massachusetts	19,704	....	....	19,704
New Hampshire	4,110	1,500	4,110	....
New York	314,763	6,015,945	314,763	....
Ohio	51,823	1,085,550	51,823	....
Pennsylvania	840	100	840	....
Rhode Island	25,000	100,000	25,000	....

of water power. Apparently, the use of water power for manufacturing purposes has decreased relatively in thirty years from nearly one-half of the motive power to less than one-sixth, but the figures of manufacturing industry do not do, and cannot be expected to do, justice to the growth of the utilization of water power as a means of obtaining electric current for light, heat, electrochemical processes, electrometallurgical work, etc. It is pointed out that there is no inclusion of the figures for electric

TABLE 24.—ELECTRICAL MEASURING INSTRUMENTS: NUMBER AND VALUE, BY STATES, 1900.

STATES.	Total value.	ESTABLISHMENTS REPORTING QUANTITIES AND VALUES.		Establishments reporting values only.
		Number.	Value.	
United States	$860,265	25,921	$584,033	$276,232
Connecticut	43,200	600	6,000	37,200
Illinois	94,538	8,104	78,538	16,000
Massachusetts	89,360	1,210	6,860	82,500
New Hampshire	57,000	....	....	57,000
New Jersey	482,635	15,607	482,635	....
New York	25,356	400	10,000	15,356
Pennsylvania	68,176	....	....	68,176

launches or electric carriages, one going under shipbuilding and the other under the carriage industry. The production of electric automobiles in the census year was 1,575 vehicles, of a value of $2,873,464, out of a total of 4,192, valued at $4,899,433, of all classes. The statistics given in Table 7 would include part of this electrical product, as the figures given of 3,017 motors for electric automobiles, of 8,220-hp, and valued at $192,030, are in general reported by concerns not in the carriage field. In other words, the motors are built by regular electrical manufacturers

TABLE 25.—ALL OTHER PRODUCTS: VALUE, BY STATES, 1900.

STATES.	Value.	STATES.	Value.
United States	$14,634,984	Massachusetts	$3,203,943
		Michigan	14,150
California	69,349	Minnesota	102,000
Colorado	5,000	Missouri	48,117
Connecticut	445,449	Nebraska	18,350
Delaware	5,202	New Jersey	1,159,979
Georgia	3,500	New York	1,915,108
Illinois	3,218,171	Ohio	1,285,431
Indiana	308,532	Pennsylvania	2,225,336
Iowa	39,882	Rhode Island	294,893
Kentucky	5,085	Tennessee	36,157
Louisiana	21,200	Texas	53,115
Maine	9,471	Wisconsin	146,064
Maryland	1,500		

to meet the necessities of carriage builders and miscellaneous automobile manufacturers. Some of the automobile concerns have built their own motors, but many, even of the largest, have bought from outside motor makers, or have had the motors constructed in separate electrical shops which they owned or controlled. The noninclusion of electrical automobiles, avoids any possible duplication, although it may err conservatively by not including motors built by those who are enumerated specifically in the carriage schedules.

In spite of the careful and somewhat minute division of the production of electrical apparatus into at least a score of different branches, there remains under the heading of "all other products," shown in Table 25, the large amount of $14,634,984. It is possible that some of this amount might have been separated and put under one of the categories dealt with above, but in each case reasons were considered which were deemed sufficient for non-inclusion. The public has probably very little idea of the vast range of the industry and its application, although in these modern times few efforts are spared to make it believe that electricity is a panacea for whatever ill or deficiency has not yet

TABLE 26.—AMOUNT RECEIVED FOR CUSTOM WORK AND REPAIRING: BY STATES, 1900.

STATES.	Value.	STATES.	Value.
United States	$2,063,736	Massachusetts	$108,936
		Michigan	83,216
California	97,633	Minnesota	29,060
Colorado	2,500	Missouri	15,365
Connecticut	4,075	Nebraska	7,000
Georgia	23,000	New Hampshire	8,663
Illinois	206,360	New Jersey	129,081
Indiana	86,504	New York	863,128
Iowa	7,490	Ohio	63,866
Kentucky	11,830	Pennsylvania	211,330
Louisiana	9,474	Rhode Island	20,340
Maine	12,269	Wisconsin	61,141
Maryland	1,475		

been cured or rectified in the advance of civilization. An idea of the miscellaneous character of the innumerable articles of an electrical nature now manufactured may be formed from the fact that a catalogue of a well-known supply house includes in its index over 2,000 separate articles, none of which belong in the category of large apparatus and all of which are embraced under the general head of "supplies." It is true that a great many of these articles would be included in the classes which have been discussed in this report, but there is a large residue, forming an extremely heterogeneous collection, best grouped as "all other products." As time advances, many of these crystallize into a new art, which, in turn, will demand treatment in later census work.

Old-Time Telegraphers in the West.

The twenty-second reunion of the Old-Time Telegraphers and Historical Association and the Society of the U. S. Military Telegraph Corps was held at the Kenyon Hotel, Salt Lake City, September 10, 11 and 12. About 200 members with their wives and daughters were in attendance, and enjoyed the sights in and around the city during their stay. Some of the Eastern delegates extended their trip and are making excursions to the far West and California.

At the business meeting, held at the Kenyon, Wednesday forenoon, President G. H. Corse was in the chair, and was decorated with a beautiful medallion, on which was carved the face of Prof. Morse, the father of telegraphy. An address of welcome was delivered by Rev. W. Simpkins, to which fitting response was made by Mr. Cochrane, of Milwaukee.

The report of Secretary-Treasurer John Brant showed a membership of over 1,000, with a large list of applicants for membership. The age limit for admission was raised to 25 years, with an additional five years of actual prior service. This action was deemed necessary in order to keep the membership down to reasonable limits. Many of the present "old-timers" are comparatively young men.

Milwaukee was selected as the next meeting place for the reunion in September, 1903. Thursday evening a banquet was given at the Kenyon, and delightful reminiscences, toasts and stories, witty and pathetic, of experiences dating back to the days of '49, kept the large assembly in good humor until another day had dawned.

The meeting of the U. S. Military Telegraph Corps consumed but a few minutes, as no business of importance was transacted. The visitors expressed their delight and satisfaction with the hospitality of the City of Zion, and departed highly pleased after having enjoyed a delightful season among the easy-going dwellers in the picturesque Mormon capital.

Convention of the Association of Edison Illuminating Companies.

The twenty-third convention of the Association of Edison Illuminating Companies was held last week at the Mount Washington, White Mountains, N. H. The proceedings began on Tuesday, Sept. 9, with an address by the president, Mr. Louis A. Ferguson, of Chicago. In the course of his remarks, Mr. Ferguson paid a deserved compliment to the work done by the various standing committees, particularly the lamp and meter committees, and also the storage battery committee, which was appointed last year for the first time. He advocated an extension of the work done by the appointment of additional standing committees to collect data and formulate opinions for the use of the members of the Association. Among these should be standing committees on other kinds of illumination which compete with electricity; on steam turbines; on rates; on relations with kindred societies and associations; and on theft of current. He spoke strongly on the importance of devoting more time than had hitherto been spent upon mechanical and theoretical problems which arose in connection with the problems of the electrical art. He also referred to the proposed action of the National Board of Fire Underwriters in reference to high potential currents, and urged upon the members the importance of giving their closest attention to the proposed changes in the rules of the National Board so that the electrical industry would not be prejudiced thereby.

In submitting the report of the committee on higher potential conductors, the chairman, Mr. J. W. Lieb, Jr., of New York, spoke of the proposed action of the National Board of Fire Underwriters in limiting the use of high potential conductors in the vicinity of buildings, and of the desire of the various representative electrical bodies to secure harmonious co-operation with the national board of fire underwriters without sacrificing the interests of the electrical industry. In conclusion Mr. Lieb proposed that the name of the committee should be changed to that of the committee on the National Code in order more clearly to define its functions.

The sessions of the convention were held each morning from 9:30 to 1:00, and each evening from 8:00 until 10:30. This allowed the whole of the afternoon for excursions and for golf playing. On Tuesday a large party of ladies and members drove to the base of Mount Washington. On Wednesday no formal program was set, but in the afternoon a large party walked to the Upper Falls of the Ammonoosuc and thence through the woods to the new road, returning to the Mount Washington. On Thursday two golf tournaments took place, one for the ladies, and one for the members. The ladies' tournament occupied the forenoon. Two trophies were presented as prizes by Mr. Louis A. Ferguson, the president of the Association. The first was a handsome pitcher of Bohemian glass with a beautiful design of deposited silver. The second prize was a flask of similar material. These prizes, which were awarded for the lowest net score, were won by Mrs. Walter C. Fish, of Lynn, and Mrs. Alexander Dow, of Detroit. The members' tournament took place the same afternoon, the prizes for which were presented by the Boston Edison Company, consisting of a handsome oxidized silver tankard and an oxidized silver pitcher. The first prize in this contest was won by Mr. L. K. Edgar, of Boston, and for the second prize Mr. H. W. Hillman and Mr. W. L. R. Emmet, both of Schenectady, were tied. In the evening there was a ping pong tournament, for which prizes were presented by Mrs. C. L. Edgar, of Boston. The winner of the first prize was Mrs. W. C. Fish, of Lynn, and of the second Miss Duclos, of Boston. The convention adjourned early in order to allow the members to join in an informal dance, which lasted until midnight. There was also a fine water polo tournament in the hotel swimming pool under the management of Mr. Walter H. Johnson, who also participated.

The General Electric Company acted as host on Friday, and invited the members of the Association, and those who accompanied them, to luncheon at the Summit House, Mt. Washington. About one hundred and thirty members and ladies accepted this invitation and were taken up on the Mt. Washington railway on specially reserved cars. After luncheon about fifty members of the party took the stage to Glen Station, while some thirty others walked across the mountains to the Crawford House, the remainder returning by train.

This ended the most largely attended convention which the Edison Association has ever held, and one of the most enjoyable not only in regard to the scenery and the perfection of the hotel accommodations, but also in regard to the fine weather which prevailed during the sessions of the convention.

Over 20 papers were read before the convention. Of those presented in printed form, we give abstracts of two elsewhere in the issue, namely, one by Dr. Clayton H. Sharp on checking electrical instruments, and another, by Mr. Geo. H. Lukes, on high-tension work in the Far West.

Mr. H. G. Stott read a paper, entitled "Steam-Pipe Covering and Its Relation to Station Economy," in which an account is given in detail of tests made by the Manhattan Railway Company on a number of kinds of steam-pipe covering. A paper, by Mr. W. S. Andrews, had for its subject, "Automatic Voltage Regulators," which were described under the heads of automatic regulators and feeder regulators. "Coal Deposits of the United States" was the title of a paper read by Mr. W. L. Abbott, which included maps of the various coal regions of the country and several charts, one of these latter giving a sectional view through the coal basins of Iowa, Illinois, Indiana, Ohio and Pennsylvania, and another, a section through an anthracite bed. A compilation of great interest was presented by Mr. F. W. Wells, giving the principal dimensions and data of the five great New York power stations, which were illustrated by sections and plans. "Curves Showing the Available Capacity of a Lead Accumulator" was the title of a paper by Mr. Ernest Lunn, in which instructions are given for the laying down of curves, by means of which it may be determined at short length how long a certain rate of discharge can be carried on a given battery. Abstracts of the above and some of the other papers read will be given in future issues.

LIST OF ATTENDANTS.

GENERAL ELECTRIC COMPANY.—C. A. Coffin, Elihu Thomson, W. S. Andrews, W. L. R. Emmet, C. B. Davis, F. P. Cox, C. T. Hughes, J. W. Howell, R. Fleming, E. H. Mullin, H. J. Buddy, J. R. Lovejoy, G. F. Morrison, F. W. Willcox, P. D. Wagoner, B. E. Sunny, A. L. Rohrer, W. C. Fish, E. E. Gilbert, C. D. Haskins, H. W. Hillman, F. M. Kimball.

NEW YORK EDISON COMPANY.—T. E. Murray, J. W. Lieb, Jr., A. Williams, P. Torchio, H. M. Edwards, A. H. Ackerman, T. W. Varley.

CHICAGO EDISON COMPANY.—S. Insull, L. A. Ferguson, W. M. Anthony, O. J. Bushnell, W. G. Carlton, J. F. Gilchrist, P. Junkersfeld, R. C. P. Holmes.

BROOKLYN EDISON COMPANY.—W. W. Freeman.

DETROIT EDISON COMPANY.—A. Dow, H. Post, G. W. Cato.

PHILADELPHIA EDISON COMPANY.—A. J. De Camp, W. H. Johnson, J. T. Maxwell, J. D. Israel, G. R. Green, W. C. L. Eglin.

BOSTON EDISON COMPANY.—C. L. Edgar, H. S. Kimball, A. S Knight, R. S Hale, G. Goettling, C. H. Parker, H. A. Wagner, L. L Elden.

COMMONWEALTH ELECTRIC COMPANY, Chicago.—L. Stieringer.

U. S. ELECTRIC LIGHT COMPANY, Washington.—G. H. Harries, L. E. Sinclair.

CLEVELAND ELECTRIC ILLUMINATING COMPANY, Cleveland.—M. E. Turner, R. Lindsay.

DES MOINES (IA.) EDISON COMPANY.—R. H. MacMullan.

ROCHESTER (N. Y.) GAS AND ELECTRIC COMPANY.—G. A. Redman.

ATLANTA (GA.) EDISON COMPANY.—J. G. Roseman.

EDISON COMPANY OF ERIE, PA.—T. G. O'Dea.

NEWPORT (R. I.) ILLUMINATING COMPANY.—G. P. Magner.

MANHATTAN RAILWAY CO., N. Y.—H. G. Stott, Cons. Engr. Buffalo General Electric Company.

NEW BEDFORD (MASS.) EDISON COMPANY.—G. R. Stetson, G. R. Price.

ALTOONA (PA.) EDISON COMPANY.—E. B. Greene.

COLUMBUS (O.) EDISON COMPANY.—A. W. Field.

WASHINGTON WATER POWER COMPANY, Spokane, Wash.—D. L. Huntington.

CHATTANOOGA (TENN.) LIGHT AND POWER COMPANY.—B. T. Burt.

TOLEDO (O.) RAILWAY AND LIGHT COMPANY.—E. J. Bechtel.

WILLIAMSPORT (PA.) EDISON COMPANY.—E. H. Davis.

INDIANAPOLIS (IND.) LIGHT AND POWER COMPANY.—C. C. Perry.

The following were also present: C. H. Sharp, Lamp Testing

Bureau, N. Y.; F. E. Barker, chairman Mass. Gas and Electric Light Company; T. C. Martin, editor Electrical World and Engineer; S. Douglas; T. E. Crossman, official stenographer; W. S. Barstow, consulting engineer; C. W. Rice, vice-president, and Mr. Beebe, chemist, Nernst Lamp Company; T. E. Hughes, Standard Underground Cable Company.

The following ladies were also present: Mrs. Thomas E. Murray, Mrs. John W. Howell, Mrs. Frank W. Lund, Mrs. C. A. Coffin, Miss Coffin, Miss Alice S. Coffin, Mrs. Samuel Insull, Miss Bird, Mrs. L. E. Sinclaire, Mrs. A. L. Rohrer, Mrs. J. T. Maxwell, Mrs. W. S. Andrews, Mrs. E. Marden, Mrs. E. B. Greene, Mrs. Charles T. Hughes, Mrs. H. W. Hillman, Mrs. Alex. Dow, Mrs. J. F. Gilchrist, Mrs. Hoyt Post, Mrs. C. B. Davis, Mrs. F. W. Wilcox, Mrs. R. Fleming, Mrs. C. R. Price ,Mrs. George R. Stetson, Mrs. H. C. Wirt, Mrs. L. L. Elden, Mrs. C. D. Haskins, Mrs. F. T. Cox, Mrs. T. E. Hughes, Mrs. C. C. Perry, Mrs. H. M. Edwards, Mrs. J. W. Lieb, Jr. Mrs. W. W. Freeman, Mrs. C. L. Edgar, Mrs. W. S. Barstow, Miss Duclos, Mrs. A. S. Knight, Miss Howell, Mrs. J. R. Lovejoy, Mrs. Fred. M. Kimball, Miss N. L. Kimball, Mrs. B. E. Sunny, Miss Sunny, Mrs. Louis A. Ferguson, Mrs. Philip Torchio, Miss Eglin, Mrs. A. J. De Camp, Miss De Camp, Mrs. W. H. Johnson, Miss Huntington, Mrs. E. H. Mullin.

Checking Electrical Instruments.*

By Dr. Clayton H. Sharp.

Undoubtedly the best arrangement for checking a voltmeter as well as for the accurate measurement of steady direct-current potentials in general, is the potentiometer, used with a standard cell. In central stations only a few voltages need be cared for, and a potentiometer suitable for reading only a few voltages can be made very simple in construction and in operation. Such a potentiometer may be used in connection with a voltmeter to keep all the pressure employed in the station checked up. The scale of the voltmeter should be calibrated once for all so that the variation of its correction at all required points is known, after which a determination of the absolute value of its correction at one or two points suffices to give its correction at all points.

A diagram of the circuits of a simple potentiometer intended to measure only one definite voltage is given in Fig. 1. The voltage to be measured is brought to the binding-posts, *A* and *B*, which are connected by coils of high resistance—100,000 ohms or higher. From a suitable point, *D*, of the coils a tap is brought out to the binding-posts D^1. *D* is so chosen that the resistance *AD* bears the same ratio to the resistance *AB*, as does the e. m. f. of the standard cell to the e. m. f. to be measured.

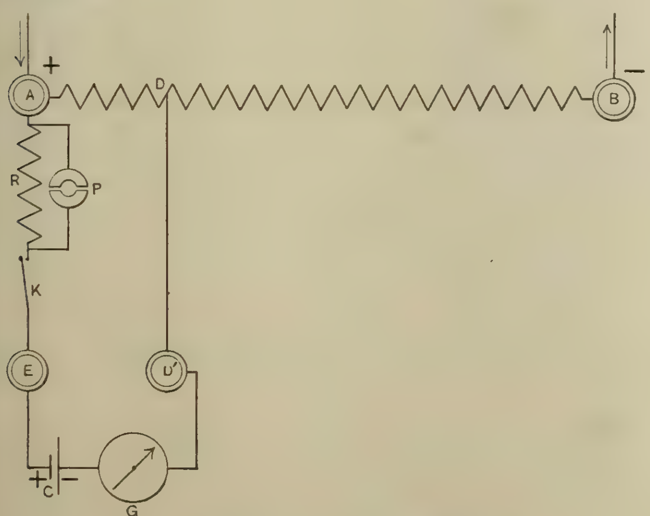


FIG. 1.—DIAGRAM OF SIMPLE POTENTIOMETER.

The standard cell, *C*, is connected to *A* through the binding-post, *E*, and the key *K*, and is connected to D^1 through the galvanometer, *G*, and the high resistance, *R*. The latter is intended for the protection of the cell against anything approaching a short-circuit, and may be itself short-circuited at *P* when the potentiometer has been nearly balanced. If *A* is connected to the positive side of the circuit, the positive terminal of *C* is connected to *E*, and *vice versa*.

If connections are made as described, when the proper e. m. f. is applied to *AB*, and the key *K* is depressed, the galvanometer shows no deflection. If on depressing the key a deflection is noted, the e. m. f. on *AB* must be adjusted until the deflection is reduced to zero. If a voltmeter is connected in multiple with *AB*, and a reading of it is taken at the time the above adjustment is secured, the value of its correction is obtained at once.

If it is desired to arrange the potentiometer to read more than one voltage, more taps similar to DD^1 are added. It is an advantageous arrangement to have the potentiometer read three or more voltages, which are multiples of each other, such as 58, 116 and 232. These voltages cover the principle ranges for incandescent lamps. Now, if two cells which agree with each other in the indication of any one voltage are connected in series on the 58-volt point, they should give the same indication as does one cell alone on the 118-volt point. Thus the accuracy of the potentiometer can be partially checked.

The Clark standard cell has a large temperature coefficient, the variation of its e. m. f. amounting to nearly 0.1 per cent. per degree centigrade. It is, consequently, necessary in using a potentiometer with this cell either to apply a correction to its indications corresponding to the temperature of the cell, as can readily be done from a table of corrections, or to construct the potentiometer so that these variations can be compensated for.

A diagram of a three-point potentiometer with compensation for temperature is shown in Fig. 2. Here a series of taps is brought out

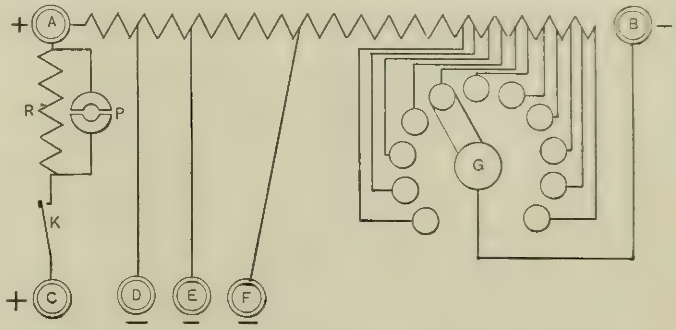


FIG. 2.—DIAGRAM OF THREE-POINT POTENTIOMETER.

from the resistance *AB* to contact studs over which a switch contact. *G*, sweeps. Each of the studs is marked with the temperature of the Clark cell to which it corresponds, hence in making measurements it is necessary only to set *G* on the proper stud to get results which need no correction for cell temperature.

This potentiometer may be further extended to make it a self-contained, portable instrument. To this end a pivoted galvanometer of the moving coil type, of high resistance and strongly damped, together with three portable standard cells, are inclosed in the same box with the resistance coils. When this is done, outside posts should be provided for connecting the cells either singly or in series, and for using. if desired, an outside cell and galvanometer.

A portable three-point potentiometer of this type has been in use by the Lamp Testing Bureau for some time, and has given very satisfactory results. The sensitiveness of the little galvanometer is such that voltages can be read to 0.1 per cent. It possesses among other merits that of great simplicity in construction and use, consequently it requires no especial skill to operate it. Any person who can read a voltmeter accurately, can be taught in a short time to use the potentiometer. The calibration of the voltmeter throughout its scale can, of course, be done only by using a regular potentiometer or its equivalent.

Dr. Sharp discussed the Clark and cadmium standard cells, and expressed the opinion that the latter is more convenient to use than the Clark cell.

To secure the utmost reliability in the indications of a standard cell, certain simple precautions need to be taken. The most important thing is to avoid drawing any appreciable current from it. A current passing causes polarization in the cell and diminishes its e. m. f. If, by accident, a cell has become polarized by being short-circuited, its usefulness is by no means at an end, since if it is properly constructed it will come back to its normal e. m. f. in the course of a few hours or days. The potentiometer method, being a zero method, makes no demands on the cell for current when once a balance has been secured. Until such a balance has been nearly secured, a high resistance should be included in the cell circuit.

For absolute certainty, it is advisable to have three or more cells,

* An abstract of a paper read at the Mt. Washington Convention of the Edison Illuminating Companies.

[illegible] are checked against each other. If those cells which are known to have been [illegible] and found at any time to be in substantial agreement, that is, if they do not differ from each other by more than a few ten-thousandths of a volt, it is almost certain that they are right. It is better to use only such cells as have been compared with standards of known accuracy. The e. m. f. of [illegible] may be relied upon as being within a few hundredths of [illegible] its nominal value. The adjustment of the resistance in the construction of the potentiometer can be carried out to a similar degree of accuracy, which becomes consequently the measure of the accuracy attainable with the potentiometer method.

The best way to measure current strength accurately is (if we leave the silver voltameter out of account) by finding the potential difference between the terminals of a conductor of known resistance, through which the current flows. Suitable conductors for this purpose are made of manganin, an alloy which has a very low temperature coefficient, of a resistance as low as one-ten-thousandth of an ohm, and calculated to carry as much as 2,000 amperes without undue heating. The measurement of the potential difference must be made with a complete potentiometer.

A modification of this method, which is very suitable for checking ammeters consists in the substitution for manganin low resistance standards, high resistance standards in the form of incandescent lamps. These lamps are standardized, not by determining their resistance, but by measuring very carefully their current consumption at a given voltage or series of voltages, using the standard resistance and potentiometer, or any other good method of current measurement. Good lamps should be selected for this purpose, and these should be carefully and cautiously seasoned to the point, that they can be relied upon to change only very slowly with age. To secure durability, the temperature at which they are operated should not be higher than that corresponding to four watts per candle, but it should not be so low that the resistance of the filament is appreciably influenced by changes in room temperature. They should be standardized for current consumption at a voltage which the station potentiometer indicates.

Lamps which are so prepared and which are never subjected to a voltage higher than that for which they are standardized, constitute very permanent and reliable standards of as high accuracy as may be desired. A series of such lamps may be selected which when operated in multiple in various combinations, will cover a wide range of current values with very small steps from one value to the next. The accompanying table gives a series of ampere lamps in the possession of Lamp Testing Bureau:

Series of Ampere Lamps.

Amperes at 116 Volts.	Amperes at 116 Volts.
0.0519	1.005
0.0515	[illegible]
[illegible]	[illegible]
[illegible]	2.070
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	
0.499	

It is quite probable that by sampling a larger variety of lamps, a nearer approach to the theoretical series could be obtained, but it is doubtful if any gain would result. A lamp with higher current consumption than 3.5 amperes would, however, be useful.

Alternating-current voltmeters can best be checked by comparing them with a standardized direct-current voltmeter through the medium of an inductionless transfer instrument. Probably the best transfer instrument is an electrostatic voltmeter, although a hot-wire voltmeter, the series resistance of which has been wound to avoid inductance and capacity, can be used with good results.

The hot-wire voltmeter is especially sensitive one, constructed by the Stanley Electric Manufacturing Company, one-tenth of a volt being easily readable on its scale. This voltmeter is calibrated by bringing it in multiple with a Weston laboratory standard direct-current voltmeter, which has been checked by a three-point potentiometer. The pressure is adjusted to the point at which a check is desired, and the error of the hot-wire voltmeter is determined. The alternating-current pressure is at once thrown on to the hot-wire instrument and the check is obtained. For greater security the direct-current readings may be remade after the alternating-current measurements.

With seady pressures, both alternating current and direct current, quite a close check can be obtained in this way. On account of its high sensitiveness, the range of this instrument is small, from 110 to 120 volts only. The resistance in series with the wire seems not to be entirely free from reactance, as the indications are from 0.05 to 0.1 volt lower than the reactanceless electrostatic instrument gives.

The other transfer instrument referred to is a Kelvin multicellular electrostatic voltmeter of the vertical scale type, of 60 to 140 volt range, fitted specially with a mirror attached to the moving part so that delections can be read with the aid of a telescope and scale, or of a lamp and scale.

The torsion-head of the instrument is adjusted so that its indications come on the scale at the voltage to be measured, and deflections on direct current are obtained. The leads to the electrostatic instrument must be reversed in this test, and the mean of the direct and reversed deflections taken. This is on account of a small contact e. m. f. existing in the instrument itself.

The alternating-current pressure is then applied, and the deflection is again noted. To evaluate in volts the difference between the alternating-current and direct-current pressures, as measured in scale divisions, a near-by direct-current voltage is measured, and the number of scale divisions per volt is determined. The value of this quantity will vary somewhat with the angle of deflection, but in all cases it is sufficiently large. In the instrument referred to, a deflection of about 6 cm. per volt, at 116 volts, with the scale about one meter distant, is obtained. One-tenth of a volt corresponds then to six small scale divisions.

By adjusting the torsion-head of the instrument, it may be used for checking voltages in the 50-volt range, or in the 220-volt range. By using a volt-box multiplier, the range may be extended upward almost indefinitely. The sensitiveness of the instrument at a given angle of deflection is proportional to the voltage.

A check can easily be made in this way to 0.1 volt on steady pressures. With unsteady pressures a good comparison is much more difficult to obtain, since the Kelvin instrument is very sluggish in its movements, due to oil damping and to the very small moving force. For rough checks, such as alone are necessary when the pressure is unsteady, the telescope and scale may be dispensed with, and comparisons made by reading the pointer of the instrument directly. This type of transfer instrument has the very great advantage of being entirely free from reactance.

For the calibration of alternating-current ammeters not belonging to the types, such as the Kelvin balance, the Siemens electrodynamometer, hot-wire instruments, etc., which are themselves reliable direct-current—alternating-current transfer instruments, the series of ampere lamps used with an alternating-current voltmeter, calibrated at one point, as indicated above, serve admirably well. Practically all that has been said about these lamps in connection with direct-current work, applies equally well to them used on alternating-current.

Having voltmeters and ammeters calibrated by the methods indicated above, the calibration of direct-current wattmeters and of alternating-current wattmeters on power-factor unity, can be made from them. Incandescent lamps standardized for watts instead of for amperes, are useful in wattmeter calibration, rendering the use of a calibrated ammeter unnecessary. A set of lamps can serve both as ampere standards and as watt standards.

American Electrochemical Society.

At a meeting of the Board of Directors of the American Electrochemical Society, held at the Society's headquarters, in Philadelphia, September 4, the following new members were elected: Prof Dr. Nicolas Piltschikoff, University of Kharkov, Kharkov, Russia; Prof. Dr. Richard Lorenz, Zurich, Switzerland; Dr. Henry T. Boettinger, president German Electrochemical Society (Deutsche Bunsen Gesellschaft), Elberfeld, Germany; J. A. Capp, Schenectady, N. Y.; Stanislaus P. Franchot, Niagara Falls, N. Y.; Walter B. Bishop, Grand Forks, B. C.; Charles B. Borton, Berlin, N. H.; Wyatt Hamilton Allen, San Francisco, Calif.; Robert Anton Fliess, East Orange, N. J.; Sol. D. Benoliel, Niagara Falls, N. Y.; Aldus C. Higgins, Worcester, Mass.; F. M. Perkin, Forest Hill, London, Eng.; George N. Jeppson, Worcester, Mass.; Robert T. Frazier, Washington, D. C.; Oliver P. Fritschle, Denver, Colo.

Construction of Transmission Lines.

At the recent convention of the Edison Illuminating Companies Mr. Geo. H. Lukes read a paper, entitled "High-Tension Work in the Far West," which after considering the conditions that have led to the great development of high-tension work on the Pacific Slope, treats at length of the construction of transmission lines. This portion of the paper we reproduce below, in full, together with that part treating of switching, regulation and rates:

The poles commonly in use on the newest transmission lines are either of square sawed redwood, tapered from butt to top, or Oregon or Washington cedar. The Oregon cedar poles used by the Bay Counties Company in its lines from Colgate to Oakland, a distance of 142 miles, are painted with hot tar from the top of the pole to a point six inches below the bottom cross arm. The butts are saturated with hot carbolineum for three and one-half feet where the pole enters the ground. The following table gives data on the poles:

Height.	Top.	Butt.	Depth in Ground.
40 Ft.	9x9"	14x14"	6 Ft.
45 Ft.	10x10	15x15	6 Ft. 6"
50 Ft.	12x12	16x16	7 Ft. 6"
60 Ft.	12x12	18x18	8 Ft.

The redwood poles are from the hearts of young trees, not more than four poles being taken from one tree, and being free from sap when set, they will last from 25 to 35 years. The following table gives the dimensions and other data on the redwood poles used by the Standard Electric Company on the transmission line from their power house at Electra to San Francisco:

Height.	Top.	Butt.	Depth in Ground.
35 Ft.	7x7"	12x12"	5 Ft. 6"
40 Ft.	8x8	13½x13½	6 Ft.
45 Ft.	9x9	15x15	6 Ft. 6"
50 Ft.	10x10	16x16	7 Ft.
60 Ft.	11x11	17x17	8 Ft.

The cross arms are made of selected kiln-dried Oregon pine 6 x 6 inches square, and an overall length depending on the distance between wires. After passing through the dry-kiln they are placed in an enclosed boiler containing asphaltum oil, and subjected to a temperature of 220° F. for several hours. This preserves the wood, and at the same time increases the insulation of the pole top. The arms are gained into the pole a distance of one inch and are held in position by two ⅝-inch through bolts with cast-iron washers three inches in diameter under both head and nut. The cross arms are surfaced all round and crowned on top to shed the water. The insulator pins are of oak, locust, or eucalyptus wood. The latter wood is universally used on the Coast on account of its immunity from attack by worms and bugs, even the deadly teredo not touching it. The eucalyptus pins are treated in the following manner: The timber is sawed into sticks three inches square and placed in boiling water for 24 hours. After being air dried for several months, it is worked up into pins. The pins are then placed in a vat of boiled linseed oil, and kept at a temperature of 210° F. for several hours. The pins are 16⅞ inches long over all, and the diameter at the lowest shoulder is 2¾ inches. They are driven into the cross arm with special care, a hardwood pin-set being used. The pin holes in the arm are 2¼ inches in diameter and 5 inches deep, leaving one inch of solid wood below the pin. On each side of the pin, at a distance of 3 inches from the pin and 2 inches from the top of the cross arm, ½-inch carriage bolts are placed, in order to prevent the arm from splitting when unusual strains are thrown on the pins. That this accomplished the purpose is shown by the result of a series of tests made by the Standard Electric Company, in which the cross arm was split without the bolts with a pull on the thread of the pin of 1,200 pounds, whereas with the bolts in position, the pin broke at the shoulder with a pull of 2,200 pounds, thus almost doubling the strength of the arm.

One very noticeable feature of the pole-line construction is the absence of guy wires. On account of the high voltage, the ordinary strain insulator is of no use, and the common practice is to use wooden struts. These are 6 x 6-inch timbers, fastened to a deadman, buried 5 feet in the ground, and bolted through the pole at the cross arm. Sometimes when a guy cannot be avoided the strut is used as an anchor, or if a guy is used, a 6 x 6-inch timber, 20 feet long, is inserted in the guy as a strain insulator. The poles are usually set about 130 feet apart, and whenever a small angle is made in the line two poles are placed close together, in order to divide the strain. On all angles double arms are used, and double cap pieces bound with wrought-iron bands support the top wire. In single construction, the pole-pin is usually driven into the top of the pole, and a wrought-iron band driven down onto the pole to keep it from splitting. In some cases a bracket pin, 3 feet long and 4 x 4 inches in section, is bolted through the pole.

As an illustration of scientific methods applied to pole-line construction, the line is staked out by a surveyor, the poles are set with a plumb-bob, and the foreman of construction carries a thermometer and a set of curves, from which he fixes the proper sag to give to the wires. The wires are placed at the points of an equilateral triangle. The wires are from 36 to 42 inches apart, and are spiralled, one-third of a twist being made every mile. The Telluride line, in Utah, is unique in that no iron was used in the construction. The cross arms are mortised through the poles, and wooden pins are used instead of bolts. Wooden cross arm braces are fastened to the poles, and cross arms with wooden pins. The object of all this is to increase the insulation of the pole head, but it is open to the criticism that it is mechanically weak.

The insulator is, without doubt, the most important part of the line. As long as the voltage did not exceed 20,000, and the wires to be supported were of small size, the problem of providing a satisfactory insulator was comparatively easy. When 150-mile lines, transmitting 10,000 hp at 40,000 volts over aluminum cables ⅞-inch in diameter were designed, great difficulty was experienced in finding an insulator that was both electrically and mechanically strong. The insulator in common use for this purpose is of the two-part type, the upper petticoat being of porcelain, and the lower part of glass cemented into the porcelain. The upper petticoat is nearly flat, and is provided with a rim and spout to drain the water clear of the cross arm. The lower petticoat is shaped like a truncated cone, and protects the pin. This insulator measures 11 inches in diameter across the top petticoat, and is 11 inches in height. When in position on the arm, the wire is 15 inches above the cross arm. There is much difference in opinion among power transmission engineers on the insulator question. Some condemn glass and others porcelain. Some insulators are strong mechanically and weak electrically, and others are just the opposite. The difference in opinion is probably due to the different nature of the troubles encountered. For instance, the engineers of one company were very much surprised to find that their insulators gave less trouble in wet weather than in dry. As soon as the fall rains began the insulator trouble ceased. An investigation showed that where the lines ran near railroad tracks the insulators got very dirty and insects of various kinds lodged under the petticoats. This decreased the striking distance, and the insulators broke down. The remedy applied in this case was to shut down the line periodically and wash off the insulators. The general feeling among power transmission men is that no insulator in use at the present time would be safe to use on 60,000 volts. The large transmission companies intend to go up to 60,000 volts as soon as additional line capacity is needed, but as this means changing every insulator on their lines, at an expense of several hundred dollars per mile, they will delay action until they are reasonably sure that they have secured the proper insulator.

Aluminum wire has been used largely for transmission purposes on the Coast, with good results. The Standard Electric Company's line from Electra to Mission, San Jose, is aluminum cable of 37 strands, with a total cross-section of 471,034 circular mils. The weight per mile is 2,404 pounds, and its tensile strength is 28,000 pounds per square inch. Owing to the high coefficient of expansion of aluminum, care must be taken in stringing the wires to allow sag enough so that the wire will not be too taut in cold weather. A peculiarity of aluminum wire, which makes its use in small sizes objectionable, is its low melting point. Aluminum melts at 1157° F., copper at 1929° F., and wrought-iron at about 2800° F. When an iron wire falls across an aluminum circuit and makes a short-circuit, the aluminum wire is melted through, and the iron wire remains intact. Thus the trouble is cleared from the circuit, but at the expense of opening the line. This peculiarity was taken advantage of a year or two ago in a substation supplied from a long-distance line at 30,000 volts. A short-circuit occurring on one of the distributing circuits, the switchboard attendant pulled an air break switch in the circuit. A tremendous arc resulted, which set fire to the substation. Not being able to reach the power house by telephone to have the line shut down, the substation was in imminent danger of being burned up. A quick-witted lineman, seeing the danger, threw a coil of iron wire over the aluminum transmission line outside of the station, and thus opened the circuit.

Transmission lines at these extremely high voltages are run as far as possible on private rights-of-way, from 50 to 300 feet in width.

by timbered country. The trees have been cleared out for some distance each side of the line so that no trees by falling can cross the line. The lines are patrolled very carefully, each patrolman having a section 10 or 12 miles long. He reports frequently to the station over a private telephone circuit run on a cross arm about a foot below the power circuit. At intervals of two or three miles taps are brought down from the telephone line to booths at the foot of the poles, and insulated stools are provided in the booths for the patrolman to use while connecting his portable telephone set. The telephone wires are transposed frequently to cut down the induction, and as a rule work fairly well as long as the load is in a balanced condition on the transmission line. When something, such as a short-circuit occurs, which unbalances the power line, the telephone line goes out of commission. As the telephone is most urgently needed at times of trouble on the power line, the value of a telephone line on the same set of poles with the power line is questionable. For the reason also that crosses occur between the power line and the telephone line, thus endangering life, the plan of removing the telephone wires from the transmission-pole line and installing on a separate pole line has been suggested more than once.

That pole lines are not absolutely reliable, and, moreover, are expensive to maintain, is shown by the fact that one company is seriously considering the plan of substituting a series of steel towers, about [illegible] feet in height and [illegible] feet apart, the wires to be suspended from tower to tower and separated about 9 feet. Although this construction will be more expensive than that of the ordinary pole line, it is thought that the decreased number of breakdowns and lower maintenance and depreciation charges would warrant the extra investment.

The construction of long-distance lines, using high voltages, for the purpose of supplying current to large lighting and railway companies, led to the use of duplicate transmission lines. At first two lines were installed on the same set of poles, but it was found that when trouble occurred on one line it was usually communicated to the other line, and so this practice has been abandoned and duplicate lines on separate pole lines are now considered necessary. Even with the introduction of duplicate pole lines, the situation is not entirely satisfactory on account of the short shut-downs caused by the difficulties in switching high-tension lines. The switches in ordinary use are of the air-brake type, and, while it has been claimed time and again that they can be opened safely under load, yet the fact remains that it is dangerous to do so, both on account of the surges set up in the transmission line and the arc at the switch, which is often disastrous. When one transmission line is held in reserve and trouble occurs on the line in use, it takes some little time to switch in the good line. When the two lines are run in multiple and a short-circuit occurs, the usual practice has been to either burn off the trouble or shut down the station and start up on the good line. If the short-circuit is serious and is burned off, the disturbance in frequency and voltage is usually sufficient to cause all synchronous apparatus at the end of the line to drop out of step. The same operating problem to a certain extent confronts the Eastern central station manager who contemplates the erection of a large station generating alternating current at high voltage, to be transmitted to substations and there converted into direct current. The Eastern man may avoid possible shut-downs by the use of time-limit, oil-switches and reverse-current relays, or he may, as a last resource, subdivide his station into several distinct parts, supplying separate lines, and use storage batteries as a reserve. In the West, oil-switches for voltages of 40,000 and over have not yet been developed; or, if they have, the price is prohibitive. Storage batteries can be used to a limited extent on direct-current and railway loads, but the high price has retarded their use.

The problem of securing good regulation on long lines has been a very troublesome one. Some of the difficulties due to inductive loads and charging current have been overcome by the proper use of induction and synchronous motors, combined with reactance coils connected across the circuit, but the facts remain that a railway load on the end of a long transmission line is a bad thing as far as regulation is concerned, and the time will come when the transmission companies will be forced to refuse railway business unless storage batteries are installed to keep down the rapid fluctuations in load.

The transmission companies are wholesalers of electric current. They generate current, transmit it to the market, and sell it in large quantities to the local companies, reserving the right as a rule to sell current directly to large power consumers. The usual method of charging is by the horse-power per year. The rate varies from $18 to $90 per hp per year. The best price is obtained at points remote from railroads, where fuel must be hauled by wagon, such as at mines. The lowest price is obtained at cities on the water, where fuel is cheaper. Other methods of charging are in use in special cases. Current is sold to a street railway, for instance, on a car-mile basis; to a flour mill at so much per 100 barrels of flour turned out. In one case it is sold to a local company for a certain percentage of its gross receipts. It is needless to say that this local company is selling light in large quantities at flat rates, and is making money. Charging by the horse-power year method is supposed to be logical for water-power plants, because the operating expense does not vary with the load. Nevertheless, the method has all the objections that apply to any flat-rate system. It encourages waste and demoralizes rates. As long as the local companies can buy current on the horse-power year basis, they will sell light at flat rates. It is not impossible that the method of charging will have to be changed at some future time, for the following reasons: The water supply in this country is not unlimited. Already some of the companies find it necessary to provide storage to carry them through the dry season. As each company approaches the limit of hydraulic development, it begins to cast about for some means of increasing its capacity. Some companies have found it practical to construct storage reservoirs at the heads of their pipe lines. During the hours of small load, the water runs from the flume into this reservoir, and when the peak comes on the reservoir is discharged into the pipe line, and thus helps to take care of the peak. When this point is reached by any company it is evident that any method of charging which reduces the waste, even at the hours of small load, becomes highly desirable, and so it seems quite likely that in the course of time it will be necessary to get on some sort of maximum-demand basis.

The future of long-distance, high-voltage transmission in the West depends largely upon the development of oil as a fuel. If the production of the oil fields continues to increase so that oil entirely displaces coal as a fuel in certain sections of the country, it is evident that the price of fuel will be so lowered that the transmission plant will be unable to compete with local plants using oil as fuel. On the other hand, in certain sections, fuel will always be high, on account of high cost of transportation. It is in these localities that the power transmission companies will find their best field for growth.

Nickel-in-the-Slot Attachments for Telephones.

Whether a subscriber for a Kinloch telephone has a right to use a nickel-in-the-slot attachment, rented from an outside corporation, is a question which the courts probably will have to decide. A test suit will be instituted by Will E. Berryman, a St. Louis druggist, against the Kinloch Company. Mr. Berryman insisted upon using the coin attachment, which the telephone company objected to. He has paid his subscription in advance, and, therefore, the instrument was not taken out. The service, however, has been discontinued.

Several weeks ago the Druggists' Association and later the Retail Butchers' Association decided that free Kinloch telephones were becoming a nuisance. The privilege, they declared, was being abused, particularly by young men and women, who were in the habit of coming in and indulging in long conversations. The Controller Company of America was then organized to exploit a patent attachment.

It is stated that about seventy-five controllers have been put into use by the subscribers of Kinloch telephones for their own protection. The nickel-in-the-slot box is not placed upon the telephone, but upon the wall. It has an extension lever which projects over the receiver hook. When a coin is dropped in the box this lever is released and a person is enabled to get a connection.

The Controller Company claims that a subscriber has a right to lock up his telephone if he wants to, and this is what the controller does. It, therefore, becomes the subscriber's business. He has it placed near the instrument, not upon it, and the telephone is locked in a convenient manner. By an outsider it is unlocked with 5 cents.

It is stated that the Kinloch Telephone Company had caused more than fifty of its subscribers to discard the use of the controllers, because they were interfering with the service. It is also said that many of the subscribers who have paid their subscriptions have been cut out. The Kinloch Company, it is stated, intends to reserve the right to attach coin collecting devices to its instruments.

Underground Work for Telephone Exchanges—IV.

By ARTHUR V. ABBOTT, C. E.

The square duct presents the advantage of requiring a minimum expenditure of mortar in the construction of the subway, while the smooth surface requires this shape to depend for solidity on the actual adhesion of the mortar to the exterior of the vitrified clay. In the case of the round pipe, a maximum amount of concrete or mortar must be employed in order to fill all the voids between different ducts. Here again solidity depends upon actual adhesion, but with the round pipe, each duct lies in a matrix of concrete, in pre-

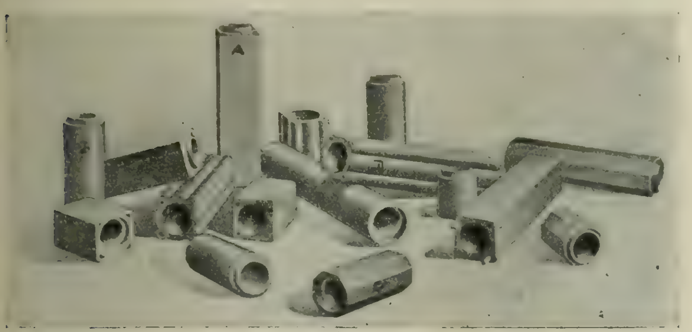


FIG. 21.—TYPES OF SINGLE-DUCT CONDUIT.

cisely the same manner as with wrought-iron pipe or cement-lined pipe ducts. The hexagonal form offers a compromise between the round pipe and the square brick, while the fluted pipe is designed to secure a maximum strength by allowing the cementing material to imbed itself in the corrugations molded upon the sides. The American Vitrified Company score good points in supplying their single duct material with socket joints, so that the successive lengths may fit into each other, thus securing a much better joint than can ever be obtained with simply butted ends. Each piece of the square type is provided with a dowel-pin hole in each corner, so, if desired, four dowels may be used at each joint, thus insuring the best possible centering of every piece.

Fig. 23 illustrates the general design of multiple duct form which may be obtained with any number of cable spaces from 2 to 16, and with this wide selection, it must be a very exacting designer who cannot pick such a form of duct material as will best suit the particular needs of the work in hand. In Fig. 22 the latest form of so-called "Round Hole Multiple Duct" is shown. This type is a kind of compromise between the hollow brick and the regular multiple duct system.

The following table, No. 7, recites the general sizes of the various forms of duct material thus obtainable:

TABLE 7.—CONDUIT SIZES.

THREE-INCH DUCTS.

Type of Conduit.	Size of End Section in inches.	Standard Lengths in inches.	Special Short Lengths in inches.	Approximate Weight per Duct Foot.
Single dowel	4¼ x 4¼	18	6 & 12	10 lbs.
Square, self-centering	5 x 5	18	6 & 12	14 "
Round, self-centering	4⅞ dia.	18	6 & 12	10 "
Octagon, self-centering	4⅞ dia.	18	6 & 12	10 "
Two-duct	4⅜ x 8¾	24	6 & 12	8¾ "
Three-duct	4⅝ x 13	24	6 & 12	8½ "
Four-duct	4¾ x 8¾	36 & 48 & 72	6, 9 & 12	8 "
Four-duct	4¾ x 17	24	6 & 12	8 "
Six-duct	8¾ x 13	36 & 48 & 72	6, 9 & 12	8 "
Nine-duct	13 x 13	36	6, 9 & 12	7¼ "
Twelve-duct	13 x 17	30	6, 9 & 12	7¼ "
Sixteen	17 x 17	30	6, 9 & 12	7¼ "

TWO-INCH DUCTS.

Type of Conduit	Size of End Section in inches.	Standard Lengths in inches.	Special Short Lengths in inches.	Weight per Duct Foot.
Six-duct	6 x 9	36	....	4½ lbs.
Nine-duct	6 x 9	36	....	4¼ "

In Fig. 24 a series of diagrams are given, showing in detail the way in which multiple ducts of various capacities may be grouped in order to obtain a subway of any desired number of ducts from 2 to 72. These diagrams are based upon the use of a 4-in. concrete foundation for the conduit, with a 3-in. cover, but with no concrete upon the sides. The bottom foundation is essential to life and durability. The top cover is of use to prevent injury to the conduit from careless street excavations, and is only desirable for this purpose. The concrete at the sides serves a similar purpose only, and both the sides and top may be omitted if the economy thus obtained is considered equal to the risks incurred of injury to the subway, but there is no question that the complete concrete encasement gives the strongest, most substantial and securest structure, and is, by the best opinion, considered fully worth its cost.

The method of laying both the single and multiple ducts have been already so fully described, that it is only necessary to refer to Fig. 25, showing the construction of a 34-duct subway of single-duct material, and Fig. 26, the construction of a 48-duct subway using four 9-duct sections and two 6-duct sections. In both cases the duct material is placed upon its concrete foundation, the trench is sheeted with timber, allowing three inches on each side for the concrete encasement. In Fig. 25 the cheapest form of lumber is used, which is often allowed to remain in the trench, as costing less to leave than to remove it, while in Fig. 26 the timber walls are made of heavy planking so arranged as to form a mold around each section of conduit remaining in place only until the concrete is tamped and set. and then being pulled along to serve for the next succeeding section.

4.—WOOD-PULP DUCTS.

The most recent suggestion for duct material is that embodied in the use of wood pulp or paper in the construction of a tube which forms the desired "hole in the street." From time to time the use of some form of fibre has been presented for the purpose, but it is only recently that an asphalted-paper pipe has been perfected sufficiently to make a commercial article. The Electrolysis Proof Conduit Company is placing before the electrical engineer a tube composed of paper pulp saturated with asphalt, tightly rolled and thoroughly compressed so as to form an exceedingly durable and valuable structure. It is made in lengths of ten feet or more, provided with male and female ends, the joints being completed by dipping each length as it is laid in hot asphalt and driving it home upon the preceding piece. The method of constructing the subway with this form of duct material is exactly the same as that employed for cement-lined pipe. Fig. 27 shows the construction of a 7-duct conduit, built of electrolysis-proof ducts as installed in Salt Lake City, and is so self-explanatory as to need no further comment. It is claimed that this form of duct material possesses the advantages of being indestructible

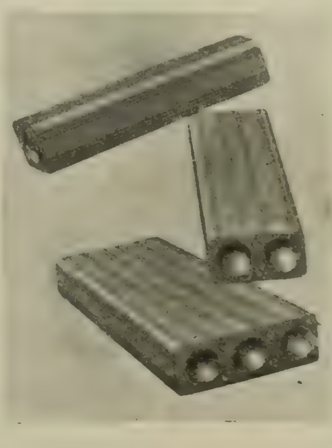


FIG. 22.—ROUND-HOLE MULTIPLE DUCTS.

underground, of extreme lightness, and, therefore, cheap and rapid in construction; entirely water-proof and of good insulating properties. It would certainly appear that paper pulp, thoroughly saturated with asphalt, would be practically rot-proof, but as this assertion has not yet received the actual test of time, a final verdict must be reserved until this opinion has received the conclusive test of experience. Of its lightness there can be no question, as the duct material weighs about two pounds per linear foot, and for this reason, freightage, cartage and handling are decidedly easier than is the case with any other forms. As the paper tube is very tough, there is no

FIG. 23.—SOME MULTIPLE DUCT FORMS.

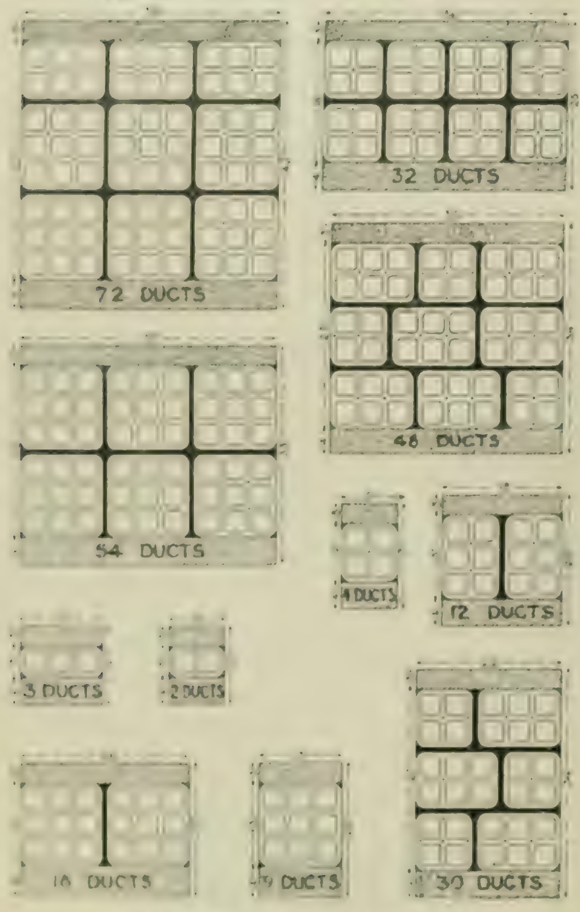


FIG. 24.—[illegible] MULTIPLE DUCTS.

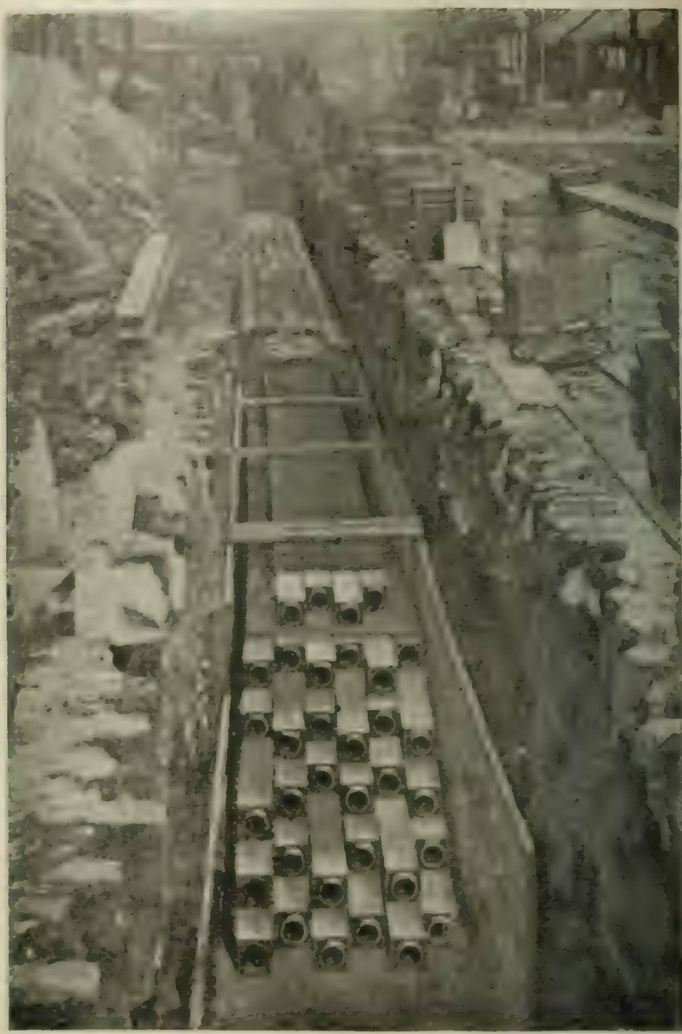


FIG. 25.—SUBWAY OF 34 SINGLE DUCTS.

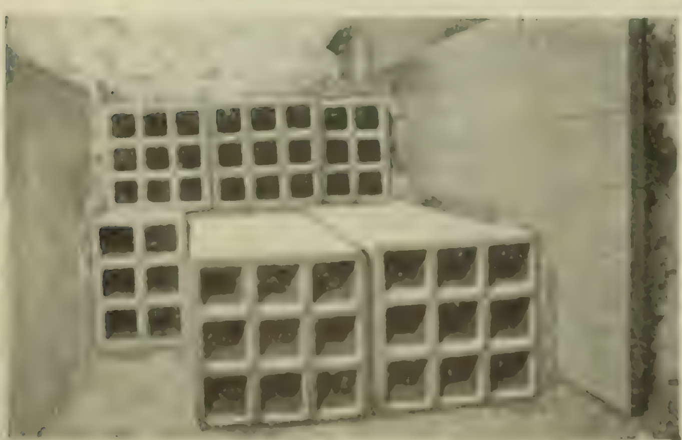


FIG. 26.—MULTIPLE DUCTS.

FIG. 27.—ELECTROLYSIS-PROOF CONDUIT.

FORMS OF TELEPHONE MULTIPLE DUCTS AND METHODS OF INSTALLATION.

reason for breakage—an item of some moment in the vitrified clay forms. Also the paper tube can be readily cut to any desired length with a saw, and the proper socket reamed upon the fresh end with an adequate tool. In all these respects the electrolysis-proof conduit presents distinct advantages. A strong claim for the use of this form is that its high insulating qualities will render the cables immune from parasitic electric currents, and thus, as its name indicates, relieve the telephone engineer from the street railway current bugbear that is supposed to menace cable sheaths. That this duct material has high insulating properties there can be no doubt, as it is abundantly substantiated by the tests which its manufacturers quote, showing that it has successfully withstood 40,000 to 50,000 volts.

It would certainly be highly desirable, if practical, to obtain a conduit which would be a perfect insulator, and so protect the cable from any possible exposure to electrolytic action, but to accomplish this it is not only necessary that the duct should be a perfect insulator, but also that all manholes, distributing boxes, cable terminals and other parts of the subway must have equally high resistances, for if any point fails to protect the system breaks down. Also the entire structure must be absolutely moisture-proof, or otherwise no matter how good an insulator the material, it will sooner or later become coated with a moisture film and its insulating qualities, so far as the cable sheaths are concerned, destroyed. Such an ideal subway has never appeared, and the task of installing one is too herculean to tempt most telephone engineers, so in the absence of moisture-proof manholes and other auxiliaries, the specific resistance of the duct material is a matter of small moment.

Annual Meeting of the New York State Street Railway Association.

The twentieth annual gathering of the New York State Street Railway Association was held on Sept. 8 to Sept. 11, at Caldwell, on Lake George, at the Fort William Hotel. The programme for the meeting itself was carefully arranged, and provision had been made for the discussion of several very important topics. The business sessions began Tuesday morning with a meeting of the executive committee at 9 o'clock, followed an hour later by the formal opening of the convention. Tuesday was given up entirely to the business of the Association and sessions were held during both the morning and afternoon. The annual banquet was held in the evening at the Fort William Henry Hotel. About 200 delegates and guests sat down. Speeches were made by Messrs. Rogers, Colvin, Daly, Powers, O'Connor, Brady, Stedman and Ely. Mr. Colvin acted as toastmaster. Wednesday morning was devoted to the sessions of the Association, and the final business sessions of the Association were held on Wednesday morning. A number of interesting trips and excursions were provided for the ladies and delegates.

President Rogers made, as usual, a valuable and suggestive address, in the course of which he said: It is my belief that in the near future the steam roads will seek ownership or a closer alliance with electric lines which will serve as feeders to them, as is illustrated by the acquisition and extensive construction of roads by the New York, New Haven & Hartford and other steam railways. The advantages of such an alliance to both parties are numerous and cannot help but be a benefit to the public and property. In the recent decision by the Court of Appeals in the suit brought by the Hudson Valley Railway to compel the Boston & Maine Railroad to make a physical connection of their tracks and to interchange freight, the court held that the Legislature of the State has recognized electric railways as a part of the transportation system of the State, and that travelers and shippers of freight are entitled to the benefit of all facilities provided for in the articles of incorporation of transportation companies as well as the duties imposed by the railroad law of the State. The court, after stating that the steam railroads have become great arteries over which the greater part of the commerce of our country is carried, says: "It has not been considered profitable or practicable for steam roads to be constructed to every village, hamlet or productive district in the country. This, however, is being rapidly accomplished by the numerous electric roads that are in process of construction or are contemplated. By their means the farmer and mill owner and the merchandise vender in distant places may be able to reach the steam roads, and through them the great markets of our cities, with their merchandise and products, and in this way one road may become the feeder and distributor for the other."

In development of the same general subject, Mr. Rogers said. The great activity in electric railroad building, which surpasses the most sanguine expectations of a few years ago, is in a large measure accountable for the falling off of the increase of new mileage by the steam railroads of over 50 per cent. between 1890 and 1900, as compared with the interim between 1880 and 1890. When a steam road is requested to give additional train service by the public, the public is often met with the reply, "Another train won't pay." By this policy they do not stimulate travel. The electric road doesn't wait for business, but goes after it, and the result is that when they tap a territory of an existing steam railroad, they increase the rides per capita per annum many fold over what they were with the steam roads. This is largely due to lower fares and more frequent service. The cordial relation existing between the steam railroads and street railways of this State is a matter of favorable comment and congratulation, and make possible a great deal in the way of development and interchange of business from which the general public inherit an untold benefit that would not be available if this friendly relation did not exist.

Mr. C. R. Barnes presented a valuable and timely paper on "Accidents on Electric Railroads," based upon his experience as a member of the New York State Railroad Commission. He gave the following statistics: In the year 1898 there were 1,174.38 miles of electric railroads in this State; 4002 box, 3408 open, 10 mail and 208 freight, express and service cars operated. In that year there were 74 persons killed and 541 injured. In 1899 there were 1,225.16 miles of road; 4743 box, 3681 open, 139 mail and 631 freight, express and service cars operated. There were 126 persons killed and 589 injured. In 1900 there were 1,413.26 miles of road; 5098 box, 3666 open, 22 mail and 666 freight, express and service cars operated. There were 148 persons killed and 650 injured. In 1901 there were 1,548.66 miles of road; 5190 box, 3945 open, 10 mail and 558 freight, express and service cars operated, and 160 persons were killed and 867 injured. The complete reports of mileage and the number of cars operated for the year ended June 30, 1902, have not yet been received in the Railroad Commission office. In this year to June 30 there were 127 people killed and 823 injured. They were all familiar with the serious accidents which have occurred since June 30, one of which resulted in 14 deaths and the injury of 60 persons; another in 4 deaths and 20 or 30 injured; one where three were killed and several injured; two where one was killed and several others where a number were injured. These figures show that the death rate caused by accidents in reference to miles of road operated was .063 in 1898, .102 in 1899, .104 in 1900, and .103 in 1901. As stated above, these figures cannot be given for 1902. But, with the exception of the year 1901, in which year the death rate in proportion to miles of road was less than the year previous, there has been a continuous increase in the death rate as compared to the mileage. This increase between the years 1898 and 1901 was .040, an increase of about 63 per cent. The percentage of passengers injured in reference to miles of road operated in 1898 was .462; in 1899, .480; in 1900, .450, and in 1901, .559. This shows a steady increase in the percentage of passengers injured in reference to mileage of road except in the year 1900, when the percentage was less than in the year previous. There has been an increase between the years 1898 and 1901 of .097, an increase of about 21 per cent.

He stated that the greatest loss of life and the greatest injury to passengers in the last five years had been due to rear end collisions; with head-on collisions next, and, he added: "The statement can safely be made that in a large majority the primary cause of the accident can be traced to inefficient management of the road." He added: The accidents at grade crossings of steam and electric railroads and at grade crossings of electric railroads, are invariably caused by violation of the running rules of the company, for I do not know of a crossing of steam and electric tracks in this State, where there is any considerable volume of traffic on the steam road, but what the company's rules require the electric car to come to a stop and the conductor to go ahead and flag his car over the crossings. But some collisions have been caused by the power giving out while the electric car was going over the steam tracks, or by the trolley leaving the

[illegible] nearly every crossing of two electric tracks the cars on one of them are required by the rules to come to a full stop before proceeding over the crossing.

Mr. R. E. Danforth presented an interesting paper on "Power House Accounting," in the course of which he said: Power stations [illegible] purpose—to show the cost of power developed, and to enable the management to locate the uneconomical features of the plant. The accounts should [illegible] generated or distributed, and the various items, more or less classified, which enter into the cost of such power. It is, for instance, important to know that your firemen generate steam with the proper amount of fuel per horse-power, that the engines and generators convert this steam into electric power, with the least possible loss, and that in each of these operations the machinery is not only being worked to maximum efficiency, but with a minimum cost for repairs. It is further important to be able to determine whether the various units are cut in and out of service at the most economical time, to the end that the proper kilowatt capacity, and no more, is at times being operated.

Some Electric Furnace Methods.

By Clinton Paul Townsend.

In recent issues of this journal, several forms of electric furnace for glass melting have been described, each designed for continuous operation, and each seeking to avoid contamination of the product through direct contact with the heated carbon terminals. In the most recent structure of this type, herewith diagrammatically shown, we find drawn for the first time a distinction between a continuous feed of the raw material, and its continuous passage through the melting zone. In feeding a fusible pulverized charge to the zone of radiation from the arc it is first agglomerated, then melted; and the agglomeration of the particles into masses interferes with the absolute continuity of their passage beneath or between the arcs, rendering necessary an artificial stoking, and such stoking almost inevitably involves an intermittent contact of the charge with the electrodes. From such contact arise the difficulties of contamination of the melt, of [illegible] of a non-homogeneous product.

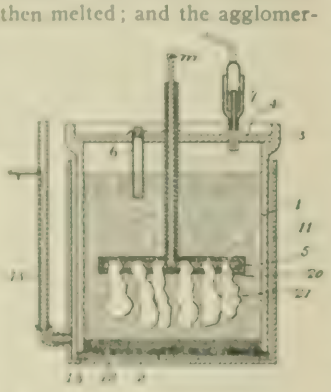


FIG. 1.—[illegible] ELECTRIC FURNACE. FIG. 2.—SOMMER ELECTROLYTIC CELL.

The solution now offered by Jegor Bronn, of Cologne, Prussia (a brief note of which was made last week), is essentially that heretofore suggested by several workers in the calcium carbide art—to first agglomerate the powdered charge by means of a suitable binding agent, and to feed it in the form of a continuous rod or band into the immediate proximity of the arc. In the carbide methods referred to, the agglutinant has usually been tar, or other hydrocarbon, a car-[illegible] will not contaminate the product; [illegible] the binding agent must be such as will not color or interfere with the transparency of the glass. For this purpose water glass, hydraulic lime [illegible] are suggested. The charge is mixed in the hopper, *a*, formed into bands or rods by rolls, *r*, [illegible] and passed as a continuous body . . over the inclined hearth beneath the arc terminals, *c*; or the rod may be fed downward between [illegible] to the hearth.

In the manufacture of glass there appears [illegible] reason for an intermittent operation: it is quite otherwise, however, with the manufacture of calcium carbide. This carbide, like glass, passes through a partially melted or viscous stage, but, unlike glass, it is not strictly necessary that it should at any time reach a temperature of complete fluidity: and a continuous process which depends for its continuity upon such complete fusion as will permit free tapping, must necessarily consume considerably more electrical energy than an intermittent or continuous method operated at the lower temperature limits.

Dr. Isaiah L. Roberts notes that the carbide ingot resulting from the intermittent method, as commonly practiced, is non-homogenous, but contains near the bottom an excess of lime and near the top an excess of carbon. This would indicate that a stratification of the charge occurs as fusion is reached, the coke, in which form carbon is usually supplied, tending to rise to the upper portion of the molten bath. His solution of the difficulty is to substitute for the coke the specifically heavier anthracite coal. Dr. Roberts claims for this substitution the advantages of a more nearly homogenous ingot, due to the absence of stratification; a more nearly dustless operation, due to the higher specific gravity of the coal; an increased yield, attributable to the combination of substantially the whole of the elements of the charge; and a less porous and, therefore, less hygroscopic product.

PRODUCTION OF CAUSTIC SODA.

An electrolytic cell for the decomposition of brine, the invention of Adolph Sommer, of Cambridge, Mass., interpolates into familiar constructions two or three interesting features. The type is that of Le Sueur—an inverted bell of stoneware, containing the anode and resting upon supports in an iron cathode tank, the mouth of the bell being closed by a diaphragm; in operation brine is introduced within the bell, and the caustic withdrawn from the external tank. As shown in the accompanying figure, the covered bell, 1, 4, rests on a series of spaced insulating blocks, 12, within the cathode tank, 11. The diaphragm, 2, which closes the mouth of the bell, is formed of a sheet of wire cloth, which is electrically unconnected, covered by bed of loose sand. Brine is admitted through a water joint, 7 which serves also for the eduction of chlorin, and the caustic is withdrawn through an adjustable pipe, 13. The anode is of a familiar construction, rough blocks, 21, of retort carbon being secured by casting into a lead base, 5, protected by an insulating sheath, 20. Points of novelty are the unconnected wire gauze diaphragm support, and the tube, 6, the latter serving for the introduction of solid salt which, during operation, rests upon the back of the anode.

New Telephone Patents.

The issue of the Patent Office for September 2 contributes an addition to the growing collection of nickel-in-the-slot telephones in a coin-controlled telephone, the invention of Mr. Sylvester P. Grey, of Fort Wayne, Indiana. Mr. Grey's device has several ingenious features and to some extent avoids the formidable complication of delicate parts that rob many automatic pay station telephones of practicability. The present invention, however, shares with others the disadvantage of being restricted to nickel service, as it is operated by a coin of predetermined size, and the standard American coin of predetermined size is the nimble nickel.

Referring to the drawings, Fig. 1 gives a general view of the coin-mechanism attached to a telephone, part of the case being broken away to show the working parts. Fig. 2 shows the mechanism in detail. Fig. 3 the chute with a special aperture. Fig. 4 a view of the apparatus on the door of the telephone box, the additional parts over the regular telephone instruments being the magnets 43, 45 and lever 46 to operate the coin-releasing device. Fig. 5 shows a hook adapted to engage the lever 46 to prevent the door of the telephone box from being opened by an unauthorized person; Fig. 6 the contacts to close the circuit of magnets 43, 45 when a coin is to be released; Fig. 7 the details of the lever 46 with hooked end 47 adapted to operate the coin releasing slide 13 shown in detail in Figs. 8, 9 and 10. The apparatus puts it within the power of the central operator to return the coin deposited to the caller should the application for a connection be for any reason unsuccessful.

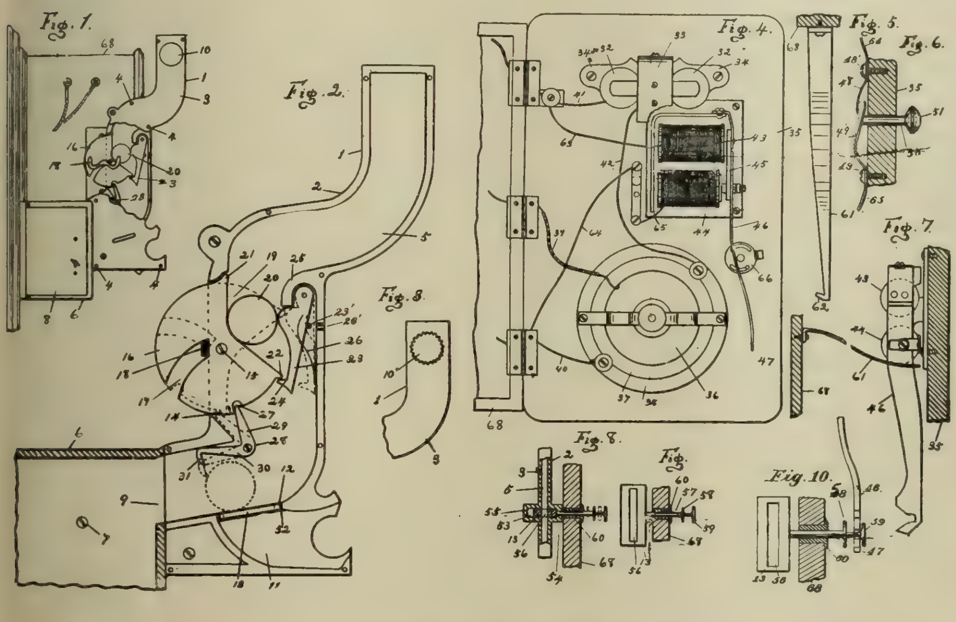
Referring to Figs. 1 and 2 it will be seen that the coin chute, formed of two grooved plates, 2 and 3 clamped together, has a lateral opening, 10, near the top, this side opening being effective

1 preventing tampering with the mechanism. As shown in Fig. the aperature may be made with a serrated edge to fit special netal checks to be supplied to subscribers or wholesale cusomers to use instead of coins. The coin-controlling mechanism onsists of the disk 16 having the inclined surface 19, adapted to eceive the coin, the lugs 21 and 22, the notch 27 and the slot 17 n which the stem of the switchhook 18 works to revolve the lisk. The disk is normally held in position by the cam lever 23 which is pressed forward by a spring, 26, and engages lug 22 by hook 24. When a coin, 20, is deposited it fills up the space between the surface, 19, of the disk and the cam shoulder of 23; the switchhook can then be raised and the disk turned, the pressure of 20 on 23 forcing hook 24 away from lugs 22, and, as the disk comes round, lug 21 bears on the cam of 23, forcing it clear back to the position shown in dotted lines (Fig. 2) and allowing the coin to pass down the chute until it is arrested by the hook, 31, on bell-crank lever 28. It will be seen that the radius of the disk, 16, between the notch 27 and the lug 22 is reduced, so that when the disk is turned in a clockwise direction by the raising of the switchhook the upper end of the holding-pawl, 28, drops back, as shown in the dotted lines and the lower arm drops forward across the chute, placing the hook 31 in a position to retain the coin directly over the slide 13. This slide or valve normally closes the slot 52, by which the coin may be

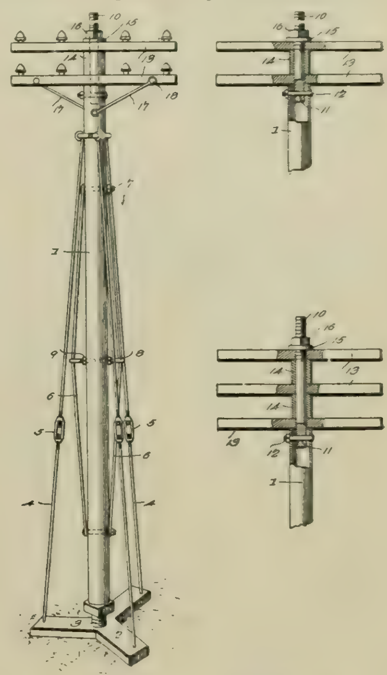
lated to a device that was as old as overhead wires themselves. The writer of the letter possibly did not know that which cannot escape the observation of any technical man who looks over the weekly output of the Patent Office—that it is apparently the rule of the Patent Office to grant a patent to any applicant, whether the application covers a real invention, a pure copy, a resurrection of some old device, a reshuffling of parts, or a simple mechanical arrangement that any blacksmith could rig up if it were desirable to do things that way. The only thing the Patent Office seems to stick at is interference, and then it sticks hard. But if an application does not interfere with some other it becomes a patent in due course, however innocent the subject may be of any trace of invention or often of any tangible improvement over existing methods.

A case in point is the patent issued to Mr. Isaac M. Warner, of Union City, Michigan, on a telephone or telegraph pole. The pole is a tubular iron or steel pole screwed into a base 2. As to how the base is secured to its base the specification is silent. At its upper end the pole carries a vertical bolt 10, attached to the pole by the transverse bolt 12, and to this vertical bolt are attached the cross arms, bolted down by the nut and washer 16, 15. If several cross-arms are used, spacing blocks, 14, are inserted between them.

The issue of the Patent Office for September 9 contributes two



FIGS. 1 TO 10.—GREY COIN-CONTROLLED TELEPHONE.



FIGS. 1, 2 AND 3.—WARNER POLE.

passed into the receptacle 11, whence it may be recovered by the caller in the event of a non-connection.

When the connection goes through all right the slide 13, of course, is not operated, and when the receiver is restored to the switchhook the disk is turned contra-clockwise back to its origianl position, thus raising the hook 31 and allowing the coin to fall into the cash-box 6. The slide or valve, 13, controlling the opening, 52, into the return box is shown in Figs. 8, 9 and 10. The slide works in slots made in the sides of the chute as shown in Fig. 8 and is pulled to and fro by the armature lever, 46, of magnet 43, 44, the lever engaging, by means of hook 47, the pin 57 attached to the slide; the hook 47 works between the two collars, 58, 59, attached to the pin 57. When the desired connection cannot be obtained the caller (so instructed by the operator) presses the button 51 (Fig. 6) which closes the circuit of the magnets 43, 44; the operator then puts current through the magnets and the attraction of the armature causes the slide 13 to be moved to one side, opening the slot 52 and thus giving free passage to the coin into the return box. A neat addition to the device is the screw-threaded lug 23′ on 23 (Fig. 2) by means of which with a special key the hook 23 may be retracted to dislodge any coin, check or slug that may have blocked the instrument.

A correspondent of the ELECTRICAL WORLD AND ENGINEER pointed out the other day that a telephone patent recently reviewed re-

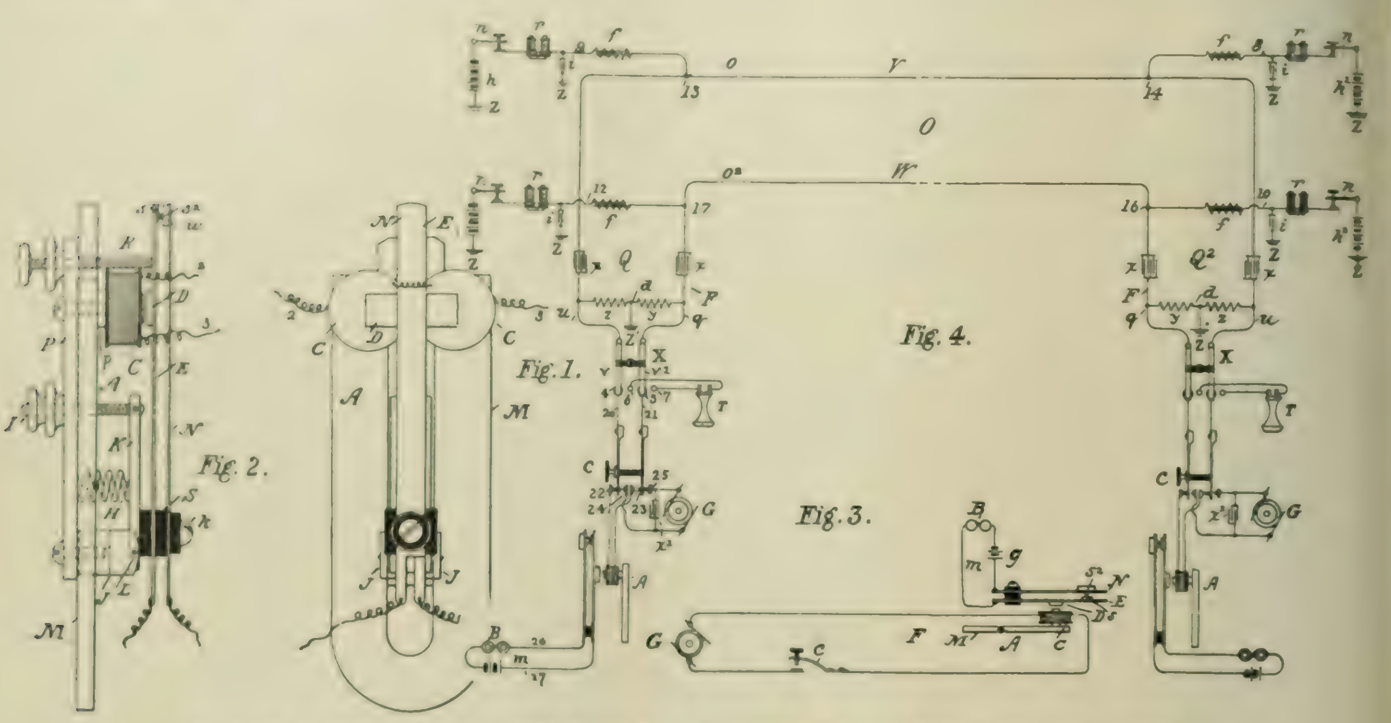
patents to the art of telephony for such widely diverse inventions as an antiseptic mouthpiece and a vibratory-current relay for use in signaling over composite telegraph and telephone circuits. The inventor of the latter is John M. Fell, of Arlington, N. J., and the patent is assigned to the American Telephone and Telegraph Company. Mr. Fell says that in the operation of systems for the simultaneous transmission of telegraphic and telephonic signals over the same circuit it has been found difficult to provide for the telephonic part of the system suitable appliances for sending and receiving call-signals, which, while efficient in their own functions, do not interfere with the normal operation of and are not themselves subject to interference or disturbance by the normal operation of other parts of the system. It is required in the operation of telephone call-signal apparatus for such a composite system that the electrical currents employed in its operation shall not in any way interfere with or disturb the instruments of the telegraphic part of the system or create inductive disturbance in neighboring telephone circuits. Moreover, such apparatus must not itself be liable to disturbance by electrostatic discharges or induced currents, which, owing to the operation of the telegraphic part of the system may appear in the telephonic circuits.

The object of the invention is to provide simple, convenient and effectual means, satisfactorily meeting the requirements for signaling between the stations of the telephonic circuits of such systems, the invention consisting of a call-signal receiving relay which is readily

[illegible] ments of the system, or to inductively [illegible] The relay has a permanent [illegible] spring bar, acting against a [illegible] re and also to establish a [illegible] but lighter spring bar, of [illegible] d to the same support, and [illegible] ove the first. The two springs are insulated fr[illegible] support, and at the outer ends carry the contact-points of the local circuit controlled by the relay; these points are normally in contact with each other.

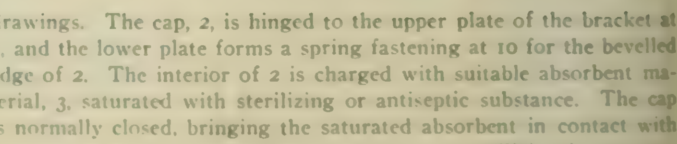
In the drawings, Figs. 1 and 2 show the relay in detail, and Fig. 3 is a diagram of a simple circuit illustrating its use. Fig. 4 illustrates the use of the relay in an improved system of composite telegraphy and telephony. In Figs. 1 and 2, M is a U-shaped, permanent magnet, having poles, p, fitted with coils C. The armature D is carried on the spring bar, E, which at its outer end carried contact-point s, normally in contact with s^2 on bar N; the two bars are mounted on the support, S, of plates of insulating material, the support being adjustable by means of the link piece K, pivoted at L in the post J, and governed by the adjusting screw, I, against which the compression spring, H, presses K. By means of I the tension of the armature spring, E, may be adjusted. The spring E beyond the armature bears on a stop, R, which prevents the armature from making contact with the magnet poles and establishes a nodal point in E, so that when E is vibrated the vibrations of the part beyond R are the reverse of those in the part between R and S. The spring N is lighter than E and is weighted at its outer end by w, so that the two springs have diverse inertia and different periods of vibration. Therefore, when the armature spring is vibrated by alternating current traversing the magnet, the lighter spring, N, does not promptly follow the vibrations of E, and the contact between s and s^2 is broken or its resistance so raised that the circuit is substantially opened, and the signal operated. The vibration amplitude of E is greatest when the current in the relay is of the same frequency as the fundamental periodicity of vibration of the spring. The relay is quite operative when the current frequency is either much below or much above the periodicity of the spring.

In Fig. 3 the relay, as described, is shown joined up in a typical circuit with an alternating generator, and arranged to control a local circuit including a signal. In Fig. 4 is illustrated the application of the relay to a composite telegraph and telephone circuit, in which a metallic telephone circuit, O, is employed to furnish two telegraph circuits, o and o^2. The circuits are arranged in much the usual manner with impedance coils and condensers, the switches, X, controlling the talking circuit of the telephone stations and the keys, c, the telephone signaling appliances. Alternating currents of a frequency of approximately 300 periods per second and a potential of 20 volts have been found suitable for the operation of the relay A. A condenser, x^2, is bridged across the generator terminals to round off the signaling current, which has no effect on the telegraph instruments, and can be transmitted to considerable distances without serious attenuation.



Figs. 1 to 4.—Tait Vibratory Current Relay for Composite Telephone and Telegraph Circuits.

A good many inventors are troubled by the idea of infection through telephone mouthpieces. The latest thing in antiseptic attachments is due to Messrs. Henry C. Smith and Mark H. Woolsey, who have devised a hinged cap or cover, 2, attached to a bracket, 5, clamped to the transmitter face by the mouthpiece A, as clearly shown in the drawings. The cap, 2, is hinged to the upper plate of the bracket at 4, and the lower plate forms a spring fastening at 10 for the bevelled edge of 2. The interior of 2 is charged with suitable absorbent material, 3, saturated with sterilizing or antiseptic substance. The cap is normally closed, bringing the saturated absorbent in contact with the periphery of the mouthpiece, cleaning and sterilizing it, and preventing the ingress of dust. The closed cap also prevents rapid evaporation of the antiseptic, and confines any vapor to the mouthpiece, where, to paraphrase the inventors, it will do the most good.



Figs. 1, 2 and 3.—Antiseptic Mouthpiece.

Low Fares.

The Essex Cross Railway Company, which is trying to obtain a franchise through East Orange, N. J., has made a special offer of 2½-cent fares as an inducement to the granting of the privilege.

Electric Railway Systems.

An electric railway system is the subject of a patent, granted on eptember 9, to T. E. Murray and J. Van Vleck. The system proides an arrangement whereby the controller is operated by means of solenoid, which is in turn controlled by a centrifugal governor conected with the car axle. As the speed of the car increases, the controlling resistances are cut out by the action of the centrifugal governor, and current is passed through a solenoid, which releases a brakehoe normally held in contact with the wheel with spring tension. If he car should speed excessively, the centrifugal governor by moving still further will actuate the controller so as to cut in controlling resistance, and if the speed is very high, all of the controlling resistance will be cut in and the brakes applied. The patent also covers details with reference to a sectional-conductor system, which provides a dead section in advance and in the rear of the car, as a protection against collisions.

Another patent was granted to the same well-known engineers, the object of which is well described in the preliminary paragraphs, which are substantially as follows: The general construction and arrangement of the apparatus is such that, first, a car starting from a principal depot or any given station, will automatically proceed to and stop at any other given station; second, prior to reaching the predetermined station said car will automatically close a switch for leading it upon the station siding; third, prior to reaching the predetermined station the strength of the current actuating the car will be automatically reduced; fourth, prior to reaching the predetermined station an electric brake mechanism will be automatically applied to retard the motion of the car; fifth, the line conductors in proximity to the track are disposed in block sections, and by means of suitable automatic mechanism the section next to and immediately succeeding that occupied by the car is rendered dead, so protecting the car from rear collision; sixth, the car mechanism being adjusted for a predetermined speed, any excess speed will result in the automatic operating of mechanism to reduce the speed to normal; seventh, in event of the automatic switch-controlling mechanism not properly setting the switch, the car is automatically brought to a stop before the switch is reached, and cannot proceed until the fault is corrected; eighth, the track is double, and stations are located on loops extending from one track to the other, but in a different plane—that is to say, the loop may preferably rise over the tracks or descend below them—the stations being located on said loops; ninth, in case a car passing from a loop to the main track is in danger of a rear-end collision with a car on the main track, the car first referred to is automatically stopped; tenth, in case a car on the main track is in danger of a rear-end collision with a car coming to the main track from a loop, the first car is automatically stopped.

The patent refers principally to the construction and arrangement of brake mechanism and associated devices. The necessary control of the current on the car and the application of the brakes are effected by means of a centrifugal governor, operating an arm over a series of contacts which make appropriate connections. The necessary changes of switch-setting and energizing or de-energizing of power-rails in the permanent way are accomplished by solenoids connected electrically in the wiring system of the permanent way and mechanically to the devices to be actuated. Mr. Murray is the general manager of the New York Edison Company, and Mr. Van Vleck is now connected with the New York Rapid Transit system.

Water Power Development in Pennsylvania.

At points on the Susquehanna River, in the vicinity of York, Pa., operations on four gigantic electrical power plants are under way. At Conowingo Falls a $4,000,000 company is constructing a 35,000-hp plant to transmit power to Wilmington, Del., and Chester, Pa. B. Harvey Welsh, of Philadelphia, is the hydraulic engineer. A 40,000-hp plant will be located at Peachbottom and McCall's Ferry. The company constructing it is capitalized at $10,000,000, and has for its president David Warfield, of Baltimore. The power will be transmitted to Baltimore and intermediate points. At York Furnace fifteen men, under the direction of H. F. La Bella, engineer for the American Pipe Company, of Philadelphia, are making surveys for a 40,000-hp plant. Major George B. Burbank, of New York City, has been selected as hydraulic engineer for the Susquehanna Power Company.

CURRENT NEWS AND NOTES.

BRITISH PACIFIC CABLE.—The steamship Colonia, from Liverpool, with the Pacific cable on board, has reached Victoria, B. C. After coaling it goes on to Bamfield Creek, on the west coast of Vancouver Island and the terminus of the cable, where it will commence laying the cable.

POULSEN'S TELEGRAPHONE.—According to a Copenhagen dispatch the Danish company which is exploiting Poulsen's telegraphone is considering an offer from America to buy the patents on the invention for $600,000 cash, and one-third of the shares of an international company to be formed.

PRIZES OF BRITISH INSTITUTION OF ELECTRICAL ENGINEERS.—The British I. E. E. has made announcement of the award of the following annual premiums and scholarships for the year 1902: David Hughes Scholarship, £50, to Edward Fisher, of Finsbury Technical College; Sir David Salomons' Scholarship, £50, to Philip A. Laubach, of Finsbury Technical College; Fahie Premium, £10, to Mr. I. G. Brown, for his paper on automatic submarine cable relaying; Institution Premium, £25, to Mr. O. Losche, for his paper on the Zossen railway trials; "Paris Electrical Exhibition" Premium, £10, to Mr. H. W. Clothier, for his paper on high-tension central station switch gears; a premium of £10, to Mr. David Robertson, for his paper on armature winding diagrams. In addition there were awarded one extra premium of £10 and two of £5, and four students' premiums of £10, £5, £5 and £3, respectively, all for papers read before the Institution.

MARCONI'S LATEST ACHIEVEMENT.—The Marconi Wireless Telegraph Company has, according to a special cablegram, issued a statement from its London office stating that it has received "perfect" messages at Poldhu, Cornwall, from Gibraltar continuously during the passage from there to Spezia, Italy. The messages thus passed over France and Spain and over the Alps and across the Mediterranean from the warship assigned to him by the Italian Government. These messages were received on a tape-receiver, the distances of transmission varying between 900 and 1,100 miles. It is further stated that Marconi will at once sail for America on the same warship, the "Carlo Alberto," for the purpose of resuming arrangements for the establishing of a commercial wireless telegraph service across the Atlantic. While on the way over he will be in constant communication with the English station. He will first go to Cape Breton, and afterward to Cape Cod, Mass.

TECHNICAL EDUCATION IN GREAT BRITAIN.—At the recent meeting of the British Association, Professor Dewar painted in gloomy colors the present situation in Great Britain with respect to technical education. He pointed out that it is largely owing to superior technical training that Germany controls the chemical industry, the German output being $250,000,000 annually. It is through an abundance of men of ordinary plodding ability, thoroughly trained and methodically directed, that Germany at present has so commanding an advantage. It is the failure of British schools to turn out, and of British manufacturers to demand men of this kind, which explains a loss of some valuable industries and a precarious hold on others. Let no one, he said, imagine for a moment that this deficiency can be remedied by any amount of that technical training which is now a fashionable nostrum. It is an excellent thing, but it must rest upon a foundation of general training. Mental habits are formed for good or evil long before men go to technical schools. We have to begin at the beginning. The really appalling thing is not that the Germans have seized this or that industry, or even that they may have seized a dozen industries. It is that the German population has reached a point in general training and specialized equipment which will take Great Britain two generations of hard and intelligently directed educational work to attain; it is that Germany possesses a national weapon of precision, which must give her an enormous advantage in every contest depending upon disciplined and methodized intellect. It may be remarked that so far as electrical engineering is concerned, the statements of Professor Dewar will apply in a comparison between Great Britain and the United States.

[illegible] TELEGRAPHY.—A dispatch from Rome, Italy, states that the government is considering the ad[illegible] system across the [illegible]ry, and that Signor Marconi will be consulted on the subject.

THE KAISER AGAIN.—At a dinner recently given by the German Emperor, at which were present the American officers in attendance at the war manœuvres, the Kaiser, in referring to the accident to the President at Pittsfield, denounced electric cars as [illegible]

WIRELESS TELEGRAPH STATION AT CRETE.—The experiment is projected of establishing wireless telegraphy stations in Greece, on the Island of Crete, for the purpose of communicating northward with Italy, and to the south with Egypt, which would enable a great reduction in the telegraph charges between these countries.

A SMALL PLANT'S LONG RUN.—Mr. S. S. Hartzell, of the Hartzell Light and Milling Company, Poplar Bluff, Mo., writes: We shut down our engine and closed our fan season this morning, September 7, after a continuous, uninterrupted run of seven weeks, or 1,176 hours. There was no real necessity for stopping, as engine and dynamo were both in good order. Our main-drive belt during this time traveled 72,486 miles. This run, which shows what can be done 24 hours daily from a small plant, was made with a 16 x 36 heavy duty Hamilton-Corliss engine, and a 90-kw, 60-cycle Warren generator.

GERMAN ARMY MANŒUVRES.—Two novelties at the German army manœuvres just ended were wireless telegraphy and Boer tactics. The result of the wireless experiments seems completely satisfactory, and in the opinion of the military chiefs will enormously affect the transmission of intelligence during battle. A description of the apparatus is not available, because visitors at the manœuvres when they came close to the stations were requested to retire. The exterior of the apparatus is simply a cubical iron box, about three feet each way, mounted on a wagon resembling a gun carriage and drawn by four horses. The messages sent were caught on a wire attached to a small balloon several hundred feet above the carriage. These stations were moved freely about the field, the horses sometimes going at full trot; but they were stopped for telegraphing. The operator used a key producing a shrill, metallic sound audible for a hundred yards. The cavalry corps, in making its evolutions, kept constantly in touch with headquarters through the wireless telegraph, enabling the corps to hasten or retard its movement, throughout the thirty-two miles' ride, as in the judgment of the headquarters staff changes in the situation were required. It will now be possible to deliver co-ordinate attacks by widely separated divisions in a way hitherto impossible.

AN EARLY SECONDARY BATTERY PATENT.—A patent was granted, June 25, 1867, to Dr. Geo. G. Percival, on "Secondary Electric Piles." In the specifications the inventor states, "I am aware of Ritter's charging pile, but he used plates of copper alone. I am also aware of the various polarization plates mentioned by Faraday, Becquerel, De La Rive and others, who used platinum. I am also aware of a secondary electrical pile, where sheet lead is immersed in dilute sulphuric acid. Also of Kirchoff's patent, February 26, 1861, of Leclanche's patent, dated April 23, 1867, and also of Prof. Thompson's English patent; but I am not aware of a secondary electrical pile being formed of lead combined with some other metal, more especially zinc or copper or iron." As described, the battery consists of a glass jar, containing a saturated solution of sulphate of zinc and two elements, one of which is composed of six plates of sheet lead, each 6 inches long and varying from 3¼ to 4½ inches wide, the wide plates being in the middle; alternating with these are seven plates of amalgamated sheet zinc of the same size. The plates are held parallel to each other and one-fourth of an inch apart by a separator of hard rubber. The first operation consists in immersing the elements of a cell in a solution of sulphate of mercury, and passing through the same a current from a Bunsen battery; it is stated that in a short time the zincs are beautifully amalgamated, and the lead is prepared to receive a coat of the peroxide. The plates are then put in the regular electrolyte and charged from a Bunsen battery; in a short time the lead plates are covered with a film of peroxide of lead, and metallic zinc is deposited on the zinc plates. "When the battery has been disconnected, very little action takes place in the pile until the circuit is established, when it will for a short time give a current of surprisingly large quantity. If connection be not made for a week there will still be some portions of the charge remaining, provided a powerful charge was given. By pouring off the liquid and keeping the pile dry, it will retain its charge six months or more." The inventor says that when too much battery power is used he thinks there is a tendency to give off free oxygen from the lead plate of the pile rather than to form peroxide of lead and sometimes, when the pile is allowed to run down completely scales separate from the lead plate, but these can be easily removed by a stream of water, and the pile recharged. Sheet copper of the same dimensions may be substituted for the zinc plates, and a solution of sulphate copper for the zinc solution, the other parts remaining the same. Plates of iron and a solution of iron may be substituted in the same manner. Solutions of chloride may also be used.

LETTERS TO THE EDITORS.

Electrode Terminology.

To the Editors of Electrical World and Engineer:

Sirs.—In regard to the use of the terms "positive-pole electrode" and "negative-pole electrode" to indicate the peroxide and spongy lead plates, respectively, as set forth in the article, "Electrode Terminology," ELECTRICAL WORLD AND ENGINEER, July 12, 1902, I have found that the use of the terms was suggested in a paper of Fr. Kirstädter, in Dr. Franz Peters' *Centralblatt für Accumulatoren und Elementenkunde*, 1900, p. 379. This publication was not at hand when I wrote the article, or reference would have been made thereto.

WASHINGTON, D. C. ALBERT M. LEWERS.

Safety in Elevators.

To the Editors of Electrical World and Engineer:

Sirs.—There appeared in your paper of August 16 a criticism by Mr. O. F. Shepard of my article of July 12, on "Safety in Elevators." The question whether elevator accidents are numerous or not numerous might perhaps be termed a matter entirely aside from the question. It is most likely that even if the number of accidents were much smaller than at present, there would be some persons still complaining about their frequency.

The fact that the motor of an elevator is compound-wound is, of course, not of itself an element of danger, and any abnormal increase in speed need not occur as long as the machinery is operated as intended by its builder. It is, however, possible in elevator service that the motor may act as generator before the attendant has cut out any of the series winding, and then the speed will greatly increase. A considerable speed increase will occur even if the motor is shunt-wound, and becomes a generator before its starting resistance is cut out, but the said increase will naturally be greater in the case of the compound-wound motor. It may amount to a great deal more than the 25 per cent. computed by Mr. Shepard, but in these days of close regulation of electric machinery even 25 per cent. increase in speed might be considered too great, and had better be prevented.

The arrangement suggested in my article was intended to short-circuit all the resistance in series with the armature, whether the motor is shunt or compound-wound, whenever it is driven as generator, so that the said speed increase will not result if the attendant should fail to cut out said resistance.

Mr. Shepard does not give any good reasons for his statement that the speed governor would seem to be "the only means to prevent a runaway" in case the power supply circuit is opened while the motor is driven as generator. This statement is rather too broad. It is true that the solenoid brake, as ordinarily installed, will not act in such case, but it is not so as a matter of necessity, and the fact is that by the addition of suitable and quite simple apparatus the same solenoid brake will be applied also on this occasion. Since patents are pending on such apparatus, it is, however, not proper to discuss it in detail at present.

NEW YORK. GUSTAVE RENNERFELT.

The Highest Lighting Plant.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to the article under "Current New and Notes," of your last issue, entitled "The Highest Lighting Plant," I beg to state that I have put in operation a lighting plant in South America, within three miles of Casapalea, Peru, "Mina Americana," the latter being at an elevation of more than 16,000 feet above sea level, about 2,000 feet higher than Casapalea. The mine is the property of Señor Alejandro Garland, of Lima, Peru, and is situated at the peak of the water-shed of the Andes Mountains, which at this point are very high. The dynamo is a 5-hp General Electric, direct-current, belted to a Pelton water-wheel, which is supplied with water from a lake some 200 meters distant, the waters of which divide between the Atlantic and the Pacific sides. There are here lighted the factory, in which the ore is crushed and separated, and the miners' dwellings. The place is covered with snow the year around, and many deaths have resulted from the mountain disease, "surroche"—bleeding of nose and general hemorrhages.

Casapalea is about 100 miles from the coast, on the line of the Ferrocarril Central del Peru, between Callao and Oroya, which is the route to the famous Cerro de Paseo region, now being exploited by a North American company, capitalized at $10,000,000. The Backus & Johnston Smelting Company's plant at Casapalea, elevation over 14,000 feet, is also lighted by electricity.

BROOKLYN, N. Y. C. A. NEWBAKER.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Aging of Transformer Iron.—NIETHAMMER, DETTMAR, ROSENBERG.—Several communications on this subject. Niethammer suggests limiting the iron temperature of transformers to 70° or 85° C. as a maximum, as transformers when operated at higher temperature for several weeks show an increase of loss. Dettmar speaks against the proposition of Niethammer, as he thinks that at the temperature usually existing in commercial transformers, there is no appreciable change of the losses due to aging of the iron. He describes some tests which showed that different sorts of iron behave quite differently. Several samples of iron were heated to 130° C. and continually tested; in one case the losses increased by 28 per cent.; in five other samples by 11 to 17 per cent. He is now investigating the question to which degree the aging is due to high temperatures, and to which degree it is due to the reversals of magnetism; he tests simultaneously two exactly equal samples, one being kept at 130° C. without reversals of magnetism, the other being kept at the same temperature, and subjected at the same time to reversals of magnetism. Rosenberg also speaks against Niethammer's proposition, as rules on the temperature should not be based on the properties of "sick" iron, which should never be used for transformers. He refers to some tests of Mauermann, which showed that some sorts of iron after having been kept at a temperature of 77° C. for two weeks had not changed their magnetic qualities, while other samples which had been annealed at too high a temperature showed considerable deterioration of the coefficient of hysteresis, after having been kept for one week at a temperature of 56° C. A comparison of result obtained by Heyn and Mauermann shows that the use of the same excessive temperature produces "sickness" of the iron in mechanical as well as in magnetic respect. Heyn found that overheated, brittle iron can be improved in mechanical respect by again annealing it for a short time at a temperature above 900 degrees, or by annealing it at 700 degrees for a longer time. It is not impossible that iron which is magnetically sick would also be improved in such a way. He refers to a case in which he observed an aging of copper; the copper of a direct-current armature which had been used for several years showed an electric conductivity of about 30, while its original conductivity had been 50.—*Elek. Zeit.*, August 7, 21.

Transformer Hazard.—LOW.—An abstract of a paper on "The Station Transformer Hazard," read before the Fire Underwriters' Association of the Pacific. He discusses the use of oil in transformers. He thinks there is only one weakness which he would eliminate in order to reduce the transformer fire hazard, and that is the use of sheet-iron casings, which, in the event of fire or particular station trouble, are easily broken or torn or punctured so as to release the oil and allow it to run out. Transformer casings should be of the most substantial and durable kind. They should, in the larger units, be erected on substantial foundations of concrete or other material of similar durability, and their oil-cooling connections should be so installed as to be free from liability to breakage or interruption, even under such severe conditions as are imposed by fire. In some cases the confinement of transformers in separate fire-proof buildings is to be recommended, but whether it is always necessary to resort to this final expedient is a matter of grave doubt.—*Jour. of Elec.*, August.

REFERENCE.

Closed Slots.—MOLLIER.—An article, illustrated by diagrams on the influence of closed slots in the primary of an induction motor. He gives the characteristic curves of a motor, in which the slots of the primary were first closed and were then cut open; the advantages of open slots are evident therefrom.—*Elek. Zeit.*, July 31.

LIGHTS AND LIGHTING.

Arc Lamps with Impregnated Carbons.—WEDDING.—A paper, read at the Berlin Electrical Society, on a long series of tests of arc lamps with impregnated carbons (Bremer arc lamp, "Flammenbogenlicht"). He first experimented with two carbons placed side by side in a nearly vertical direction, so that they form together an acute angle (as in the Bremer lamp), the voltage and current being kept constant; and the arc being acted upon by a magnetic field. The positive carbon was impregnated and had a diameter of 8mm., the negative was not impregnated and had a diameter of 7 mm.; a reflector was placed above the carbons. He first investigated the influence of varying quantities of fluor-spar, with which the positive carbon was impregnated. For an addition of 0, 8, 15, 20, 40 per cent. of fluor-spar the mean hemispherical candle-power is 1,173, 1,728, 2,505, 2,808, 3,574, respectively, and the watts consumed per candle 0.458, 0.232, 0.162, 0.144, 0.113. The best percentage to be added is 15 per cent., as larger additions have certain disadvantages. The influence of these impregnations is clearly shown in the adjoining diagram, Fig. 1, which gives the candle-power in different

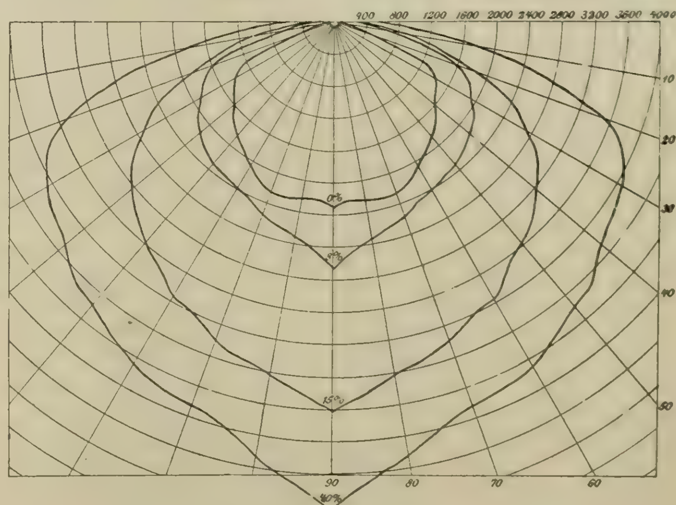


FIG. I.—CANDLE POWERS IN DIFFERENT DIRECTIONS.

directions for varying percentages of impregnation. It is evident how the illumination increases with increasing impregnations, especially up to 15 per cent., and how gradually a sharp maximum, perpendicularly below the lamp is developed. The next object of his investigation was to study the influence of equal additions of differ-

[illegible] material; calcium gives yellow light, strontium red, and barium white; these experiments were made with alternating current, the current being 9 amperes, and the voltage 45; the yellow (calcium) light gave a mean hemispherical candle-power of [illegible] c., and measured 0.235 watt per c.; the red (strontium) light 1.430 c., and 0.299 watt per c.; the white (barium) light 1.768 c. and 0.242 watt per c.; the calcium impregnation, therefore, gives the best results. Another important result is that when the carbons are arranged, as described, side by side in a nearly vertical position, alternating current does not require a greater consumption of watt per candle than direct current. Nevertheless, he doubts whether the side by side arrangement of the carbons will in practice replace the old arrangement of one above the other. The latter arrangement has, therefore, also been tried with impregnated carbons. The economy is not so good as with the side by side carbon arrangement, but it has other advantages. He compares the distribution of illumination in the plane below an arc

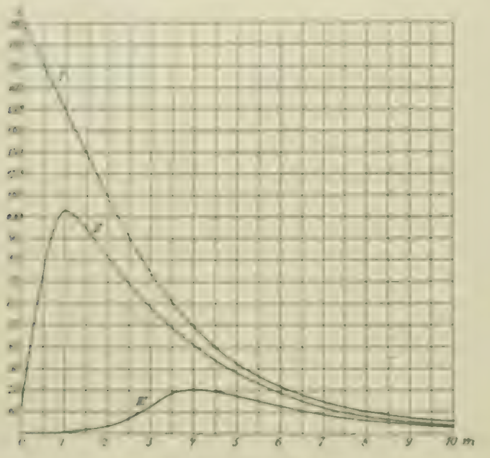


FIG. 2.—CURVES.

lamp, the result being given in the adjoining diagram, Fig. 2. Curve 1 refers to a lamp with impregnated carbons, placed side by side; curve 2 to a lamp with impregnated carbons, placed one above the other; curve 3 to an ordinary lamp with unimpregnated carbons. The current in all three cases is 9 amperes; the voltage for curve 1 was 45, for curve 2 it was 42.6, that for curve 3 is not given (but from a reference to a former paper it appears that this third lamp was an ordinary arc lamp, as they are used, two in series, with a resistance on 110-volt mains, the voltage at the terminals of each lamp being about 40). The ordinates of the diagram represent candles, and the abscissas the distance in meters from the point perpendicularly below the lamp, so that the curves show the variation of the illumination on a plane below the lamp. The superiority of the impregnated carbons is evident. The curves also show the slight superiority in economy of the side by side arrangement over the one above the other arrangement; the maximum of illumination is directly under the lamp in the side by side arrangement, at a distance of 1 meter in the one above the other arrangement with impregnated carbons, and at a distance of 4 meters for ordinary carbons. But these curves refer to arcs without a globe; in practice a globe is used and the conditions change considerably. While there is a slightly less watt consumption for the same candles when the impregnated carbons are arranged side by side than when arranged one above the other, the latter arrangement has the advantage of giving a more uniform illumination throughout a room. The influence of varying voltage at constant current appears from the following figures: The current was 9 amperes, the voltage 37.2, 40.7, 42.8, [illegible]; the mean hemispherical candle-power [illegible], 1,300, 1,361, respectively; the consumption of watts per candle [illegible], 0.296, 0.273; this shows that it is only at high voltages that the economy improves. The voltage cannot be raised beyond certain limits, because otherwise the light is not quiet. He then describes some experiments with the arc itself. He refers to a chemical investigation of Arndt, who found that no dangerous gases are developed during the burning of the lamp with impregnated carbons. He thinks that the new lamps are most suitable for out-door lighting, for large places and long and broad streets.—*Elek. Zeit.*, August 7.

Power.

Steam-Engine Economy.—Weighton.—An illustrated paper, read before the Brit. Inst. Mech. Eng., on some experiments on steam-engine economy; also some editorial comments on it. Experiments lead him to believe that the economies effected by reheating the steam after it leaves the high-pressure cylinder of a compound engine, and by the use of high vacua with engines running condensing, are both illusory. In the discussion which followed the paper, the opinion generally expressed—especially with regard to the question of vacuum—was that the nature of Weighton's results was due to the design of the particular engine used for the test, and that with an engine properly designed to work condensing, and with a high vacuum, the greater the vacuum the greater will be the economy.—*Lond. Elec.*, August 29.

REFERENCE.

Electricity in a Paper Mill.—An illustrated description of the electric installation in a British paper mill, which was formerly operated by a large number of engines scattered throughout the departments, and in which electricity was introduced a year ago. There are installed 20 motors of, together, 990 hp. The principal advantages of electric power are the greater facilities for regulation of speed and manipulation of the paper in its different stages, but there is also a saving in coal, which is estimated to pay off the first costs in about five years.—Lond. *Elec. Times*, August 14.

Ten Thousand-Volts, Three-Phase Locomotive.—Reichel.—A well illustrated article on a locomotive for high-speed railways, built by Siemens & Halske. He starts with some remarks on the well-known Zossen high-speed, three-phase railway experiments. While the electric installation for this proved to be entirely satisfactory, the rails were not. It appeared, therefore, important to diminish the wear and tear on the track, and for this purpose it was decided to try the use of an electric locomotive, operated directly on 10,000 volts, so that no stop-down transformers have to be carried on the train, and the weight of the locomotive is considerably decreased. The locomotive has four axles and two geared motors. The primary winding is placed on the stator, and to obtain a large cooling surface, rather deep slots were chosen. The rotor has a radius of 34 cm., and is 30 cm. broad. The stator has 72 open slots and 67 wires per slot, star connection being used. The rotor winding is placed in 90 half-closed slots, and consists of single copper bars, four bars in each slot. The accessories are, with the exception of the rheostats, of the same design as used on the high-speed experimental motor cars. Starting and speed regulation is accomplished, as usual, by inserting resistance in the secondary circuit, the rheostat having 24 stops. The rheostat consists of kruppin wire spirals, connected in parallel. The locomotive has been tested at a voltage of 6,000 to 11,000. The highest speed obtained was 63 miles, as had been the intention. If for high-speed railroads it is intended to use a speed of 96 miles, at a frequency of 35 and a pressure of 8,000 volts, a car equipped with those motors, together with a trailer of 42 tons weight, including passengers, can carry 100 passengers, and there are 1,200 kgr. total weight per passenger. He says that the corresponding figures for steam traction would be 1,800 kgr., so that there is an advantage in favor of electric traction.—*Elek. Zeit.*, August 7.

REFERENCE.

Suburban Railroad.—A long and well-illustrated description of the Aurora, Elgin & Chicago Railway, which operates, electrically, nearly 100 miles of its own track near Chicago, and has connections with several other suburban electric railways. Three-phase currents are used for transmission from the power house to six substations containing synchronous converters and transformers.—*St. R'y. Rev.*, August 20.

Installations, Systems and Appliances.

Three-Wire Systems.—Morgan.—An article on distribution with insulated neutral. There should be no fuses anywhere on the neutral conductor; in the outers, however, fuses are a necessity. He suggests placing fuses between each feeder and the distributors connected to it, but not on the feeder itself. A switch on each outer on the station board will in practice be found sufficient protection for large feeders, as the current is always under observation. If it is decided to fuse the feeders, the fuses should be designed to melt at not less than 2,000 amperes per square inch. Wherever the section of a distributor undergoes alteration, a fuse should be inserted, and it would be quite possible to standardize a network with three sizes of distributors, involving, therefore, only three sizes of fuses. He would fuse distributors for about 1,500 amperes per square inch, arranging the fuses in accordance with the section of main, and not

according to the connected load on the section. Finally, he recommends the following system of distribution for three-phase currents: Three-core cables, lead covered, the lead being used as earthed neutral, the lead being wiped on to all boxes, and the services taken off by lead-wiped joints. He would also consider the possibility of dispensing with the neutral conductor, and connecting one wire to the existing water or gas pipes in the consumer's house, but this raises a legal question.—Lond. *Elec. Rev.* August 29.

Middle Wire in Three-Wire Systems.—HOOGWINKEL.—An article in which he advocates the use of an uninsulated middle wire in a three-wire system. While this is not allowed in England, it is in universal use in continental Europe. In England, for the neutral conductor a cross-section is chosen, equal to about 50 per cent. of the outers, while in continental Europe a section of about 25 per cent. is the rule. He speaks in favor of the continental use, and remarks that an uninsulated middle wire is more reliable, as faults in the outers will not remain unlocated or unrepaired. He recommends connecting the middle wire and the armor of the outer cable at intervals of about 50 yards by means of copper section wires. There should be no fuses on the middle wire, neither at the station nor in houses, and the uninsulated middle wire must not enter the network boxes, but should be simply connected up by copper links.—Lond. *Elec. Rev.*, August 29.

REFERENCE.

Chicago.—BLANCK.—A long and well-illustrated article on the system of the Chicago Edison Company.—*Elek. Zeit.*, July 31, August 7.

WIRES, WIRING AND CONDUITS.

Calculation of a Transmission Line.—HUTTON AND CROWELL.—A paper read before the Pacific Coast Transmission Association. The authors remark that since the discovery of great oil fields, the use of fuel oil has begun to compete seriously with electric power in the West. They consider the design of a 50,000-hp, 80,000-volt, 200-mile transmission line. The rule of Scott is mentioned, which recommends using a pressure in thousands of volts, equal to one-third of the number of miles of the transmission line. They assume a somewhat higher voltage, to make allowance for th higher cost of latticed steel poles, which are suggested for use instead of wooden poles. Aluminum is assumed for the transmission wire, and four cases are analytically treated: First, two three-wire, three-phase circuits, operated at 60 cycles per second; second, two three-wire, three-phase circuits, operated at 30 cycles per second; third, four three-wire, three-phase circuits, operated at 60 cycles; and, fourth, four three-wire, three-phase circuits, operated at 30 cycles. The last system is the most suitable. For a plant of this size, where the bulk of its capacity would be used for driving motors, a frequency of 30 cycles, or even less, should be adopted, using motor-generator sets when lighting is required, thereby getting a much better voltage regulation for lighting than is shown in the average transmission plant of to-day.—*Jour. of Elec.*, July.

Insulation of Electric-Supply Cables.—CHARPENTIER.—A paper in which he points out that the high-insulation resistance usually required of cable makers is not in itself of much value; even if the resistance were reduced to one-thousandth of its usual value, the loss of energy by leakage would be negligible. These high insulations are demanded merely as a guarantee of the quality of the cable, but they should not enter into the specification of a cable, for an insulation of equal durability and equal strength against rupture might have far less resistance and be equally serviceable in practice. The insulation of a cable should satisfy the three conditions of a definite maximum leakage, strength against rupture, and durability. As a measure of the resistance should be taken, that observed when the current has become practically constant, not that after one minute's electrification. The ratio of these two resistances varies largely in different sizes of cables, and for continuous currents the former alone has any practical value. The strength against rupture bears very little relation to the insulation resistance. It depends really on the uniformity of the materials used and the care exercised in manufacture, for over a small surface the thickness of insulation for a given strength is often only about one-tenth that required in a long cable. It is not advisable to test the whole cable, as is usually done, at a pressure double the working pressure, as such a test may permanently injure the insulation. The better test is to measure the pressure of rupture over a length of the cable and allow a factor of safety of 4 to 5. He suggests that cables should be cheapened by substituting, for the armoring, lead sheathing, and for a dielectric of high insulation resistance, a thick layer of moderately insulating material, sufficiently strong to withstand handling and laying, which could be applied to the bare copper as the cable was laid.—*Soc. Int. Elec. Bull.*, March; abstracted in *Science Abstracts*.

Capacity of a Cable.—SCHWEITZER.—An account of a test of a Felten and Guillaume cable 185 meters in length, having an external diameter of 47 mm., a core diameter of 5.7 mm., and an exterior conductor of internal and external diameters 15.3 mm. and 17.2 mm., respectively. It was provided with two lead mantles and two iron bandages. The total volume of the polarized dielectric was 29,290 cc. He endeavored to find a change in the dielectric constant of the insulating medium on varying the e. m. f. The capacity was determined by discharging the cable through a ballistic galvanometer; the charging potentials successively used were 10,100 and 1,000 volts, respectively. In such a case the charge was completed in 25 seconds at the most; the discharge was completed in 10 seconds. Taking these times into account, 34 different charging potentials, varying from 0.77 to 1,840 volts, were applied, under conditions which kept the temperature of the cable constant. The capacity was found to be 0.03715 microfarad, and the dielectric constant 3.569. The extreme values of the dielectric constant were 3.583 and 3.554. The variations were within the errors of observation. It appears, therefore, that within the potentials mentioned, the capacity of the cable shows no alteration.—*Mett. Phys. Zuerich*, No. 2, 1902; abstracted in Lond. *Elec.*, August 22.

Stranded Cables.—HOLITSCHER.—An article in which he defines the "coefficient of the utilization of the space" in a stranded cable as the ratio of the effective copper cross-section to the total available cross-section. This coefficient should he high. He suggests demanding that it should be between the limits of 70 and 75 per cent., but never below 70 per cent. By mathematical calculations and with the aid of diagrams he endeavors to show that this would be a fair and practical requirement.—*Elek. Zeit.*, July 31.

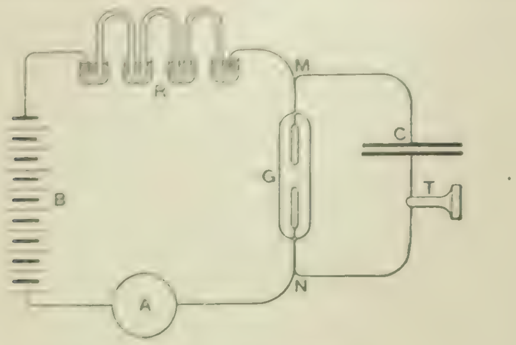
ELECTRO-PHYSICS AND MAGNETISM.

Electrostatic Law.—BARNETT.—A note "on the Cavendish experiment and the law of inverse square in electrostatics." He does not want to cast any aspersions upon the law of inverse square or upon the Cavendish experiment itself, but he claims that a serious fallacy is involved in attempting to investigates the law of force in electrostatics by any such experiment. He points out the importance of inserting the permittivity, or dielectric constant, in the expression for the law of force, the force for given charges being inversely proportional to the permittivity, whatever the law of its variation with the distance. When the medium filling up the whole field is not electrically homogeneous and isotropic, the fact cannot be expressed by a simple law.—*Phys. Rev.*, September.

Application of Lagrange's Equations of Motion to Electric Currents.—DAY.—A paper describing an experiment which is analogous to one made by Maxwell. The latter investigated whether or not any part of the kinetic energy of an electric current could be expressed by a term depending on the product of an ordinary velocity and an electric current. The velocity he considered was a velocity of the wires carrying the current in the direction of its length, and Lagrange's equations of motion show that if the term referred to exists, whenever a current is started or stopped in a wire, there would be an impulse acting on the wire in this direction. Maxwell could not discover any evidence of such an effect. The present author has made an experiment for a similar purpose, but in his experiment the mechanical co-ordinate considered is one whose velocity means a rotation of the wire around its axis, the corresponding impulse when the current is suddenly started or stopped being an impulsion torque, if the term in question exists. But no evidence of the existence of such an effect was discovered.—*Phys. Rev.*, September.

Singing Vacuum Tubes.—RIGHI.—An account of experiments, in which he obtains clear musical notes by means of the apparatus shown in the adjoining diagram, where *B* is a battery of accumulators, *A* a galvanometer, *C* a condenser, *G* a vacuum tube, *R* a copper sulphate resistance, and *T* a telephone. The pitch of the note heard in the telephone increases on increasing the number of cells in the battery, or on diminishing the resistance, the capacity, the pressure in the tube, or the distance between its electrodes. By suitably varying these elements, it is possible to pass through the whole range of musical notes, from the lower to the higher limit of audibility, and beyond. The notes are not due to an alternating current, as in the singing arc, but to a varying period of retardation of discharge in one

[illegible] inductance makes the phenomenon much more complicated, and approaches the conditions of Duddell's singing arc. As a general rule, an increase of inductance lowers the pitch of the note, but in an irregular manner. At



SINGING VACUUM TUBES.

certain points there is a sudden transition. Thus the gradual introduction of an iron core gives rise to an abrupt succession of notes, sometimes marked by a tremolo at the point of transition.—*Nuovo Cimento*, July; abstracted in Lond. *Elec.*, August 29.

Electrothermal Effect in Tourmaline.—STRAUBEL.—A paper in which he described some experiments made to detect an effect predicted by Lord Kelvin from thermodynamical consideration; if a pyro-electric crystal be brought into an electric field so that the lines of force run from the analogous to the antilogous pole, it will be heated; if the orientation of the crystal in the field is reversed, a cooling will take place. He experimented with a Brazilian tourmaline, and, although his experiments were only qualitative, the results agree with the theory.—*Phil. Mag.*, August.

REFERENCES.

Faraday's Theory.—TROTTER.—The first parts of a long, popular article on "the old and the new electrical theory." He makes some introductory remarks on science, hypothesis and theory, on concepts and precepts, and then goes over to Faraday's ideas of the lines of force. The term current is unfortunate, as it carries with it the suggestion that there is something which flows. But it will probably be impossible to get rid of this term.—Lond. *Elec. Rev.*, August 8, 15.

Röntgen Tube.—HENNE.—An illustrated description of the Gundlach-Dessauer X-ray tube.—*Elek. Zeit.*, July 31.

ELECTRO-CHEMISTRY AND BATTERIES.

Copper Refining.—PHILIP.—Continuations of his long article on the financial basis and design of electrolytic metal refineries, the first part of which was recently abstracted in the Digest. He gives formulas for the costs of various constituents of the plant. In a special case the price of the refined copper may be $375 per ton, the price of anode copper $350 per ton, the output of refined copper 1,000 tons per year, the current density 10 amperes per square foot at anodes, the price of copper sulphate crystals $125 per ton, the thickness of the anode plates 1 inch, and 250 amperes per square inch allowed in the copper [illegible] conductors, then his formulas give the total capital invested as $56,125. He then discusses the various items of the annual cost of refining. He then points out the great influence which the current density has upon the capital and annual outlay per ton of copper refined per year; there is, in fact, some particular current density which will yield the most satisfactory financial results, and this particular one varies with the price of coal, the cost of melting down each ton of refined copper into ingots, the rate of wages paid, the rate of interest paid upon the capital invested; and, lastly, but most important, upon the difference in price at the works between the price paid for anode copper and the price obtainable for the refined copper, together with the value of the silver and gold separated from it, if this value goes to the refiner. The current density at the anode used in different plants varies between 1 and 15 amperes per square foot; he is strongly of the opinion that it cannot pay to use a greater current density than 16 amperes per square foot at the outside. He uses his formulas for calculating the different items of the capital investment and the annual charges, to show how all these items vary where the current density is varied between 5 and 20 amperes per square foot. From the results obtained, it appears that the percentage profit on the capital invested, under the particular conditions stated, will be greater when the current density at the anode is somewhere about 15 amperes per square foot.—Lond. *Elec.*, August 15, 22.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Mil-Ammeter and Galvanometer.—SCHAEFER.—The first part of a long article on the capabilities of the mil-ammeter and the galvanometer, in general testing and in submarine cable testing. After some general remarks on cable testing, he points out how certain formulas of formidable appearance are reduced to very simple ones with the assistance of the mil-ammeter which lends itself admirably to a more simple and practical mathematical solution of numerous problems. He then discusses in detail the adaptability of the mil-ammeter to the following problems: To find the internal resistance of a battery, the e. m. f. being known and assumed constant; to find the resistance of a cell or battery and also its effective e. m. f.; to measure a simple resistance; to measure the resistance of earths; to find the resistance of a galvanometer; to find the constant of a galvanometer by the mil-ammeter; to find the e. m. f. of a polarizable battery; to determine the resistance of leakage in a battery and its resultant position; to use an ordinary proportional deflection galvanometer as a mil-ammeter; to find the internal resistance of standard cells. The methods are illustrated by numerical examples.—Lond. *Elec.*, August 15, 22, 29.

REFERENCE.

Hysteresis Tester.—EWING.—A brief communication on his hysteresis tester, by which the hysteresis of a sample is found by comparison with two or more standards whose hysteresis is known. He points out that these standards ought to be checked from time to time.—Lond. *Elec.*, August 15.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wave Tranmission Over Sea and Earth.—JACKSON.—An illustrated Royal Society paper on some phenomena affecting the transmission of electric waves over the surface of the sea and earth. He reaches the following conclusions. Intervening land of any kind reduces the practical signaling distance between two ships or stations, compared with the distance obtainable in the open sea, and this loss in distance varies with the height, thickness, contour and nature of the land; on the basis of the results of these observations, it may be concluded that some of the waves of electric induction, transmitted by wireless telegraphy, may pass through, over, and possibly round the land, and are comparable to the passage of ocean waves through or over a reef, or round high land, which waves proceed along their course with diminished energy, after passing such obstructions. Material particles, such as dust and salt held in suspension in a moist atmosphere, also reduce the signaling distance, probably dissipating and aborbing the waves. Electrical disturbance in the atmosphere also acts most adversely to the regular transmission of these waves, in addition to affecting the receiving instruments by lightning discharges. A system of transmission in which the oscillations are rapidly damped, is irregular in its action on distant receivers, owing to the irregularity of the trains of waves giving rise to different types of disturbance at different parts of their path, which may not have at certain points the necessary cumulative effect on the receiving circuit. The earth's function in the transmission of waves is most important, but its importance is secondary to that of the aerial wire or capacity insulated in the air above the surface of the surrounding sea or earth.—Lond. *Elec. Rev.*, August 22, 29.

Vibrating Cable Relay.—GULSTAD.—The conclusion of his paper, the first part of which was recently abstracted in the Digest. It is said that wherever the vibrating relay has been applied, an immediate and very considerable increase in the maximum speed otherwise attainable, has been the result, although this increase does not appear to be in proportion to the K R of different cables when the very same relay arrangement is used in all cases. Concerning the relay performances at the station of the Great Northern Telegraph Company, at Gothenburg, it is said that in this case a delicate cable relay, well adjusted and worked in the old fashion, will translate up to 30 words a minute, while the maximum speed is now increased to 120 words per minute by applying the vibrating relay, the play of the tongue between the battery contacts at the same time being greater than in the former case. The ordinary daily working speed from month to month is 90 words per minute on this circuit. The article is concluded by a mathematical appendix.—Lond. *Elec. Rev.*, August 29.

Effects of Contacts upon Telegraphic and Telephonic Currents.—DE PAUSO.—A paper in which he states that when two wires covered with oxide are in contact, telephonic conversation is not interfered with; and when the oxide is thick enough the alternate currents from a

magneto are also obstructed by it. He views the oxide of copper as a dielectric, for both undulatory and alternating currents. He quotes a case on the line from Brussels to Paris, where, during a contact telephonic communication was good, but telegraphic indifferent. A similar effect was noticed during a heavy frost, when the wires were in contact between Leuze and Tournai. The frozen particles acted as a dielectric in the one case and as a conductor in the other. In the discussion which followed, several speakers quoted cases where telephonic circuits, even 7 km. in length, laid on ice or dry snow, have been successfully operated. Here the insulating property of snow and ice comes into play.—*Soc. Belge. Elec.*, Bull 19; abstracted in *Science Abstracts*, August.

REFERENCE.

Common Battery.—Kelsey.—An illustrated article, in which he discusses several points in different common battery systems.—*Telephony*, September.

MISCELLANEOUS.

Electric Response of Living and Dead Matter.—J. C. Bose.—An account of experiments in which he continues his attempts to co-ordinate the phenomena of living and dead matter. As the most general and delicate sign of life is the electric response, he reproduces the various forms of the electric response to stimulus in animal, vegetable and mineral matter. A nerve, a vegetable fibre and a wire show similar responses to mechanical shock when stretched between two unpolarizable electrodes. Platinum and some other metals also show "fatigue," *i. e.*, the diminution of the reaction on repeated application. In other cases again, there is increased reaction. The effect of heat is the same in animal and vegetable tissue, as it reduces the reaction and eventually kills the tissue, *i. e.*, makes it incapable of response. The "stimulating" effect of sodium carbonate upon the response of platinum and the "poisoning" effect of potash or oxalic acid upon tin are striking analogies, and so is the stimulating effect of a small dose of a substance, which in larger quantities acts as a poison. "It now remains for the author to finally dispose of vital force by restoring the capacity of response in dead animal or vegetable matter, as it can be restored in metal."—*Jour. de Phys.*, August; abstracted in Lond. *Elec.*, August 22.

REFERENCES.

Biography.—A biographical sketch, with portrait, of James Swinburne, the present president of the (British) Institution of Electrical Engineers.—Lond. *Elec. Rev.*, August 1.

Manufacturing Plant.—Thompson.—An illustrated article on the Schenectady works of the General Electric Company.—*Am. Mach.*, September 4.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Next meeting, Sept. 26. Paper by B. G. Lamme, "The Washington, Baltimore and Annapolis Single-Phase Railway." Oct. 24, paper by C. P. Matthews on "An Integrating Photometer for Glow Lamp and Sources of Like Intensity."

American Street Railway Association, Secretary, T. C. Penington, 2020 State Street, Chicago, Ill. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Indiana Electrical Association, Secretary, Hal. C. Kimbrough, Muncie, Ind. Next meeting, Indianapolis, Sept. 17 and 18, 1902.

International Association of Municipal Electricians, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

Lincoln Power House, Boston Elevated Railway.

In our issue of June 15, 1901, a general description was printed of the Boston Elevated Railway, which was supplemented by an article by Mr. F. H. Shepard, on August 10, following, on the operating features of the road. Recently in our issue of June 7, a description in detail appeared of the Charleston power house, and we are now enabled to present a similar description of the Lincoln power house, in which a third large unit has lately been installed.

The Lincoln power house differs in many respects from the various other power houses of the same railway system. It is located on the lot known for many years as Lincoln Wharf, on the water front of Boston Harbor, and in the heart of the old city, near the junction of Commercial Street and Atlantic Avenue, where there are excellent facilities for the docking of coal and other supplies. The general appearance of the building is imposing, the architectural design being notably fine. The massive chimney, extending to a height of 250 feet, and one of the first things to catch the eye, is said to be the tallest stack in the city. The building is divided into two longitudinal sections, the boiler room and all apparatus pertaining thereto being in one section, and the engines, generators and condensing system in the other. The engine room is served by a large electric crane of 40-tons capacity. The walls of this room are faced with white enamel brick, adding much to its general appearance and illumination.

The present station contains three units, aggregating about 13,500 hp. While it is now complete in itself, ample ground area has been provided for the extension of the building and plant on harmonious lines to accommodate four additional units, thus permitting an ultimate equipment of about 30,000 hp.

The boiler installation consists of eight 468-hp and four 490-hp Babcock and Wilcox boilers. An equipment of Roney mechanical

FIG. 1.—EXTERIOR OF LINCOLN POWER STATION.

stokers of the same type as those in the large power houses in New York City has been installed by Westinghouse, Church, Kerr & Co.

Coal will be automatically unloaded from vessels and stored in a large pocket holding 5,000 tons, with a further storage bin of 3,000 tons in the boiler house, or a total storage capacity of 8,000 tons. It is carried to the boilers by a Hunt coal and ash conveying system, which conducts the coal into overhead conveyors leading to the stokers, thus practically eliminating all manual labor in the handling of coal and ashes. The coal apparatus is so arranged that coal can be taken from the pocket to the storage bin in the boiler house and, in addition, tracks are located on either side so that coal cars can be automatically loaded to carry coal to the various other stations if desirable, viz., to the Charleston, Harvard, Allston and Central Stations, as well as to some thirty or more car houses situated in different parts of the city. The plant is equipped with Green economizers.

Feed water is supplied to the boilers by means of two vertical compound pumps, manufactured by the George F. Blake Manufacturing Company. A Star vacuum feed-water heater of 8,000-hp capacity is placed on the base of the chimney conveniently near the feed pumps. As the smoke flues from the boilers enter the stack at a point some

[illegible] uch auxiliaries [illegible] gravity return system and heating system.

The original engine installation consisted of two [illegible] units, of [illegible] hp each, built by the [illegible] Engineering Company. The generators and flywheels are carried on the shafts

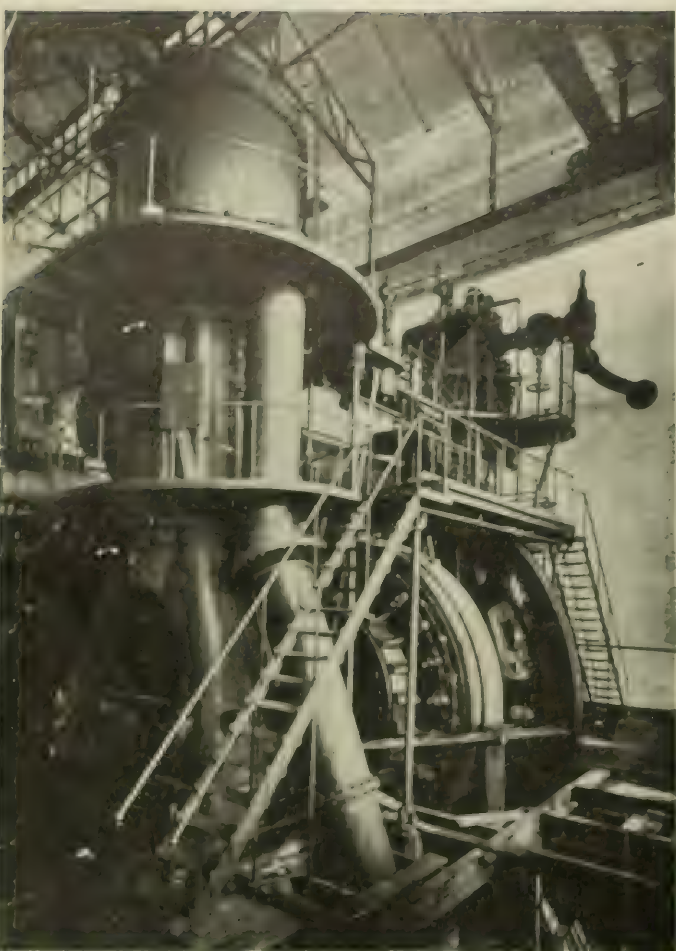


FIG. [illegible] ENGINE DIRECT CONNECTED TO 2,700-KW GENERATOR.

between the high-pressure and low-pressure sides. The generators are direct-current machines, rated at 2,700-kw each. A third unit, which has just been completed, consists of a vertical cross-compound engine of about [illegible] hp, designed and built by the Westinghouse Machine Company, and installed by Westinghouse, Church, Kerr & Co. It is of the same design as the one recently furnished for the Charleston Power Station, and is direct connected to a Westinghouse direct-current generator of [illegible]-kw capacity of the same make, and similar to one of the two machines mentioned above. The engine, however, differs considerably in design and construction from the two engines first installed. The high-pressure cylinder is fitted with poppet valves, for use with superheated steam, which is supplied by superheaters built by the Babcock & Wilcox Company.

This station is built upon land situated in the center of Boston's most desirable wharf property, and the cost of the location was, presumably, high. Had it been necessary to use other than vertical engines, the amount of land required in such a valuable locality would have given rise to a serious financial problem.

The steam piping represents all that is modern in this important portion of the plant. Steam is conveyed from each side of the boiler room by 8-inch mains to a 36-inch drum, from which it is conducted by 12-inch risers to Cochrane receiver separators, and thence to the engines. All the live steam drips from steam drums, separators and reheating receivers are carried back to the boilers by the steam loop and Holly gravity return system.

Ingersoll-Sergeant air compressors, each driven by a 50-hp Westinghouse 500-volt motor, supply compressed air for the block signal and switching system, used by the road. Early in the conception of the scheme of running trains at high speed under the rather complex conditions there existing, the engineers of the Boston Elevated Railway realized that a block system was necessary as a safeguard against accident. After careful consideration, the Westinghouse electro-pneumatic interlocking system, manufactured by the Union Switch and Signal Company, of Swissvale, Pa., was chosen. There were many reasons for this decision, among them being the quality and reliability of the material furnished and, again, the small space required for switch towers, signals and operating mechanism.

The elevated road includes some 14 miles of trackage. The switches and signals are controlled from four switch towers, and the automatic block signals are located at distances of about 800 feet apart. Each tower is supplied with indicators, showing the approach of trains. The towers at the junction of the Atlantic circuit and main line control some 1,200 elevated trains daily. The largest tower is located at the Sullivan Square terminal, where some 500 elevated trains and 700 surface cars pass in and out daily, involving 6,000 switch and signal movements. A force of only two men on duty is required to operate the switchboard mechanism, consisting of 35 pneumatic levers. The terminals are also supplied with lamp indicators, showing the relative location of approaching trains. While the train movements at Sullivan Square are not so complicated as those at the Boston South Terminal Railway Station, the Elevated Railway Company has less track room at its disposal and handles a much larger number of trains for a given number of tracks.

High Torque Induction Meter.

In all the types of motor meters, theory requires that the torque, speed and load should all increase in the same proportion. This is not possible, however, for the reason that torque has two factors, namely, the generation of foucault currents in the damper, which varies according to the law of the perfect meter, and the overcoming of friction, which does not vary according to such law. It is, therefore, evident that the higher the torque with a given friction, the smaller will be the deviation from the law. This principle is employed in the Thomson high-torque induction meter, made by the General Electric Company, which is shown in the accompanying illustrations. In this case the torque is made a maximum, while at the same time the utmost care has been taken to reduce the friction to a minimum. Moreover, similar care has been taken in the design and construction to insure that a meter shall not only be reasonably

FIG. 1.—INDUCTION METER.

accurate under all reasonable conditions, but shall remain accurate and retain its value over a long period of years.

The static portion of the meter elements occupies the back of the case, and is magnetically separated from the damping magnets and shaft mechanism by a magnetic shield, shown in Fig. 2. This magnetic shield serves jointly with the iron case and cover to completely protect the damping magnets from any stray fields incident to heavy load or short-circuits which might otherwise tend to weaken the damping magnets and impair the accuracy. This shield also plays an important part in the general behavior of the meter.

The case of the meter is removed directly towards the front, as shown in the illustration. It is made of cast-iron, finished in black enamel, and rests against the back frame upon felt packing, to which it is securely bound by two wing nuts, both of which may be sealed.

The register is of the new "no constant" type, having five indicator hands, as on all Thomson recording wattmeters. The readings are uniform with the readings of the Thomson recording wattmeters, and may be recorded and tabulated on the same system.

The binding-posts are located at the bottom of the meter, and are so arranged as to render installation easy and rapid. A small cast-

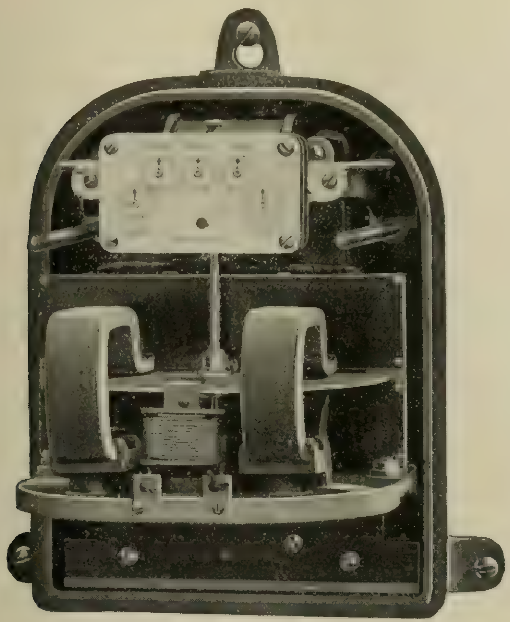


FIG. 2.—VIEW OF METER MECHANISM.

iron lid covers an oblong aperture in the base of the meter case, and is held in place by a wing nut. This lid, when removed (Fig. 1), exposes the binding-posts and gives access to them without in any other way opening the meter.

As friction is a variable, it is important to provide means for easily and immediately compensating for friction. The high-torque meter has been provided with a device for this purpose, which is generally known as the light-load adjustment. This device consists of a small and entirely independent torque producing structure which will be noted between the magnets in Fig. 2 and in Fig. 3. This device is provided with a movable sector, which by adjustment gives complete control of friction, compensation, and light-load accuracy, without disturbing the other essential characteristics of the meter, such as accuracy on inductive load, changes of frequency, wave form, potential and the like.

The light-load adjustment device permits of a 10 per cent. speed variation plus or minus at light load without affecting general calibration.

It is conceded that accuracy on inductive loads is essential to an induction meter for general alternating-current service; the high-torque induction meter is designed and proportioned so as to secure the highest possible inductive load accuracy, and may be relied upon to record true watt hours either upon an entirely non-inductive load, such as incandescent lamps, or upon highly inductive loads, as fan, or other motors.

The meter, in common with all other meters of its class, must be proportioned and calibrated for the frequency upon which it is to be used. In view of the fact that 125 cycle systems are now quite generally being converted to 60 cycles, all high-torque induction meters ordered for use on 125 cycle systems are provided with means for immediate reconnection for 60 cycle service, to provide for a possible future change. Meters ordered for 60 cycle service, however, are not provided with this feature, as it constitutes in that case an unnecessary complication.

It is probably not generally appreciated that the principle of the induction meter renders it especially sensitive to variations of wave form, but great care has been exercised in the design of the high-torque meter to secure satisfactory behavior in this particular.

A large proportion of central-station systems of moderate size have appreciable variation of potential from the normal potential of the system, either on different portions of their lines or during different portions of the 24 hours. It is, therefore, highly important that the meters used on such a system should be accurate irrespective of such potential variations. This characteristic may readily be determined by test, and constitutes an important consideration. The high-torque meter is unaffected by a 10 per cent. variation in voltage, either side of that for which it is calibrated.

Minute attention is given to the matter of producing reliable magnets. Each shipment of steel from a manufacturer is assigned a distinguishing symbol, and immediately upon receipt, a certain portion of it is put through special processes, is formed, hardened, magnetized and aged, and complete measurements are made at each step. Upon the results of these measurements is based the acceptance or the rejection of this particular shipment. If rejected, the remainder of the shipment, together with these samples, is returned to the manufacturer to dispose of as best he may. If acceptable, the remainder of the steel is put through, each magnet being stamped with the distinguishing symbol of this shipment, and the shipment is passed to production. After passing through the hardening furnaces, the magnets are subjected to hammer blows, and those failing to ring absolutely true are thrown out. They are magnetized in a machine of special construction, and are subjected to numerous processes of artifical aging, the most essential of which are patented. The magnets are then carefully measured and stored in individual trays for a period of time, after which those magnets which do not measure exactly as when laid aside are discarded.

A long and thorough investigation has demonstrated that there is but one grade of sapphire for jewel-bearing stones which is satisfactory for service in connection with motor meters. It is a certain grade of Eastern sapphire, which must be cut and polished with the greatest care. The General Electric Company buys and uses Ceylon sapphires only, and rejects a large percentage of the total purchases. As an additional precaution, the stone is bought in the pebble, selected by an expect lapidary, and is cut and polished in the company's factory

In the manufacture of jewels from sapphire, it is possible to polish them only by the use of diamond dust, which is carried in a heavy oil for convenience of application. This diamond dust is graded according to the number of hours required to precipitate it from the oil

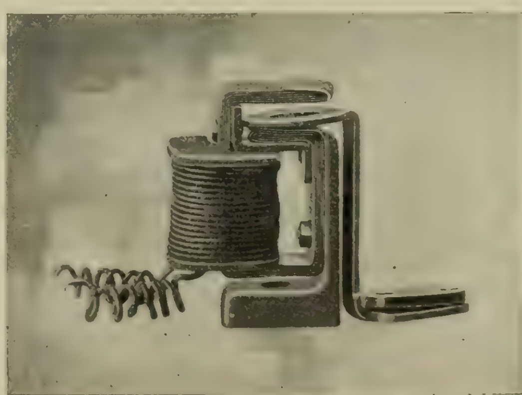


FIG. 3.—DEVICE FOR PRODUCING TORQUE.

in which it is carried. The precipitate, which will polish a perfectly hard stone in a satisfactory manner, is sufficiently rough to cut and scratch a soft stone. By using only that precipitate which is sufficiently coarse to cut soft stones, an additional inspection is secured, for the workman finds it impossible to polish any stone which is not of the higher grade of hardness.

The exact strength of the supporting spring beneath the piston of the jewel mount in relation to the weight of the moving element of the meter is a highly important factor in the life of the jewel. The strength of this spring is, therefore, the subject of careful test and inspection in connection with every complete jewel screw issued. The strength of each spring is carefully gauged by high and low limit weight, and all springs not falling within the proper limits are rejected.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—[illegible] on Friday, [illegible] The closing rate for [illegible] The stock market retained a bullish [illegible] speculative activity showed a decrease, [illegible] rates and in the diminished supply of money in the market. [illegible] higher [illegible] Greater attention was paid to industrials as a class, although [illegible] to the railroad share list. The traction stocks were [illegible] of talk about the increased earnings in the Brooklyn Rapid Transit. In Boston there was some excitement in [illegible] prevailed in that market. Brooklyn Rapid Transit after reaching 72 closed at [illegible] General Electric ranged between [illegible] the lowest, and 195, closing at 192, a net loss of 1½ points. Metropolitan Street Railway was quiet, closing at 147, a net loss of 1 point. Western Union closed with a net gain of 1⅛ points, the alleged pool showing a tendency to support that stock more effectually. [illegible] Westinghouse [illegible] the highest quotation of the week being 233; and American Telephone and Telegraph at [illegible] Commercial Cable made a gain of 11½ points, closing quotation being 174½. Following are the closing quotations of September 16:

NEW YORK.

	Sept. 9	Sept. 16		Sept. 9	Sept. 16
American Tel. & Cable	[illegible]	[illegible]	General Electric	[illegible]	192
American Tel. & Tel.	[illegible]	[illegible]	Hudson River Tel.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Metropolitan St. Ry.	[illegible]	[illegible]
Brooklyn Rapid Transit	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Commercial Cable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Western Union Tel.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

BOSTON.

	Sept. 9	Sept. 16		Sept. 9	Sept. 16
American Tel. & Tel.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PHILADELPHIA.

	Sept. 9	Sept. 16		Sept. 9	Sept. 16
American Railways	[illegible]	[illegible]	Phila. Traction	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Phila. Electric	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

CHICAGO.

	Sept. 9	Sept. 16		Sept. 9	Sept. 16
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]			

* Asked.

WESTERN UNION.—The Western Union Telegraph Company [illegible] the following statement for the quarter ending September 30, [illegible] the figures for the current year being partly estimated, while [illegible] are actual:

	[illegible]	[illegible]	Changes.
Net revenue	[illegible]	[illegible]	[illegible]
Bond interest	[illegible]	[illegible]	[illegible]
Balance	[illegible]	[illegible]	[illegible]
Dividends	[illegible]	[illegible]	[illegible]
Surplus	[illegible]	[illegible]	[illegible]
Previous surplus	[illegible]	[illegible]	[illegible]
Total surplus	[illegible]	[illegible]	[illegible]

The actual returns for the quarter ended [illegible] were: Net revenue, [illegible] bond interest, [illegible] balance, [illegible] dividends, [illegible] surplus, [illegible] previous surplus, [illegible] total surplus, [illegible] The directors of Western Union have declared the regular quarterly dividend of [illegible] per cent., payable October 15, to stockholders of record September [illegible]

EDISON ELECTRIC COMPANY, LOS ANGELES.—It is proposed, as already noted, to reorganize the Edison Electric Company of Los Angeles, Calif., in order to increase the company's capital stock to $10,000,000. The reorganization contemplates the exchange of securities in the present company for an equal amount of new preferred stock with 20 per cent. of the new common stock added, merging the present Edison Company with the Redlands Light and Power Company, Santa Ana Gas and Electric Company, Pasadena Electric Company and other Edison subcorporations. The new stock will be divided into $4,000,000 preferred and $6,000,000 common, $2,000,000 of the preferred and $400,000 of the common stock to be issued at once, and the remainder to be held in the company's treasury. It is contemplated in the proposed reorganization to create a $10,000,000 five per cent. gold bond issue, which is already pledged to be taken by a syndicate of Chicago, San Francisco and New York bankers. Bonds of the old parent company and subcompanies will be retired. The new fund will be used for the construction of a 20,000-hp hydro-electric plant on Kern River, with transmission lines to Los Angeles; the erection of a steam plant in Los Angeles for reserve purposes, and similar plants on Mill Creek and Santa Ana River.

DIVIDENDS.—The Philadelphia Traction Company has declared the regular semi-annual dividend of $2 a share, payable Oct. 1. The Chicago South Side Elevated has declared the regular quarterly dividend of 1 per cent., payable Sept. 30. The directors of Detroit United Railway have declared the regular quarterly dividend of 1 per cent., payable October 1. The Louisville Railway directors will declare a dividend on the common stock January 1, and will place it on a 5 per cent. basis. The company will also issue $500,000 of new common stock at $50 a share, similar distributions to be made the next two years. The regular quarterly dividend of 1 per cent. on the common stock of International Steam Pump is payable October 1.

NORTHERN OHIO TRACTION COMPANY.—The plan for refinancing the Northern Ohio Traction Company, at Cleveland, contemplates the organization of the Northern Ohio Railway and Light Company, with a bond issue of $7,000,000 and a capital stock of like amount. Improvements to the system will be made at a cost of $500,000.

BELL TELEPHONES.—An increase of 3,098 instruments is reported in the net output of the American Telephone and Telegraph Company for the month ended August 20, making a net increase of 90,182 instruments since December 20 last.

Commercial Intelligence.

THE WEEK IN TRADE.—Fall trade is still expanding in volume, reports of unabated activity coming from all sections. Industry is active, and present outputs equal and in most cases exceed reports, except in the hard-coal region and iron and furnace work, the latter because of the coke shortage. Railway earnings were rather more irregular because the season of grain movement is somewhat later, and strikes are reflected in decreases on some roads; but excluding the hard-coal roads, the month of August shows 5 per cent. gain in the gross receipts over last year. The anthracite coal strike appears to be fading away, some other strikes have been actually ended, and labor is well employed as a rule. Building material is brisk, and in the East, where quiet prevailed of late, there is an active call for lumber. The shortage of fuel still aggravates the iron situation, which keeps the flood of foreign iron and steel steadily rising; the July import is not far from 100,000 tons. Rails and structural materials are still the prominent features, and trade in wire is improving. Hardware is in excellent demand everywhere. Copper is stronger in tone. There was a short-lived boom on Friday as a result of which producers reaped a handsome profit by making large sales, and even exporters who purchased copper previously for export at low prices resold it in this market at a good profit. Lake sold as high as 12¼c.; electrolytic brought 11⅝c. to 12c., and casting 11½c. to 12c. There was a slight reaction at the close of the week, the final prices being 11.80c. to 12.25c. for Lake, spot to December; 11.75c. to 11.90c. for electrolytic and casting, and 11.20c. to 11.60c. for standard. The business failures for the week ending September 11, as reported by *Bradstreet's*, aggregated 197, as against 133 the week previous, and 182 the same week last year.

PORTO RICO WATER-POWER PROJECT.—A scheme is on foot for the purpose of taking advantage of the most important water power in Porto Rico. The project includes the building of a dam and power house on the Rio Plata, located in the mountains, about 17 miles distant from San Juan; the construction of a transmission line from the hydraulic plant to San Juan, and the construction and equipment of a substation in that city; the furnishing of a ferryboat to run from San Juan to Catano, a small town situated across the bay, and the present terminus of a narrow-gauge steam road, which runs from Catano to Bayamon, a distance of about 4⅓ miles; and, lastly, the conversion of the above-mentioned road to a standard gauge electric traction system. Regarding the power plant, the total head, with a dam, would be 190 feet. At this head, with a minimum flow of the river, the horse-power at the end of the water-wheel shaft would be 1,600. It is proposed to equip the power house with three generators of 500-kw capacity each. Ultimately, it is proposed to build a number of storage dams with a view to increasing the capacity of the plant. The first section of the pipe line will be built of 5 feet 6 inch pipe. The second will be constructed of 5 feet size. For the third section, where the gradient is much steeper, it is proposed to use a diameter of 4 feet 6 inches. The length of the pipe line will be about half a mile. All the pipe will be steel riveted. The Luz Electrica, a San Juan lighting plant of about 800-hp capacity—5,050 incandescent lamps, of 16-cp—is to be taken over by the new enterprise, which is called the Rio Plata Electric Company, and of which George W. C. Drexel, of Philadelphia, is president, and Ramon Valdes, Edison Building, Broad Street, New York; Andrew C. Gray, Wilmington, Del.; Chas. Sinkler, 501 Drexel Building, Philadelphia, and United States Engineer Cosby, of Mobile, Ala., are largely interested. The Lux Electrica plant at present is equipped with General Electric generators and Harrisburg, Payne & Westinghouse engines. The carrying out of the entire project will involve an expenditure not far short of three-quarters of a million dollars.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials from the port of New York for the week ended September 6: Azores—3 pkgs. material, $563. Argentine Republic—63 pkgs. material, $1,730; 2 pkgs. machinery, $42. Amsterdam—1 pkg. machinery, $72. British West Indies—75 pkgs. material, $3,024; 210 pkgs. machinery, $11,386. British Guiana—23 pkgs. material, $521. Bremen—76 pkgs. material, $2,268. British Australia—49 pkgs. machinery, $4,524; 251 pkgs. material, $6,014. British Possessions in Africa—4 pkgs. material, $102. Bristol—22 pkgs. material, $16. Brazil—18 pkgs. material, $1,224; 82 pkgs. machinery, $27,797. Berlin—1 pkg. machinery, $715; 19 pkgs. material, $748. Chili—37 pkgs. material, $1,935. Cuba—33 pkgs. material, $11,825. Central America—19 pkgs. machinery, $400; 26 pkgs. material, $254. Dutch West Indies—10 pkgs. machinery, $1,705. Dover—1 pkg. material, $22. Ecuador—67 pkgs. material, $396. Fiume—12 pkgs. machinery, $4,800. Gilbraltar—1 pkg. material, $50. Genoa—2 pkgs. material, $103. Glasgow—2 pkgs. material, $81. Hamburg—4 pkgs. machinery, $337; 8 pkgs. machinery, $314. Hayti—7 pkgs. material, $80. Havre—9 pkgs. material, $190; 1 pkg. machinery, $40. Japan—6 pkgs. machinery, $1,940. Leicester—2 pkgs. material, $65. London—12 pkgs. machinery, 12,653; 54 pkgs. material, $3,649. Liverpool—148 pkgs. machinery, $17,448; 97 pkgs. material, $4,440. Newcastle—7 pkgs. machinery, $1,100. Mexico—1 pkg. machinery, $799; 7 pkgs. material, $254. Milan—2 pkgs. material, $45. New Zealand—8 pkgs. machinery, $410; 15 pkgs. material, $356. Peru—11 pkgs. material, $245. Southampton—102 pkgs. material, $1,528. U. S. Colombia—3 pkgs. material, $45; 7 pkgs. machinery, $3,750.

THE RAILWAYS AND LIGHT COMPANY OF AMERICA, whose executive offices are in the Continental Trust Bldg., Baltimore, Md., has recently opened in addition a general manager's office in the Shafer Building, Richmond, Va. This office is in charge of Mr. E. L. Bemiss, who has recently been appointed general manager of the company, in place of Mr. E. C. Hathaway. Mr. Bemiss was formerly with the Richmond Traction Company. Mr. Hathaway has been appointed general manager of the Norfolk, Portsmouth and Newport News Company, with offices at Norfolk. This company is one of the consolidations effected and operated by the Railways and Light Company of America. It comprises railway, electric and gas lighting and ice manufacturing interests, and is a consolidation of 14 former companies, operating in Berkeley, Newport News, Portsmouth, Hampton Roads, Old Point Comfort and Norfolk. Mr. Berkeley Williams, who was formerly purchasing agent of the Richmond Traction Company, has been made purchasing agent of the Railways and Light Company of America, with the idea of making blanket contracts to cover all the properties owned and operated by it. Mr. John Pope has recently accepted a position on the engineering force. Mr. Pope was formerly with the Virginia Electrical Developing Company.

ANOTHER MEXICAN POWER PROJECT.—The North American Beef Company, composed of Chicago capitalists, intends to erect a huge water-power plant at Uruapam, in the State of Michoucan, Mexico, for the purpose of operating a $500,000 packing plant there and supplying the cities of Morelia and Acambaro, also the mines of the El Oro with power for general purposes. C. Mallory, of Chicago, until recently a member of the Mallory Commission Company, and now president of the Mexican Plantation and Steamship Company, is primarily interested in the North American Company. Other parties concerned include W. Ball, of the Chicago Board of Trade; Judge Holmes, attorney of the Union Traction Company, and Judge Palmer. It is proposed in the first instance to construct a hydraulic plant of about 3,000 hp capacity. Eventually it is intended to increase the equipment up to 5,000 hp for the purpose of operating large tanneries, candle and soap factories and other industrial plants which the company intends to establish in the near future.

BROOKLYN SUBWAY AND WIRES.—The Board of Estimate of Greater New York met last week and authorized a bond issue of $3,000,000 for the Brooklyn tunnel extension. The contract for the Brooklyn extension from the rapid transit subway at City Hall, Manhattan, down Broadway and under the East River to Brooklyn, was signed on Thursday, and within twenty-four hours the money for the work was appropriated. Commissioner Monroe, of the Department of Water Supply, Gas and Electricity offered a resolution that in Brooklyn trolley feed wires and all others except those now securely attached to elevated structures on several of the most traveled thoroughfares in Brooklyn be put underground. Prof. Colin, of the Brooklyn Rapid Transit Company, objected to the passage of the resolution on the ground that is was unnecessary. The resolution suggested by Commissioner Monroe was adopted.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, of Chicago, has just closed a contract with the Keystone Telephone Company, Philadelphia, for two more common battery multiple relay switchboards, of 4,800 lines capacity each, for its fifth and sixth district exchanges, respectively. Included in this contract is a chief operator's desk, wire chief's desk and manager's desk, all of which will be of mahogany, to match the main switchboard, together with all necesary power apparatus, relay racks, distributing frames, lightning arresters and sneak-current apparatus. This will make a total ultimate equipment of 34,080 switchboard lines, which the Kellogg Company will have furnished the Keystone Telephone Company for its extensive system in Philadelphia.

POWER PLANT IN INDIANA.—Plans are well under way for the construction of a large electric power plant at Horseshoe Bend, eight miles south of Monticello, Ind. A tract of 40 acres at this point on the Tippecanoe River has been purchased by Charles Meeker and other Lafayette capitalists. It is proposed to furnish electricity for power and lighting to Delphi, Lafayette, Monticello and other neighboring towns, and for the proposed electric railway along the old Wabash canal.

NEW POWER PLANT IN CONNECTICUT.—The Connecticut Railway and Lighting Company has asked for bids on plans for three new buildings which will be erected by the company in Shelton, New Britain and Waterbury. To erect these buildings, an amount close to $200,000 will be expended. In Shelton, the company will erect an entirely new power plant and another one in New Britain. In Waterbury a large addition to the present power plant will be constructed.

A. B. SEE ELEVATOR WORKS.—The A. B. See Electric Elevator Company, factory at 116 Front Street, Brooklyn, has bought more than eight acres on Pacific Avenue, Pine and Carnoth Streets, Jersey City, and will erect works there, moving from Brooklyn. The new buildings are to cost $70,000. The concern has done a large and growing electric elevator business for many years past.

LIGHTING PLANTS.—The Steam & Electrical Equipment Company, Conestoga Building, Pittsburgh, has received orders from the Poughkeepsie Light, Heat & Power Company, of Poughkeepsie, N. Y., for one 190-kw Stanley, 60-cycle two-phase 2200-volt alternator, and from the Waynesburg Electric Light, Heat & Power Company for a Babcock & Wilcox 108-hp boiler.

MR. G. M. GEST, the well-known conduit contractor, has recently secured the contract for the conduit system for the Schenectady Railway Company, Schenectady, N. Y. This work will amount to over 2,000,000 feet. It is Mr. Gest's intention to make this installation a model one in every respect. Many new features will be designed for this particular installation.

ANOTHER ELECTRIC ROAD FOR TAMPICO.—An electric traction system is to be constructed in the City of Tampico, Mexico, to connect with the docks at Dona Cecilia and the mouth of the Panuco River. The total length of the lines will be a little over seven miles.

BUNNELL INTERESTS CONSOLIDATED.—It is stated that a consolidation has been effected of the Bunnell interests in the electrical manufacturing field, Mr. Morris Wise, of the Bunnell Telegraphic and Electrical Company, having bought out J. H. Bunnell & Co. from Mr. C. McLaughlin. Details are not yet forthcoming.

General News.

THE TELEPHONE.

[illegible] y C. F. Guthridge. [illegible]

[illegible] Lines will be built in El Paso, Arapahoe, Boulder, Clear Creek, Gilpin, Jefferson, [illegible]

[illegible] Telephone Company has been incor-[illegible] Townsend, Jr., [illegible]

[illegible] granted a franchise to M. C. Rowe, of Starke, for a telephone system in De Land.

JACKSONVILLE, FLA.—On Oct. 1 the Southern States Telephone and [illegible] The capital stock will be [illegible] hundred miles, connecting Jackson-[illegible] will be president of the new com-pany.

[illegible] Telephone Company, of this city, has [illegible] Company. Some time ago the city [illegible] the Bell Company a charter to operate [illegible] ny had to run its long distance wires around the [illegible] the city limits. It is said that unless [illegible] the Bell Company a new franchise, it will continue to [illegible]

CULDESAC, IDA.—The Nez Perce Co-operative Telephone Company will build a line from Ilo to Dublin and thence to Mohler by way of Fletcher.

CARMI, ILL.—The White County Telephone Company has been incorporated by J. C. Stokes, G. P. Hanna and T. H. Land. Capital, $9,000.

CHICAGO, ILL.—The Illinois Telephone Company's downtown tunnel is rapidly nearing completion, despite the City Council's non-action. It is said the downtown conduits will be finished by Dec. 1, and that by Feb. 1, 10,000 [illegible]

CHICAGO, ILL.—Long distance telephone connection is to be established between Grand Marais and Whitefish Point, Lake Superior. This will be of great service to life-savers in case of disaster, and also will aid the weather bureau in the display of storm signals.

WINDSOR, ILL.—The Windsor Mutual Telephone Company contemplates making some extensions of its lines into the country. It has just been organized. Its switchboard has a capacity of 100 drops, the apparatus used being of Stromberg-Carlson make. The service is conducted on the "mutual plan."

HYMERA, IND.—The Hymera Telephone Company, of Sullivan County, has been incorporated. The capital stock is $5,000. The company will construct and operate a telephone system in Hymera, and subsequently extend the service throughout the county. The directors are: James M. Barnett, O. B. Kattmau, [illegible] and John Funkhouser.

[illegible] Telephone Company, of Kosciusko County has been incorporated with a capital of $20,000. The company will construct and maintain a telephone system in Kosciusko County with a central exchange and office at Milford. The company proposes to extend its service to ad-[illegible] James Haller, G. G. Grady, M. O. Whight, P. T. Miller and W. B. Neff constitute the board of directors.

INDIANAPOLIS, IND.—Complete figures compiled from the record of the recent session of the State Tax Board, show a large increase in the assessment or valuation of tangible telephone property over last year. In 1901 the [illegible] for a valuation of $4,436,666, exclusive of [illegible] an increase of $628,660.30. Telegraph [illegible] $[illegible], a decrease of $36,6[illegible]

[illegible] Telephone Company has [illegible] $[illegible],000,000 in favor of the Union Trust Company [illegible] payment on 1,200 gold-bearing five per cent. [illegible] in twenty years. The bonds are for $1,000 and for $[illegible] property of the company in thirty [illegible] being placed on record in [illegible] general improvement and ex-[illegible] the system. The lines will be extended into other [illegible]

FRANKFORT, KY.—[illegible] Telephone Company of [illegible] $2,500, by A. J. Stern, [illegible] and others.

BALTIMORE, MD.—[illegible] Company of Baltimore is installing [illegible] subscribers.

PITTSFIELD, MASS.—[illegible] Company has accepted the [illegible] begin the work of establishing a telephone system.

AUGUSTA, ME.—The General Automatic Exchange, capitalized at $1,000,000, [illegible] The [illegible] was organized at Port-[illegible] used in building and operating telegraph, telephone and district messenger lines. The promoters are H. M. [illegible] Franklin C. Payson and [illegible] of Portland.

MARSHALL, MICH.—The new exchange of the Marshall Telephone Com-[illegible] with 400 subscribers. A long distance line [illegible] to connect with Grand Rapids and points in [illegible] has been constructed to connect with Jack-[illegible]

DETROIT, MICH.—Mayor Maybury and a group of Detroit capitalists are prepared to work out plans to push to completion an independent telephone plant for this city. It is the plan to take over the incompleted telephone plant of the People's Telephone Company, which is owned by the Federal Telephone Company of Cleveland; also to buy out the Co-operative Telephone Company, organized by local people, and which has progressed to the extent of securing [illegible] The People's Telephone Company offers [illegible] installed for $400,000: $[illegible] to be paid in cash, and $300,000 in the securities of the new company and to invest $200,000 in the new company's stock. The Co-operative Company is willing to sell its property for $35,000. It is stated it would cost about $750,000 to place the plant in working order and that $600,000 of this has been subscribed by the Detroit people. It is expected this deal will be closed in the near future.

NATCHEZ, MISS.—The Cumberland Telephone and Telegraph Company has [illegible]

[illegible] The Cumberland Telephone Company will establish a system here, the requisite number of subscribers having been obtained.

JOPLIN, MO.—The Home Telephone Company, of this city, has filed letters of incorporation, with a capital stock of $200,000, all paid. The incorporators are Theodore Gary, J. L. Bridgeford, Ross Larrabee, Raymond E. Frey, Dan R. Hughes and John Scovern, of Macon, Mo., John W. Layne, of Carthage, W. H. Warren, George G. Bayne, G. F. Newburger and others.

ST. LOUIS, MO.—The Bell Telephone Company of Missouri will erect a new building on the southwest corner of Grand and McRea Avenues, to be known as the Grand station. The building will be a modern, slow combustion one, the exterior of which will be constructed of vitrified brick, with stone and terra-cotta trimmings, laid in Portland cement. There will be no plastering, but, instead, the entire interior of the building will be lined with enameled brick of various colors. The stairway and entrance are to be of white marble and iron, with brass trimmings and all the window frames, etc., will be made of galvanized iron and glazed with wire glass. The building will be equipped with a low pressure steam heating apparatus. Especial attention has been given toward the comfort of the employees, in providing a dining-room, kitchen, etc. When completed, this building will enable the telephone company to operate its underground system in the southern district of the city. The building will cost $30,000.

HASTINGS, NEB.—The Adams County Telephone Company (Independent) has been granted a franchise in this city, and will expend $30,000.

LAKEWOOD, N. J.—The Township Committee two years ago passed an ordinance granting the New York and New Jersey Telephone Company permission at its request to place its wires underground throughout the town. This the company has made no attempt to do. Because the company erected new poles on several of the streets last week, which is claimed to be an alleged violation of one of the sections of the ordinance passed, the Township Committee at its meeting revoked the franchise granted it. Any attempt now made to place its wires underground will probably be met by an injunction restraining it from doing so.

SAYRE, N. Y.—The Lehigh Valley Railway Company is to erect a telephone line along the Montrose branch, between Tunkhannock and Montrose.

CHARLOTTE, N. C.—The Bell Telephone Company has been granted the privilege of putting its wires underground.

SPRINGFIELD, OHIO.—The Springfield Home Telephone Company is building a line to Orchard.

ANDOVER, OHIO.—The Andover Electric Telephone Company is building a line to West Williamsfield.

HICKSVILLE, OHIO.—The Hicksville Telephone Company has increased its capital stock from $10,000 to $25,000.

KENTON, OHIO.—The Kenton Telephone Company is building copper circuits to Marion, Mt. Victory, LaRue and other towns.

RAVENNA, OHIO.—The Ravenna Home Telephone Company has leased new quarters and will remove at once. The company has 700 lines in operation.

PITTSFIELD, OHIO.—The Pittsfield Home Telephone Company has just completed the work of installing its exchange. It will build additional farmers' lines.

HAMILTON, OHIO.—The Hamilton Home Telephone Company has agreed with the city to install much of the system in the business section in underground [illegible]

SALEM, OHIO.—The strike of the operators of the Columbiana Telephone Company has been adjusted and the girls have returned to work with a small increase in wages.

PORT CLINTON, OHIO.—The Port Clinton Home Telephone Company has been sold to the Ottawa County Telephone Company, which will incorporate with a capital stock of $150,000.

CLEVELAND, OHIO.—Charles Richeter, a real estate man, has brought suit against the Cleveland Telephone Company for failure to include his name in the Telephone Directory. Mr. Richeter claims he has been a subscriber for thirteen years. He claims to have lost a number of real estate transactions through failure to have his name in the book, and he demands $10,000 damages.

MANSFIELD, OHIO.—It is stated that the option on the Mansfield Telephone Company, which has been held for some time by Senator Laning, of Norwalk, has been closed and that the system will speedily pass into the hands of the Norwalk syndicate. The Mansfield stockholders will retain their minority interest, and it has been arranged to make a number of improvements to the plant.

CLEVELAND, OHIO.—An enterprising retail grocer has taken advantage of the offer made by the Cleveland Telephone Company, of one-way kitchen service for six months free at $1, and has placed orders for two hundred

instruments which will be placed in the kitchens of patrons who have no telephones. It is believed the Cleveland Telephone Company will put in 20,000 new telephones under this plan.

CLEVELAND, OHIO.—If plans now under consideration do not miscarry, the Everett-Moore syndicate, which a short time ago was acknowledged to be the strongest factor in the independent field in this country, will soon practically retire from the telephone business. The announcement is made that in all probability 60 per cent. of the holdings of the United States Telephone Company will be sold to a syndicate of capitalists headed by Edward L. Barber. Forty per cent. of the holdings would still remain in the hands of the Cleveland people, but it appears to be the policy of the syndicate to dispose of all its telephone interests. The capitalists, among whom Mr. Barber is the leading spirit, have already constructed nearly thirty exchanges in Ohio, recently completing one in Toledo, and are now building exchanges in Louisville, Kansas City and Chicago. It is claimed that in his operations Mr. Barber is backed by interests allied with the Standard Oil Company.

CHESTER, PA.—It is learned that the amalgamation of the Keystone State Telephone Company and the United Telegraph and Telephone Company will be effected, the latter merging with the former.

HARRISBURG, PA.—Judge Weiss, in an opinion, declares that telephone companies have the right of eminent domain in Pennsylvania under the act of 1874.

PIERRE, S. D.—The Hyde County Telephone Company, of Highmore, S. D., has been incorporated with a capital stock of $1,000.

ABERDEEN, S. D.—At the annual meeting of the stockholders of the Dakota Central Telephone lines at Aberdeen, the old officers and directors were re-elected. The annual report shows that during the past year $120,000 has been expended in extensions, improvements and general equipments. One thousand miles of new lines have been constructed and seven exchanges bought, including the Aberdeen exchange. Several important improvements are now contemplated, especially in the way of constructing copper metallic circuits on the more important lines of the company.

FORT MILL, S. C.—S. L. Meacham has been granted a franchise for a telephone system in Fort Mill.

CLARKSVILLE, TENN.—The Clarksville Home Telephone Company, capital stock $100,000, has been incorporated by W. G. Nagel, D. Fox, B. F. Gill, and others.

GRAHAM, VA.—The Graham Telephone Company is building a line to Stowersville, which will connect with the Clear Fork Company's lines.

PETERSBURG, VA.—It is rumored that a new telephone company is being projected. This, if successful, will be the third system in this town.

COLLIERSVILLE, VA.—The charter of the Rockbridge Telephone Company, of Colliersville, has been filed with the Secretary of State. The capital will be $5,000.

RICHMOND, VA.—The Bell Company, having completed its new system in Richmond, will require all subscribers to sign a new contract by October 1, which will increase rates. The city will investigate the proposed increase.

RICHMOND, VA.—The Fluvanna Telephone Company of Virginia is building a line between Whitehall and Wingina. The line will be extended to Bremo Bluff according to present plans. At the latter place a long distance connection will be made.

PARKERSBURG, W. VA.—Five hundred citizens attended a recent mass meeting to protest against the increase of rates by the Bell Telephone Company here. Those present agreed to discontinue the Bell service and subscribe for that of the West Virginia Western Telephone Company, the independent company. A committee was appointed to secure subscriptions to a bond issue to enable the independent company to place its system in first-class shape.

ANTIGO, WIS.—The Wisconsin Telephone Company is constructing lines from Wausau to this place.

ELECTRIC LIGHT AND POWER.

LOS ANGELES, CALIF.—The Etiwanda Power Company's capital stock has been subscribed in part by Geo. Chaffee, N. W. Stowell, J. W. Swannick, R. Harris and A. M. Chaffey, all of Los Angeles. The capitalization is $250,000.

SAN FRANCISCO, CALIF.—The Edison Electric Company, the Los Angeles corporation, which has commenced the hydraulic work on its 15,000-kw electric transmission system on the Kern River, recently closed a contract with the General Electric Company for a temporary generating plant. There will be two 150-kw 60-cycle 2300-volt generators and three 75-hp induction motors. These will operate the air compressors which will supply pressure for the air drills used to bore the big water tunnel that will require nearly a year in construction. It will take two years to complete the plant.

SOUTH MANCHESTER, CONN.—The electric plant which Cheney Bros., silk manufacturers, have erected on the Hockanum River is completed and electricity generated by water power is transmitted to the mills two miles away. The enterprise has involved $200,000. Electric power will be used both for operating purposes and lighting.

GEORGETOWN, DEL.—The Sussex Light, Heat and Power Company, of Georgetown, has been incorporated; capital, $25,000.

ROME, GA.—The town of Rome proposes to establish a municipal electric lighting plant and the city attorney has been requested to prepare a bill to be presented to the next legislature authorizing the issuance of $15,000 bonds for the same.

ALTON, ILL.—A communication has been received by the Alton city council from a Chicago company offering to establish in Alton for $35,000 an electric lighting plant of sufficient size to meet the present and the future needs of Alton. The city is now lighted by the Alton Railway, Gas and Electric Company, which has no opposition.

GOSHEN, IND.—The city council has granted a fifty-year franchise to the Hawkes Electric Company to operate an electric light plant in Goshen. This movement puts the private concern in a position of advantage over the plant owned by the municipality and may mean the absorption of the city plant by the Hawkes concern, as it is not on a paying basis and has always been the subject of political discussion.

RICHMOND, IND.—The electric light commissioners for this city, in charge of the municipal plant, have surprised the citizens by notifying the city that it will be charged for service the same as private consumers—the rate being $75 a year for each arc light. The commissioners say that if the plant is to be placed on a money-making basis at the start the city should assume the attitude of a private patron toward it.

SOMERSET, KY.—The village council has closed a contract for the erection of a $10,000 municipal lighting plant. Fifty arc lamps will be provided.

PRINCESS ANNE, MD.—The Princess Anne and Deal's Island Light, Power and Railway Company will build a railway line to Deal's Island with lateral branches. An organization was perfected on Sept. 2. H. P. Dashiell being elected president and O. T. Beauchamp, treasurer. As soon as the capital stock is subscribed the road will be built.

BUCHANAN, MICH.—There will soon be completed at this point one of the most notable electrical transmission plants in the middle west, one in which upward of $500,000 has been invested and from which many Indiana industries are expected to draw their power. The power will be furnished by ten turbine water wheels. Each wheel will furnish 300-hp. The wheels will be operated by the water of the St. Joseph river. The power house is 270 feet long, 30 feet wide and 30 feet high, the superstructure being of brick.

SCRANTON, MISS.—An offer of $25,000 has been made to the town of Scranton for the electric light and water plant. The offer comes from a northern capitalist who is also projecting an electric railway between Pascagoula and Moss Point.

NATCHEZ, MISS.—Negotiations for purchasing the Natchez Gaslight Company's plant have been on for some weeks, the object being a combination of electric light and street railway plants in the city. The Light, Power & Transit Company has recently sold out to the Electric Street Railway and Power Company for $75,000.

CASTILE, N. Y.—At a recent special election it was voted to build a municipal electric light plant to cost $10,500.

BUFFALO, N. Y.—The Fillmore Electric Light & Power Company, of Fillmore, has been organized. It has purchased the control of the waterfall in the Wiscoy Creek, which will be developed for the purpose of running the electric plant. It is estimated that 450 horse power will be available.

COLUMBUS, OHIO.—The Ada Water, Heat and Light Company has increased its capital stock from $25,000 to $75,000.

CONNEAUT, OHIO.—The municipal lighting plant has started the new equipment recently installed, consisting of a 360-hp Erie City engine, and a 4500-light Warren generator. New boilers are to be installed.

COLUMBUS, OHIO.—The East Columbus Heating & Lighting Company, which has recently secured a franchise to operate in the east end of the city, has secured a site for its power station and will commence work at once.

HUDSON, OHIO.—Messrs. Goeppinger & Backman, of Youngstown, have secured a 25-year franchise to operate an electric light plant in Hudson. There is a provision that the town may purchase the plant at the end of ten years.

TOLEDO, OHIO.—The Toledo Heating & Lighting Company is making extensive improvements to its system and is installing a large generator, a 400-hp Ball and Wood cross-compound engine and Green Engineering Company's chain-grate mechanical stokers.

GALLIPOLIS, OHIO.—The Gallipolis Electric Light Company offers to supply the town of Gallipolis with 70 arc lamps at the rate of $50 per lamp per year. The council is inclined to give the contract to Maxon & Eyesenbach, who ask $64 per lamp. The first-mentioned company is appealing to the citizens to secure the contract.

CLEVELAND, OHIO.—Prof. C. H. Benjamin, the city smoke inspector, is endeavoring to induce the city group-plan commission to build one central power station to furnish light, heat and power to the group of public buildings to be erected in Cleveland. The plan would effect a great saving and would decrease the amount of smoke in the vicinity.

KUTZTOWN, PA.—The Kutztown electric light company has increased its capital stock from $15,000 to $50,000, and will make many improvements.

ALLENTOWN, PA.—The United Waterpower Improvement Company has been incorporated to utilize the water power obtained from the several waterfalls in lower Pike County for the generation of electricity. The headquarters of the company are in the Betz Building, Philadelphia. The officers are J. P. Logan, president and treasurer, and C. J. Young, secretary and general manager. It is stated that 20,000 horse power will be utilized for the lighting and supply of power to the surrounding country.

ST. MATTHEWS, S. C.—Dr. L. M. Able is installing an electric plant for lighting stores; eventually, it is said, the town will be lighted by electricity.

NASHVILLE, TENN.—The new electric light plant of the city has been successfully tested. Four hundred and fifty arc lights are in use.

MEMPHIS, TENN.—The lighting committee of the city council has agreed upon a plan permitting a merger of the Memphis Light and Power Company and the Equitable Gaslight Company.

[illegible] at Pel-[illegible] of its mills and [illegible] the company [illegible] gold [illegible], which [illegible].

ST. ALBANS, VT.—[illegible] Light, Heat and Power Company [illegible] at [illegible] and [illegible] A. O. [illegible] The principal [illegible].

NORFOLK, VA.—[illegible] Portsmouth, Va., will be [illegible] Syndicate, and a big power house will be erected.

NORFOLK, VA.—R. B. Fentress has again applied for a franchise to put in a [illegible] light and power plant. [illegible] his application until the new constitution of the State was adopted.

[illegible] install an electric light plant, $5,000 having been appropriated for this purpose by the legislature. Dr. John W. Dawson is chairman of the board of visitors.

NORFOLK, VA.—The steamer "Atlanta," built by W. E. Cole, for catching fish by electric light, has proven a complete failure. The cost of the boat was $10,000. The plan was to attract fish by powerful electric lights and then [illegible] them in.

BALLARD, WASH.—At its last meeting the city council passed a resolution declaring in favor of building a new $25,000 electric light plant. The clerk was instructed to advertise for bids.

THE ELECTRIC RAILWAY.

SALEM, ARK.—Articles of incorporation have been filed by the Salem and Eastern Electric Railway. R. A. Youngblood is president and Sheriff H. F. [illegible], secretary.

SAN JOSE, CALIF.—The San Jose and Santa Clara street railway and the [illegible] railway, once separate corporations, but for the past two years owned and controlled by George and Hugh Center, have been purchased by the Standard Electric Company of San Francisco, which company, a few months ago, purchased the two gas and electric companies of this city, and is now operating them under the title of the United Gas and Electric Company.

FT. WAYNE, IND.—The Ft. Wayne & Northern Electric Railway Company has incorporated for the purpose of constructing and operating an electric road between Ft. Wayne, Garrett, Auburn, Waterloo and Kendallville, and electric light plants in towns along the line. The capital stock of $10,000 will be increased. Becks Erick, H. A. Randall and C. M. Neizer constitute the directors.

NEW CASTLE, IND.—Senator A. D. Ogborn, who holds a franchise for an electric railway from this city to Dunreith, announces that the road will be financed by St. Louis capitalists and the line built and put in operation by the first of the year. The line will connect with the Indianapolis, Greenfield and Richmond line at Dunreith, thus affording direct trolley connection with Indianapolis and Richmond.

COLUMBUS, IND.—An electric railway is projected to connect Indianapolis with Louisville by way of this city. The County Commissioners have granted [illegible] Hall and others. The various persons interested will [illegible]. The road will connect with the Indianapolis and Greenwood line at Columbus, making a line from Indianapolis to Louisville, a distance of 163 miles. Louisville capitalists are backing the enterprise.

NEW IBERIA, LA.—The city council of New Iberia, La., has granted two franchises for electric railways, one to [illegible] of New Orleans, and another to Hon. John A. McIlhenny.

FREDERICK, MD.—The Maryland Construction Company, which it is understood will build the Baltimore and Frederick trolley line, has received [illegible] its tracks in the latter town.

MT. VERNON, OHIO.—[illegible] of Martinsburg, [illegible] for a franchise for a line to [illegible] Mt. Vernon to [illegible] of Martinsburg.

MEDINA, OHIO.—Engineers of the Pomeroy-Mandelbaum syndicate are [illegible] the Cleveland & Southern Railway [illegible] and Seville.

CLEVELAND, OHIO.—As the result of the new through Cleveland-Toledo service of the Lake Shore Electric Railway, the Nickel Plate (steam) has [illegible] its suburban trains to Lorain and Vermillion.

MANSFIELD, OHIO.—The County Commissioners will probably grant a franchise to the Mansfield, Mt. Gilead & [illegible] Electric Railway. W. W. [illegible] and C. W. [illegible] are at the head of the project.

SANDUSKY, OHIO.—President [illegible], of the Sandusky, Clyde, Tiffin & Southern Railway Company, announces that arrangements have been completed with Eastern parties to finance the road and that construction work will soon start.

CONNEAUT, OHIO.—The county commissioners have granted the Conneaut & Eastern Traction Company a franchise from the State line to Conneaut. The road will run to Erie, Pa., as a part of the great system building along Lake Erie.

AKRON, OHIO.—The Akron-Alliance Connecting Railway Company has, it is stated, secured all the right of way, and work of construction will start in the near future. The power house will be located at [illegible]. Freight trains are to be hauled by electric locomotives.

CLEVELAND, OHIO.—The [illegible] on the Oberlin-Norwalk extension of the Cleveland, Elyria & Western Railway, has been completed and cars are now operated from Cleveland to Norwalk without change. At present the through cars are operated on a two-hour headway.

AKRON, OHIO.—The Northern Ohio Traction Company has placed an order with the [illegible] Electric & Manufacturing Company for twenty sets of equipment for new cars which are to be built. In all, the company will purchase fifty cars, the majority of them for Akron city service.

FREMONT, OHIO.—The Lake Shore Electric Railway Company is planning to abandon the old Sandusky, Norwalk & Southern power station at Milan, and will build a combined sub-station, freight and passenger station at Milan to take care of that division of the system, current being furnished from the Fremont power house. A sub-station is also to be erected as Vermillion.

CINCINNATI, OHIO.—The Cincinnati Interurban Company has been incorporated with $100,000 capital stock by W. K. Schoepf, G. H. Warrington, W. H. MacAlister, S. C. Cooper and F. B. Spangler. The company will operate the consolidated line formed by the Millcreek Valley Railway Company and the Hamilton, Glendale & Cincinnati Traction Company, which have been leased to the parties mentioned.

CANTON, OHIO.—The Canton & New Philadelphia Railway Company has elected officers as follows: Philip Saltonstall, Boston, president; L. E. Myers, Chicago, vice-president and general manager; Chauncy Eldridge, Boston, secretary-treasurer. The above, with J. Reeves, Canal Dover; E. C. Lewis, Canal Dover; J. C. Welty and G. W. Rounds, of Canton, are directors. This is the company which is building a southern extension of the Canton-Akron Railway.

TOLEDO, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Traction Company has elected officers as follows: Ellis Bartholomew, president and manager; S. M. Finch, 1st vice-president; J. H. Forrest, 2nd vice-president; I. N. Covault, secretary; Wm. P. Heston, treasurer. The above, with T. F. Whittlesey, S. S. Thorn, S. C. Heston and E. C. Schinness, are directors. A portion of the road is already under construction and arrangements have been completed to commence work on an additional 40 miles.

SPARTANBURG, S. C.—Northern capitalists have investigated a project for a 30-mile trolley line to Greenville, and it is said that a charter will soon be applied for. It is proposed to develop several fine water powers along the route.

HARRIMAN, TENN.—A scheme is being agitated contemplating an organization of Roane County capitalists to build an electric railway to Rockwood and Kingston, also to Knoxville by way of several intermediate points.

NASHVILLE, TENN.—A new electric and steam railway to McMinnville will be built, it is said, to be under the management of W. S. McKittrick, a Chicago railroad contractor. The cost will be over $750,000. The road will be 73 miles long and will pass through several prominent towns en route to McMinnville. Northern capital will operate the line, a survey for which has already been completed.

AUSTIN, TEX.—Important extensions of the street railway system of the Austin Electric Street Railway Company are being made. One of these extensions is to run from the union station to the State blind asylum, through a residence part of the city which is now without street railway transportation facilities. Several handsome new cars have also been ordered for use on this system.

SALT LAKE CITY, UTAH.—It is stated that American capital is interested in a group of mines in the West Kootenay country, British Columbia, and proposes to construct an electric railway from the mouth of the Duncan River several miles up its course, with side lines connecting with mining camps.

WHATCOM, WASH.—The commissioners of Whatcom County, Wash., have granted a franchise for an electric railway between Whatcom and Lynden to C. A. Wiatt, G. H. Butters and C. L. Likins.

CITY OF MEXICO, MEX.—The work of constructing several important extensions of the Federal District Street Railway Company's lines in the City of Mexico is delayed on account of the failure to receive the rails promptly from the American manufacturers. Thirty new cars have been ordered for use on these lines.

TAMPICO, MEX.—The construction of the new street railway system in the city of Tampico, is now in progress. A. P. Breton, an American, is at the head of the enterprise. At first the system will be operated by mule power, but the terms of the concession granted to Mr. Breton specifies that it is to be converted into an electric system within two years after construction is completed. The road is planned to run from the wharves of the port, through the principal streets of the city and to the fashionable seaside suburban resort of Dona Cecila, and thence to the beach, four miles from the city. The road will be ten miles long.

THE AUTOMOBILE.

AUTOMOBILE ENDURANCE TEST.—Some thirty automobiles are already entered for the 500-mile reliability contest, New York to Boston, of the Automobile Club of America. All are gasoline or steam. Mr. A. L. Riker has entered one gasoline made by the Locomobile Company of America, of his design, and the Ward Leonard Electric Company has two gasolines.

NEW INDUSTRIAL COMPANIES.

THE LA BOITEAUX COMPRESSED AIR ELECTRICAL COMPANY, of Cincinnati, Ohio, has been incorporated with a capital of $[illegible].

THE SPARTANBURG ELECTRICAL MACHINERY COMPANY, of Spartanburg, S. C., has applied for a charter. Its capital stock is $8,000.

THE BOSTON ELECTRIC FAN AND HEATING COMPANY, of New York City, has been incorporated at Dover, Del., with an authorized capital of $225,000.

THE MODERN ELECTRIC COMPANY has been incorporated at Camden, N. J., with a capital stock of $300,000, by Jas. W. Forster, Samuel Forster and A. A. Rolf.

THE REVERSIBLE ELECTRIC CAR-SIGN COMPANY has been chartered at Richmond, Va., to manufacture electric signs and other specialties. Mr. W. M. Glazebrook is president.

THE NEW YORK ELECTRIC HEADLIGHT AND TRAIN LIGHTING COMPANY, of Yonkers, N. Y., has been incorporated at Albany, with a capital stock of $1,000. The directors are H. D. Crippen and W. J. Huston, of New York City, and F. A. Curtiss, of Nutley, N. J.

THE NATIONAL TELEGRAPH NEWS COMPANY, has been incorporated at Hillsboro, Ill., the capital stock being $150,000. The incorporators and directors are L. M. Martin, A. K. Bromn, F. E. Crawford, A. T. Stewart and W. R. Stewart, Jr. The principal office is to be located at Chicago.

LEGAL.

A BRAKE ORDINANCE.—At Detroit, on Sept. 13, Judge Phelan handed down a decision upholding the city ordinance requiring the street railway company to operate its cars with electric or air brakes. He found the street railway company guilty of violating the ordinance and imposed a fine of $50. The case will be appealed by the company to the State Supreme Court, and perhaps to the United States Supreme Court. In his decision Judge Phelan says: "The point was made, and is still insisted upon by the respondent, that this ordinance is *ultra vires,* and beyond the corporate power of the City of Detroit to enact as municipal legislation, and this may be true, unless this municipal legislation can be supported as a just exercise of police power to protect the lives and limbs of its citizens and sojourners within limits from undue risk. If this ordinance has a tendency to preserve life and limb and avoid deplorable accidents in any considerable degree, it is my duty to sustain it. I believe this will be the effect."

PERSONAL.

MR. C. P. PLATT, of the sales department of the Kellogg Switchboard & Supply Company, of Chicago, is confined to his house with typhoid fever. His many friends hope for a rapid recovery.

MR. HARRY DE STEESE, formerly of the Western Electrical Company, has become connected with the Stuart-Howland Company, of Boston, and will have charge of its New York office, a position for which his familiarity with the electric railway field gives him special qualifications.

MR. J. R. WHARTON, manager of Butte, Montana, Electric Railway, had charge of the exhibition in connection with the recent meeting at Butte of the International Mining Congress. The success of this feature was so great that the exhibition will be kept permanently in that place, though it may be shown at the St. Louis Fair.

EDUCATIONAL.

THE ASSOCIATION OF ELECTRICAL AND MECHANICAL ENGINEERS has been formed out of the members of the senior class of the University of California college of mechanics. Bi-weekly meetings will be held, and at intervals, tours of inspection through electrical and mechanical plants will be made. The officers of the organization are Robert Sibley, president; A. J. Turner, vice-president; H. Philips, Secretary; C. C. Murray, treasurer.

Trade Notes.

THE YOUNGSTOWN MANUFACTURING COMPANY, Youngstown, Ohio, is working up a very large business in the manufacture of electric cranes.

THE GOLTZ ENGINEERING COMPANY, Chicago, makes a specialty of manufacturing metal block letters for electric signs. Its new bulletin No. 3, just published, should be in the hands of firms installing electric signs.

THE COLONIAL ELECTRIC COMPANY, Ravenna, Ohio, has elected directors as follows: T. H. Gillmer, E. W. Gillmer, E. E. Nash, E. E. Roberts and W. C. Ward, of Warren; W. C. Gans, of Youngstown, and J. B. Estabrook, of Ravenna.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is advising the trade to anticipate their requirements in the matter of Butmann wattmeters. The growing popularity of this meter is bringing a rush of orders that is bound to tax the capacity of the factory.

THE GARVIN MACHINE COMPANY, New York, has just issued a catalogue (No. 12) descriptive and illustrative of its line of duplex drill lathes, hand lathes, slide rests and spring coilers. The dimensions of the different machines are given in tabular form.

NORTHERN MULTIPOLAR MOTORS.—The Northern Electrical Manufacturing Company, Madison, Wis., in its bulletin No. 29, very fully describes and illustrates the construction of its line of power motors. Illustrations show the details of the machine very clearly.

THE STEAM & ELECTRICAL EQUIPMENT COMPANY, Pittsburg, has recently sold a 190-kw Stanley 60-cycle, 2200-volt two-phase alternator to the Poughkeepsie Light, Heat & Power Company, and a 108-hp Babcock & Wilcox boiler to the Waynesburgh Electric Light & Power Company.

INJECTORS.—Metropolitan injectors constitute the subject of a 48-page pamphlet just issued by the Hayden & Derby Manufacturing Company, 85 Liberty Street, New York. The pamphlet is artistically illustrated and gives much specific and general information on the subject of injectors.

COPPER PRODUCTS.—The Eureka Tempered Copper Company, North East, Pa., has just issued a 48-page catalogue and price-list of its copper and brass products for all purposes. The illustrations include commutator segments, street railway commutators, Brush segments, brushes, and a line of switches.

"INDUSTRIAL RAILWAYS FOR SHOP TRANSPORTATION," is the title of a pamphlet recently brought out by the C. W. Hunt Company, West New Brighton, Staten Island, N. Y. Six of the eight pages are entirely taken up by illustrations of installations of this class. The advantages possessed by the Hunt system of "Industrial" railways are briefly pointed out.

THE LINK-BELT ENGINEERING COMPANY, Nicetown, Philadelphia, Pa., has issued a pamphlet illustrating and describing a few special applications of its machinery in railway and steamship work. The illustrations show locomotive coaling stations and ash-handling plants in practical operation in various parts of the country, and actual installations of freight carriers for loading and unloading vessels.

SCALE IN BOILERS.—The Harrison Safety Boiler Works have issued a pamphlet entitled, "That no Scale Shall Form in Boilers," and devoted to an account of the Sorge-Cochrane system of feedwater heaters and purifiers. The principle of this system is to heat the feed water almost to the boiling point, and by a simple mechanical and chemical treatment remove the scale-forming constituents and neutralize any free acid present.

VICTOR INSULATORS.—Mr. Fred. M. Locke, Victor, N. Y., has just issued a very artistic catalogue containing illustrations of his extensive line of high-tension insulators and accessories. Besides insulators, there are several views of high-tension lines in California for the insulation of which Victor insulators are used. Accompanying the illustrations of the insulators are given the dimensions, and at the back is given a list of plants using Locke insulators and pins.

BULLOCK BULLETINS.—Bulletins 1002, 1003 and 1012 of the Bullock Electric Manufacturing Company, have for their respective subjects, Bullock type "N" motors; marine lighting and power sets and direct-current multipolar motors. Each of the bulletins is profusely illustrated, the apparatus being shown in complete detail, not only by photographic reproductions, but also by line drawings. In the first-mentioned bulletin a large number of machine tools are shown fitted with Bullock motors.

BRAZING IRON.—The American Brazing Company has absorbed the American Ferrofix Company, together with its American rights, for a process recently brought out in Germany for brazing iron. It is claimed that by this process iron may be brazed so that a mended joint is stronger than an unbroken section of the same area. It is also claimed that the process can be used for mending broken castings. The company announces that its plans are to reach directly every responsible blacksmith in the country.

MANVILLE FIRE EXTINGUISHER.—The H. W. Johns-Manville Company, New York, has added another and valuable article to its long list of products, in the form of a fire-extinguishing powder. The powder is enclosed in decorated tubes which may be hung in convenient places in the house, office, factory or warehouse, and is always ready for immediate use. It is stated to be non-poisonous, will not freeze, cake in the tubes, is not affected by dampness and will not deteriorate with age. A neat booklet, just issued by the company, tells all about this interesting product.

THE READING GAS & ELECTRIC FIXTURE CO., Reading, Pa., has appointed the Carleton-Chase Electric Co., Havemeyer Building, New York, selling agent for its line of electrical apparatus including knife switches, panel, switch and tablet boards and electric, combination and gas fixtures. Owing to its recent consolidation with the National Brass & Iron Works, the Reading Gas & Electric Fixture Co. is in possession of greatly increased manufacturing facilities and can guarantee not only first-class work, but what is of almost equal importance—prompt shipments.

WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, general selling agents for A-B arc lamps, reports that the demand is increasing steadily, and that it anticipates an unusually heavy Fall business. It states that it now has over 100,000 of these lamps in general use, and that it is being rapidly adopted by most of the larger cities. This is one of the oldest arc lamps on the market, and as the A-B Company has devoted its exclusive attention to the manufacture of arc lamps, it has lost no opportunity to improve them in every way. These lamps are made with weatherproof, solid copper or pressed steel cases, and for all circuits. The company issues a number of bulletins describing these lamps fully, which are mailed on application.

LUNKENHEIMER CATALOGUE.—The extent of the business of the Lunkenheimer Company may be appreciated from a perusal of its latest catalogue which contains 208 pages of description and illustrations of its complete and extensive line of steam specialties. The variety of the brass and iron steam specialties produced by this company, as shown by this catalogue, is quite surprising, and with one or two exceptions all of the goods listed are entirely manufactured by the company. The company expects to occupy its new factory buildings by the end of this year. These buildings, it is stated, will be unsurpassed by any similar structures of their kind. Every steam engineer will be interested in this catalogue, a copy of which will be sent free on application.

INCANDESCENT LAMPS.—The Sawyer-Man Electric Company, New York, has issued a handsome pamphlet giving a historical sketch of the incandescent lamp, and a very clear description of the process of manufacturing the Sawyer-Man lamp. The manufacture of this lamp was the subject of an illustrated article in ELECTRICAL WORLD AND ENGINEER of Aug. 16, last. The pamphlet is very artistically and profusely illustrated with views of historical lamps and shows applications of incandescent lamps for illumination and decoration, some notable buildings and establishments being included. The illustrations of the various steps in the manufacture of the Sawyer-Man lamp are especially interesting and the descriptive matter gives much information that is not generally known concerning this industry. The booklet will likely become a very desirable addition to electrical libraries for reference on account of the information it contains.

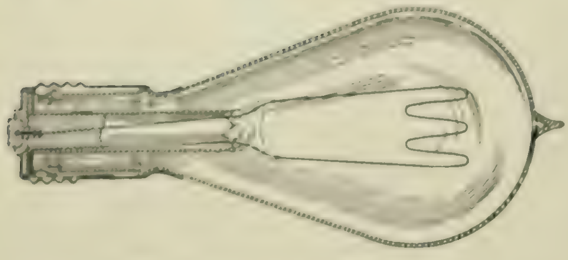
Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER [illegible]
[illegible]

[illegible] VIBRATORY CURRENT RELAY; [illegible] App. filed [illegible] (See page [illegible])

[illegible] TROLLEY POLE; [illegible] App. filed [illegible] [illegible] regardless of the direction in which it turns.

[illegible] TRAP FOR AMALGAM; [illegible] App. filed [illegible] to catch the amalgam flowing in stamp-mills, [illegible]



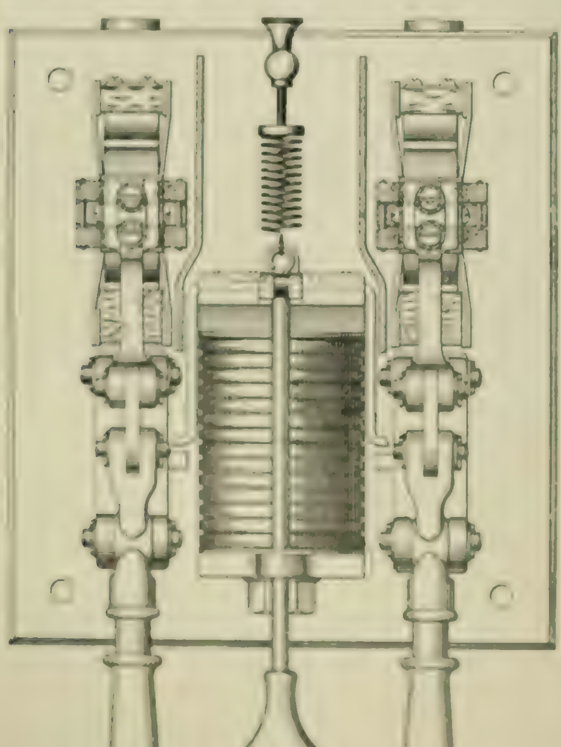
708,653.—Incandescent Electric Lamp.

[illegible] whereby a current is established and the amalgam attracted to the cells.

708,653. INCANDESCENT ELECTRIC LAMP; A. W. W. Miller, South Orange, N. J. [illegible] which may be readily opened at the neck for cleaning and inserting a new filament, reclosed, exhausted and sealed.

708,656. ELECTRIC RAILWAY; T. E. Murray and J. Van Vleck, New York, N. Y. [illegible] (See page 461.)

[illegible] COMMUTATOR BRUSH HOLDER; W. J. Richards, Milwaukee, Wis. App. filed Jan. 20, 1902. Details.



[illegible]

[illegible] ANTISEPTIC ATTACHMENT FOR TELEPHONE MOUTH PIECES; [illegible] San Francisco, Calif. App. filed [illegible] (See page [illegible])

[illegible] JUNCTION BOX; [illegible] App. filed June [illegible] [illegible] serve [illegible]

[illegible] METHOD OF MANUFACTURING SECONDARY BATTERY PLATES; Geo. H. Christian, Cleveland, Ohio. App. filed Dec. 7, 1901. In the formation of lead plates the peroxide is reduced in an electrolyte containing a compound of an organic reducing agent and an alkaline earth, such as oxalate of potassium, sodium, etc.

708,695. METHOD OF MANUFACTURING PLATES FOR SECONDARY BATTERIES; Geo. H Christian, Cleveland, Ohio. App. filed Dec. 7, 1901. The above patent with a different phraseology of claims.

708,708. ELECTRODE SEPARATOR FOR BATTERIES; Arthur W. Harrison, Los Angeles, Calif. App. filed May 7, 1902. A plate separator made from the tree yucca from which the fine fibrous material has been extracted without destroying the fibre, by boiling in sulphuric acid or caustic soda.

708,710. CIRCUIT BREAKER; E. M. Hewlett, Schenectady, N. Y. App. filed Sept. 29, 1898. Two independent switches operated simultaneously by a tripping coil.

708,724. OPERATING MECHANISM FOR MOTOR CONTROLLERS; F. A. Merrick and J. D. Forrer, Johnstown, Pa. App. filed Feb. 12, 1901. A mechanical relation of the reverse and regulating switch-handle, whereby it becomes inconvenient for the motorman to operate the reverse switch unless the regulating switch is at its off position. Although subject to such inconvenience the reverse switch may be operated at any time and in all positions of the regulating switch.

708,755. ELEVATOR; M. A. Chennam, San Francisco, Cal. App. filed Jan. 26, 1901. A system in which the car can be started in either direction and stopped at a particular landing by a person located on any floor.

708,796. BLEACHING APPARATUS; Chauncey Cook Clark, Philadelphia, Pa. App. filed Jan. 22, 1901. The separation of chlorine gas from common salt is produced by a series of electrodes suspended in the salt solution, the residium falling to the bottom of the receptacle where means are provided for its removal. The heat forming during electrolysis is absorbed by a series of tubes in the solution, through which cold water is circulated.

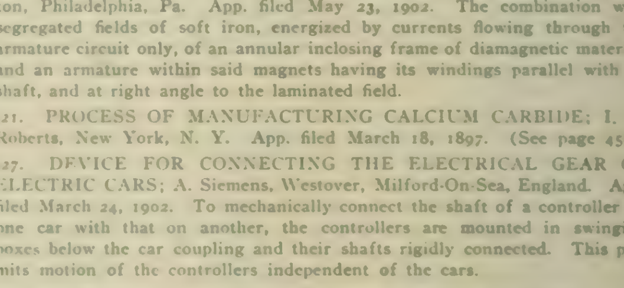
708,803. DYNAMO AND MAGNETO-ELECTRIC MACHINE; N. H. Edgerton, Philadelphia, Pa. App. filed Aug. 22, 1901. Details of construction.

708,875. DYNAMO AND MAGNETO-ELECTRIC MACHINE; N. H. Edgerton, Philadelphia, Pa. App. filed May 23, 1902. The combination with segregated fields of soft iron, energized by currents flowing through the armature circuit only, of an annular inclosing frame of diamagnetic material, and an armature within said magnets having its windings parallel with its shaft, and at right angle to the laminated field.

708,921. PROCESS OF MANUFACTURING CALCIUM CARBIDE; I. L. Roberts, New York, N. Y. App. filed March 18, 1897. (See page 458.)

708,927. DEVICE FOR CONNECTING THE ELECTRICAL GEAR OF ELECTRIC CARS; A. Siemens, Westover, Milford-On-Sea, England. App. filed March 24, 1902. To mechanically connect the shaft of a controller on one car with that on another, the controllers are mounted in swinging boxes below the car coupling and their shafts rigidly connected. This permits motion of the controllers independent of the cars.

708,960. METHOD OF CONTROLLING ELECTRIC MOTORS; J. C. Henry, Denver, Colo. App. filed June 3, 1899. A method of starting a pair of motors consisting of first placing them in parallel in opposite relation to each other, each armature being in series with the corresponding field and cross-connecting them so that each armature is in shunt with the field of the other motor.



[illegible]—Device for Connecting the Electrical Gear of Electric Cars.

708,961. METHOD OF CONTROLLING ELECTRIC MOTORS; J. C. Henry, Denver, Colo. App. filed April 1, 1901. The method of controlling a plurality of electric motors, whose fields are excited by a circuit independent of the armatures, which consists in starting with the armatures in series and the fields in parallel and speeding up by changing the fields to series without breaking their circuit.

[illegible] ELECTRIC VEHICLE; S. A. Henry, Denver, Colo. App. filed June 3, 1899. The motors are employed to operate and stop a vehicle to regenerate to the battery in the form of electricity the energy ordinarily [illegible] by the [illegible] of frictional brakes where they are used to overcome the force of [illegible] or gravity.

[illegible] ELECTRIC RAILWAY; T. E. Murray and J. Van Vleck, New York, N. Y. App. filed March 14, 1902. (See page 461.)

Electrical World and Engineer

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T. R. TALTAVALL, - - - - - - - - - - - - - Associate Editor.

NEW YORK, SATURDAY, SEPTEMBER 27, 1902.

CONTENTS.

THE FIRE ENGINEERS.

No more useful body of men exists in the ranks of public servants than that represented in this city last week by the Fire Engineers, who held a most successful convention. Their work has many points of contact and relationship with the various branches of electricity, and the development of the modern fire alarm telegraph service is, indeed, closely associated with the efforts and inventions of several of the most prominent among pioneer American electricians. This chapter of history was admirably reviewed by Mr. Stover in a paper, of which note is made elsewhere. One passage of his paper is, however, so striking that we have reserved it for quotation here, as it will arouse painful surprise, we believe, in the minds of many people who have been educated to consider the fire alarm telegraph system of New York the best in the world. He said: "Since 1865, when the fire department of the city of New York by legislative enactment was first organized as a paid department, it has been generally known as a splendidly equipped and highly efficient department; but I regret to say that it has always been behind in its means for giving prompt alarms. It adhered to its watchmen and bell towers with but slight attempts at improvements, until 1869, when the Farmer & Channing system, as improved by Gamewell & Co., who had become its proprietors, was introduced—the system having then been in successful use in Boston for a period of seventeen years. With some exceptions in its central office equipment, about 50 modern type of signal boxes, and the undergrounding of its wires, the system in New York remains to-day substantially the same as when completed in 1869. Brooklyn, however, has a much better record. Long before New York it had a system of fire alarm telegraph, and in 1884, thanks to Hon. Seth Low (then its mayor), who personally investigated the subject, the city adopted the non-interference type of signal boxes, notwithstanding the cost was considerably in excess of the type of boxes then in use. Other improvements followed, including a complete central office equipment in 1892."

We fear that this serious impeachment of the fire alarm telegraph system of the largest city of the country is but too well founded. Where the blame lies, we will not attempt to say, but unless we are greatly in error the equipment and the staff are utterly inadequate to the requirements. What is true of Manhattan Island may, in fact, apply to other large centers of population and property. Our own observation may be but casual and uninformed, but it is, nevertheless, our sincere belief that the fire engineering departments generally need being brought up to date in respect to electrical apparatus, the swifter intercommunication of alarms and signals, and the automatic detection of incipient fires. The warning uttered by Mr. Stover is not to be dismissed lightly as prompted by self-interest; for there is altogether too much at stake for all of us; and until it is shown to be without reason, the impression it leaves is most depressing, as well for the public as for the insurance companies.

THE ST. LOUIS WORLD'S FAIR.

If the plans of Director Goldsborough relating to the electrical part of the St. Louis Exposition receive the required support from the electrical industry, the electrical feature of the show will undoubtedly form one of its greatest attractions. It is the intention to give a prominent place to working exhibits, and for this purpose 2,000 horse-power will be reserved. It was pretty well demonstrated at the Paris Exhibition, and more recently at the Pan-American

[illegible] apparatus, such as can be made in a hall, possesses features to interest the general electrical public, or even non-electrical visitors. It is out of question to exhibit the huge machines which actually represent the latest developments in electrical engineering, and in other lines there is not much to show which has not been worn threadbare at previous expositions. Even if some of the working exhibits may not involve processes of intrinsic interest, they will nevertheless serve to attract the attention always given, in the words of Devery, to "somethin' doing." Who would not stop, for example, to see a dry cell constructed, an incandescent lamp manufactured or a telephone apparatus assembled. That the plans of the exhibition referred to appeal to those most directly interested appears to be indicated by the endorsements thus far received, resolutions in support of the work having been passed by the National Electric Light Association, the Independent Telephone Association, and more recently by the American Electrotherapeutic Association and the American Electrochemical Society. While manufacturers and others have parted with much of their old-time enthusiasm for exhibitions, the St. Louis World's Fair, owing to the enormous appropriations from Congress and its comprehensive plans, cannot, from the standpoint of self-interest, well be neglected.

Canal Towage.

Recent developments in the use of electricity in respect to canal towage, which are being made in Europe, are attracting the attention of those connected with the canals of the Dominion, according to our Canadian correspondent. In Canada, the water ways of which are to be greatly enlarged and extended in the near future, the application of electricity, as a motive power for the vessels traversing them, will necessarily be of the very first importance. The development of electric towage in Belgium is being watched with much interest. It is said that a scheme is now being considered for the establishment of [illegible] Rideau Canal, which terminates at the city of Ottawa on one end. It is claimed that there are no great difficulties in the way of operating such a system, abundant water powers being on all sides to furnish electricity. On the commercial canal routes of the Dominion, the adoption of electricity to the needs of the traffic will, it is argued, not only be a saving in money, but tend to conserve the canal banks, as the wash occasioned by propellers will cease to cause injury. It may not be long before electric power will be moving the barges on Canadian canals.

It will be remembered that a few months ago we gave the latest results of the work done in Belgium, under the [illegible] plan with automobiles with three-phase motors, running along the ordinary towpath. There the work is associated with local light and power distribution. [illegible] for some reason, although its feasibility has been pretty well demonstrated. [illegible] The canal business is not, however, a very progressive one, and canals owned by the [illegible] States seem to be costly investments. [illegible] that would put the canals on a paying basis and prevent them from becoming [illegible] pathways of commerce.

The Enclosed Arc Lamp.

There are many points of separate interest in the figures given in the [illegible] relates to open and enclosed arc lamps. It appears that according to the returns of the manufacturers the number of open arcs made in this country in 1900 was only [illegible], as compared with [illegible] of the enclosed type. If anything, the process here disclosed has been accentuated in the two years that have elapsed, and the numbers would now be even more at variance. Here is exhibited, at any rate, in definite form, the remarkable revolution undergone by the arc lighting industry in the second half of the decade, and its present development along the newer lines to the almost total neglect of the older. In this change, the inventor with a fundamentally sound idea should find much encouragement; for the enclosed arc was regarded as hopeless by many and was long decried after it had reached the stage of practical application. It is now seen, even by the most critical, that there were no really insuperable difficulties, and many attendant real advantages, so that a most valuable device has been added to the resources of the art of illumination.

Not to go outside that field, we think stimulus and inspiration may well be derived from such a showing by those who are [illegible] ing in fields barely yet recognized as practical and feasible by the average man. We know that in many quarters the long and ar[illegible] labors of Mr. Tesla in new methods of electric illumination are regarded as more or less visionary, in spite of the fact that others also, like Mr. Moore and Mr. Hewitt, have been actuated by like [illegible] and have also made notable advances. We have heard that at the late Edison convention, the Nernst lamp was pretty well "jumped on" by its critics there. Of course, it was hardly in the house of its friends, and possibly at this early stage it is not all that the central station man wants; but here again, all the criticisms leveled at it could probably be duplicated from the early poundings endured by the enclosed arc, now so universally popular and triumphant.

Submarine Cables in Warfare.

[illegible] England relates to the possibility of her submarine cables [illegible] in the shallow waters off the coast of Nova Scotia. Evidences of British agitation on this subject have not fallen under our own observation, but the topic is an interesting one, and if it has not indeed been considered by the British Admiralty and military authorities, we should indeed be astounded. We are not so sure, however, that grappling for cable in the shallow waters off Nova Scotia is altogether the easy and pleasurable pastime depicted. It is said that a French man-of-war lay off the coast, in 1899, ready to start cable cutting in case of war; but we surmise that there were one or two English cruisers around the corner. If we had cable cutting to do we think our preference would be for the sunny Cuban coast and Spanish sharpshooting rather than the foggy banks and [illegible] the upper North Atlantic. Besides, even when the coast is "clear," in more senses than one, we have known cable ships fitted with cabling appliances and expert crews waiting for weeks before they dared or could start operations for repairing cable or laying new sections. Hence, when it is urged that "an ordinary sea-going tug would do the work within twenty-four hours, and within another day could have every one of those broken," [illegible] is offered that the suggestion did not come from a submarine [illegible] engineer.

Motors in Steel Works.

[illegible] R. M. Daelen, of Dusseldorf, Germany, recently makes note of the growing use of motors, but [illegible] conservative in his statements. "The use of electric motors for driving rolling mills is," he remarked, "at present very limited and will probably only be adopted in cases where the electricity is generated more [illegible] largely used for driving the auxiliary machinery about the mills, and it is [illegible] entirely [illegible] the low pressure hydraulic machinery which formerly was in common use. Still, it must be admitted that the same [illegible] attainable by electric means, and for this reason many practical engineers of iron works still have a preference for low-pressure hydraulic

power, especially as the machinery which gives it effect is constantly being improved." This strikes us as a serious understatement of the facts and as an unjustified criticism in regard to the electric crane and hoists. The swiftness, smoothness and delicacy of electric crane operation is something not approached by any other kind of power. Mr. Darlen certainly cannot base his observation on American practice, and we refuse to believe that German electric cranes and hoists are lacking in precision of movement or general flexibility.

THE AMERICAN ELECTROCHEMICAL SOCIETY.

Elsewhere we print a report of the meeting last week at Niagara Falls of the American Electrochemical Society, incorporating therein, with some corrections, our report of the session of the first two days, which, owing to a delay in the mails, arrived too late to place in the body of last week's issue, and appeared as a supplement to that issue. As at Philadelphia, the young society scored a success at its Niagara meeting, of which the industry represented may well be proud. While almost all interested in electrical matters have been more or less aware that this newest branch of electrical application has been proceeding with great strides, the full strength of the movement was probably not generally recognized, and has only recently been partially disclosed through the organization and meetings of the American Electrochemical Society. Though projected only about six months ago, the Society has already nearly 400 members enrolled, and at its first two meetings about two score papers were presented, of a quality unexpectedly high, in view of the newness of the organization, and as representing first attempts on the part of many of the authors. In the earlier days of electrical development it was a subject of frequent comment that the new industry attracted to it the ablest and most energetic young men from other careers and from the schools; at Niagara even the most casual observer could not escape being impressed with the fact that, with respect to personnel, this latest development is proceeding along similar lines, and, moreover, is drawing some of its best material from the older electrical fields.

While, as noted above, the papers read at both the Philadelphia and Niagara Falls meetings are on the average of excellent quality, there is room for improvement, both with respect to subjects and care in preparation. As in the earlier days of the American Institute of Electrical Engineers, many of the papers doubtless appeared on the programme not so much for the reason that the authors considered that they had something of especial value to communicate to the literature of electrochemistry, as in response to solicitations to lend their aid in filling out a programme. This will, of course, be corrected in time, and as in the case of most papers now presented before the older electrical body, the communications will then represent carefully prepared contributions having a substantial *raison d'etre*. A long step in this direction will be taken when the requirement is made that all papers shall be delivered in sufficient time to enable them to be put in type and in the hands of members in advance of reading. While the discussions at Niagara were excellent so far as they went, they were principally confined to minor points, except in rare cases where one of the audience had a special knowledge of the specific subject as a whole. Had the papers been printed and distributed in advance, not only the subject matter would probably have received greater care in preparation, but there would undoubtedly have been a much broader range of discussion.

As at the first meeting of the society, established theory fared badly at the hands of some of the authors. One paper made an onslaught on the very foundations of modern science, including even Newton's gravitation theory; and, for the edifice tumbled down, the new corpuscular hypothesis, notwithstanding its present slender support, was offered as a substitute—the exchange of an embryo of uncertain future for a thing of bone and sinew. The dissociation theory as a whole was attacked on the basis of an experiment, doubtful as to accuracy, and yet more doubtful as to application. One paper proposed a new system of electrical units, based upon the coincidence that 500 amperes flowing for one day will liberate almost exactly one cubic meter of hydrogen, which will weigh almost exactly one pound. It was proposed to adopt the unit of 500 amperes for one day, and call it a pound col, and from this were to be derived other units, such as the colad for the unit of capacity, cojoule for the unit of work, etc. While the relation brought out between a given quantity of electricity and a corresponding volume and weight of hydrogen is an interesting one, and might serve a useful purpose as an empirical unit in some kinds of electrolytic work, it offers little basis for any new system of units, unless the relation found is established to be a natural one and not a mere coincidence. There is probably a need in some electrochemical operations of a unit of quantity larger than the ampere-second or coulomb, but this could be obtained through the employment of the ampere-hour with appropriate prefix. If, for example, 500 amperes per day represents a convenient order of magnitude, since it is equal to 12 kiloampere-hours, the latter multiple unit would appear to be of a sufficiently convenient magnitude to meet the need.

Of the more practical papers read, one by Prof. Hutton, of Owens College, Manchester, England, described a process for the working of quartz in the electric furnace, which contains commercial promise; and Mr. Fitzgerald described in detail a method of testing the commercial value graphite electrodes. A paper suggesting the use of the electric furnace in the magnetic concentration of ores met with little favor from those who joined in its discussion. In view of the little success thus far achieved in the concentration of low-grade ores by the inexpensive dry process, there is certainly not much promise in a method which calls for the relatively more expensive intervention of the electric furnace with the accompanying expenditure of heat in fusing the entire mass of raw material. A paper by Mr. Woolsey McA. Johnson performed a good service in setting forth the real facts which affect the density of current in electrolytic reduction where the anode contains two or more metals. In practical work it has been found that the current density must be reduced when the cathode contains more than one metal, but it has been considered that this was due merely to the undue carrying effect of the stronger current. Some years ago, when this difficulty was experienced in a large refinery, a great loss resulted in operation while experiments to obviate it were carried on, the experiments presumably not being directed by a proper knowledge of the principles involved; and a discussion of these latter forms the subject matter of Mr. Johnson's paper. The concentration cell of Prof. Carhart was the subject of another communication to the society, and the clarifying of the situation by the previous discussion in Philadelphia and that at Niagara brought out that in this case, as in so many others, a paradox when analyzed may result in still more firmly establishing the theory which at first sight it appears to contradict. Prof. Haber, in a paper accompanied by experimental demonstrations, further established the importance of taking into account secondary reactions that may occur in electrolysis, and which may give rise to unexpected results. The experiments performed very neatly showed the effect of electrolysis in a solution which attacks the element or elements released by electrolysis. A paper by Mr. Weightman, on cathodic reduction, also showed how unexpected results may be obtained when previous consideration has not been given to all of the factors that may enter into an operation. These several papers, as well as some read in Philadelphia, bring out the fact that electrolytic processes are far less simple than was formerly supposed, and that many of the accepted laws of electrolysis require considerable qualification.

The Convention of Fire Engineers in New York City.

[illegible] at the Grand [illegible] and its effects on water [illegible] He recommended breaking [illegible] the insertion of insulating [illegible] any flow of current [illegible] track would have to re- [illegible] capacity be increased either [illegible] rails, or the addition of [illegible] pted, an increased coal bill [illegible] breakers was not adopted at first, because none had been devised. But within a quite recent period, such circuit breakers have been devised, manufactured and used." Capt. Brophy added:

"In one of our large cities a natural gas system of piping had been [illegible] large cable to the dynamos of the street railway sys- [illegible] drain them of current, but electrolytic corrosion took [illegible] at the joints. In this case "necessity was the mother [illegible] and an insulating joint was devised and inserted at [illegible] system, and the connection to the dynamos [illegible] h time no corrosion has taken place.

"I have quite recently taken measurements between the natural gas pipes and the rails of the street railway in Wheeling, West Virginia, to ascertain the flow of current from pipes to rails, also to ascertain the flow of current in the different lines of pipes. I will not give here a list of these measurements, but as a result of one made near [illegible] I found 300 amperes flowing from pipe to rail, the [illegible] or representing a little over 3 horse-power. The gas company has decided to place insulating joints in their pipe system. I have just returned from Wheeling, where the work has [illegible] far enough to show that the lines wherein these joints [illegible] placed have no current flowing over them, and when the work is completed, these pipes will not act as return feeders for the railroad, and electrolytic corrosion will cease. It will be a matter of indifference to the owners of these pipes what the condition of the [illegible] Wheeling, however. Up to the present time the return or stray currents were [illegible] tly by the gas and water pipes, but from this time on the [illegible] st be borne by the water pipe."

[illegible] gress of Fire Alarm Telegraphy." He noted that the 29th of April last marked the fiftieth anniversary of the introduction of the Farmer & Channing system of fire alarm telegraph into the City of Boston, for on that day, 1852, the first alarm was electrically transmitted [illegible] to call attention, he said, to the fact that Charles Robinson, who [illegible] two years prior to the completion of the [illegible] time divided into eight fire districts, with a tower bell and a watch- [illegible] on their own bells, thus spread- [illegible]

[illegible] municipal systems in giving promptly direct alarms to fire departments. It has been in successful use for over 14 years, and has never [illegible] and means, it was at first open and subject to many criticisms; but [illegible] in the improvements and extension of means for the transmission [illegible] He said. "I am aware that this auxiliary system of fire alarm telegraph was not received as favorably in some quarters as it should have been, for the fact that it was erroneously believed that its introduction would retard, to some extent, an increase in the number of street boxes used in connection with regular systems of the alarm; but experience has proven the fallacy of all such apprehension. In many cases where the auxiliary service has been brought into use, special street boxes have been purchased by private parties, and placed where they could be used by everybody in the vicinity in case of need. Another objection often heard was (and I may say is) that the auxiliary system as generally used does not indicate the exact locality of a fire. Neither does a street box; but I have been frequently told by chiefs of large experience, that there was never any trouble in discovering a fire of any account, when the nearest street box is pulled. However, this objection has been fully provided for, and wherever it is desired, those who control the auxiliary system stand ready to furnish a number of devices which completely overcome this objection, if it is one. I am confident that the auxiliary system, improved and perfected since its introduction, can be relied upon to do all that is claimed for it; that it cannot when properly installed, under any circumstances interfere with the integrity or operation of a municipal plant. It has been in use in this city for more than six years, and notwithstanding it encountered from the start the bitter opposition of interested and prejudiced parties, it steadily won its way until January 1st of this year, when it had in use over 2,400 boxes—a number equal to the number of street boxes in use in Greater New York. It has received the approval of the New York Board of Underwriters, and Mayor Low has recently recognized the great value of this service by recommending its absolute control by the fire department through municipal ownership."

A very interesting paper was that of Building Commissioner Stewart, on "Fire-proof Wood," detailing tests made. He said: "The result of all tests proved conclusively that while treated wood is in no sense fire-proof, it is of a very slow burning nature, and is a fire retardant." There is a fifteen story building in course of construction in New York City, he said, in which all the trim, sash and doors will be of wood covered with metal, and all the partitions of fire-proof material. There are also other materials, the basis of which are magnesia, asbestos, cement and other incombustible materials, which can be made into doors, trim, wainscoting, and, in fact, everything used in the interior finish of a building, while the decoration of the building is not diminished at all, or if any, to a very slight extent. There is one thing that can be said in regard to this manner of decoration and the trim of buildings: If these materials, which are incombustible, would be used, it might interfere to a certain extent with the interior architectural finish of the building; it might offend the æsthetic eye, but it would increase the revenue of the building on account of the small rate of insurance upon a building of this character

Programme of Convention of Municipal Electricians.

The International Association of Municipal Electricians will hold its seventh annual convention at Richmond, Va., on October 7, 8 and 9, with headquarters at Murphy's Hotel. The delegates will be welcomed by Governor Montague and Mayor Taylor. The entertainments include a trip, on the second day, down the James River, [illegible] trolley cars to the Lakeside Park.

The papers to be presented are as follows: "Municipal Inspection and Control," Walter M. Petty, superintendent Fire Telegraph, Rutherford, N. Y.; "Relation of Electrical Interests to Other Branches of the Municipality," Capt. Wm. Brophy, Boston, Mass.; "Classifying of Records of Electrical Departments and Standard Specifications for Supplies and Contracts," Edw. F. Schurig, city electrician, Omaha, Neb.; "Report of Committee on Rules for Electrical Inspection and Control, Especially with Reference to the Occupancy of Streets," Morris W. Mead, superintendent Bureau of Electricity, Pittsburg, Pa.; "The Telephone Service in Connection with Fire and Police Signal Systems," Jerry Murphy, superintendent Police Telegraph, Cleveland, O.; "Electrical Government," A. S Hatch, assistant superintendent Public Lighting Commission, Detroit, Mich.; "Joint Use of Conduits," Chas. F. Hopewell, city electrician, Cambridge, Mass. Mr. Hopewell will also give his "Illustrated Lecture of Fire and Police Telegraph." Mr. Frank P. Foster, of Corning, N. Y., is secretary of the association.

The Sault Ste. Marie Water Power.

By Frank C. Perkins.

THE great power canal, power house and hydraulic installation for the Electrical Power Transmission Development, at Sault Ste. Marie, Mich., is now about completed. The Michigan Lake Superior Power Company expect soon to have the water from this great lake turned into the power canal, which is 224 feet wide and about two and a third miles long. The accompanying illustration shows the power canal and power house during construction. In this enormous power station there are 320 turbines, equipped with Sturgess water-wheel governors. They are set in 80 penstocks, in groups of four each. Each of the 80 units of 4-33-inch turbines is to operate a Westinghouse or Stanley electrical generator of 400-kw capacity. Each hydraulic unit is composed of four 33-inch new American turbines, arranged in two pairs on one shaft. Each pair is housed in one case and discharges into one draft tube. Each unit under normal conditions takes 391 cubic feet per second at an effective head of 16 feet, and has a capacity of 568 M. H. P. The maximum efficiency varies from 81 per cent. to 82 per cent., and this was carefully ascertained by regular tests prior to their acceptance.

The 80 units, operating each a 400-kw generator, will supply electrical energy of 32,000 kw, or about 40,000 hp, and this energy will be used by various manufacturing plants now being built or projected. It will also be used for supplying current for arc lights on the city streets as well as for operating the street railways.

At this point the waters of Lake Superior flow over a sandstone rock ledge nearly 3,000 feet wide, and half a mile long, with a fall of about 20 feet. The total amount of power which may be developed at the lowest conditions will be about 57,000 hp. About four millions of dollars will be expended for right-of-way, canal, power house, docks and equipment.

The total quantity of water which is discharged from Lake Superior at the Sault Rapids varies from 3,000,000 to 7,000,000 cubic feet per minute, and represents from 100,000 hp to 250,00 hp. The area of Lake Superior, which is about 30,000 square miles, is fed by an immense watershed, and the water discharged fluctuates with the varying conditions of evaporation and precipitation.

In the construction of this great work, more than 1,000,000 cubic yards of rock had to be excavated, and about 3,000,000 cubic yards of sand was dredged. All of this material was utilized for the reclaiming of lands under water, covering about 260 acres. Nearly 3,000 linear feet of navigation docks have been built, and 22 miles of rails laid and operated. The vast amount of work necessary in this construction may be realized to some extent when it is known that 3,500,000 linear feet of piles had to be driven and 170,000 cubic yards of concrete and monolithic block had to be laid. In addition to this, 90,000 cubic yards of sandstone masonry, together with 32,000 square yards of dry sandstone pavement was required, and for this amount of masonry about 260,000 barrels of cement was necessary, while the iron roofing used would cover an area of 24,000 square feet. This construction work was carried on day and night, and 24 locomotives, with 350 four-yard dump cars, were kept busy taking care of the excavation carried on by the equipment of eight steam shovels.

Much money and energy has been spent in overcoming this obstruction, the Sault Ste. Marie, to the continuity of navigation between Lake Superior and Lake Huron. Many efforts have been made in past years to harness also this great power at the Sault, and various water power developments have been planned and carried out, utilizing a portion of this energy. At the present day, there is every prospect of the utilization of nearly half of the power available, and the locks now in operation are capable of passing the largest merchant vessels afloat.

Fig. 2.—Hydraulic Equipment.

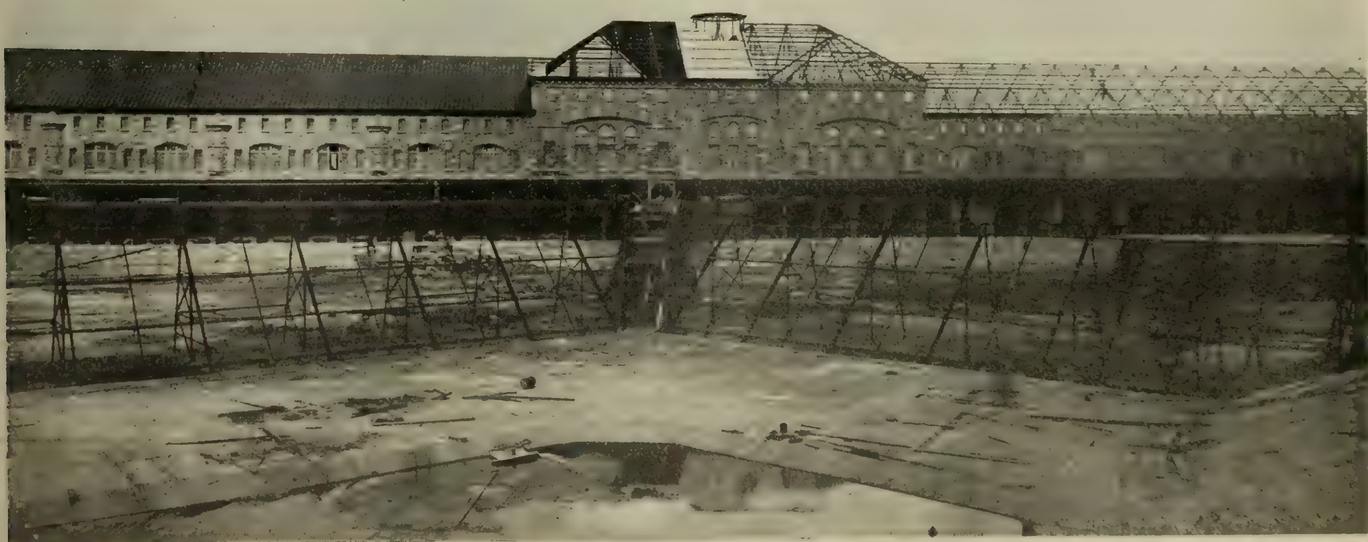


Fig. 1.—Forebay, Showing Ice Rack.

The president and acting manager of the Michigan Lake Superior Power Company is Mr. Francis H. Clergue, and the conception and successful realization of this great undertaking must be credited largely to him. The wreckage of former attempts, in the way of mortgages on real estate and right-of-way, held by a local bank, were secured by this company in 1894, and it became owner of the charter rights and property formerly owned by the St. Mary's Falls Power Company, of 1885-7. During the next two years the general plan was outlined for the utilization of about 60,000 hp. A canal had to

be carried through the city of Sault Ste. Marie, Mich., and this canal had to be provided with six iron foot and vehicle bridges. The canal was designed to take the water from Lake Superior about the Sault Rapids and carry it to the nearest available point below the rapids, there discharging it into the St. Mary's River through the great power house, seen in the accompanying views.

The great power house has walls of sandstone, excavated from the canal, and a roof frame of steel, covered with galvanized, corrugated iron. The down-stream portion of the substructure not occupied by the penstocks is provided for the dynamos upon this structure. Supported by steel columns and steel floors, rises the upper portion of the power house, consisting of two floors 85 feet wide and 1,368 feet long. The power house is built on a foundation of the pile type. Fifty-foot piles, numbering about 12,000, were driven through the clay to the rock, and their tops were capped and the whole structure was filled with a mass of concrete three feet deep.

The substructure was designed to carry the water into the river below after passing through the turbines. This substructure consists of 81 chambers, 20 feet high and 100 feet long. These chambers were separated from each other by walls of three-foot masonry, the floors and roofs being monolithic concrete arches, closed on the up-stream side by masonry concrete arches.

The penstock structure, which rests on the pit structure, also has 81 chambers each, 15 feet wide, 20 feet high and 45 feet long. These chambers open on the up-stream side, and are divided from each other by steel and concrete work, and closed on the down-stream side by steel-plate bulkheads of semi-circular shape, open at the top. The water wheels are placed in these chambers and are submerged to their full height, the water being received from the Forebay Falls through the turbines into the pit below.

The end of the canal is at [illegible] At the Forebay Rock [illegible] structed the intercepting rack and spillway chute. The canal head gates consist of four steel shutters, each 48 feet wide and 26 feet high, operating between masonry piers. From Johnston Street to Spruce Avenue, the canal has a three-degree curve, 1,000 feet long, through clay. The semi-elliptical prism may be noted at this point.

FIG. 4.—CANAL HEAD GATES.

The width at the water-line is 214 feet, and the flowage area is about 4,600 square feet, and the whole is lined with timber.

The canal from Ashman to Johnston Streets, a distance of 2,300 feet, is through sand, and the trapezoidal prism slopes one in one. The width at the bed is 164 feet, and at the water-line 214 feet, while the flowage area is about 4,500 square feet. The entire canal prism below water-line is lined with timber planking, spiked to transverse timber frames secured to piles.

FIG. 3.—MAP OF SAULT STE. MARIE, SHOWING WATER POWER CANAL, ETC.

and power house. The intake is 2,000 feet long and is 950 feet wide at the entrance. Its normal width is 220 feet and its normal depth is 22 feet. From Fort Street a down-stream view of the canal may be had to Ashman Street, a distance of 2,300 feet. The Forebay gradually expands to a width of 1,400 feet and the slopes and construction are the same as the canal. Near the power house is con-

The power house is 105 feet high, 100 feet wide and 1,368 feet long. It is an imposing structure, and its sandstone walls give it a neat and substantial appearance. The tenders for the construction of this power house and forebay were called for in the summer of 1898.

and the contract was awarded in October, 1898, to the Mason & Hoge Company, of Frankfort, Ky. The intake to the power canal lies just south of the western entrance to the United States Ship Canal. The contract for the intake was let to H. W. Hubbell & Co., of West Bay City, Mich., in the Fall of 1898. The width is some 950 feet, its southern alignment running nearly east and west from its intersection with the established Harbor line on a tangent for about 2,900 feet. Its northern boundary commences at its junction with the terminal of the ship canal pier, and trends southeasterly, gradually curving in towards the south line. It narrows from 950 feet at the intake to a width of 250 feet about a fifth of a mile from the point where the water of Lake Superior enters. It continues at this width to the eastern end of the intake, where it terminates in the head gates of the canal, also called the movable dam.

This movable dam structure was designed to close off the flow of water from the canal under all possible conditions, and, therefore, forms the entrance to the canal proper. The total length of the canal from this point to the forebay is almost two miles. It runs easterly for more than a mile, and then gradually curves north for the remaining 3,00c feet, when it expands into the forebay.

This forebay has the character of a great mill pond, being enclosed by a dam, which has been elaborated into a long power house. The water really falls through the power house for a distance of 20 feet, coming first from Lake Superior through the intake, canal and forebay, and finds its final exit in the tail race at St. Mary's River and Lake Huron level. The canal was constructed by E. D. Smith, of Philadelphia, and the total distance of the entire constructed waterway is about 13,000 feet, the width of the same being about 200 feet.

FIG. 5.—TIMBER-LINED CANAL.

It was excavated to such a level that when the full power is being used, the water will flow at a uniform depth of 23 feet.

A great variety of material was met with in the construction of this canal. Beginning at the intake, it passes through drift of Lake Superior sand, boulders and gravel for about a quarter of a mile. For nearly a mile, then, a strata of rock was encountered, which traverses this region, and is responsible for the existence of the Sault Rapids. A formation of drift sand and boulders was then met with for something over a third of a mile, and then the canal passes through a form of silicious clay to the power house.

At the various sections of the canal, the flow area differs. It is calculated that the water will flow through the entire canal at about a depth of 23 feet when the full plant is in operation. The velocity of the water when operating at full capacity is calculated to be about 4½ miles per hour. This would deliver to the turbines about 30,000 cubic feet of water per second, which would supply an output of about 60,000 hp, allowing a reasonable loss for the conduit..

It is stated that every portion of the conduit, except the beds of the intake and forebay, is formed either of smooth rock or timber surface, so constructed as to preserve the original shape of the conduit, and exposing only stone to the wearing influence of the elements. The accompanying illustrations show the waterway under construction and the power house in its completed or nearly completed state.

Electric Light in Chinese Palace.

The Pekin Summer Palace of the Chinese Emperor is being refitted. Meantime arrangements are being made to light it by electricity.

Signaling Through Space Without Wires.

BY A. FREDERICK COLLINS.

UNDER the above title the Electrician Publishing Company (London) has brought out the third edition (second issue) of a work by Sir Oliver J. Lodge, F. R. S., which was originally entitled "The Work of Hertz and Some of his Successors," this in turn "being the substance of a lecture delivered at the Royal Institution on Friday evening, June 1, 1894."

This lecture was delivered before the advent of commercial wireless telegraphy, and in the period intervening between the delivery of the lecture and the issue of the present book many things have occurred besides the advance of signaling through space without wires, as this article will show.

The principal additions to the recent work is an article "On the Application of this Method of Signaling at a Distance to Actual Telegraphy," and a paper relating to the further development in the (wireless) telegraphic direction, entitled, "Syntonic Telegraphy, a History of the Coherer Principle and an Account of Hughes' Experiments." The first article is by far the most interesting of the newly included matter, and while it does not throw much light on the advances of the art, it does show the prejudice of certain English scientists toward inventors of other nationalities than their own. For instance, when they saw the laurel wreath of success accorded to one of Italy's sons they became furious, for had they not a familiar knowledge of the principles involved in wireless telegraphy long prior to its advent commercially? The answer comes back without wires, Yes! and with it the statement, truthfully, that they lacked the acumen of mind to foresee that which was so evident to Righi's student—a commercial possibility in the new arrangement.

In this particular paper Lodge shows how wireless signaling was accomplished by himself and others prior to and in 1894, or two years before Marconi evolved his system. As everyone knows who is at all interested in wireless telegraphy, a futile attempt has been made to elevate Lodge, the Englishman, on the pedestal of glory erected to the inventor of wireless telegraphy, and to dislodge at the same time Mr. Marconi, who had climbed there by dint of much scheming and hard work. But this procedure, which has been so ably abetted by Lodge's article, "The Application of this Method of Signaling," follows the prescribed course of the narrow-minded historians of foreign scientists, and which has been so long in vogue. particularly in England, namely, their attempt to throttle the efforts of every worker except those from their own country. Had the mantle of genius which brought into existence the telegraph without wires fallen on the shoulders of John Doe, of Nowhere, England, instead of on that very bright young man, Marconi, of Italy, we would have heard little of the rights of Lodge—or anyone else.

Certainly this is a mediæval spirit which one might have expected to exist long before cables were invented, and when months, aye, years might have elapsed before the workers of one country could ascertain what those living apart from them had done, or were doing. But in the days of wireless telegraphy it is absurd, laughable, were it not for the rank injustice to those who have made the thing possible.

Lodge invites attention, with some display of feeling, to the similarity of Hertz's oscillator and the Marconi radiator consisting of a vertical wire connected in series with a spark-gap and the earth, or, to use his own words, "It (the Marconi radiator) may be regarded simply as a Hertz vibrator with its axis vertical as Hertz often used it, and with its lower plate replaced by the earth so as to double the variable capacity."

This is to say, all Marconi did was merely to extend one arm of the oscillator into the air 30 or 40 meters and ground the opposite arm; like the flower trick of Kellar, it is so very simple when you know how. But in this one simple feature lies the great difference between the experiments of Hertz and all his successors to the time of Marconi, for by this very method the Italian was able to syntonize accurately his sending and receiving instruments.

Lodge says that by earthing one arm of the oscillator its capacity is doubled. That the oscillations are considerably slowed down is, of course, apparent, but capacity does not damp out the oscillations any more than a heavy weight would damp out the oscillations of a pendulum; it is the resistance of the circuit that has the damping effect, as when the pendulum would be made to oscillate in a viscous medium; or in electric oscillators when R is greater than $\sqrt{\frac{4L}{C}}$

[illegible] always in [illegible]

[illegible] the only difference was that whereas the author [illegible] or brass filings in high vacuum, Marconi preferred nickel filings in low vacuum." But I will add, lest by some it might perchance be overlooked, that differing from the Lodge coherer, [illegible] mm., and its sensitiveness increased as its size was decreased, making [illegible] eminently adapted for long distance telegraphy. Lodge further maintains that when Marconi brought his apparatus in a sealed box to Sir William Preece there were no novel features in it, but Preece evidently found novelty in it, if in no other form than in its ability to work over distances greater than had been attempted, and Preece was probably the best-posted man at that time in England on wireless telegraphy. Again, Lodge asserts that Dr. Slaby pursued successfully the development of wireless telegraphy, but Slaby apparently had no idea of commercial wireless telegraphy until he was present at some experiments of Marconi's across the Bristol Channel in May, [illegible]

The principles which form the foundation of syntonic wireless telegraphy are the subject of the second article by Lodge, which begins with a criticism of the existing patent law, showing the injustice of it; he briefly states how he would have it expurged or eliminated altogether, and instead of having to pay a fee for registering claims in order to be safeguarded, he would have it so amended that to the scientist who reads his paper before some recognized scientific society would accrue the credit, and incidentally any moneys which might be derived thereafter from its use. This is an idealistic view [illegible] one from the viewpoint of the scientist; but in the event of such a law being passed by Parliament the profits of the commercial company would have to be split into an infinitesimal number of portions to pay the various living inventors and discoverers and the heirs, executors, administrators and assigns for their own use, benefit and behoof forever of inventors and discoverers who may have died these past hundred years.

It is usually the organizer who gets the plums, and this is as true of the organizer of ideas as it is the organizer of financial interests; but unlike the latter who holds his right always, the former has a patent for a comparatively short period of years. But the generally [illegible] are those who make a tangible commercial commodity from a few intangible scientific facts, and for this reason it is seldom that a cry is raised against patent laws.

That these laws in any country are imperfect must be admitted, but it should be considered that there are three factions who are involved—the inventor, the state and the people. The laws, especially in England, are so drafted that if there are claims in a specification which have been allowed without regard to the rights of others, the patent in whole or in part may be invalidated; and after all this system of red tape has been exhausted in an effort to protect the rightful inventor, the courts may be appealed to. But, as Lodge consistently holds, "The instinct of the scientific worker is to publish everything, to hope that any useful aspect of it may be as quickly as possible utilized and to trust to the instinct for fair play, that he shall not be the loser when the thing becomes commercially profitable; [illegible] to grant him the privilege of fighting for his monopoly is to grant him a pernicious privilege which will sap his energy, waste his time and [illegible]"

[illegible] and his various patents for selective signaling, a short review of [illegible]

[illegible] instruments with earth terminals in tune with each other, and, therefore, bars the way for syntonization between individual sets of instruments. Lodge has proven the correctness of this theory, though his [illegible] could have any commercial value. But his efforts were in the right direction, and in this field Lodge was first, and if he had only de- [illegible]

Marconi's fame would soon be relegated to the place caloric, where his English contemporaries and critics so sincerely wish him. But it appears that Lodge is doing no more with syntonic wireless telegraphy than he did in sending messages without wires prior to Marconi's time.

Lodge is prolific in evolving schemes and words, but he lets someone else do the tiresome work of developing the arts to which they relate as he rests on his oars; for now Braun is making gigantic strides in syntonic wireless telegraphy, just as Marconi did in producing a commercial system for long-distance work. But we cannot all be universal geniuses, and it is given to some men to be scientists whilst others are mechanicians, and Lodge is strictly the former, whereas Marconi is the latter if anything.

"Coherer History" is the third of the new papers appearing in Lodge's book, and though interesting considering the early date of its publication, its reproduction at this time is not conclusive proof by any means that Marconi is getting more credit for the development of the coherer than he is entitled to, nor to Lodge the less. The paper on "Prof. Hughes' Observations," in which it is stated that Hughes transmitted and received signals from 1879 to 1886, would here make a most valuable addition to the knowledge of loose contacts or microphonic joints had it been written immediately after the experiments were made instead of 13 years later. It is good reading now as a matter of history, but as a method of claiming priority this precedent established by Hughes is bad form, if not indeed a pernicious practice; it certainly does not appeal to the technician very strongly. It is quite significant, too, that so much stress should be laid on the fruitless observation of Hughes, the Englishman, and so little on the actual accomplishment of Branly, the Frenchman.

The cry to-day is for workers, not merely for men who do something for the love of scientific investigation and after evolving an idea or hypothesis drop it for same new fancy, but for men who do something, the results of which are visible at once to the world it benefits. The success of Edison is due, not to original discoveries, but to his genius in improving from uncollected scientific data things of great and immediate utility. Aside from his polyphase work, Tesla was lauded, prematurely, because he was able to show magnificent phenomena which seemed on the face to solve the riddle of a better and cheaper illuminant; but that was ten years ago, and where Edison is still close to the hearts of the people and his name a household words, Tesla has gradually sunk into oblivion, and even his claims to the fatherhood of wireless telegraphy, both mundane and Martian, are not sufficient to bring him forth into the light of popular esteem in which he was formerly held.

All the world admires a savant, but it will accept a man of only moderate learning if he will create from the remnants of knowledge something for the immediate good of humanity.

Trolley Franchise at Provo, Utah.

An application has been made to the City Council, of Provo, Utah, by Reed Smoot, Jesse Knight, C. E. Loose, George Havercamp and Samuel R. Thurman, for a franchise to build an electric street car line in that city. The mayor, Thomas N. Taylor, vetoed the resolution to the Council, giving as a reason that in his opinion the streets of the city belong to the people for their use, and when any portion of the streets are monopolized or used by any firm or corporation for their private gain, they should pay for them just the same as other individuals or corporations pay for ground on which they may wish to erect buildings or other conveniences to engage in such business as they desire. As the streets cannot be sold, he claims the next thing should be a suitable rental for the same, that they may be a source of revenue to the city. He further states that the people have expended thousands of dollars to build these streets and are entitled to remuneration. The mayor suggests further that in lieu of this grant that a similar one be given so amended that the grantees be made to pay Provo City $30,000, commencing ten years from date of said franchise, $500 per year for 20 years, and $1,000 per year for the last 20 years of said franchise. This, he claims, would be a very small rental for the property, and yet would aid the city in paying the many expenses, thus cutting down the taxes. He says that cities who have given away similar franchises now regret their action. As men in all parts of the country are putting in electric lines, there will be no trouble in selling this franchise for even more than the amount named, he says.

Massachusetts Statistics of Electrical Supply.

BY ALTON D. ADAMS.

IN the early days of lighting from central stations Massachusetts began to collect statistics of the industry, and it remains the only State that publishes comprehensive data of electrical supply.

Massachusetts has constantly been a leader in the distribution of electrical energy. The peculiar value of its records, therefore, is not only that they began early and are complete, but also that they represent substantially, in kind, the development of electrical supply throughout the United States.

Commissioners were given general supervision of all corporations and persons manufacturing and selling electric light in Massachusetts, by Chapter 382, Acts of 1887, approved June 8 of that year. This law required every electric light company to make a return annually to the commissioners in a form and at a time prescribed by them. In this return the amount of capital and indebtedness on the first day of January preceding were required to be stated, also the income, expenses and dividends declared or paid by the company during the preceding year. A list of all salaried officers and the amount annually paid to each were also required, and the return must be sworn to by the president and treasurer of the company and by a majority of its directors.

Besides this annual report, the law requires each company at all times on request of the commissioners to furnish any information concerning its condition, management and operation. Each company must keep an office in the city or town where its works are located, and at this office must be all books required by law to be kept within the Commonwealth, including books to show receipts, expenses and indebtedness of the company. These books must be open to the inspection of the commissioners at all times. Any court having jurisdiction in equity may on application of the commissioners enforce the foregoing requirements by a suitable decree in equity.

The first annual reports of electric light companies under this law were required to be for the year ending June 30, 1888. For neglect to make the annual return required by law of each electric light company a forfeit of five dollars per day during the first fifteen days, ten dollars per day during the second fifteen days, and not more than fifteen dollars per day thereafter, from the second Wednesday of September in any year was imposed by Chapter 263, Acts of 1892. This act further provides a forfeiture of not more than five hundred dollars for final neglect or refusal to make the annual return in each case.

Beginning with the first day of July, 1896, every person and corporation engaged in the manufacture and sale of electricity was required to keep such records of the operations of its plant as the commissioners might require, by Chapters 356 and 480, Acts of 1896. Chapter 426 of the same year authorized the supreme judical court to enforce orders of the commissioners by appropriate process in equity.

This series of legislative acts has not only given the commissioners ample authority to collect complete data concerning electrical supply, but has put the entire machinery of courts of law and equity at the disposal of the commissioners to enforce their orders and demands.

Acting under the legislation of 1887, the commissioners at once proceeded to collect statistics relating to the equipments and operations as well as to the financial condition of the companies engaged in electrical supply.

The act creating the electric light commissioners requires them to make annual reports to the Legislature, giving abstracts of the data collected from the electric companies. The first of these annual reports was made for the year ending June 30, 1888, and they have been continued yearly up to the present time. Under the Act of 1887, the commissioners had authority to ask and the electric companies were required to give any desired information concerning the technical as well as the financial side of the business, but the requirement to keep books extended only to the financial side. It thus came about that companies could not in all cases give data asked for by the commissioners, because there were no records. This state of affairs led to the Act of 1896, by which the companies came under the duty to record all operations and outputs of their plants and systems according to forms prescribed by the commissioners.

By this last named act the commissioners are put into a position to find out all that any of the companies or their officers know about the electrical supply business.

In general the electric lighting companies have readily complied with the requirements of the commissioners, and in the few instances where this has not been true the heavy fines for delay and the equity jurisdiction of the courts have proved to be ample remedies. Concerning the accuracy of reports made by the electric lighting companies to the commissioners, it is not to be presumed that the president, treasurer and the majority of a board of directors of a corporation engaged in electrical supply will incur the penalties of perjury by knowingly swearing to a false return. Moreover, the mass of data in the hands of the commissioners is now so great, its records of each company through a series of years so complete, and its power of inspection of all company records so unlimited, that any serious misstatement as to the finances or operations of a company are almost sure to be quickly detected.

While the commissioners have included in each of their annual reports a large mass of statistics relative to the equipments and technical operations of the electric companies, the legislation of 1896 concerning the form of records to be kept on these subjects has tended to make subsequent reports more complete. Discretion as to what portion of the data obtained from the electric companies shall appear in the annual reports of the commissioners rests with them, and not all of the statistics collected by them have been published. A notable illustration of this policy relates to the kw-hours delivered at switchboards and to consumers by the companies. The commissioners collect this information as to energy developed and sold, but do not publish it. In order to secure complete and uniform reports from the companies engaged in electrical supply, the commissioners have from the beginning issued to each company yearly a book of printed, numbered questions, with blank spaces thereafter for the answers. These printed forms are sent in duplicate to each company, one copy to be retained by the company and the other to be returned to the commissioners. The first set of these forms was issued to the companies under date of June 28, 1888, and the reports were returnable, for the year ending June 30, 1888, not later than September 12 of that year.

In these first forms the financial affairs of the companies were arranged under five separate schedules. The first schedule related to capital, debts and cost of plant, and contained twenty-three distinct items to be filled in. In the second schedule were included expenses of operation with twenty-six items and money incomes with ten to thirteen items. The third schedule was devoted to the profit and loss account in which was included, besides, the results of operation, the items of interest, depreciation, reserve funds and surplus. Assets separated under twenty-two items and liabilities under ten items formed the subjects of the fourth schedule. Particulars of the reserve fund under nine items made up the fifth schedule.

Technical details of equipment and operation were covered at length in these forms. The location of plant, area of land, size and construction of buildings, and whether owned or leased were required to be stated. In the case of boilers, engines and water wheels, the number, capacity and description of each was to be stated. The make, type, number and capacity of dynamos was required. Arc and incandescent lamps were specified according to number and candle power of each. Motors were arranged with reference to their numbers, capacity, type and voltage. Distribution circuits were designated as to their lengths and the sort of service rendered by them. Numbers of poles, lengths of underground conduit and the feet of wire carried by each were included.

The items of operation at stations included the kinds and quantities of fuel consumed. Numbers of public and commercial arc and incandescent lamps operated, and the candle powers of each were required to be stated. For street lamps the number of hours of operation per night and the nights per month were to be included. The general schedule of prices for commercial service and the contract rates for street lighting formed items in the report. In addition to these stated, many minor matters went to make up the technical data required by the commission-

[illegible] report to which the president, [illegible]

[illegible] reports just considered, the general nature of the data [illegible] by the commissioners has remained about the same, but the number of separate items covered and the [illegible] have been materially extended.

Thus, in the reports of 1901, the cost of plant included 32 items, operating expenses 31 items, and the technical statistics of equipment and operation were largely increased. A list of [illegible] now be stated for each circuit. The list of transformers must now include the number and capacity of each, and the date when installed. Electric meters are reported as numbers, capacities and additions. Storage batteries are described as to make, number of cells, number of plates per cell, voltage per cell and the discharge rate of each battery at one, five and ten hours. The records now required of energy outputs include the kw-hours from each type of dynamos delivered at the switchboard and sold to consumers, also the kw-hours sold for lighting and for power.

[illegible] presents the dry, statistical form. When the reports are separated into distinct parts, arranged in chronological order and analyzed, they offer, at once, the best available record of the past development and of the present condition of electrical supply in the United States.

Massachusetts, through its commissioners, has performed a great service for electrical interests and the public at large, in the preservation of this unique record of the rise of the central station industry.

Lead vs. Nickel Storage Batteries.

At the Niagara meeting of the American Electrochemical Society, Mr. Hugh Rodman read a paper, entitled "Storage Battery Invention," which contrasted at length the relative merits of the lead and nickel types of storage batteries. In opening, Mr. Rodman pointed out that besides charge and discharge, storage batteries must withstand overcharge, a putting in of more ampere hours than can be taken out; and this condition implies unchanging electrodes in an unchanging electrolyte. After discussing numerous possible storage battery combinations and the corresponding reactions, the conclusion is reached that the list of available anodes and electrolytes finally reduces to lead in sulphuric acid and nickel in an alkali [illegible].

This does not mean that the active material must necessarily contain nickel or lead, but simply that the grid, the current carrying part of the oxygen plate upon which the active material rests, must be one or the other of these metals in its appropriate solution. The active material of the oxygen plate, considering permanency only, may be any insoluble oxide or salt; while the grid and active material of the hydrogen plate, putting aside as impracticable any dissolving material, such as zinc, may be either of the same metal as the oxygen plate, as lead in sulphuric acid, or else of some other metal [illegible] current, as iron in hydroxides. Practically, this all reduces to two classes: First, lead peroxide and spongy lead upon lead plates in sulphuric acid, the battery in general use; and, second, mercuric or nickel peroxide upon nickel plates, together with cadmium, nickel or iron sponge upon iron or nickel plates in an alkali hydroxide, the battery proposed by Mr Edison. As the most promising member of this latter type, we may take an oxygen plate of nickel peroxide upon nickel with a [illegible] plate of iron sponge upon iron and compare it with the usual Plante and Faure types of lead cell.

The alkali battery [illegible] in making its support plates of a stiff, easily-worked metal. The stiffness insures absence of buckling (a trouble which must be considered and compensated for with lead plates), while the stiffness and ease of working together admit of a high mechanical perfection. It should be borne in mind, however, that the ordinary antimonial lead grid used with pasted lead plates is neither prohibitively heavy nor short-lived; it will probably last as long as the nickel grid when subjected to electrolytic action only; the inferiority lies in its mechanical weakness and in the difficulty of making fine castings.

Lead peroxide is a conductor. We can use it in comparatively large and porous masses. Nickel peroxide is not a conductor, and so must be held in close contact with some conductor itself inactive as nickel or carbon. This may be done in two ways: First, by peroxidizing a highly developed surface of nickel, corresponding with the Plante form of lead plate; second, by packing the active material or material to become active with powdered or flake graphite held rigid in a perforated box.

An objection to the first method is, that as nickel peroxide does not conduct, only a thin layer of low capacity can be utilized; another objection is that the disintegration by shedding is even more pronounced than with lead, and without the advantage of a continuing and compensating formation of the remaining metal. An objection to the second method is that the dense active mass impedes diffusion. An advantage is that the close-held mass with its stiff finely perforated cover is apparently not subject to deterioration. It is well to note that the disintegration of one plate and long life of another is in no way due to the intrinsic qualities of one or the other active material, or to the difference in chemical action taking place; there is no apparent reason why lead peroxide reducing to lead oxide or to lead sulphate should fall to pieces any more quickly than nickel peroxide reducing to nickel oxide—in fact, the reverse is true. The difference lies entirely in the method of holding the active material and in its porosity.

For hydrogen carrying materials, we have spongy porous lead in the acid cell, and in the other spongy iron or a low oxide of iron packed with flake graphite. Here we see no reason why the spongy lead plate should not last indefinitely, and, until recent years, this was supposed to be the case. It loses no material; it does not change chemically; but actually, its capacity lessens with age, and so, while its deterioration is not so rapid as that of the peroxide plate, it must nevertheless be occasionally renewed. The opposite is now hoped for the iron plate; its active material is held rigid by a stiff grid and unchanging graphite packing, and, apparently, should not lose capacity; this, however, for either iron or nickel can be proven only by a much longer life test than the plates have yet had.

One battery uses an acid solution that is absorbed during the discharge by the active material of both plates, and released upon charge. The other uses a solution of potassium hydroxide that is inactive except as an electrolytic conductor, a means of carrying oxygen from one plate to the other. The result of this difference in electrolytes is most important; in the alkali battery we use only enough electrolyte to make a path for the current, while the acid battery must have a mass of electrolyte large enough to hold both the acid needed for the reactions and enough over to insure low electrolytic resistance at the end of discharge. Now, while the possibility of using a small amount of electrolyte, which means putting the plates close together, is one of the important factors in making the alkali battery light enough and small enough for commercial practice, this very advantage adds greatly to an already serious trouble—refilling. In overcharging, a portion of the water is uselessly decomposed, passes off as gas and must be replaced. The actual amount lost is fixed by the time of overcharge and by the current. The relative amount lost is inversely proportional to the volume of solution in the full cell.

Here the alkali cell is inferior to the lead cell. First, the overcharge is greater. The densely packed active material allows only slow diffusion in its mass, with the result that a large proportion of the current breaks up the electrolyte at the surface of the nickel plate, rather than pass through the attenuated alkali solution held in the active material and maintained there by the outward electrolytic movement of the potassium ions. Second, the current is greater. The voltage of the alkali cell is only about one-half that of the lead cell; therefore, for the same energy output, we must double either the current or the number of cells, so multiplying the useless dissociation by two. Third, the alkali cell has comparatively a small mass of electrolyte to draw upon. In all, the question of electrolyte mass comes to this: that in the alkali battery we multiply a serious trouble by a factor of three or four and then halve the means of getting around it.

Another trouble arising from refilling is the quality of the water used. In large commercial operation or in laboratory work, where distilled water can be gotten, this is not serious, but with small users where the hydrant is the common source of supply, it is often the means of putting into the electrolyte some active agent that eventu

ally disintegrates the plates. Obviously, the lead battery has the advantage.

Again, the acid electrolyte is commercially the better for the ease of handling. This advantage will be overcome if the alkali battery will need no overhauling, but for the ordinary run of events, overturned cells, over-filled cells, handling of old plates, moisture from gassing in overcharge, for the numerous contingencies arising in actual work, there can be no question that alkali is worse than acid for woodwork, clothes and hands. Acid does not creep—alkali both creeps and turns to carbonate. The advantage sometimes claimed for the alkali simply upon the ground of its not changing is a little hard to understand. There is, on the face of it, no reason why the electrolyte should not change as well as the plates; in fact, a battery with unchanging electrodes and changing electrolyte would in many ways be better than its opposite. For instance, the change of electrolyte density is, in the lead cell, a very useful and needed means of determining the state of charge and discharge.

Adaptability to different uses of one or the other battery will be finally determined by a balance between utility and cost. For central station work, which at present takes about 75 per cent. of the battery output, the position of the lead cell seems secure. Its low first cost, low internal resistance, high voltage and general efficiency more than overbalance the deterioration. This deterioration is a matter of careful figuring: in so many years so many plates must be manufactured and installed to keep a given battery in good condition; as an offset, so many pounds of scrap lead and so many pounds of battery mud are returned. The renewals ordinarily mean no interruption of work and not much expense in installing.

For lighter service, particularly for electric wagons, where watt efficiency and cost are to some extent subordinate to convenience, the choice will depend largely upon capacity and reliability.

Data is wanting upon the capacity of the alkali cell per unit of volume and weight, but it seems reasonably certain that neither will be far different from that of the pasted lead battery. As for reliability, which must not be mistaken for long life, data on the alkali cell is again wanting and must be wanting until the cells are put into ordinary service with ordinary care and attention. It seems certain that the necessity for frequent refilling will mean serious trouble in the way of low cells and irregularity of working, while the problem of the alkali electrolyte and excessive gassing will need most careful consideration.

The commercial life of lead plates in truck or cab service is about 15,000 to 20,000 miles for negatives, 12,000 miles for Plante positives and 6,000 miles for pasted positives. In other words, a four or five ton truck running 20 miles per day for 300 days in a year requires new positives once in a year or once in two years, according to the type of plate used, the choice of one or the other being determined by the character of service and length of run desired. Cabs and lighter wagons have about the same life, with a capacity of 40 to 100 miles on one charge.

Work done under these conditions, actual work reduced to dollars and cents, has shown that the electric wagon gives better city service than can be gotten from gas or steam or horse. A better battery, either an improvement on the old or a better new one, would control practically all city traffic not on rails.

Incandescent Lamps in Holland.

Mr. S. Listoe, United States Consul General at Rotterdam, Holland, makes the following communication to the State Department as to incandescent lamps in Holland:

While about 500,000 incandescent electric lamps are annually used in the Netherlands, there are only three firms engaged in their manufacture, viz., Philips & Co., at Einhoven, and E. Goossens, Pope & Co., and the Company "Constantia," at Venlo. Most of the lamps used are imported, the principal part coming from Germany and a small percentage from England, Belgium, and Switzerland.

Lamps are imported in every quantity, from lots of 50 or 100 to 1,000 or more. I have not been able to ascertain the total imports, no statistics existing on the subject. Foreign manufacturers who send incandescent electric lamps to the Netherlands are "Die Allgemeine Elektricitats-Gesellschaft," Berlin; Siemens & Halske, Berlin; the Edison & Swan United Electric Light Company, Limited; La Société Anonyme Belge, Brussells; the Improved Electric Glowlamp Company, Limited, London; Gebrüder Pintch, Berlin; and the Zurich Incandescent Lamp Company, Zurich, Switzerland.

The market price per lamp for 1902 is quoted at 50 pfennigs (about 12 cents) by the "Allgemeine Elektricitats-Gesellschaft." Various discounts are granted, according to the size of the order given. The "Nernst" lamp of this company, which has during the last year come into wide use here, costs 2 marks (48 cents). The import duty on electric lamps in the Netherlands is 5 per cent. of the value, inclusive of packing. There are no regulations restricting the importation of lamps.

The competition in this line is very keen, and purchases are largely governed by price considerations; naturally, the best quality at the lowest figure is in demand. Generally speaking, the people here are favorably inclined toward American manufacturers, and if American lamps can compete in price and in quality with German manufacture there will undoubtedly be a good market for them. Electricity is slowly but surely replacing gas and oil.

There are no special underwriters' regulations applying to incandescent lamps in the Netherlands, with reference to the base of lamps. Most of the lamps are fitted with the ordinary "Edison screw" base or with the "Swan bayonet" base.

The principal importers of electric lamps at Rotterdam are H. C. van Mens, G. S. Kaufmann & Landheer, J. M. A. Bekking, Continental Incandescent Light Company, Croon & Co., G. L. Dahlmann, Electricitiets Maatschappy Volta, Meteor, Nieuwmeyer, Heukelom & Co., Van Rietschoten & Houwens, J. M. Scheffer & Co., C. Wasser & Co., Wynmalen & Hausmonn, and Van der Laan & Co.

Kansas Independent Telephone Convention.

The second annual convention of the Kansas State Independent Telephone Association was held at the Coates House, Kansas City, Mo., September 11 and 12. The delegates were welcomed by Mayor Reed, who in his address expressed some views on the question of government ownership of the telephone, and also gave the Bell Telephone Company a rap. "You are," he said "endeavoring to bring into closer touch the independent telephone lines in Kansas. If you do not wish us to quote you as a little below par you must include Missouri. The present conditions of the telephone business are lamentable. If relief is to come to the people it must come either from legislation of the most radical character or through an intelligent union of independent systems, managed along honest lines and by honest men. That, of course, leaves out the Bell company, which is nothing better than a pirate.

"There should be only one company," he continued. "That should be owned by the government, be connected with the postal service and its telephones should be in every farmhouse in the land. We may never reach this, and in the meantime must try to meet present conditions. The Bell company, which never did an honest act in its life, takes out of Kansas City, at a low estimate, $300,000 annually, and swears to the assessor that the value of its entire property in Jackson county is $22,000." Mr. W. H. Nelson, of Smith Center, responded to the mayor's address.

Papers were read as follows: "Construction and Maintenance of Metallic Toll Lines," by Harry Faris; "Enforcement of Message Time-Limit," by W. W. Dilworth. The exchanges at Salina, Atchison, Topeka, Wichita and Kansas City were described by D. A. Van Trine, E. H. Barry, B. F. Pankey, Hon. Frank L. Brown and Jas. S. Bailey, Jr., respectively.

The main object which the association is working to accomplish is to connect, by long-distance lines, the 300 independent exchanges of Kansas and Missouri. This will be done, probably, when the Kansas City Home Telephone company opens its exchange for business next July. The local independent company will act as a "central" for the various independent exchanges in the Missouri valley. At the meeting, resolutions were passed expressing full confidence in the Home Telephone Company, of Kansas City, and the assurance was given that the plant now building would be connected with all the Kansas independent lines. By the time of its completion, next July, three branch lines are expected to enter Kansas City from Kansas. Mayor Reed was thanked for his earnest and persistent fight against the "Bell monopoly" and his efforts to secure lower rates and a fair treatment of the public.

The executive committee was instructed to confer with the Home management relative to arrangements for making connections.

There was a large exhibition by telephone manufacturing concerns and supply dealers of apparatus and appliances.

Data of Principal Power Stations in Greater New York.

At the recent meeting of the Association of Edison Illuminating Companies, Mr. W. F. Wells presented a paper in which was given a comparison of the five principal power stations in Greater New York of latest construction, as follows: Station of Metropolitan Street Railway Company, at Ninety-sixth Street and East River; Manhattan Railway Company, at Seventy-fifth Street and East River; Metropolitan Street Railroad Company at 216th Street and Harlem River (Kingsbridge); Rapid Transit Subway Company, at Fifty-eighth Street and North River, and the Waterside Station of the New York Edison Company, at Thirty-eighth Street and East River. Below are given the principal data of the compilation:

	Metropolitan.	Manhattan.	Kingsbridge.	Rapid Transit.	Edison.
[illegible]	48,800	[illegible]	39,360	116,000	53,819
[illegible]	3	2	–	1	–
[illegible]	[illegible]	85,000	34,560	46,980	[illegible]
[illegible]	[illegible]	35,340	20,960	69,020	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	39,000	[illegible]
[illegible]	[illegible]	[illegible]	36,000	80,000	83,200
[illegible]	[illegible]	100,000	50,000	125,000	128,000
[illegible]	38,500	[illegible]	28,000	50,000	56,000
[illegible]	[illegible]	[illegible]	......	75,000	80,000
[illegible]	[illegible]	4	2	5	4
[illegible]	353′	[illegible]	200′	[illegible]	196′
[illegible]	[illegible]	[illegible]	[illegible]	15′	[illegible]
[illegible]	[illegible]	908	308	880	908
[illegible]	[illegible]	8.1	[illegible]	?	7.3
[illegible]	9,000	15,000	[illegible]	15,000	10,000
[illegible]	87	64	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	650
[illegible]	[illegible]	33,280	[illegible]	39,000	36,400
[illegible]	[illegible]	160	[illegible]	175	[illegible]
[illegible]	[illegible]	0.51	[illegible]	0.49	0.44
[illegible]	255,200	335,570	153,600	390,000	364,000
[illegible]	[illegible]	7,360	[illegible]	?	3,220—2,464
	4,669	......	......	......	5,684
[illegible]	[illegible]	45.2	45.2	?	[illegible]
[illegible]	[illegible]	[illegible]	3.12	4.87	4.37
[illegible]	[illegible]	0.221	0.221	?	0.18—0.13
[illegible]	5.45	5.68	[illegible]	?	5.4—7.4
Forced Draught, Cubic Feet per min., each	......	57,000	......	......	58,000
[illegible]	......	[illegible]	3″	......	[illegible]
[illegible]	......	98,334	57,600	124,800	......
Total heating surface, Primary Heaters	[illegible]	......	2,360	......	......
Total heating surface, Secondary Heaters	5,100	......	2,480	5,000	10,664
Number of Engines	11	8	8	10	16
Height, floor to top of cylinder	34′ 9″	38′ 4″	35′	35′	37′ 3″
Floor space	[illegible]	2,000 sq. ft.	28′x38′	40′x37′ 6″, 1,500 sq. ft.	41′x23′, 943 sq. ft.
Type	Vert. cross Comp.	Double comp. 2 hor. cyl. 2 vert. cyl.	Vert. cross comp.	Double comp. 2 hor. cyl. 2 vert. cyl.	3 cyl. vert. comp.
H. P. each, nominal	4,500	8,000	4,500	8,000	5,200
H. P. each, maximum	6,000	12,500	6,250	12,500	8,000
H. P. total, nominal	49,500	64,000	36,000	80,000	83,200
H. P. total, maximum	66,000	100,000	50,000	125,000	128,000
Cylinders	46″-86″	(2) 44″-(2) 88″	46″-86″	(2) 42″-(2) 86″	43½″-(2) 75½″
Stroke	60″	60″	60″	60″	60″
[illegible]	[illegible]	750	750	750	750
[illegible]	[illegible]	160	150	175-200	175
Valves	Corliss	Corliss	Corliss	Poppet high, Corliss low	Poppet high, Corliss low
[illegible]	[illegible]	[illegible]	[illegible]	4.2:1	6.02:1
[illegible]		1,544	1,590	1,544	1,137
[illegible]	[illegible]	[illegible]	[illegible]	2	3
[illegible]	[illegible]	8″	[illegible]	8″ H. P., 10″ L. P.	9″
[illegible]	[illegible]	13′ 6″	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	5.4	5	5.4	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Center [illegible]; overhung [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14x14
[illegible]	[illegible]	[illegible]	[illegible]	25′ 3″	[illegible]
[illegible]	[illegible]	37″	[illegible]	37″	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	16″	[illegible]
[illegible]	[illegible]	34″x60″	34″x60″	[illegible]	26″x60″
[illegible]	[illegible]	[illegible]	507,000 lb.	439,000 lb.	[illegible]
[illegible]	[illegible]	none	[illegible]	[illegible]	23′
[illegible]	[illegible]	none	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	65
[illegible]	Surface	Jet	Jet	[illegible]	Surface
[illegible]	[illegible]				0.200
[illegible]	88,000				147,200
[illegible]	[illegible]				[illegible]
[illegible]	11	8	8	10	16
[illegible]	3	3	3	3	3
K. W. capacity, rated each	[illegible]	[illegible]	[illegible]	5,000	3,500
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5,000
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		304	450
[illegible]	Y	Y	Y	Y	Y
Volts	[illegible]	[illegible]	6,600	11,000	6,600
Speed	[illegible]	[illegible]	[illegible]	75	75
[illegible]	[illegible]	[illegible]	40	40	40
[illegible]	[illegible]	[illegible]	......	32′	16′ 8″
[illegible]	[illegible]	[illegible]	150,000	370,000	130,000
Weight of armature	[illegible]	[illegible]	[illegible]	520,000	125,000

	Metropolitan.	Manhattan.	Kingsbridge.	Rapid Transit.	[illegible]
Circumferential speed per minute	3,927	7,540	......	7,540	3,927
Diameter frame	21′ 6″	43′	25′ 9″	43′	[illegible]
Total weight, lbs.	260,000	890,000	......	890,000	[illegible]
Frame divided into segments	2	6	2	7	[illegible]
Inherent regulation	5%	6%	......	6%	[illegible]
Guaranteed efficiency, ¼ load	90.8%	90%	......	......	[illegible]
Guaranteed efficiency, ½ load	94.8%	94.5%	......	......	[illegible]
Guaranteed efficiency, ¾ load	96.2%	95.5%	......	......	[illegible]
Guaranteed efficiency, full load	96.7%	96.5%	......	......	[illegible]
Guaranteed efficiency, 1¼ load	97%	97%	......	......	97%
Actual efficiency, ¼ load	......	93.15%	......	......	[illegible]
Actual efficiency, ½ load	......	96.20%	......	......	95.5%
Actual efficiency, ¾ load	......	97.29%	......	......	[illegible]
Actual efficiency, full load	......	97.75%	......	......	97.0%
Actual efficiency, 1¼ load	......	97.98%	......	......	97.2%
Guar. temp. rise, full load, 24 hours	......	35° C.	......	......	30° C.
Guar. temp. rise, 1¼ load, 24 hours	......	45° C.	......	......	......
Guar. temp. rise, 1½ load, 3 hours	......	......	......	......	50° C.
Guar. temp. rise, 1½ load, 2 hours	......	55° C.	......	......	......
Insulation test field coils, 1 minute	......	2,500 V.	......	2,500 V.	2,500 V.
Insulation test armature coils	......	25,000 V. 30 M.	......	25,000 V. 30 M.	15,000 V. 30 M. 25,000 V. 1 M.
Armature winding	Form Wound	Built up, or bar type.	Built up, or bar type.	Built up, or bar type.	Form Wound.
Number exciters	6	4	5	4	5
Capacity exciter generator	150 K. W.	250 K. W.	160 K. W.	250 K. W.	150 K. W.
Voltage	125	250 volts	125	250	300
Capacity exciter storage battery, all fields	None	None	None	None	1 hour
Amperes per field normal load	300	225	......	225	120
Volts across field terminals	100	200	......	200	176
Switchboards, type	Panels and bench boards	Panels and bench boards	......	Panels and bench boards.	Individual panels and switch peds.
Approximate floor space, sq. ft.	6,400	12,000	......	......	10,000
Number generators	11	8	......	10	16
Total normal K. W. cap.	38,500	40,000	......	50,000	56,000
Number feeders, present	......	34	......	36	28
Number feeders, ultimate	80	48	......	64	40

Production of Natural Gas.

A special bulletin, issued by the U. S. Geological Survey, C. D. Walcott, director, gives some data on the production of natural gas. The consumption has continued to increase, although the pressure, except in the new field of West Virginia, has continued to decline, necessitating the expense of compression in order to market an increased production from the declining field, which expense must continue to increase as the pressure declines and the distance to the source of supply increases. The value of natural gas consumed in the United States in 1901 was $27,067,500, which, at 15 cents per 1,000 cubic feet, is equivalent to 180,450,000,000 cubic feet. If 20,000 cubic feet of natural gas be taken as equal to 1 ton of coal, 8,458,600 tons of coal, valued at $3.20 per ton, would be required to yield the sum of money for which the natural gas sold.

The value of the production for 1901 was greater than that of 1900 by $3,368,826, or over 14 per cent. It also exceeded that of 1899 by $6,992,627. It may also be interesting to note that the value of the 69,389,194 barrels of petroleum produced in the United States during 1901 was $66,417,335, and that the value of the natural gas amounted to 40.7 per cent. of the value of the petroleum for the same year, and that, further, when the fuel value of the coal and wood displaced by natural gas in 1900—which amounts to $32,445,156—is considered, this estimated displacing value of natural gas is nearly 49 per cent. of the entire value of the crude petroleum produced in the same year.

There were 10,297 wells producing natural gas at the close of 1901, of which number 74 were not turned into the gas mains, and 2,088 producing wells were drilled in the same year; there were 453 dry holes, or non-producers, and 1,084 were abandoned. There were very nearly 800 miles of pipe laid during 1901, the mains varying from 2 inches up to 20 inches. This brought the total up to 21,848 miles of natural gas mains of from 2 inches to 36 inches diameter in use at the close of 1901.

As a source of power, natural gas stands at the head of the list for economy among the fuels, both as to expense of installation and expense of operation. It has been supplying the power for a very large number of factories and operations in the gas belt, and lately it has been extensively applied in creating the power by which the natural gas itself is compressed from a low to a high pressure when the original pressure has failed and the pipes are insufficient to deliver the necessary quantity of gas at the well pressure. A number of these compressors work up very close to 1,000 horse-power, with an economy that enables 8 to 10 cubic feet of natural gas to develop a horse-power for an hour, a saving of from 40 to 50 per cent. over high-duty steam engines.

It is estimated that fully 1,000,000 domestic fires are supplied by natural gas, and that 4,000,000 people are furnished with this ideal fuel for light.

Companies or individuals to the number of 1,545 report the use of natural gas in manufacturing establishments of various kinds, numbering in all 5,742, including 102 iron and steel works and 219 glass works.

Trolley Development Around Salt Lake.

One of the most important pieces of railroad work undertaken in the vicinity of Salt Lake for years past has been commenced. It is a preliminary survey for the Salt Lake and Suburban Railroad. The value of this line is beyond question. It opens up one of the finest tracts of residential country and reaches outlying districts, which for years have been seriously in need of this service.

The surveyors will go into the field at once, under charge of Guy Sterling, of Salt Lake City, who will have supervision of the engineering and construction work. The surveys will require about two months to complete, but the construction work will be commenced inside of thirty days. The work will be crowded, and the engineer will be followed closely as soon as he has had a sufficient start.

The road will not be a single line, but will have branches extending north and south into every part of the surrounding country, as it is intended to reach all the outlying towns in those directions from the city. It is yet a matter in abeyance as to where these branches will begin. This will be determined later on by the engineer in charge. This road will connect the city with a magnificent plateau south of the city, which is high and dry when the city itself is surrounded by fog. It has water rights dating back to '47, which are fed from Parley's Canyon, in the Cottonwood district, and other systems in that section of the State.

Niagara Falls Meeting of the American Electrochemical Society.

[illegible] The total number of members and guests [illegible] and the registry [illegible] during the four days of the meeting. About 110 members were present out of a total membership of less than 400, which corresponds to a percentage perhaps unique as compared with meetings of other similar organizations.

While at the time of naming Niagara Falls as the place of meeting of the [illegible] ance that members would be permitted to [illegible] of the electrochemical works there, it was, nevertheless, a matter of disappointment to learn that by preconcerted arrangement this courtesy was not to be extended. Of almost a score of electrochemical establishments of Niagara Falls, all but four denied admittance, the exceptions being the Carborundum Company, International Acheson Graphite Company, Electrical Lead Reduction Company, and the Atmospheric Products Company. The [illegible] of these companies gave a cordial invitation to visit their [illegible] and detailed [illegible] of their staffs to conduct members about [illegible] ain the processes there carried on. The same courtesy was also extended by the Niagara Power Company and the Niagara Falls Hydraulic Company, which provided every facility for a profitable visit to their respective generating stations.

The local committees were unrelaxing in their efforts to entertain the visitors and did much to counteract the effect of the action of the plant officials above referred to. An extensive programme was provided for each day and evening, including a gorge searchlight trip and a banquet on Wednesday evening.

Among the attendants at the meeting were Prof. Dr. F. Haber, of Karlsruhe, Germany, and Prof. R. S. Hutton, of Owens College, Manchester, England. Dr. Haber, who is one of the faculty of the Technical High School, of Karlsruhe, was the accredited delegate to the meeting of the Bunsen Society, formerly known as the German Electrochemical Society, of which Prof. Van't Hoff is president. Prof. Hutton is in charge of the only extensive electrochemical course in Great Britain, in connection with which a very complete electrochemical laboratory has been established. Both of these gentlemen presented papers and took a prominent part in the discussions.

It was a source of great regret that Mr. C. J. Reed, the very efficient secretary of the society, was compelled by a sudden illness to [illegible] the close of the session. [illegible] organizers of the society, and subsequently as secretary, Mr. Reed has during the past six months been burdened with a vast amount of work for the organization, in addition to his professional work, the extent of which former can be surmised from the programmes of the Philadelphia and Niagara meetings, and the rapid building up of the membership. The duties falling to him have been enthusiastically discharged, without pecuniary compensation and with an ability and tactfulness to which the society owes much of its success. The [illegible]

On Wednesday evening the Local Entertainment Committee gave a banquet at the International Hotel to the members and guests of the society. Almost 150 seats were occupied at the tables in the large dining hall. Mr. Wm. B. Rankine presided as toastmaster [illegible] "Niagara Falls." Mr. Rankine sketched the electrical development in the vicinity of the Falls [illegible] President [illegible] responded to the toast to the society, and gave a sketch of the founding of the same. The society grew out of a meeting in Philadelphia of several [illegible] electrochemical subjects, the gentlemen being Messrs. Reed, Hering and Roeber. When the matter of forming a national organization was discussed [illegible] purpose of organization [illegible] a short time after sending out the circulars, and at the time of the first meeting [illegible] names were enrolled for membership. Since then additions have brought the membership almost to 400.

As delegate of the German Electrochemical Society (now known as the Bunsen Society), Dr. F. Haber responded to a toast, and spoke in high terms of the cordial reception which, as a member of the German society, he had received in this country from representatives of the profession and industry. Prof. R. S. Hutton, of Owens College, Manchester, Eng., responded in graceful terms to a toast referring to the British chemical workers. Prof. W. D. Bancroft, of Cornell University, responded to the toast, " Our Universities," and Prof. F. B. Crocker to a toast on the sister societies, and Dr. N. S. Keith did justice to the subject assigned to him—namely, "The Ladies."

At the session of Friday morning, Mr. A. Isakovics presented a motion, which was seconded by Dr. N. S. Keith, inviting the society to hold its next general meeting in New York City. As finally adopted, the motion expressed the wish of the members present at the session that the board of directors should consider favorably the proposition to hold the next general meeting in New York City.

At the close of Friday's session, Mr. Hering offered resolutions of thanks for courtesies received, to the Local Entertainment Committee; the Ladies' Committee; the National Food Company; Niagara Power Company; Niagara Falls Hydraulic Power Company; Electrical Lead Reduction Company; International Acheson Graphite Company; Carborundum Company, and the Atmospheric Products Company. The meeting then adjourned *sine die*.

Following is an account in detail of the proceedings in session. Owing to a delay in the mails our report of the sessions of Monday and Tuesday was not received in time to be incorporated in the body of the paper, and appeared as a supplement to last week's issue. To make this report complete, that part of the matter relating to papers and discussions is reprinted herewith with some corrections.

MONDAY'S SESSION.

Mr. Francis A. J. Fitzgerald presented the first paper of the meeting, the title being "Notes on Testing Carbon Electrodes." It was pointed out that the efficiency of an electrode depends largely on its density, and the paper deals with methods for the determination of density. Two determinations are made—first, of the density of the carbon of which the electrode is made, and, second, the apparent density or the ratio of the weight to the volume of the electrode as a whole. The difference of these quantities divided by the first-mentioned expresses the porosity. The paper gives the methods of determination in minute detail. In the case of a specimen, the real density was found to be 2.19, the apparent density 1.63, and the porosity 0.26. In certain electrolytic processes the presence in an electrode of amorphous carbon is undesirable, owing to the accompanying disintegration, and the paper describes a method of testing to determine the presence of amorphous carbon, which consists of a treatment with nitric acid and potassic chlorate, which removes the amorphous constituent.

Mr. Fitzgerald's paper was briefly discussed by Messrs. Hart, Hutton and Keith, their remarks referring more particularly to details of the testing process.

In a paper, entitled "Cathodic Reduction," Mr. Alfred T. Weightman gave the results of experiments with sulphide electrodes, which showed that Thomson's rule does not apply, at least when expressed in its simple form. The two divergences are with respect to the voltage of reduction and the amount of hydrogen released. It was shown that much less hydrogen is released than the rule calls for, which fact is of advantage in commercial working. The higher voltage accords with the views of Caspari and others, that the voltage necessary to liberate hydrogen is not a constant as implied by Thomson's rule, but is dependent on the metal which constitutes the cathode. Mr. Weightman adds that in addition there is probably also a variation in voltage in the case of H_2S with different metals.

A lengthy discussion followed the reading of the paper, in which Messrs. Reid, Keith, Smith, Rodman, Haber, Smith, Blackmore, Hering, Hutton and Sperry participated. Mr. Reed did not consider Caspari's theory necessary to explain the results arrived at, but Prof. Haber and others took the opposite view—namely, that Caspari's theory of over-voltage is correct and applies to the experiments in question. In reply to a question by Mr. Hering as to the source of the energy corresponding to the over-voltage, Prof. Smith said it corresponds to the second term of Helmholtz's equation containing the temperature coefficient of the e. m. f. Prof. Haber said that it should not be lost sight of that there may be inter-

mediate steps between ions and gases, such as solution, adsorption, the formation of an alloy, etc.

President J. W. Richards' paper, entitled "Efficiency of Electric Furnace Operations," discussed a large number ot operations. From the data presented, it appears there is an unexpected uniformity in the efficiency of different processes where the heat is employed not only in melting the material but also in chemical action. In the latter case the efficiency is generally 50 to 60 per cent. In processes where there is simply heating without chemical action, the efficiency is higher, approximating 70 to 75 per cent.

In the following discussion, Mr. Hering said that determination of the efficiency involves knowledge of the actual energy necessary to a given process, but that in many cases this is not exactly known; consequently until this theoretical quantity is fixed, efficiencies must be accepted with caution. In reply to a question by Mr. Brindley as to the reduction of radiation loss by double walls, Prof. Richards said that the important factor is whether the operation is conducted slowly or quickly. The size of furnace, of course, is also a factor in radiation.

The final paper of Monday's session was read by Prof. Louis Kahlenberg, the title being "Differences of Potential Between Metallic Sodium and Solutions of Cadmium Iodide in Various Solutions." The greatest potential difference was measured between cadmium and cadmium iodide in a large number of different solutions, the other electrode in each case being Helmholtz's normal electrode. The general result was that the potential difference between a metal and a solution is primarily determined by the chemical affinity. With solvents of similar chemical character there is little variation in the potential difference.

TUESDAY'S SESSION.

The first paper of Tuesday's meeting was entitled "Developments in Electrometallurgy of Iron and Steel," and in the absence of the author, Mr. Marcus Ruthenberg, was read by Prof. Hart. The method outlined consists in principle in using an electric furnace combined with the action of a magnetic field. The melting zone of the electric furnace is a magnetic field. The ore being magnetic, the magnetic field seizes and holds the grains of the magnetite, the polar projections being at the same time the electrodes of the smelting circuit; the magnetic bridge thus formed by the ore forms a high resistance in the smelting circuit. The heat of the smelting circuit is engendered within the bridge of ore itself. The electrodes are water-cooled. When the ore is melted it loses its magnetism and drops out of the magnetic zone, new material being substituted. An animated discussion followed, in which Messrs. Hart, Keith, Johnson, Reed, Richards and Salom took part. The general opinion seemed to be that there is at present no probability of the electric furnace superseding the blast furnace in the reduction of iron ores; that the ordinary iron smelting furnace of to-day is a very efficient piece of apparatus; and that magnetic concentration of ores is only applicable in the case of low-grade ores.

In a paper by Dr. Eugene A. Byrnes, entitled "Voltaic Cells with Fused Electrolytes," the results are given of a great many measurements of the e. m. f. of cells, in which the electrolyte was fused sodium hydroxide. The cell was divided into two parts by a porous diaphragm. The one electrolyte was graphite, and for the other many different substances were used. Different depolarizers were used. The results of the measurements are in several points in good agreement with results obtained by Liebenow and Strasser. In the discussion, Mr. Reed claimed that the e. m. f. of such cells is nearly wholly thermoelectric, but this was contested by Mr. Byrnes, who said that the thermo e. m. f. is only a factor and not the principal one.

In a paper, entitled "The Fusion of Quartz in the Electric Furnace," Prof. R. S. Hutton, of Owens College, Manchester, described a process for making quartz fibres and small tubes for scientific purposes. An arc furnace is used, and the quartz is fused in a mould of graphite. At first difficulties were encountered, owing to air bubbles, but these have been overcome. Prof. Hutton considers there is a commercial future for the process. The paper was briefly discussed by Messrs. Whitney, Bancroft, Fitzgerald and Doremus.

In a paper, entitled "Thermoelectric Theory of Concentration Cells," Prof. H. S. Carhart extended his discussion of this subject, which was presented at the Philadelphia meeting. In Nernst's formula, the e. m. f. of a concentration cell is proportional to the absolute temperature, which suggests a thermal origin. The same conclusion is reached from Helmholtz's formula for the e. m. f. of a voltaic cell; for a concentration cell the first term of this formula is zero, corresponding to the formation heat of the chemical processes, and the e. m. f. is directly equal to the absolute e. m. f. multiplied by the temperature coefficient of the e. m. f. A concentration cell was defined as a device for converting heat into electrical energy. Curves were exhibited, showing the relation between thermo e. m. f. and concentrations, and it was shown how the law of the inverse relation of the thermal e. m. f. with the concentration explains several obscurities relating to the Daniell cell. The paper was discussed at length by Messrs. Bancroft, Haber, Hering, Carveth, Patterson, Weightman, Richards and Keith. Doubt was expressed whether the particular nickel cell is really a true concentration cell, and Prof. Carhart said he could not affirm there is no chemical action in it.

In a paper, entitled "An Apparent Electrochemical Paradox," Mr. Carl Hering described a curious experiment which he and Mr. Reed made some years ago, in which water was decomposed in visible quantities at voltages far below the theoretical (about 1.45), even as low as about 0.3 volt. The experiment consisted in electrolyzing acidulated water in a strong N-shaped glass tube, which was sealed at both ends, and provided with a bend containing mercury, which enabled the mechanical pressures to be read off. The results were shown in a curve. The pressures reached about 23 atmospheres when the tube exploded. The voltage at the terminals when a constant current passed diminished rapidly and very decidedly to about 0.3 volt, at about 16 atmospheres, and then remained practically constant. Allowing for the loss due to resistance, the actual voltage of decomposition was even much lower—nearly zero. There was visible gasing during the whole test, showing that water was really being decomposed; the increasing pressures also showed this. A possible explanation was suggested, based on the assumption that some of the gases probably passed mechanically to the opposite electrode, which they could easily do in suspension, as the electrodes were very close together. These were consumed as depolarizers, so that only a fraction of the theoretical amount of gas was really liberated. This depolarization lowered the voltage. A calculation based on the reduced amount of gas which was actually liberated, on the actual current which passed, and on the energy which must be accounted for to conform with theory, would also show that the required voltage may be very low; and the lower, the greater the amount of depolarization. The paper concluded with a suggestion of an experiment in which water is electrolyzed in a strong, sealed vessel, which is completely filled so as to leave no room for the gases. Some curious results may then be expected. The paper was discussed by Messrs. Rodman, Johnson, Carhart, Reed, Hutton, Burgess, Bancroft, Haber, and Richards, most of whom accepted Mr. Hering's explanation.

WEDNESDAY'S SESSIONS.

Two sessions were held on Wednesday, September 17, one in the morning and the other in the afternoon. The first paper of the morning session was by Prof. W. E. Goldsborough, on "Electrochemistry at the World's Fair, St. Louis." The paper gave an outline of the plans for the exhibition, which it is intended shall outrank all international exhibitions thus far held. In the electrical department a strong attempt will be made to show processes rather than manufactured articles; 2,000 hp will be available in the electricity building, to give the exhibitors an opportunity to show their processes in operation. There will be shops in which electric motors, incandescent lamps, storage batteries, etc., are being made, so that the different steps of the manufacture can be clearly seen. In the electrochemical department, the aim will be to make the people of the country at large familiar with the electrochemical applications. There may be electrochemical exhibits in various other portions of the exposition, but in the electricity building electrochemical processes will be shown in operation, the exhibitor, of course, not being required to show anything which it would be expedient to keep from the public. He may exhibit a model plant which embodies only the fundamental and essential points of the process, while it may differ in many details from the actual process as worked on an industrial scale, thus not revealing any trade secrets. The speaker concluded by extending to the American Electrochemical Society an invitation from the Business Men's League, of St. Louis, to hold a meeting there in 1904.

The following resolution, proposed by Mr. Carl Hering and

[illegible]

[illegible] Society, in convention [illegible] importance of the Louisiana Purchase Exposition, and [illegible] it will do much in placing [illegible]

[illegible]

[illegible] Electrochemical Society hears with [illegible] that steps are being taken, looking [illegible] comprehensive exhibit in the [illegible]

[illegible] of Continuous Flow Calorimetry," was the subject of a paper read by Dr. H. T. Barnes, of McGill University, Montreal. The author has in recent years been a very active worker in determining some of the fundamental quantities of the science of physics, and his paper was interesting through showing the high accuracy which can be obtained in modern methods for this purpose. In principle, the method of continuous flow calorimetry [illegible] in having a flow of liquid continuously heated by an electric current in a fine-flow tube. When the conditions have become stationary, the temperature of the in-flow and out-flow and e. m. f. and current are measured. The different sources of error were discussed in detail, and methods were described for eliminating them. The paper was discussed by Messrs. Kahlenberg, Cowles, Hutton, Potter, Whitney, Carhart and Patterson. A fact brought out in the discussion was that the investigations of Dr. Barnes have given [illegible] which are in almost exact agreement with Carhart's determinations of the e. m. f. of the Clark cell.

Mr. Woolsey McA. Johnson followed with a paper on "The Electrolytic Dissolution of Soluble Metallic Anodes," which dealt mainly with the problem of the dissolution of anodes consisting of alloys. Every metal has a certain electrolytic "tension" (or potential difference against the electrolyte), depending on its physical condition, its temperature and the electrolyte. This tension is greatly affected by alloying the metal with other metals, and the conductivity is greatly decreased. In a composite metallic anode are segregated various voltages, corresponding to the different metals. The author gave some [illegible] of these principles, and discussed especially the phenomenon of [illegible] in electro-refining processes. For many purposes he [illegible] pyro-metallurgical treatment, before the electrolytic process [illegible]. Dr. Keith claimed that the difficulties in electrolytic refining processes referred to are assumed rather than existent in reality.

[illegible] Hypothesis and its Application." In the first part he gave a summary of the modern hypothesis of electrons or negatively charged corpuscles, smaller than atoms, and of the experimental facts concerning radiant matter, upon which this hypothesis is based. In the [illegible] some fundamental conceptions [illegible] that the law of gravitation is [illegible] for the law of gravitation. In the discussion which followed, Prof [illegible]

[illegible] From the requirements of practice. Mr. Rodman considers that the [illegible] tery, and compares it with the lead cell with respect to grid, active [illegible] the important factors in making the alkali battery light and small. [illegible] of refilling. As to the question of electrolyte mass, in the alkali battery we multiply a serious trouble by a factor of three or four, and then halve the mass by way of getting around it. Concerning adaptability to different uses, he believes that for central station work the position of the lead cell seems secure. For lighter service, particularly for electric wagons, where watt efficiency and cost are to some extent subordinate to convenience, the choice will depend largely upon capacity and reliability. Exact data are wanting for the alkali cell. For the lead cell he considers that a four or five-ton truck, running 20 miles per day for 300 days in a year, requires new positive plates once in a year, or once in two years, according to whether pasted plates or plates of the Plante type are used, the choice of one or the other being determined by the character of service and length of run desired. Cabs and lighter wagons have about the same life with a capacity of 40 to 100 miles on one charge. Work done under these conditions has shown that the electric wagon gives better city service than can be gotten from gas or steam or horse. A better battery, either an improvement on the old or a better new one, would control practically all city traffic not on rails. A fuller report of Mr. Rodman's paper will be found elsewhere in this issue.

The first paper in the afternoon session was read by Dr. F. Haber, Professor at the Technical High School of Karlsruhe, Germany, and the official delegate of the German Bunsen Society, on "The Phenomenon of the Formation of Metallic Dust from Cathodes." Dr. Haber has studied this peculiar phenomenon for several years, and showed two experiments, in both of which an iron nail was the anode in a 20 per cent. solution of caustic alkali, while the cathode was a strip of lead in the one case, and one of tin in the other. By using a current of 20 storage batteries, a black cloud goes off from the cathode and is distributed throughout the solution, so that it finally becomes inky. The cloud consists of fine suspended particles of dust of the material of the cathode. This phenomenon appears singular at first glance, because it is generally the anode and not the cathode which is attacked in electrolysis. The explanation of the phenomenon is as follows: The cation of the electrolyte forms an alloy with the metal of the cathode, and if the current density is high enough the alloy formed contains a relatively high percentage of the alkali metal; such an alloy, however, cannot exist in contact with a caustic alkali solution, because it is at once attacked chemically. When such an alloy is prepared by a purely chemical method and placed in a caustic alkali solution, the same formation of dust occurs at once, and the phenomenon has exactly the same appearance as in the experiments where the dust goes off from the cathode. Hence the formation of an alloy on the surface of the cathode is the primary electrochemical action, while the formation of the dust is secondary and purely chemical. When the electrolyte is an acid, the cathode also is sometimes attacked, although the phenomenon is here much less visible; the author believes that in this case a hydrogen alloy is formed.

The paper was discussed by Messrs. Keith, Bancroft, Reed, Carhart, Kahlenberg and Richards, and it was brought out that the phenomenon is of much more general importance than appears at first sight. Thus Dr. Kahlenberg said that the fundamental [illegible] for obtaining a well adhering deposit in electroplating is the formation of an alloy. Prof. Carhart related an interesting method by which he obtained a very firm and closely adhering deposit of platinum black on platinum. He decomposed zinc sulphate with a small current (0.1 ampere) and 50 sq cm. surface of the platinum cathode for five or six hours; afterwards the circuit was broken and the platinum cathode was left in the solution. After several hours it was found that the cathode was covered with platinum black; the explanation is that primarily a zinc platinum alloy had been formed but this cannot exist in the solution which contains free acid and disintegrates, leaving the platinum surface coated with platinum black.

"[illegible] Electrical Units" was the title of a paper read by Mr. Alfred H. Cowles, of Cleveland, Ohio, the well-known pioneer of electrochemical industries. He pointed out that 500 amperes in one day will decompose practically a pound molecule of any univalent compound; he suggests to use this as a unit and to call it the pound Col. While this relation is only approximately correct the following is said to hold true with great exactness—namely, that 100 amperes for one day will liberate one cubic meter of hydrogen. On account of the great exactness, Mr. Cowles believes that this relation is not accidental, but represents a law of nature. He therefore proposes to use it as a fundamental unit of electrical quantity, and to make it the basis of a complete new system of units. He suggests this in order to co-ordinate mass quantity with electricity

quantity and for use in tracing energy in its transformations accompanying chemical reactions. He stated that he has not yet completely solved the problem and found all connecting links which are required, but he believes this can be done.

In the discussion, Messrs. Whitney, Hering, Bancroft, Keith, Reed and Richards participated, most of whom considered the particular relation described to be merely accidental.

"A Closed and Continuous Working Electric Furnace," was the title of the last paper of the afternoon session, the author being Mr. Edward R. Taylor, of Penn Yan, N. Y. He described some recent advances made in the design of his carbon bisulphide furnace, which has been described in detail in these pages. In the older form of his furnace the life of the electrodes was prolonged by regularly feeding upon them at their ends, by gravity, broken conductive material. In his new furnace he goes a step further, and has practically a self-renewing and continuously reproducing electrode in a closed furnace, the broken and moving portions in their continual descent themselves constituting the electrodes. New material constantly descends and takes the place of that exhausted at the ends or points of wear. He showed, in illustrations, some special devices to insure that nothing shall interfere with the regular descent of the furnace charge and the regular continuity of the work.

THURSDAY'S SESSION.

The first paper of the Thursday session had for a title "Pumps and Other Accessories in Electrochemical Processes," the author being Mr. David H. Browne, of Cleveland, Ohio. In his absence, the paper was read by Mr. Woolsey McA. Johnson. The author describes in detail the great mechanical difficulties which he has encountered, and the experience which he has collected, in overcoming the difficulties of handling a hot concentrated solution of chloride of copper and nickel, with many impurities. He describes in detail the mechanical problems in devising lifts for this purpose. As the paper relates mainly to mechanical details, it cannot be briefly abstracted.

Messrs. Keith, Hering, Johnson and Richards took part in the discussion of Mr. Brown's paper. The advantages were pointed out of compressed air lifts in the case of acid solutions, several different forms of which were suggested. The vacuum lift is also efficient, but there is no aeration of the solution. Steam injectors are suitable for small units, but are economically inefficient.

In the absence of the author, Mr. Henry Noel Potter read a paper by Prof. J. W. Langley, entitled "Electrochemical Polarization," which criticised a definition of polarization offered by Mr. C. J. Reed in a paper read some years ago before the Franklin Institute. The parts of Mr. Reed's definition to which exception was taken were that exhaustion of the chemical agents in the neighborhood of the electrodes is a factor, and that polarization is progressive. Among the factors that have been put forward as components of polarization are the counter e. m. f. of the gases formed at the electrode, the resistance of the gas envelope, chemical changes and changes in temperature. Prof. Langley claims that polarization per se is not progressive, that ohmic resistance forms no part, and he excludes heating effect entirely. His conclusion is that polarization is due to chemical changes and is not in any manner related to ohmic resistance. Mr. Carl Hering, in behalf of Mr. Reed, who was not present, stated that in his opinion Prof. Langley had misunderstood the definition of Mr. Reed. Mr. Cowles considered that there was no contradiction in the two views with respect to the final state of polarization, the difference of opinion referring to the actions leading to this final state. Mr. Potter criticized the experimental proof of Prof. Langley, owing to the existence of an indefinite time element, which introduced a doubt with respect to the experimental results. He remarked that there are two kinds of definition, one of pedagogic value using general terms, and another expressing closely all the facts; it was, therefore, natural that differences of opinion should exist between those holding to one or other form of definition. Prof. Richards said that the view of Prof. Langley amounted to a statement that polarization is identical with counter e. m. f.; he considered, however, that one factor of polarization is the resistance of gas at the electrode.

In the absence of the author, Mr. Carl Hering read a paper by Mr. C. J. Reed, entitled "Some Phenomena of Electrolytic Reduction." The paper was in effect an attack on the dissociation theory, and dealt principally with the details of an experiment, the results of which were held to contradict that theory. The essential part of the experimental arrangement was somewhat as follows: A receptacle was divided by two porous diaphragms into three compartments. One of the outer chambers contained a copper electrode in copper sulphate, and the others sulphuric acid. Mr. Reed held that, according to the dissociation theory, during electrolysis both the volume and weight of the contents of the middle compartment should decrease, whereas the experiment showed an increase in both of these. Other divergences from the theory were noted as the result of the experiment, one being that the migration constant is not a constant but dependent on the nature of the electrolyte and on the action at the electrodes. In the discussion, Mr. Woolsey McA. Johnson pointed out that the factors of voltage and rise in temperature should not have been neglected in the experiment. Mr. Hering said that a water bath had been used, but it was pointed out that difference of temperature might yet have existed in the electrolyte. Mr. Henry Noel Potter said that an attack on the dissociation theory could not be conclusive unless it also took into account the support which that theory received from non-electrical facts; for example, the changes in the boiling and freezing point caused by the presence of salts. Mr. Hering said that Mr. Reed's experiments seemed to him to be a mere determination of the migration velocities, and that his results merely differed from those of other experimenters; he also called attention to the fact that the nature of the diaphragm would make a difference. Moreover, the dissociation theory should not be condemned merely because the determination of the migration velocities did not coincide with those of other experimenters. Mr. Potter thought that the apparatus of Mr. Reed was of such a kind as to introduce errors; for example, heat effects could give rise to the difference of volume observed. Mr. Hering also pointed out the probable seat of another error, due to difference of hydraulic pressure. Mr. Potter described an experiment with the Caldwell interrupter, in which the level rose independently of electrolytic action and of the direction of the current; this phenomenon enabled him to make a Barker's mill of this type of interrupter.

Prof. Richards considered that the use of the name "dissociation" was unfortunate, for the reason that it caused the student to connect dissociation with chemical disruption. He gave a mechanical analogy to illustrate the difference between purely chemical bond, and the bond existing in a dissociated compound according to the dissociation theory. The former was likened to a bond tying the atoms together, and the latter to the atraction between magnets, which may be strong but is less rigid. Mr. Potter stated that there is a real physical difference beween solutions with and without dissociation, which can be detected by optical means. Prof. Richards said sight should not be lost of the fact that dissociation is not decomposition and does not call for energy, the relations of the energy being changed but the quantity remaining unaltered.

An Italian Telpherage System.

The telpherage idea which has recently been taken up again and developed very practically and successfully in this country, is now receiving attention in Europe. The following dispatch from London desscribes what looks very much like an imitation of American electric telpher methods, which include arrangements also for underground conveyance of mails and express, like the pneumatic tubular system:

The mere suggestion that London may have an electric postal system is startling when one thinks of the sleepy indifference with which the General Post Office usually regards any suggested improvement. Yet it is now asserted that, if Signor Taeggi, the Italian inventor of a scheme for sending letters by electricity driven boxes on overhead wires, can satisfy the British postal authorities that his plan is feasible and possesses half the advantages he claims for it, we may soon see some interesting changes. Signor Taeggi says his aluminum letter boxes, besides being propelled at the rate of 250 miles an hour, will collect letters automatically. The invention is to be thoroughly tested between Rome and Naples by the Italian government, while the British authorities have invited specifications for consideration.

According to Signor Taeggi's explanation his boxes will run on four overhead wires, the motor wheels running on the two top ones and the box rollers on the two lower ones. The post boxes, the contents of which are collected automatically, are in the shape of poles, and are themselves marvels. When a letter is posted, the stamp is automatically defaced with the imprint of the name of the town, the number of the collecting pole, and the month, day, hour and minute of posting. The post box takes its contents to the top of the pole and drops the letter into a collecting box, which, automatically stopped, returns to its place at the bottom of the pole, and, while doing so, releases the wheels of the collection box, which pursues its journey to the next pole or post box.

Underground Work for Telephone Exchanges—V.

By Arthur V. Abbott, C. E.

MANHOLES.

To permit the introduction, removal and rearrangement of cables, it is necessary to provide access to the ducts at frequent intervals. This is accomplished by building beneath the street surface chambers, into which the ducts open, of sufficient capacity to permit workmen to perform the necessary avocation of cutting and splicing cables. Such working spaces are termed "*manholes*" or

FIG. 28.—MANHOLE INTERIOR.

"*vaults.*" As city conduit systems must follow routes of prevailing streets, which are usually chiefly rectangular to each other, it is necessary to have access to the ducts at such points as fall at the intersection of diverging runs of ducts in order that profitable connections to branching lines of cable may be made.

The frequency of these intersecting points will depend partly on the design of the underground system, but chiefly on the topography of the city; the arrangement and length of its blocks, etc. Measur-

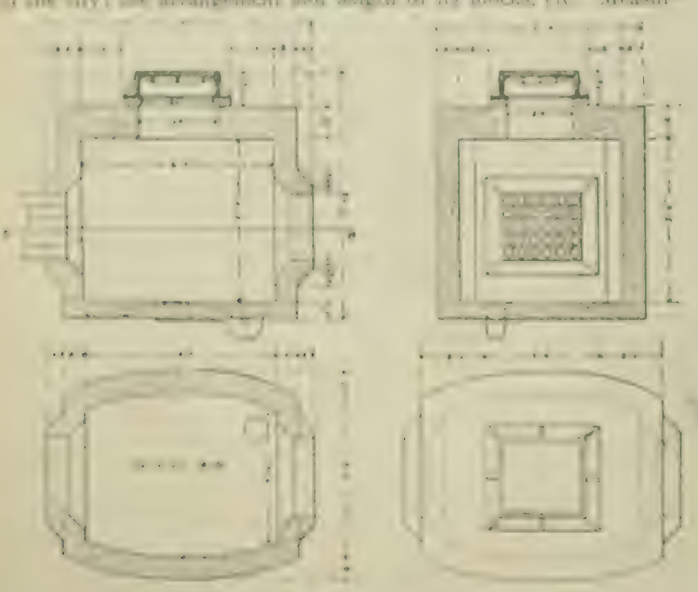


FIG. 29.—[illegible] MANHOLES.

ing distances between street centers in a number of representative cities, it is found that there is a general rough attempt to sub-divide into certain aliquot parts of a mile. Thus, in the Western cities it is common to find 4, 8, 12 and 16 blocks to the mile, or, approximately, 1,320, 660, 440 and 330 feet between street centers. In the East, a decimal sub-division is more prevalent, or 5, 10 and 20 blocks per mile, giving 1,050, 580 and 260 feet between street centers. In no city are uniform block sub-divisions universal, so that in any definite conduit plan the arrangement for the town must be worked out for itself. But, usually, in the central portions of cities it is reasonable to calculate upon placing a manhole, from topographical considerations, as often as every 350 feet, while on the outskirts one every 500 feet will suffice. It is not safe to expect that this allowance will be sufficient for an extensive system, for usually many additional manholes will be needed to reach distributing points, to permit of changing alignment due to street obstacles—so a margin of 10 per cent. for such purposes is necessary.

From a manufacturing standpoint, it is at present impractical to obtain continuous pieces of telephone cable more than 1,000 feet in length, for when longer sections are attempted transportation becomes impractical, as the inner layers on the reel are crushed by the weight and tension of superincumbent ones. The cost of handling and the difficulty of drawing in and out a long piece, the risk of accident and injury to the sheath, increases with great rapidity, and a point is soon reached when it is cheaper to build a manhole and make a splice. This is particularly true in view of the rapidly increasing size of telephone cables. Hence from a cable standpoint, experience indicates that it is desirable to place manholes as often as every 500 feet. This distance may sometimes be profitably exceeded, but on the whole, it appears to be about the average economic limit; and thus in the outskirts of cities, geographical and structural limitations for manhole distances coincide at from 500 to 600 feet,

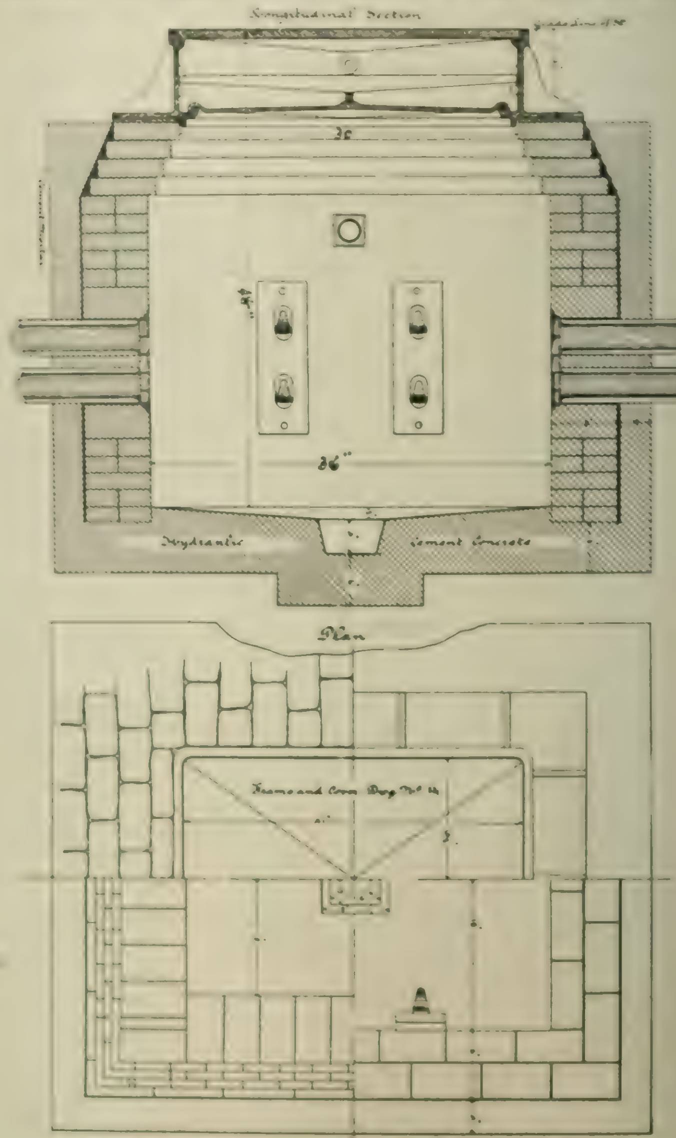


FIG. 30.—TYPICAL BRICK MANHOLE.

while in the more densely populated centers, topographical considerations prevail, reducing manhole centers to from 250 to 300 feet.

The *raison d'etre* of the manhole is, to give working room around the cables, and this for economy's sake should be of the smallest dimensions compatible with reasonable working space. Yet the error of building too small manholes is a frequent one, resulting in the conditions of affairs as exhibited in Fig. 28. Under such circumstances, the work of cable changing becomes slow, difficult and ex-

pisive, to say nothing of the exposure and injury to which the wole mass of cables is subjected. The only cure is to tear out and earge the manhole, a much more difficult and expensive process tin to construct it originally of reasonable dimensions. Necessarily t: vault design must be amply strong to support all superincumbent seet traffic, and in addition should meet, as far as pracicable, the gnerally desirable qualities of duct material—indestructibility from lth decay and malicious interference, moisture proofness and gas joofness, and high insulation. Experience is gradually reducing anhole design to what might be termed a *"Standard Type,"* an proximately rectangular chamber of either brick or concrete about feet wide by 6 feet long on the ground plan, having about 5 feet ad room, as shown in Fig. 29. Usually the bottom consists of an inch bed of concrete, with a floated coat of cement as a finish. In e floor a first-class sewer trap should be placed, from which a inch drain is extended, connecting to the nearest sewer. The floor ould be graded about 1 inch in the foot, so that the viscous street rainage may rapidly pass off and be discharged into the sewer. he side walls and top may either be brick or concrete at pleasure, nd are built as sections of circular arcs to avoid sharp bends in e cables. At the duct entrances, the masonry is racked away and he lines of ducts are separated to give as much space as possible etween cables to secure ease in handling. Many cases will arise here, either due to street obstacles or the demands of an underround system—as, for example, in the arrangement of office manholes ontaining a large number of cables—it is desirable to depart from he so-called standard type, but each such case must be treated by tself, and special plan prepared.

Structurally two forms of construction are common, the brick and he concrete. The brick manhole is the most expensive to build, presents the least durability and resistance to outside interference; but is a more flexible type, and in some shape or other sufficient for the purpose, can usually be squeezed in between the most exasperating street obstacles. This quality of flexibility enables the manhole to be built of any shape or size, allows the mason to turn its walls around or about gas pipes, water mains or other obstacles in an astonishing manner. For uniformity's sake, it is desirable, as far as practicable, to adhere to the general dimensions of Fig. 29, yet in contracted locations a much smaller type, as shown in Fig. 30, will, excepting where a large number of cables must be cared for, suffice. For a brick manhole a first-class quality of good, hard sewer brick laid up in cement is all the description necessary.

The concrete manhole is made by preparing a collapsible mould of the size and shape of the interior of the desired vault. After the bottom of the excavation is paved with 8 inches of good concrete, the mould is placed thereon and concrete rammed about its sides and top between the wooden form and the earth walls of the excavation, thus forming a monolithic chamber of great strength, durability and cheapness. No better or more economical method of construction exists if street obstacles are not too numerous, for it is easy to prepare a segmental mould that will care for one or two gas or water pipes, but beyond this the special mould required for each case makes the concrete prohibitively expensive.

The vault mould may be constructed in a thousand different ways, every ingenious carpenter having one of his own. In general, the

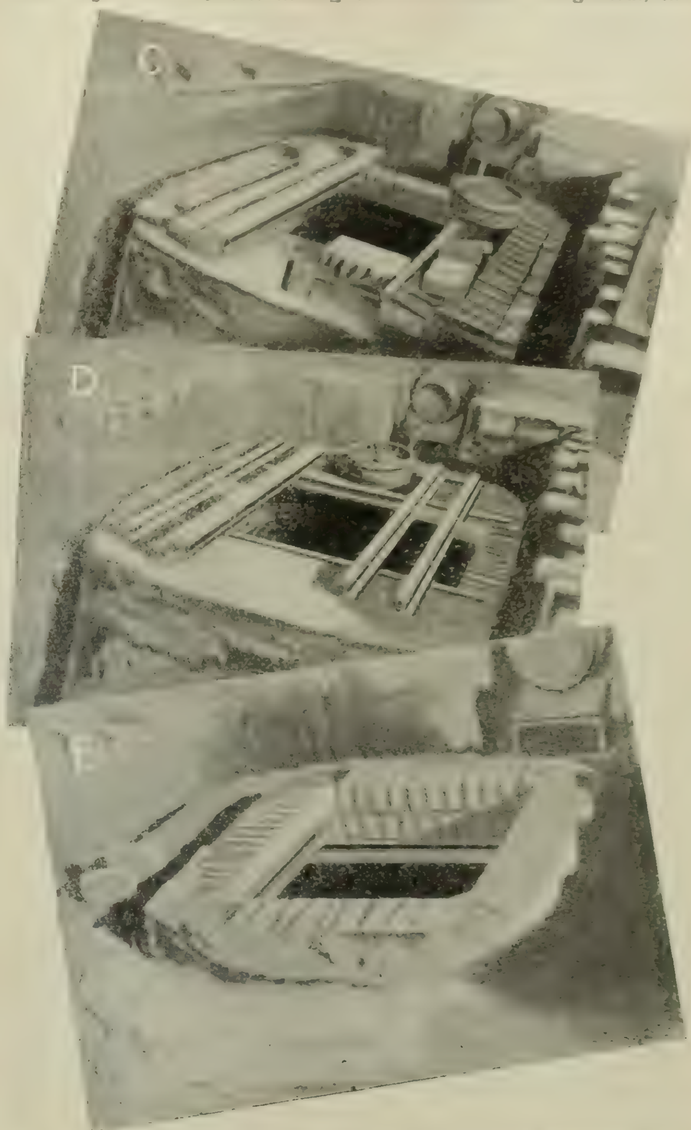


FIG. 31A.—LAST COURSE FOR RAIL ROOF. C, SETTING MASONRY; D, RAILS IN PLACE; E, READY FOR COVER.

form must preserve the desired size and shape, must have sufficient strength to permit of solidly ramming the concrete about its exterior, and of carrying the street traffic until the concrete be thoroughly set, and must be readily collapsible into pieces so small as to be easily removable through the vault cover.

As the roof of all manholes must resist the heaviest street traffic,

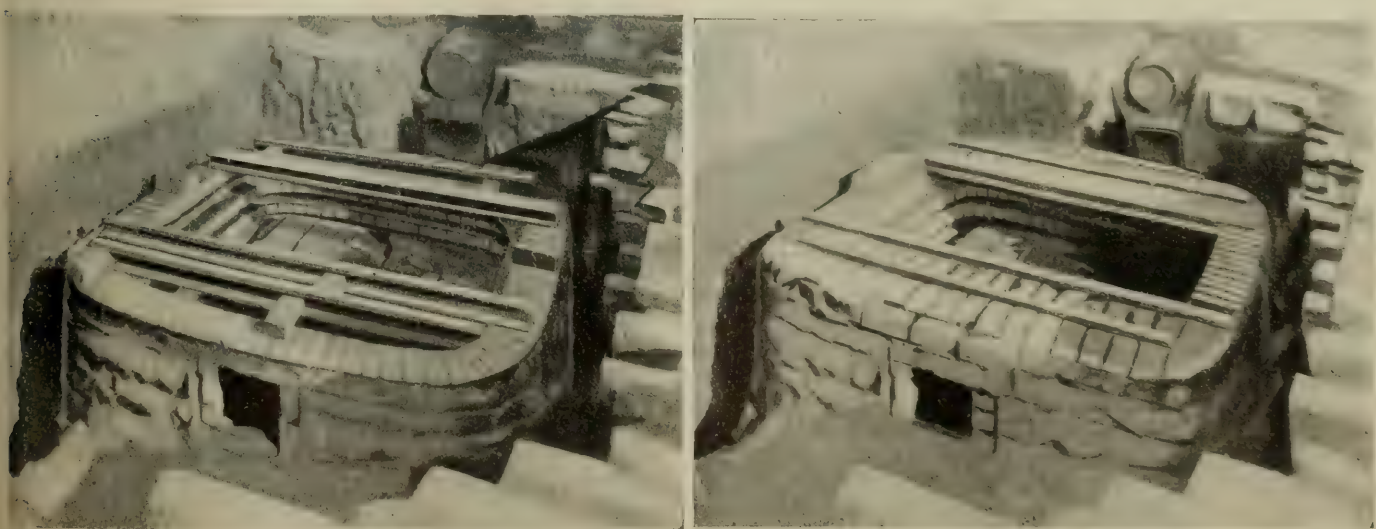


FIG. 31.—FIRST COURSE FOR RAIL ROOF. A, RAILS IN PLACE; B, MASONRY IN PLACE.

[illegible] particularly [illegible] It is probably [illegible] wheel load of more than five tons will not be met with, and trucks with such loading do not move at high rates of speed, so small impact allowance is sufficient. There are three forms of roof common to brick manholes, and while equally applicable to the concrete type, it is more usual to provide this form of construction with its own moulded roof. In the first type the walls of the manhole or roof, at a proper grade, are covered with old rails, tee iron or angles, set back to back, placed about 3 inches apart, the spacing being filled with brick set on edge, over which a second, or even a third course of brick and iron is placed, depending upon the required strength of the roof. The method of building the rail roof is given in Figs. 31 and 31a, where *A* (Fig. 31) shows the iron work, *B* indicates the completed first course of masonry, *D* (Fig. 31a), presents the two courses of iron in place and *C* the masonry partly completed, and *E* the finished top ready for cover.

Meeting of the Indiana Electrical Association.

The first annual meeting of the Indiana Electrical Association, was held at Indianapolis, September 17 and 18. At opening the attendance was small, but at each session new faces appeared, until when the time for adjournment came it was found that nearly two-thirds of the whole membership had been at the meeting. For a first effort this was considered a matter for felicitation. The origin of the Association dates from last May, when a few central station men met, and having decided that an Indiana Association was needed, called a first meeting in Indianapolis for September 17 and 18.

President T. C. McReynolds, of Kokomo, made an ideal presiding officer, and took an active part in the discussion. He was unanimously re-elected; J. N. Harding, of Kokomo, was also re-elected vice-president, and Hal C. Kimbrough, as secretary, received the unanimous approval of his fellow-members and re-election. A resolution was adopted, providing that electrical supply men be accepted as full and active members of the association with all privileges of the floor. The legislative committee selected was A. M. Barron, of South Bend; J. H. Harding, of La Porte, and H. W. Fround, of Anderson. The secretary was authorized to send circulars to every member of the association, with a blank to be filled, stating what in his opinion was the best time to hold the next annual meeting, and the president was authorized to call it for the most popular date as shown by the answers. A committee was appointed to select a design for a membership button.

In his opening address, President McReynolds said that the electrical business is now experiencing a season of great prosperity, and that the time to better conditions is when all power houses are running at good capacity and have a market for their product. He reviewed the main questions now confronting electricians generally, and Indiana electrical people particularly, where the fuel question is now presenting new trouble on account of the failing natural gas and the increasing high price of coal. He briefly ran over the programme that would be presented at the two days' session, and urged the members to get together in a helpful way on all that came before them. Fitting response was made by S. E. Gard, of Richmond.

The association added 13 new members to the roll during the meeting, bringing the total to over 50, and plans were laid to double the membership before the next gathering.

G. H. Harding read a short paper on "Bi-products," treating the subject in a broad and general way. He said the day was past when companies could get sufficient profit out of lighting alone, and that they must look to the by-products to increase their income—to the selling of their product in all commercial channels. He especially urged the profit in developing the small motor business. The paper found general commendation and provoked discussion.

A paper on "Kinds of Indiana Coal Used and Results Obtained" was to have been read by J. P. Clarke, of Terre Haute, who was absent. The subject was not ignored, however, and after informal discussion it was agreed that Indiana bituminous coal could not be excelled as fuel in the combined features of cheapness and adaptability.

The formal discussions of the convention were opened by A. M. Barron, of South Bend, with a paper on "What we Hope to Accomplish by this Association." By consultation and co-operation, he said, legislation may be so influenced that companies may be better protected than now from thefts of current, from arbitrary control by city councils and made free from fears of what may happen in time of political landslides. A specific measure is needed with respect to street lighting, based on the amount of current furnished at the carbon points; laws are wanted providing for furnishing electricity by meter measurement at prices based on local conditions and not at unprofitable rates in order to secure a privilege. Local legislation is needed, based only on the physical installment of the property and not on its earning power, and expert examination of all wiring by regularly licensed inspectors appointed after official and competitive examinations by Boards of which one member shall be from the association. Favor should be shown the manufacturers who do business by the golden rule and do not try to influence legislation in favor of municipal ownership, regardless of the effect it will have on the local plant, just so they can sell their apparatus; and laws are needed that will prevent a municipality from competing with private plants without compensation, or on the basis of an arbitrary decision.

A paper of Hal C. Kimbrough, of the Muncie Electric Light Company, was on "The Best Method of Dealing with Gas as a Competitor." He pointed out that where natural gas is used for light in connection with Welsbach burners, there is a destruction of decorations, draperies, wall paper and hangings. An oily deposit is made by natural gas that goes far to make gas, rather than electricity the luxury. One customer who had frequently to take his draperies to the cleaner and call in the paperhanger, insisted that for light natural gas costs $500 a year. He had said he could not afford electricity for general lighting, but asked for the service in his home for special occasions. Later he found out that electricity was far the cheaper, and now he is a good advocate and salesman for it. Among the merchants his company had placed the electric light gladly wherever the least opening was offered; frequently they have not been turned on for weeks, but the inevitable time comes when electric service is in demand. It is a nice question in Muncie to show the customer the need of the electric light when his natural gas is costing him 12 cents per 1,000 feet, but success has been achieved. The charge is $1 a month for every lamp, which pays a good interest on the investment. Experience in residence lighting has been that it is not a profitable enterprise, the demand for extensions, line wire, maintenance, quality of light being as exacting for the one man in the residence square as the same investment of copper in the many stores downtown.

The flat rate was condemned as leading to a waste of product and energy not appreciated as philanthropy, any more than the company appreciates an increase of peak load and no return on the money invested. Central stations should enter into the justice of buying and selling their product with that degree of intelligence that prompts the newspaper publisher to count his papers and measure the space he sells, or the butcher and grocer to count and weigh the goods they sell. That which may be weighed and measured should not be guessed at.

S. E. Gard, of the Municipal Electric Light and Power Company, Richmond, had for his subject "Meter Prejudice; its Cure." He blamed the central station manager for the existing prejudice against the meter, and for its correction said managers must convince the patrons that they are as nearly honest as it is possible for a person to be and hold the position of superintendent of an electric light plant. This can be accomplished partly by being very guarded in imparting information. Superintendents should insist that directors provide the necessary testing instruments for the meter department so the skeptical consumer can be shown that his meter is all right. Caution should be used in giving information as to the consumption of energy of any apparatus.

A paper of S. F. Dibble, Chicago, on "Small Motors," was a plea to central station managers to use every effort to promote the use of reliable and efficient motors, both for the benefit of the consumer and the profit of the company. The helpful advertisement is the one that is aimed directly at the man who can use some particular device. Vigorous systematic solicitation must follow the advertising. It is necessary to prove to a man that he will profit by it before he will make a change in his methods. The solicitor or station manager who goes out to convert a user of power must be thoroughly informed not only as to rates for current and the general advantages of electric over other forms of energy, but he must be able to tell his customer the size of motor that is required to do the work and the winding best suited to it, to suggest the best grouping of machines; it

fac to act as consulting engineer. Manufacturers are eager to co-operate with central stations in furnishing reliable data. One man should be entrusted with the work and be held responsible for the development of the power service. The results will justify the expediture. A central station manager who has employed solicitors wh marked success recently stated that the average cost of soliciting was equivalent to 40 days' free service to each new customer, or about 13 per cent. of the first year's income. Meter readers can be of assistance in this work by keeping the solicitor advised as to the requirements of consumers.

A paper that proved productive of most discussion was on "The Desirability of Enclosed Alternating Arcs of the Tub-Transformer Variety," by A. M. Barron. The author stated that at Franklin, Ind., where he has charge of the water, light and gas plant, there a in use forty-one 7½-ampere, alternating, enclosed series arc lmps, at 60 cycles, and forty-four 9 6-10-ampere, open-arc lamps. The series alternating lamps are on a tub-transformer of 50-lights capacity, supplied with current from a 120-kw General Electric alternator, which also supplies current for a maximum of 1,500 16-candle-power incandescent lamps and about 10 alternating enclosed arc lmps, used for commercial service. Some of the open arcs are but 50 feet from the enclosed arc lamps, and while the maximum amperage is maintained on the open arcs, the increased illumination of e streets by the alternating arc lamps over the open arcs is so onounced that the company has been asked by the citizens to re-ace the open arcs with the alternating series arc lamps. Although e lamps are operated at 7½ amperes, most of the central stations hroughout the country have adopted the 6.6-ampere lamp, notwith-anding the 7½-ampere lamp is available. The 7½-ampere lamp onsumes about 455 watts at the arc, and 475 to 485 watts at the erminals. The tendency seems to be in the direction of a lower nergy lamp, and systems are operating at 4.4 amperes and 285 watts t terminals. Where a city or town has been lighted with a 6.6-mpere open arc lamp, consuming only about 350 watts, a low energy amp should be considered in making a change. Where a city con-ract specifies plainly that the electric light company is to furnish a amp consuming at least 450 watts at the arc, a compromise on this oint would be hard to make, and there would be no alternative but o install the 7½-ampere alternating lamps.

In the opinion of Mr. Barron, the most desirable sizes of trans-formers for central stations are the 50 and 100-light size. The 100-light possesses the advantage of operating 100 lamps from two circuits of only 50 lamps each, instead of requiring two transformers of 50-light size. From the standpoint of power factor, efficiency, durability and generally satisfactory service, he believes the air-cooled type of transformer (not the air blast) to be superior to the oil-cooled type. The transformer is wound for both 60 and 125 cycles, the lamp likewise. A central station operating at 125 cycles, and intending later to change to 60 cycles, could purchase this system a year or more before making the change and take advantage of the economies arising from the enclosed arc system compared with the open arc. These transformers and lamps are now standardized, and the price is only slightly higher than the regular system. Some trouble from unbalancing is experienced where two transformers are installed on a three-phase system. It will not exist where the transformer is of reasonably large size, and where the generator is small a transformer could be installed on one each of two phases, and the incandescent lighting placed on the third phase with a potential regulator if necessary.

In three years under this system, the Franklin station has had no expense for repairs to the tub-transformer, and it has not failed in any particular. There has been no damage from lightning and no telephone trouble, although wires parallel one another. Regarding troubles on the line, the central station manager and his best assistants in the arc lighting department should be out on the line, where all the troubles from series alternating lighting have been. Mistakes are made by managers who do not install a hanger and cut-out or a reliable insulator to protect their system. As to the interchangeability of arc lamps, the alternating lamp has been provided with a 9½-inch carbon, and will burn in ordinary service 70 to 90 hours. If the lamps were equipped with a 12-inch carbon, which would have a life of 100 to 140 hours, it would be better for the service, but the objection is that there would be a lack of interchangeability with globes, lower frames, carbons, etc., now in use for both street and interior service. As to the breakage of inner globes and the cost of repairs, there is a lack of uniformity as to the normal life of a glass. Where breakage is excessive, it is due frequently to a lack of attention by green trimmers. Lamps are made for 4.4, 6.6 and 7.5 amperes, and frequently the same lamp is used for the 7.5 amperes as for the 4.4. Glass manufacturers should test the globes before shipment, and central station managers should constantly look for improvement in the quality of the glass, keep careful records in their arc lamp department as to the life of inner globes and the conditions under which such life is secured, and give this information to the glass manufacturers. Manufacturers should advertise more thoroughly the best methods of trimming, inspecting and caring for arc lamps. Experience at Franklin has been that the series alternating lamps illuminate more satisfactorily to a greater distance than the open arc lamps, and that it is sufficiently satisfactory to protect any central station in its city contract of whatever terms. With the three grades, 4.4, 6.6 and 7½-ampere lamp, there is a variety of illumination from which to select, local conditions determining which is best.

A New Tesla Laboratory on Long Island.

The public is always very much interested in whatever Mr. Tesla may say or do, and we are very glad, therefore, to have the opportunity of presenting herewith two views which have been forwarded us by a correspondent on Long Island, showing his new laboratory at Wardenclyffe, L. I., and the interesting tower that is associated with it. It will be remembered that after the unfortunate destruction by fire some years ago of his laboratory, near Bleecker Street, New

FIG. 1.—TESLA LABORATORY AT WARDENCLYFFE, L. I.

York City, Mr. Tesla established himself in East Houston Street, where a great deal of interesting work and many new inventions have resulted from the indefatigable labors of this well-known inventor. It would appear, however, that Mr. Tesla has needed more seclusion and quiet than could be obtained in the city, where his laboratory is not only the rendezvous of inquisitive reporters, but is the center of pilgrimages from all parts of the world of those who have heard of his work and desire to meet him, either from sheer curiosity or for legitimate purposes of scientific inquiry or industrial development. Hence Mr. Tesla has now, like Mr. Edison, established himself out of town, yet within easy reach of the metropolis.

The new Tesla laboratory at Wardenclyffe is about 65 miles from New York, or 1½ hours by fast train on the Long Island Railroad. According to the statement, quoted in our columns last year, from a circular as to Wardenclyffe, "This property was purchased from the North Shore Industrial Company, which owns an estate of something more than 1,600 acres adjoining, under an agreement that the Wardenclyffe Building Company shall have the first right and privilege to do all building and make all constructional improvements of said North Shore Industrial Company, and shall have the first right of purchase of any additional land offered by it for sale, and under which contractual rights large profits will be realized in the future. In addition to this exceptional advantage, Mr. Nikola Tesla, the foremost electrician of the age, whose achievements in electrical science eclipse in practical importance all other discoveries of the century, has just closed a contract to expend at Wardenclyffe a very large sum of money in constructing electrical laboratories and the main station for his wireless telegraphy system of communication with Europe and Australasia. This development will require

a large number of houses for the accommodation of the several hundred of people whom Mr. Tesla will employ." It was further stated that the real estate enterprise is backed by Mr. Chas. R. Flint, the well-known merchant, and that Mr. Tesla is to occupy a cottage in the vicinity of the Wardenclyffe Inn.

We are not able to give any details as to the equipment of the work, other than that some little while ago Mr. Tesla placed a con-

FIG. 2.—TESLA TOWER AT WARDENCLYFFE, L. I.

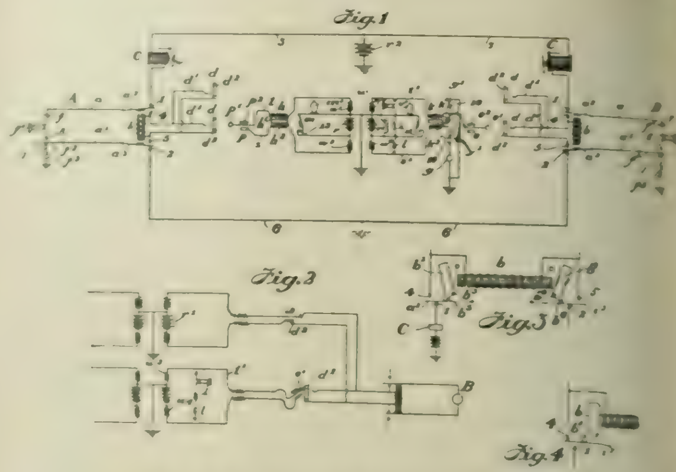
tract with Westinghouse, Church, Kerr & Company for a power plant equipment. As might be expected, and in keeping with Mr. Tesla's custom in such matters, great privacy and secrecy are observed in regard to the laboratory, and the visitor who can secure entrance is indeed a lucky man, while at the same time he is likely to be an awestruck one unable even to conjecture the meaning of what he may see going on around him. It has been stated that the large tower, shown in one of our cuts, is intended for wireless telegraphy and wireless power transmission experiments, and that underneath it is an excavation as deep as the tower is high, possibly for the purpose of perfect ground connection. A subway with conduits leads from the laboratory or factory proper to the tower.

New Telephone Patents.

In the issue of the Patent Office for September 16 there are five patents having more or less bearing on telephony. One of these is a reissue to Mr. F. W. Dunbar, of Chicago, assignor to the Kellogg Switchboard and Supply Company, of No. 689,023, dated December 17, 1901, on a telephone system. The original patent was abstracted in the ELECTRICAL WORLD AND ENGINEER for January 11, 1902, Vol. XXXIX, No. 2, p. 87. The principal features of the system are that the subscribers' lines are normally connected to the line signals, and the cut-off relays instead of merely cutting out the line relays, throw the lines from the line signals to the jacks. This enables a two-contact jack to be used, as the jacks of a line not connected are wholly inert and cannot give a false test.

As a refresher to the memory of those interested, we reproduce the drawings, Fig. 1 showing the system in general, Fig. 2 the test system, Fig. 3 the type of cut-off relay used, and Fig. 4 the relay armature and contacts controlled by it. It will be seen by Fig. 1 that the jacks are normally disconnected from the line; when relay b is energized by the insertion of the answering plug, the line is switched from the line signal, C, to the jacks by the closing of a' and a^2 on contacts 4 and 5. As shown in Fig. 2, when a line is connected the line springs of all jacks are charged, and the operator on touching a plug-tip to the thimble of the jack and removing it will get an induced current that will cause the click indicating "busy."

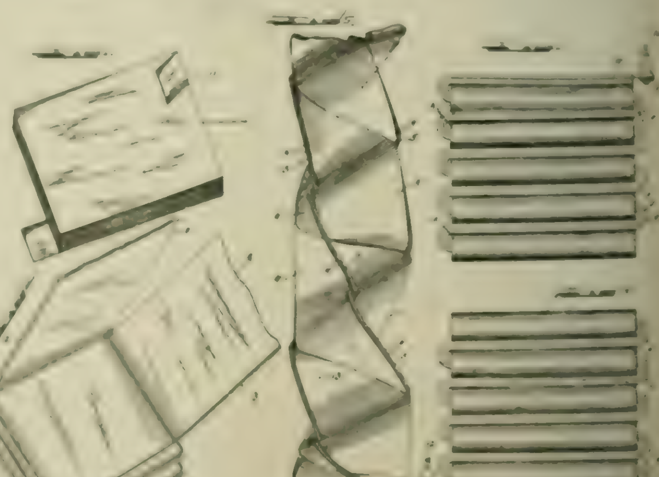
Another patent which has already been practically described is that on apparatus for composite systems of simultaneous telegraphy and telephony, granted to John M. Fell, and assigned by him to the American Telephone and Telegraph Company. On September 9 there was issued to Mr. Fell a patent on a vibrating-current relay, and



FIGS. 1 TO 4.—DUNBAR TELEPHONE SYSTEM.

this patent was abstracted and the relay described in full in the ELECTRICAL WORLD AND ENGINEER for September 30, Vol. XL, p. 460. The drawings in the two patents are identical, and the specifications cover much of the same ground, since the object of the vibrating-current relay is to serve as a signal on composite lines, therefore, there is practically no further information to be given about the Fell system.

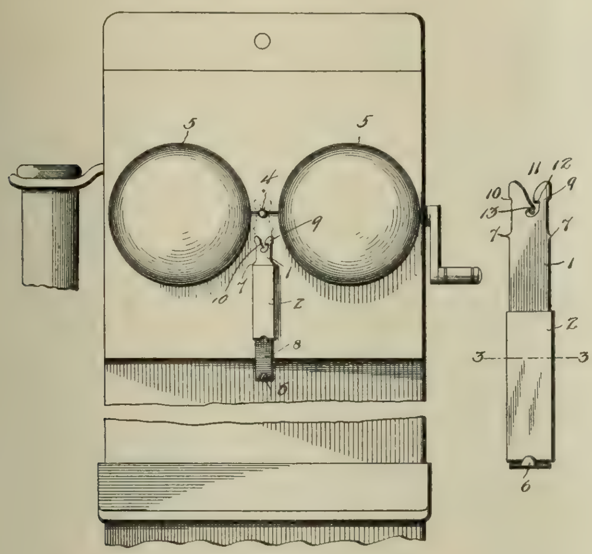
The growing use of condensers in telephony, due to their insertion at various points in common battery circuits, has made the electrical condenser a subject for the telephone inventor's thought and investigation. Mr. H. P. Clausen, of Chicago, patents and assigns to the American Electric Telephone Company a condenser which he claims will be cheap and simple to manufacture, efficient in operation, and easy of inspection and repair, without entirely unfolding or unwrapping the sheets. Mr. Clausen places two sets of strips of foil and paper at right angles to each other, and folds them over each other alternately back and forth, as clearly indicated in the drawings, in which Fig. 1 shows the completed and compressed condenser, and 2,



FIGS. 1 TO 5.—CLAUSEN CONDENSER.

3 and 4 the condenser in various stages of make-up. Fig. 5 is the really interesting picture, however, as it shows the inventor's idea of what could be done with the condenser for inspection and repair "without entirely unfolding or unwrapping the same." The specification says: "When it is desired to repair the condenser, it may be pulled open endwise, as shown in Fig. 5, by a sort of bellows or accordion

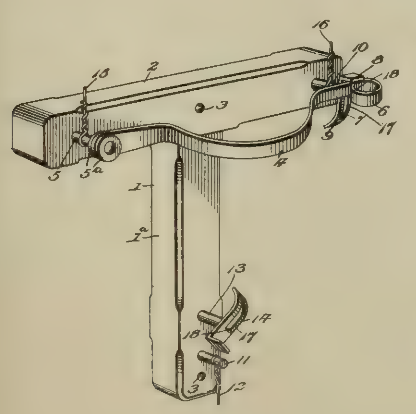
action, which gives access to any part of the sheet or dielectric for inspection, and which can be readily repaired by simply inserting a small sheet of paper or other substance over the injured portion." It is suggested that if this operation is necessary after the usual treatment with paraffin and the compression that condensers are subjected to, "the condenser would probably have to first be heated to melt the paraffin before it could be opened for inspection and repairs." We think it probably would, and we don't envy the person charged



JACKSON'S TELEPHONE-CALL ANNUNCIATOR.

with the inspection and repair of a deliquescent accordion-folded condenser.

The freak patents this week are two, one a telephone-call annunciator, to indicate which of several telephone bells has rung, and the other a switch for grounding a line during thunderstorms. The inventor of the call annunciator is Zeremba E. Jackson, of Atchison, Kan. The indicator is a little metal strip sliding in a case attached to the bell box, the strip having a stop, 6, and shoulders, 7, to hold it always within the case. The upper end of the strip is shaped into a trip latch, which is hitched over the shank of the bell hammer. When the bell hammer vibrates it wiggles out of the trip latch, and the slide drops, displacing its lower part, 8, below the case. A simpler and cheaper signal of this sort is a little strip of cardboard



M'PHERSON TELEPHONE SWITCH.

with a longitudinal slot in it. Why in these days any man should waste his money in taking out a patent on a simple two-way switch passes comprehension.

The device illustrated above is due to Mr. Columbus B. McPherson, of Birmingham, Ill. The switch is simply intended to ground the line and cut out the telephone during a thunderstorm, the line and telephone wires being connected to 5 and 10, and the ground wire to 11.

CURRENT NEWS AND NOTES.

AUTOMOBILES IN PARIS.—It is stated that in Paris and its neighborhood nearly 8,000 motor cars are now in use, 3,000 of which have a registered speed of over 18 miles an hour. The number of licensed chauffeurs in the French capital is 13,600. The second underground line from the Triumphal Arch, Champs Elysees, along the exterior boulevards, will be inaugurated October 5.

THE TROLLEY IN PARIS.—The overhead trolley has now made an advance into the heart of Paris, passing along the Rue du Quatre Septembre and the Rue Reaumur. A provisional authorization has been granted, but in France *"rien ne dure comme la provisoire."* It is feared the system will be extended elsewhere, and the beauty of the city be marred. The reason why a trolley slot system is not used does not appear.

TO VESUVIUS BY TROLLEY.—The University of Naples has forwarded to the Italian government a strong protest against Messrs. Cook's project for an electric railway from the naval arsenal in Naples to Vesuvius. The objections are based on the fact that an electric railway in such close proximity to the university observatory would seriously interfere with the seismic and magnetic and electric observations. About 50,000 people visit the crater of Vesuvius every year, most of them by means of a long carriage drive, and the present funicular railway of Messrs. Cook.

U. S. CABLE TO HAWAII.—A cable dispatch from London, of September 18, says: The submarine telegraph cable, which is to join the United States and Hawaii, as the first link in the system to the Philippines, has been completed, and is now on board the cable steamer "Silvertown," lying in the Thames preparatory to sailing on September 20, for San Francisco, whence the vessel will immediately begin laying the cable to Honolulu. The Silvertown is expected to reach San Francisco early in December. The cable is wound around three enormous spools, each 30 feet in diameter. Its total length is 2,413 miles. The strands are one to three inches thick.

ELECTRICITY AND WITCHCRAFT.—Dr. Edwin Cannan, speaking before the economic science section of the British Association, said: "When men can hardly take a step without seeing steam engines and electric motors and telegraphs and telephones and steamships, with drainage and waterworks, with railways and electric tramways and motor cars, when every shop window is filled with the products of engineering enterprise, it is getting rather difficult for people to have any belief in evil spirits and witchcraft. All the heart-breaking preaching of enthusiasts in education would produce very little effect upon an old society like that of England if it were not for the engineer."

THE S. F. B. MORSE ESTATE.—After a delay of more than 30 years, the big estate of Samuel Finley Breese Morse, the inventor of the telegraph, who died April 2, 1872, is finally being distributed under an order just entered by the New York Supreme Court. When Mr. Morse died his estate was valued at $524,000, but it was tied up during the life of his widow, Sarah Elizabeth Morse, who died in Berlin, Germany, November 14 last. During the long period that has elapsed since Mr. Morse's death, the expense of administering the estate has been great, and after deducting these costs and the commissions of the executors and trustees there was left for distribution among the heirs $346,000, the bulk of which has been turned over to Mr. Morse's children—Susan Walker Lind, Charles Walker Morse, James Edward Finley Morse, Samuel A. B. Morse, Cornelia L. Morse, William Goodrich Morse and Edward Lind Morse, or the heirs of those who are dead. An agreement has been reached on the part of Mr. Morse's children and heirs that all the orders and decorations bestowed upon Mr. Morse during his lifetime by various governments and learned institutions, in recognition of his great invention, should be turned over to the National Museum, at Washington, D. C. In accordance with this agreement, they have been turned over to the museum. Mr. Morse left $2,000 to Princeton University, to found two scholarships, the Finley and the Breese; and $1,000 to the University of New York City for a Morse scholarship medal.

TELEPHONES ON MONT PELEE.—Prof. Lacroix, who is now on his way to Martinique, will establish posts of observation near Mont Pelee. These posts will be connected by telephone with Fort-de-France, in order to give timely warning of threatening signs on the mountain, and enable the authorities to take proper precautions.

MARCONI IN ITALY.—The King of Italy is bestowing marked favors upon Signor Marconi. The inventor has visited the King and Queen at the royal castle, at Pacconigi, by whom he was greeted in a most cordial manner. On his way he was taken suddenly ill and was compelled to stop off at Bologna. He resumed his journey later, taking a physician with him.

AUTOMOBILES IN WARFARE.—An engineer in the German army urges that supply trains could be economically and speedily drawn by steam traction engines, and that the engines could also be used for working cranes to place guns on embattlements, for the driving of dynamos for lighting and signaling, etc. He estimates that with 500 such engines the government could dispense with about 10,000 horses, and reduce the complement of 5,500 men employed in connection with the horses to 1,000 machinists and 1,000 firemen.

A FOUR-TELEPHONE WIRE.—It is not unusual for three or four telephone subscribers to be on a single wire, but it is decidedly unique for one subscriber to get four exchanges at the same time. A story in the newspapers runs as follows: "A crow has been getting the Calcutta Telephone Company into trouble. It built its nest at the central office, where four wires converged, and used tin clippings and bits of wire for the purpose, with the result that it established complete electrical communication between the whole of the four lines. When a subscriber rang up some one he wanted, he was answered from four different offices at once.

MR. MARCONI'S PLANS.—Cable dispatches from London, of September 19, give the following: At a conference with Signor Galimberti, Minister of Posts and Telegraphs, William Marconi submitted plans for the erection of a wireless telegraph station, to cost $140,000, for establishing connection from Italy with the British and American stations. The scheme will be submitted to Parliament. King Victor Emmanuel has bestowed the Cross of the Order of the Crown on Marconi. The French Government has decided to install a wireless telegraphic system in the islands of Martinique and Guadeloupe, owing to the frequent interruptions of the cable service there. Two experts in telegraphy will sail from Bordeaux on September 26 with the apparatus.

ENGLISHMEN'S BLUNDER.—The British Association for the Advancement of Science closed its meetings at Belfast, Ireland, on September 17. Prof. Minot extended an invitation to the members to attend the convocation of American scientific societies in Washington next December. In accepting the invitation on behalf of the association, President Dewar said that a great blunder Englishmen had been perpetuating for many years was through ignorance of what was being done on the other side of the Atlantic. He had many times urged manufacturers that if they would only subsidize their chief officials by a donation enabling them to spend their holidays in the United States, making themselves acquainted with the great international organization, it would repay them a hundredfold. His own short visit to the United States had been a revelation to him.

BOSTON GAS MERGER.—The following item is very interesting if true and dates from Boston, September 10: All the gas companies of Greater Boston are to be merged, and eventually will furnish gas for fuel only, as the result of a conference here of some of the most prominent capitalists of the country, says the *Advertiser* to-day. The Brookline Company's plant will produce electricity, which is intended to supersede gas as an illuminant. This means the eventual consolidation of all the gas and electric light interests of Greater Boston. Ultimately the gas plants, except that of the Brookline Company, will be closed and sold or used to produce gas for fuel only, while electricity will be made sufficiently cheap to become the sole illuminant. While gas securities have been publicly cried down, there has been going on a quiet accumulation, on the part of those identified with the capitalists.

TELEPHONE LINES IN EUROPE.—Paris is the center of an international telephone wire network, whose extreme ends are London, Hamburg, Berlin and (in connection with the French-Italian line about to be opened) Turin and Milan. The Paris-Berlin line is the longest, with about 625 miles of wire. The Paris Hamburg line is about the same. The distance from Paris to Turin, measured by an air line, is about 375 miles, and that between Paris and Milan about 470 miles. But all these lines are eclipsed in length by that between Paris and Cologne, not by the direct line, but by indirect connection, often rendered necessary by breaks in the other service. In such cases a person in Paris desiring to speak to Cologne is connected via Berlin. This roundabout way increases the wire distance about 375 miles, making the total about 1,000 miles. The Cologne *Gazette* states that this does not impair the distinctness of the message, and no loss of time is noted in using this increased distance.

TELEPHONE PROFANITY.—A few weeks ago a St. Louis justice ruled that swearing through a telephone was aggressive profanity. Justice Dooley, of Chicago, now holds, says the New York *Sun*, that swearing into a transmitter is disorderly conduct. The swearer thus rebuked pleaded in vain that he was hungry, wanted to telephone for his dinner, and had found the ear of "Central" deaf. The man who consults the telephone must be urbane and long-suffering. Does he pray to no purpose at the shrine of that powerful divinity, "Central?" Is he cut off imperiously in the middle of his talk? Never mind. Let us be patient and not wear out our tissues with impotent anger. Count from 1 to 500 or say the multiplication table. Be greater than he that taketh a city. There is no joy but calm. And when you sprinkle magical numbers upon the heat of your temper, don't be rash and sudden like that hot spirit who when angered, would count 100 thus: "One, two, ninety-nine, hundred, damn!"

SAFETY DRESS.—A Prof. Artemieff has invented a safety dress for the protection of electrical engineers and others working around high-tension apparatus. It is described as being constructed entirely of fine but thickly-woven wire gauze, and includes the feet, hands and head. It is stated that this dress was tested in the high-tension laboratory of Messrs. Siemens and Halske, and the results are given in a recent number of London *Engineering*. Its total weight is 3.3 pounds; its resistance from hand to hand, 0.017 ohms, and its capacity varies from .0002 up to .00025 microfarads, according as the wearer is far away from or near to a wall. The cooling surface is such that a current of 200 amperes can pass through the dress for some seconds from hand to hand without perceptible heating effect. Standing uninsulated on the ground, and clad with this dress, Prof Artemieff drew sparks from the secondary terminals of a transformer which was developing 75,000 volts, the period being 50 cycles per second. He next seized the main, and later on, the potential being raised to 150,000 volts, he drew sparks from both terminals, and handled the latter. The machine supplying this transformer was of 170-kw capacity. In concluding the experiments, the inventor short-circuited this generator by clutching hold of the terminals, the potential difference between the two being 1,000 volts, and the current 200 amperes. The circuit was broken by simply letting go of one electrode. Throughout these experiments Prof. Artemieff declared he felt not the slightest sensation of any current through his body.

LETTER TO THE EDITORS.

The Second Law of Thermodynamics.

To the Editors of Electrical World and Engineer:

Sirs.—The remarkable communication presented at the meeting of the A. A. A. S., entitled "The Fallacy of the Second Law of Thermodynamics and the Feasibility of Transmuting Terrestrial Heat into Available Energy," has attracted probably more general attention and comment than other contributions of greater merit. The most entertaining feature of the argument is the extremely simple and inconclusive manner in which "the second law of thermodynamics is disproved." Referring to matter at the absolute zero of

mperature, the writer says: "By reason of the *incompressible* or ert condition acquired by the fluid at or near this particular temrature, it will consist of an *infinitely small* quantity of latent at ratioed or divided by the *very finite* temperature of 274 degrees, d consequently there results a value which is zero."

This, however, does not disprove the law in question. It only ves the results of a misuse of figures. What is the "very finite mperature of 274 degrees?" Applied to the scale of the air therometer it has, indeed, a definite meaning, expressing the interval etween the freezing point of water and the calculated zero of temerature. But the zero of temperature is surely not a finite temperture, since by its definition it signifies the absence of heat. There is no "temperature" at the absolute zero, hence 274 degrees is a zero quantity, and the whole argument fails. The absurdity of such an application of the formula becomes manifest when we consider that 274 is the limiting figure beyond which we cannot go in these calculations. What then becomes of our "finite temperature?" What is there at 275 degrees, for example?

There is also a rather curious assumption that some—an "infinitely small" quantity of latent heat remains in an incompressible fluid at the zero temperature. This would seem to be paradoxical. Regarding the other part of the subject, your own treatment of it is sufficiently conclusive.

New York. Romyn Hitchcock.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Testing Tramway Motors.—Field.—The first parts of a very long, illustrated paper read before the Glasgow section of the (Brit.) Inst. of Elec. Eng., on the testing of tramway motors and an investigation into their characteristic properties. He urges that tramway motors should be tested in the shop before they are put into service on the road; and for these tests a special frame should be arranged. When testing tramway motors under stationary conditions, the ventilation and cooling facilities are less than would be the case on the road. To counterbalance this the lid above the commutator is usually left open, which has been found by experience to give a fairly correct compensation for the altered conditions. The method of testing is as follows: Two motors are tested together. It is supposed that they are sufficiently similar that, with equal field current and the same speed, the e. m. f. generated in each armature is the same. With motors manufactured by good firms this is fulfilled. These two motors are erected on the testing frame, the one working as motor and driving the other, which works as generator, and is loaded on a water resistance. The current, after traversing the armature and field of the motor, passes also round the field of the generator. The iron and friction loss in each machine is the same. This enables one to arrive at the efficiency of the motor, and at the same time to separate out the losses far more accurately than can be done with the Hopkinson method. The method is described in detail, and a numerical example is given. A whole series of tests may be carried out at different voltages. If the iron losses be separated for each reading and plotted, a set of curves can be obtained showing the variations of iron and friction losses, with speed, for each field strength. Then adopting Kapp's method of "plotting loss divided by speed, or back-torque with speed," it is possible to separate out the eddy current losses from the total iron and friction loss. For determining the starting current of a motor, one motor is removed entirely from the frame, and sufficient resistance introduced into the circuit of the other as to bring it just to the point of starting. In specifying efficiencies, it is important to give the temperature at which the test is made; at the end of the hour's heat run; for instance, the resistance will often be 30 per cent. higher than at the beginning, which may mean a diminution in the efficiency of fully 3 per cent. For carrying out the one-hour heat run, it is most convenient to employ a special switchboard, which is described. To obtain the correct temperatures at the end of the heat run, he uses bent thermometers; two holes are drilled through the motor case, through one of which a thermometer can, immediately after the test is finished, be dropped down on to the surface of the armature, the bulb of the thermometer being protected by a cork hood to thermally insulate it. The second thermometer is packed into a pocket formed in the side of the field coil, so that its bulb is lying up against the winding. By making a series of tests at different current inputs, in each case allowing the test to continue till 75° C. rise is reached at some part of the motor, the thermal characteristic can be obtained. It often happens that at the upper part of the curve the temperature is governed by the armature, and at the lower part by the field coil. Before removing the motors from the testing frame, it is a good plan to try them for flashing, by connecting them up to a rheostatic break controller, running them at a high speed, and then applying the brake, *i. e.*, short-circuiting the motors after reversing the field connections, under which circumstances they act as generators. A comparison of different motors from this point of view is of great importance. In carrying out this test, an interesting phenomenon will be noticed—viz., that if the brake be suddenly applied to the motors when running at high speed they will quickly stop, and then run in the reverse direction for a few revolutions; the reason is probably that, owing to the large self-induction and small resistance of the short-circuited motors, the current generated has not died away by the time the motors have been brought to a standstill. This current, then, still circulates around the circuit as if supplied from an outside source, and the field magnets being reversed, the direction of rotation is reversed. When the motors are supplied with power from an external source, the tractive effort at the tread of the wheel represents a smaller turning moment than that exercised on the armature multiplied by the gear ratio, by an amount depending on the iron and gear losses. When, however, the motors are short-circuited and acting as brakes, the torque exerted by the rail on the car wheel must be greater than the retarding torque on the armature multiplied by the gear ratio, by approximately the same amount. This means that a larger current can be put through the motors when supplying them with power, without skidding the wheels, than can circulate when the motors are themselves generating current to brake the car. When all the characteristic curves of the motor have been obtained, the question arises, what shape should the efficiency curve have in order to get the greatest commercial advantage. This depends on the nature of the route, amount of traffic, number of stops, etc. He thinks that in many cases a considerable economy may be effected by giving due consideration to the manipulation of the controller; the best way is to install a recording ammeter on the car.—Lond. *Elec. Eng.*, August 15, 29.

Definition of Armature.—Ziegenberg, Dettmar, Osnos.—Some further communications on the proper definition of an armature (anker). Ziegenberg and Dettmar write against Singer's definition, recently noticed in the Digest; Osnos replies to a special point in Ziegenberg's letter. The latter recommends the following definition: In an electric machine, the armature is that part in which the motion relative to a magnetic field induces electromotive forces corresponding to the energy change.—*Elek. Zeit.*, August 14, 28.

Reference.

Non-Synchronous, Alternating-Current Motors.—Ziegenberg.—The first part of a long, illustrated article on the principles of the induction motor, and especially of the new motors of Heyland and Latour and the similar older motor of Goerges.—*Elek. Anz.*, July 17, 20, August 10, 17.

Power.

Electric Power in Mines.—Hall.—A well-illustrated Pacific Coast Elec. Transmiss. Assn. paper, on "recent applications of electrical power on the Comstock Lode." The hydraulic power house is at the Truckee River, and contains two 750-kw. 500-volt, three-phase generators. The voltage is raised to 24,000 for transmission to the substation at Virginia City, where it is lowered to 2,300 volts and then distributed to the works of the various mining companies. On the Comstock Lode there are 12 separate installations, with an aggre-

[illegible] hp in motor capacity that will soon be increased to about [illegible] hp by the installation of electric pumps and fans. All motors of [illegible] hp and over are operated directly upon the distribution system at [illegible] volts, except the [illegible] induction motors [illegible]. The latter and all of the smaller motors are [illegible]-volt three-phase [illegible]. [illegible] of the power transformers are 2,240 to 440-volt transformers, and are connected in delta. The lighting circuits for both enclosed arcs and incandescent lamps are all 110 volts, with one exception, where a 220-volt, three-wire system is used in a tunnel. Every conceivable use has been made of the electric motor for mining purposes, with the possible exception of the operation of the rock drills therewith, "and now that they are in [illegible] it is a difficult matter to imagine how the [illegible] got along without them." There are used 25 hp on machine tools, 75 hp on fans, [illegible] hp on sawmills, 185 hp on batteries and concentrators, [illegible] hp on air compressors, [illegible] hp on hoists, 675 hp on electric pumps, and about 60 hp on the lighting circuits, exclusive of the city lights. The wiring has been divided into power circuits, lighting circuits and telephone circuits. The different installations are described at some length.—*Jour. of Elec.*, August.

[illegible]

Electric Power in Quartz Mining.—POOLE.—An illustrated paper, read before the Pacific Coast Elec. Transmiss. Assn., in which he [illegible] the economy of electric power from his experience in the mines of the Mother Lode in California. The principal uses consist in driving stamps, concentrators, air compressors, sawmills, blowers, and pumps; in fact, he recommends the use of electric power for all purposes, except hoisting, for which he recommends compressed air. He says electrically-driven pumps will soon be a common thing on the Mother Lode.—*Jour. of Elec.*, July.

Coal Cutting by Machinery.—WALKER[illegible].—A paper read before the (Brit.) Institution of Mechanical Engineers. He discusses the advantages of curving or holing by mechanical methods, over hand labor, and describes several percussive rock drills and coal cutters. He seems to hold the balance very evenly between electric and compressed air machines, but appears to incline to the former. The same subject is also discussed in a long editorial.—Lond. *Elec.*, August 29.

Large Electric Railway Engine for Kiew.—An illustrated description of a 2,000-hp engine, recently built by the Franco Tosi, Legnano; it is of the triple-expansion type, with three cylinders and three cranks. All the details are fully described.—*St. R'y Jour.*, August 30, and *Int. Ed.*, September.

TRACTION.

Interurban Road in Southern Ohio.—A description of the interurban road between Dayton and Greenville, Ohio. The road is 39½ miles long, and passes through a very thickly populated section, including several important towns. The power house is located at Brookfield, about 13½ miles from the Dayton end of the line, and a substation is located at Arcanum, approximately 12 miles from the Greenville end of the road. This arrangement was found desirable because of local conditions. There are two 250-kw, three-phase alternators of the revolving-field type, direct connected to the engines, and operated at 150 r. p. m. There are two 22½-kw exciters, belted to the engines, each having sufficient capacity for exciting both alternators; two 100-kw rotary converters, and four 75-kw step-up transformers. The direct-current voltage of the rotary converters is 650, and the voltage of the transformers, 10,000 to 11,000. Large batteries of chloride accumulators have been installed in the power house and substation, to take the fluctuations caused by the varying load of the cars. The equipment in each case consists of [illegible] cells, each battery rated to discharge at [illegible] amperes in regulating the rapid fluctuations. Each battery, however, has a capacity of [illegible] amp.-hours when discharging at the normal rate. Three-phase current at 10,000 volts is transmitted from the power house at Arcanum over three bare aluminum wires. There is a total of [illegible] miles of aluminum cable in use. The road parallels the Dayton and [illegible] steam road, and the charges are practically the same, yet the electric road, which has only been in operation a short time, already controls [illegible] per cent. of the business.—*St. R'y Jour.*, September 6, and *Int. Ed.*, September.

Manchester.—An illustrated description of the new power station and car house at Manchester, England. The tramways and electric lighting systems are owned by the municipality, and power has been supplied from two direct-current stations containing four [illegible]-hp engines, two [illegible]-hp steam turbines, two [illegible]-hp engines, and smaller machines. In 1901, construction on a new station was started, but before it was completed the plans were modified, so that it shows a somewhat composite design. One portion has just been put in operation, and contains two 2,500-hp engines direct connected to three-phase alternators of 6,500 volts and 60 cycles. In the newer part of the station 6,000-hp, triple-expansion engines will be used. The boilers will be the largest of their type ever built. Cooling towers and canal water will be used for condensing. The distribution will be at 6,500 volts. Electrically-driven coal conveyors will be used. The new car house is said to be the largest in Europe, and will accommodate 262 cars. It is of brick, with concrete floor and concrete pit construction.—*St. R'y Jour.*, September 6, and *Int. Ed.*, September.

Halifax.—An illustrated description of the tramway system at Halifax, England. The station has recently been changed so as to transmit power by three-phase current. The power station contains various types of engines, including two steam turbines. The alternators generate current at 5,000 volts, and are 300-kw each. Rotary converters are used in the substations. The switchboard apparatus and other parts of the equipment are thoroughly described. The steepest grades are 11 per cent., and track brakes as well as the ordinary hand brakes are used. There are at present about 30 miles of track.—*St. R'y Jour.*, September 6, and *Int. Ed.*, September.

Metropolitan Railway of Paris.—An illustrated article on this underground electric railway, running approximately east and west through the center of Paris, and which has been one of the most successful traction enterprises inaugurated during recent years in France. The original train service consisted of trains of four cars each, of which the leading car only was a motor car, and was equipped with one controller and two motors. The large traffic, however, made it evident that an increase in carrying capacity was necessary, but owing to the block system used, the frequency of the trains could not well be reduced below the 2½-minute service which was then in force. It was also considered inadvisable, owing to the limitations imposed by the size of the tunnel and the sharpness of the curves, to use [illegible] locomotives so that more cars could be hauled. The company, therefore, decided to use either the multiple unit system or a train with one motor car at each end, operated by a single controller. With the acceleration required, which was a maximum of about 0.618 meter per second, the latter system was found to be the cheaper, and was adopted. This is the only railway in the world using this system in commercial operation, and in which it is possible to use the same motor cars for four-car train and eight-car train operation. The accelerations obtained by the company with a four-car train with one motor car and an eight-car train with two motor cars are compared. There is nearly as good acceleration with the eight-car train as with the four-car train. The company has now 41 two-axle motor cars, each carrying two 25-hp motors, and equipped with the double-unit system described. In addition, the company has 40 more cars under construction to be equipped in the same way. During the rush hours in the morning and evening, eight-car trains are now being run alternately with four-car trains. At other times, four-car trains are sufficient to care for the traffic. The system has been in use since November, 1901.—*St. R'y Jour.*, September 6, and *Int. Ed.*, September.

A Graphical Method of Making Time-Speed Curves.—VALENTINE.—A description of a simple method of plotting time-speed curves. The factors which effect the nature of a time-speed curve are: The tractive effort of the motors; the train resistance, due to air resistance, friction, etc.; the grade resistance, and, finally, the resistance due to curves in the road. He gives a formula which represents the relation between these factors. The last factor, when expressed in pounds per ton per degree of curve, can be combined with the resistance to grade. The tractive effort varies uniformly with the speed, and its values at corresponding speeds for any particular motor are obtainable from the characteristic curves of the motor. The train resistance may be obtained from any standard train resistance formula. To avoid the necessity of computing the acceleration for successive changes in tractive effort, the writer uses a chart, which is reproduced. In this the net tractive effort is taken as abscissæ, and the speed in miles per hour is taken for the ordinates. The train resistance speed curve is first drawn, and is here represented as a straight line, according to the Baldwin's Locomotive Works formula, although any other formula may be used. The net tractive effort time-speed curve is then plotted by making use of the train resistance curve. The effect of grades is obtained by plotting inclined straight lines, marked "per cent. grade." The second set of straight lines, called "time increment curves," which serve to give the

gain in velocity for any desired time increment, are also drawn in, as described in the article. The writer then gives an example of the use of this chart, and presents a time-speed curve which represents one particular set of conditions derived from his chart.—*St. R'y Jour.*, September 6, and *Int. Ed.*, September.

Kingsland Surface Contact System.—A description of a system in which the electric switch, by which the studs are thrown in and out of contact, is operated by mechanical means. A conduit, the height of the rail and with a slot about 15 mm. wide, is laid outside one of the rails, and the switch boxes are located in it about 20 feet apart. These boxes have handles projecting into the conduit, which are struck by levers on the car, the forward lever throwing the stud into circuit, and the second lever throwing the stud out of circuit. As all parts of the switch are hermetically closed, no damage is caused by water in the conduit. The interior of the switch box contains a metal ring with three brushes, which are set at an angle of 120 degrees apart, and two contact plates, which are set at the same angle. Every movement of the switch handle turns the brushes one-sixth of a revolution, so that the contact plates are automatically connected and disconnected with the center with every movement of the handle. Arrangements are also provided by which a blow of the striker bar will turn the switch just the right distance, that is, 120 degrees, and also by which the switch lever is returned to its normal position with absolute certainty after being struck by the bar. The skate is suspended from the wheel axles by springs, and may be of the usual pattern.—*St. R'y Jour.*, September 6, and *Int. Ed.*, September.

Danger to Metal Pipes from Electric Railways.—ULBRICHT.—An account of measurements made during a long period in Leipzig and Dresden. The remarks that the resistance of the metallic pipes themselves is generally considered to be zero compared with the "transition resistance" to earth. But this is not the case, as the joints between the pipes have sometimes a considerable resistance; he thinks this is a sort of protection. If the joints can be made to have even only a small resistance, it is unnecessary to insert special insulation pieces in the line.—*Elek. Zeit.*, August 14.

WIRES, WIRING AND CONDUITS.

Cable Deterioration.—FORMENTI.—An article in which he describes his observations of the deterioration of the return wire of an earth cable composed of 20 strands of electrolytic copper wire, covered first with cotton and then with a composite rubber coating. Soon after the cable was put down, small vesicles of liquid appeared in the rubber coating, and these increased in size until they burst. By analysis of the rubber and also of the contents of the vesicles, it was shown that the rubber envelope, and not the soil, furnished the materials for the contents of the liquid. By heating up the rubber with water, a quite similar solution to that of the vesicles was obtained. It appears, therefore, that the rubber coating acted as a semi-permeable membrane, and admitted water, which dissolved out part of the contents of the rubber. The current then set up electrolysis in the solution so obtained. The deterioration described was prevented by coating the cable with a non-permeable substance, such as coal-tar.—*Elettricista*, April; abstracted in *Science Abstracts*, August.

REFERENCES.

Transmission Line.—REYVAL.—An illustrated description of the 26,000-volt power transmission lines in the neighborhood of Grenoble, in France.—*L'Eclairage Elec.*, July 19.

Cable Joints.—SCHMIDT.—An illustrated article on the construction, the use and the advantages of cable joints which can be disconnected, and which are provided with fuses.—*Elek. Anz.*, July 27, August 14, 17.

Calculation of Distribution Networks.—KOENIG.—An illustrated article, giving notes on graphical methods for calculating distribution lines and networks.—*Elek. Anz.*, July 17, 24, 31, August 21, 31.

ELECTRO-PHYSICS AND MAGNETISM.

Radio-Activity.—RUTHERFORD AND SODDY.—The first part of a very long paper on the cause and nature of radio-activity. They have made a detailed investigation of the radio-activity of thorium compounds, which was found to be accompanied by chemical changes in which new types of matter are being continuously produced. These reactive products are at first radio-active, the activity diminishing regularly from the moment of formation. Their continuous production maintains the radio-activity of the matter producing them at a definite equilibrium value. Besides being radio-active in the same sense as the uranium compounds, the compounds of thorium continuously emit into the surrounding atmosphere a gas which possesses the property of temporary radio-activity. This emanation is the source of rays which ionize gases and darken the photographic film and excite radio-activity on all surfaces with which it comes into contact. The emanating power of thorium compounds is independent of the surrounding atmosphere, and the excited activity it produced is independent of the nature of the substance on which it is manifested. These properties make it appear that both phenomena are caused by minute quantities of special kinds of matter in the radio-active state, produced by the thorium compound. The next consideration in regard to these examples of radio-activity is that the activity in each case diminishes regularly with the lapse of time. These actions—first, the production of radio-active material, and, second, the dissipation of its available energy by radiation, which are exhibited by thorium compounds in the secondary effects of emanating power and excited radio-activity, are in reality taking place in all manifestations of radio-activity. The constant radio-activity of the radio-active elements is the result of an equilibrium between these two opposing processes. The major part of the radio-activity of thorium—ordinarily about 54 per cent—is due to a non-thorium type of matter, designated by *Th X*, possessing distinct chemical properties which is temporarily radio-active, its activity falling to half value in about four days. The constant radio-activity of thorium is maintained by the production of this material at a constant rate. The *Th X* further possesses the property of exciting radio-activity on surrounding inactive matter, and about 21 per cent. of the total activity under ordinary circumstances is derived from this source. Its rate of decay and other considerations make it appear probable that it is the same as the excited radio-activity produced by the thorium emanation, which is in turn produced by *Th X*. Thorium can be freed by suitable means from both *Th X* and the excited radio-activity which the latter produces, and then possesses an activity about 25 per cent. of its original value, below which it has not been reduced. This residual radiation consists entirely of rays non-deviable by the magnetic field, whereas the other two components comprise both deviable and non-deviable radiation. Most probably this residual activity is caused by a second non-thorium type of matter produced in the same change as *Th X*, and it should, therefore, prove possible to separate it by chemical methods. The conclusion is drawn that radio-activity is a manifestation of "sub-atomic chemical change," and the hope is expressed that radio-activity "affords the means of obtaining information of the processes occurring within the chemical atom, in the same way as the rotation of the plane of polarization and other physical properties have been used in chemistry for the investigation of the course of molecular change."—*Phil. Mag.*, September.

Emission of Corpuscles by Hot Bodies.—J. J. THOMSON.—A highly theoretical paper on some of the consequences of the emission of negatively electrified corpuscles by hot bodies. He refers to the experiments of Richardson, which show that surprisingly large currents can pass in the best vacua between a negatively electrified incandescent wire and a conductor placed in its neighborhood; thus the negative electricity streams so fast from carbon at a white heat as to be equivalent to a current of about 1 ampere for each square centimeter of carbon surface; the number of corpuscles coming in each second from one square centimeter is about five times the 18th power of 10. He discusses the effects which this great crowd of corpuscles may produce. In the first place, these charged corpuscles will move when acted on by an electric force, so that, according to the electromagnetic theory of light, they will be set into motion by a wave of light; they will thus absorb energy from the wave, and give out this energy as scattered light, which will be polarized in the same way as light reflected from small particles. This scattering of the light will cause the medium to absorb light. The most conspicuous example of a hot body is the sun, and it seems to him probable that many of the phenomena of the corona may be due to light scattered by corpuscles ejected from the sun. He then takes up another point; he regards the corpuscles coming out of the metal as evidence of the existence in the metal itself of streams of corpuscles which move freely between the molecules of the metal; he regards the corpuscles in the metal as analogous to the molecules of a liquid, and the escape of the corpuscles from the metal as analogous to the evaporation of the liquid. He finds that a collection of corpuscles describing circles under forces varying inversely as the square of the distance in the molecules of a substance, which

[illegible] would, like the ideal "black" body, [illegible] proportional to the fourth power of the temperature.—*Phil. Mag.*, August.

[illegible]—J. J. THOMSON.—A description of [illegible]. Elster and Geitel have shown that a wire [illegible] for several hours, either in the open air or in a large [illegible] radio-active, *i. e.*, it increases the electric conductivity of the air in its neighborhood. Elster and Geitel supposed that the atmosphere contains some radio-active constituent which is attracted to the negatively-charged surface. The author has, however, come to the conclusion that, though the existence of this radio-active substance in the air is possible, it is not necessary for the explanation of the effects, and that negatively electrified surfaces may become radio-active without the deposition upon them of substances having specific radio-active properties. He has been experimenting with air contained in a closed vessel of [illegible], and although under normal conditions he has not been able to get any appreciable amount of induced radio-activity, he has found that a negatively electrified wire placed in the vessel acquired, when the gas in the vessel was exposed to Röntgen rays, or had been bubbled through water, properties analogous to those formed by Elster and Geitel in wires placed in the open air. The effects with the gas which had been bubbled through water were very great. He explains his results as follows: In consequence of the negative electrification of the wire, positive ions move up to it when it is placed in the modified gas; some of these ions do not discharge to the wire, but stick close to it, forming a coating of positive electricity around it. The attention of this positive layer on the negative corpuscles drags the latter from the wire; they emerge with a sufficient kinetic energy to ionize the molecules of the gas with which they come into collision. On this view, the ionizing power of the wire is due to a kind of polarization which produces an electric field, which makes the wire a cathode emitting cathode rays of feeble penetrating power, which ionize the gas in the neighborhood of the wire. The amount of polarization seems to depend upon the way the gas in which the negatively electrified wire is placed, is ionized. Thus, when the gas is made a conductor by bubbling through water, the effect on the negatively electrified wire is much greater than when the gas is made a conductor by Röntgen rays, although the conductivity of the gas is greater in the latter case than in the former. The conductivity produced in air when it bubbles through water is explained as follows: By this process very minute drops of water get mixed with the air. If each little drop gets surrounded by a layer of positive electricity, then, just as in the case of the wire, the drop might emit cathode rays which would ionize the air in its immediate neighborhood. The formation of a layer of positive electricity outside the drop is what is to be expected if any chemical combination went on between the water of the drop and the oxygen of the air.—*Phil. Mag.*, September.

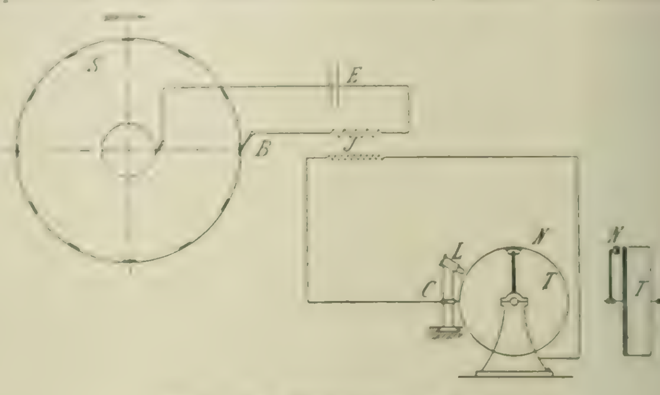
Transition Resistance.—STARK.—An article on the fact that an electric spark, or more properly speaking a self discharge, cannot occur until the difference of potential of the electrodes possesses a certain value. Maxwell supposed that there might be a condensation of air at the surface of the electrodes, leading to an increase of resistance, but Borgesius showed by an optical method that no such condensation takes place. Later the term "transition resistance" was used. But that there is no ohmic resistance between a metal and a gas may be shown by ionizing the gas between the electrodes, but not the gas immediately covering their surfaces; the resistance then practically disappears. The present author bases his own explanations upon the theory of ionic shock. The discharge potential has its minimum value when the distance between the electrodes equals the mean free path of the positive ions. These must be capable of ionizing by ionic shock before any discharge can take place.—*Phys. Zeit.*, August 1; abstracted in Lond. *Elec.*, August 22.

ELECTRO-CHEMISTRY AND BATTERIES.

Concentration Cells.—RIESENFELD.—A paper in which he shows that the electrolytic dissociation theory requires that a double layer of ions (and hence a potential difference) is formed at the boundary surface of two solvents. Since it is not at present possible to discover such an interior potential difference, he has studied concentration cells in which two different electrolytes in the same solvent were separated by a third solution. He found that such cells offer a new means of determining the transference numbers in the second solvent, but that the values show a hitherto unexplained discrepancy as against previous results.—*Ann. d. Phys.*, No. 7; abstracted in Lond. *Elec.*, August 29.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Determining the Degree of Uniformity of Speed During One Revolution.—KLOENNE.—A very long illustrated paper, read before the Society of German Electrical Engineers. He describes a method for determining the degree of uniformity of speed of a prime mover during one revolution, and also the angular displacement, which is of importance for the operation of alternators in parallel. The principle of the method is shown in the adjoining diagram. *S* represents



DETERMINING UNIFORMITY OF SPEED.

the fly-wheel of the steam engine or gas engine to be tested. In the circumference of the fly-wheel, thin insulating pieces are placed at equal intervals. *B* is a small brush which slides on the circumference of the fly-wheel. This brush opens and closes a circuit containing an accumulator, *E*, and the primary of an induction coil, *J*. The secondary contains the recording apparatus, which consists of a drum, *T*, rotating at uniform speed. The frame of the drum is connected to one end of the secondary, while the other end is connected to a pencil, *C*. This pencil is moved uniformly along the drum, parallel to its axle, and at a short distance from its surface. The drum, *T*, is driven at uniform speed by an electric motor supplied with current from an accumulator battery; to insure very uniform speed, the drum has a relatively heavy mass acting like a fly-wheel. The surface of the drum is blackened with soot. Its speed is so chosen that it is *M* times that of the prime mover tested, if *M* is the number of insulating pieces on the circumference of the fly-wheel. At any moment when the brush *B* touches an insulating piece, the current is broken, and a small spark jumps between the pencil *C* and the drum *T*, and blows off the soot, so that a distinct mark is produced. If the fly-wheel, *S*, turns at an exactly uniform speed, all the marks on the circumference of the drum are in a straight line, parallel to the axle of the drum. The variations from the straight line enable one to determine the degree of uniformity of the prime mover and the angular displacement with great exactness. Several modifications of this arrangement are described, and results of tests are given.—*Elek. Zeit.*, August 14.

REFERENCE.

Measuring the Iron Losses in Transformers.—BLOCH.—A communication in which he discusses some special points in Goldschmidt's method, recently noticed in the Digest, and suggests a modification of the same.—*Elek. Zeit.*, August 14.

MISCELLANEOUS.

Electrical Treatment of Infantile Paralysis.—WEIL.—A description of the clinical treatment of 20 cases of infantile paralysis at the Trousseau Hospital. In all cases brought in within a few days of the cessation of the fever the only treatment consisted in the application of continuous current of about 10 milliamperes, through an electrode of 100 sq. cm. joined to the positive pole, with the extremity of the afflicted member immersed in a tepid bath connected with the negative pole. The sittings lasted 15 or 20 minutes, and were repeated three times per week. Other cases were treated, in addition, with a few minutes' application of a rythmically interrupted current. In case the muscles concerned were inexcitable by a "faradic current," the treatment consisted in the application of interrupted currents through the square electrode and a pad moved up and down over the atrophied muscles. The author quotes a number of cases, almost all of which were successful. The electrical treatment with proper appliances has a distinct advantage over other methods, such

as massage, when the paralysis is of long standing; but its utility is brought out most strikingly in the treatment of fresh cases.—*Arch. d'Elec. Med.*, July 15; abstracted in Lond. *Elec.*, August 29.

REFERENCES.

German Electrical Engineers.—The complete report of the proceedings of the recent annual meeting of the Association of German Electrical Engineers, with reports of the discussions, etc. The papers read at this meeting are or will be abstracted in other parts of the Digest.—*Elek. Zeit.*, August 14.

Düsseldorf Exposition.—SEYFFERTH.—The first part of an illustrated article on the electrical engineering features of the Düsseldorf Exposition. This part deals with the alternators in the power plant. —*Elek. Zeit.*, August 14.

British Manufacturing Plant.—The first part of an illustrated description of the Ferranti works, at Hollinwood.—*Elec. Times*, August 28.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Next meeting, Sept. 26. Paper by B. G. Lamme, "The Washington, Baltimore and Annapolis Single-Phase Railway." Oct. 24, paper by C. P. Matthews on "An Integrating Photometer for Glow Lamp and Sources of Like Intensity."

AMERICAN STREET RAILWAY ASSOCIATION, Secretary, T. C. Penington, 2020 State Street, Chicago, Ill. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, Thos. R. Mercein, Milwaukee, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION, Secretary, J. H. Perkins, Youngstown, Ohio. Next meeting, Columbus, Oct. 14, 15 and 16, 1902.

Prepayment Meter.

The General Electric Company is making a prepayment device which is electrically connected to a wattmeter, but is mechanically independent. Although the meter with which it is used differs from the standard meter only in the construction and arrangement

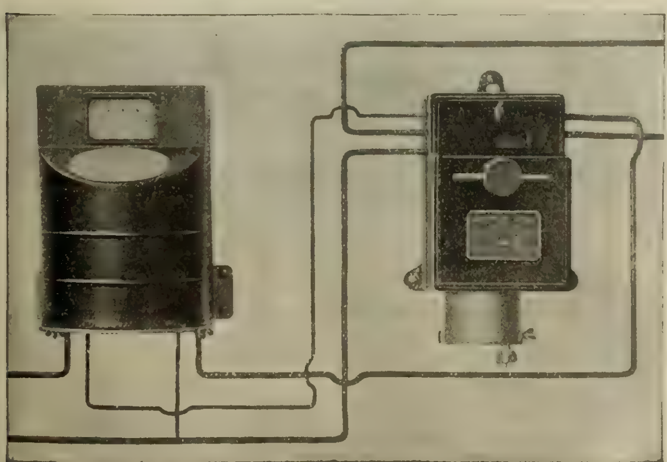


FIG. 1.—METER WITH PREPAYMENT DEVICE.

of the recording train and other minor details, the prepayment device is not applicable to Thomson recording wattmeters which have been purchased separately.

The meter register is provided with a short-circuiting commutator which communicates with the prepayment device through a simple electric circuit, shown in the accompanying illustration. The prepayment device consists of a registering wheel which is normally disconnected from the handle, but which can be connected by the introduction into the receiving slot of a coin of proper denomination. When so connected the handle can be thrown so as to set the registering wheel of the prepayment mechanism forward one notch. If the circuit is open when a coin is deposited, the same motion of the handle which sets forward the registering wheel closes the circuit switch contained within the case of the device. A portion of the registering wheel

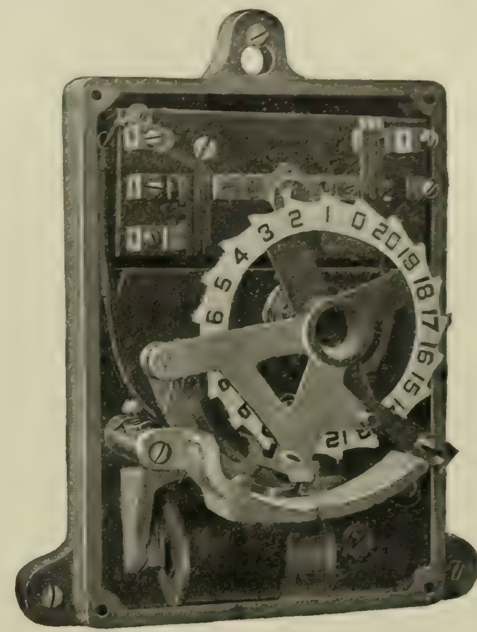


FIG. 2.—INTERIOR OF PREPAYMENT DEVICE.

is visible through the glass in front of the cover, and plain figures on the rim of this wheel, as shown in the illustration, indicate the number of coins remaining to the credit of the depositor. When the first coin is deposited and the handle moved, closing the main switch, the figure "1" is brought into view. If a second coin be deposited before the current purchased with the first coin has been consumed, a second motion of the handle will bring the figure "2" into view. Twenty coins can thus be deposited consecutively, and, as the device is designed for dimes, prepayment can be made for $2.00 worth of electrical energy at one time, after which the slot is automatically

FIG. 3.—COIN RECEPTACLE DETACHED FROM DEVICE.

closed and further prepayment cannot be made until the value of one or more coins has been consumed.

Whenever 10 cents' worth of energy has been delivered through the meter, a small amount of current is momentarily sent through the electromagnetic mechanism of the prepayment device which turns the wheel back one number. This process continues until all the energy for which prepayment has been made has been delivered, and

the depositor can ascertain at any time how much energy can be obtained without further prepayment by looking through the glass window of the device. When all the energy has been delivered, the registering wheel moves back to the first notch, and opens the switch, so that no more current can be obtained until further prepayment has been made.

The indicating mechanism shows only the number of coins which stand to the credit of the depositor, but the dial of the meter may be consulted to determine what fractional part of the value to be cancelled next is credited. The dial of the meter always indicates the amount of energy delivered, and thus serves to check the indications of the prepayment device. The use of a dial both on the prepayment device and on the meter is an important feature, since it serves to

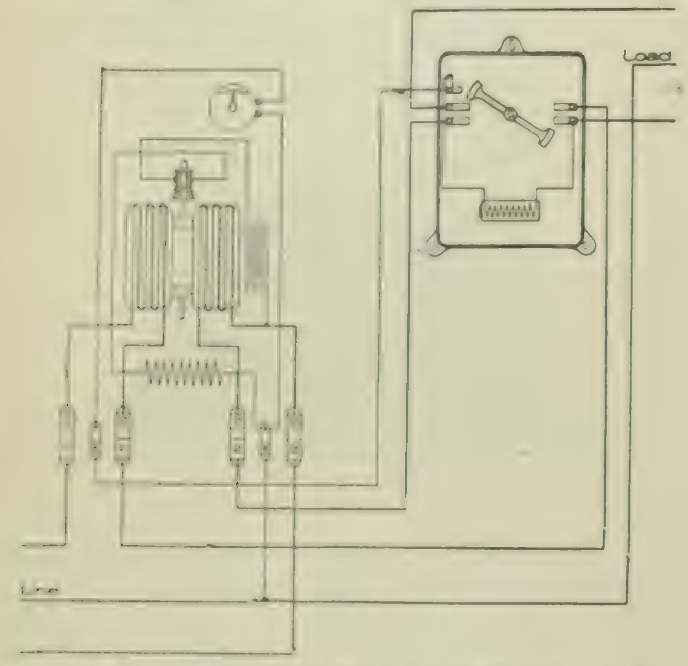


FIG. 4.—CONNECTIONS OF THREE-WIRE WATTMETER AND PREPAYMENT DEVICE.

show at once any discrepancy between the record of the meter dial and the number of coins deposited in the receiver.

The switch is of the double-pole, double-break type, and has clips and blades of ample size. It is designed to open successfully, and without injury to itself, a circuit carrying current up to the amount of the maximum overload allowable for the largest meter with which the device can be used. The closing and retaining mechanism of the switch is positive in its action, and both strong and simple in construction.

Every precaution has been taken to guard against cheating. A coin or washer larger than the coin for which the device is designed cannot be introduced into the receiving slot, and a smaller one will not operate the device. A coin having a thread or wire attached passes through the mechanism and unlocks it, but the motion of the actuating handle cuts off the thread or wire so that the coin passes into the receiving box and cannot be withdrawn, and the intended fraud is detected when the coin receptacle is opened.

The coin receptacle is detachable and may be sealed at the company's office, and the collector intrusted with simply removing it and replacing it with an empty one.

Wireless Telegraphy on the Pacific Coast.

The contract for the erection of the new wireless telegraph station on one of the islands of the Farallon group, [illegible] miles west of San Francisco, has been awarded by the Washington authorities to W. H. Healy, of Healy & Tibbitts. The station when completed will have cost the government $5,000. Professor Alex. G. McAdie, chief forecast official of the Weather Bureau, who is located in San Francisco, will have charge of the wireless system, which is to be established to communicate between Point Reyes and the Farallons. The messages will be repeated by telephone from Pt. Reyes to San Francisco.

Independent Telephone "Green Book."

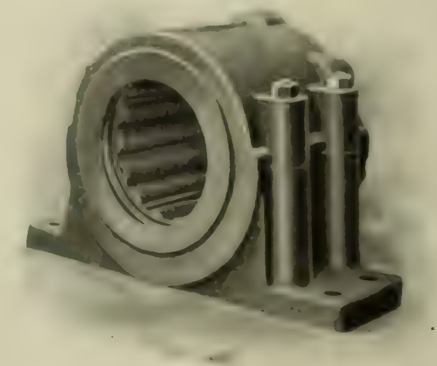
"The Telephone Green Book," for 1902, a publication issued by H. H. Robinson, general manager of the United States Telephone Company, Cleveland, Ohio, has made its appearance. It is a neat volume, and gives telephone statistics of the independent telephone movement in Ohio, Indiana and Michigan. According to this authority, there are 106,344 independent telephones in operation in Ohio, against 79,500 Bell telephones. The estimated increase in independent telephones in Ohio for the year ending June 1, 1903, is 27,027. The figures quoted do not include plants under construction, but only those in active operation.

Hyatt Roller Bearing.

The great development in roller bearings is illustrated by the fact that more than 400 patents on the same have been issued in this country. Of all the roller bearings patented there is but one which does not involve the use in some form of a solid steel roller, this exception being the Hyatt roller bearing. The distinctive feature of this bearing is that the roller is wound into a coil or spring of uniform diameter. The advantage claimed for this construction lies in its flexibility, which enables it to present at all times a bearing surface along its entire length. The result of this is that the tendency to wear of the roller as well as of the surface on which it operates is diminished to such an extent that it is not necessary that such surfaces be hardened and ground.

The accompanying figure very clearly shows the features of this type of bearing. The cuts show a heavy-duty car bearing, designed for a safe working load of 20,000 lbs., but the bearing is applicable to all duties ranging from the lightest to the very heaviest. For example, it is equally applicable to loose pulleys, automobile work, grinding and pulverizing machinery, and to the highest speeds as well as the heaviest duties at low speed.

As stated above, the efficient bearing surface of this type of roller bearing necessarily greatly diminishes the wear, and as a consequence it is not necessary that the bearing surface should be hardened and ground. When steel axles are used, as is generally the case, no sleeves are required, thereby reducing the bearing to its simplest



ROLLER BEARING.

possible elements. For the case of iron journals, an efficient and easily applied form of bushing is used.

Another advantage of this type of bearing is the manner in which it assists lubrication. The roller acts essentially as an oil reservoir, while the spiral and roller together perform the function of an oil carrier, thereby insuring perfect lubrication of all parts at all times, and thus making it possible to operate the bearings for considerable intervals without attention. Owing to the fact that all the foreign matter has a tendency to collect on the inside of the spirals, this type of roller bearing can be successfully used, though, of course, with diminished life, in dusty and gritty places.

The Hyatt roller bearing is extensively used by electrical manufacturers. For example, about 1,500 are in use in the shops of the General Electric Company, at Schenectady.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was offered with a little more freedom, 6 per cent. being the rate for all periods. The easier money condition was reflected in the stock market in recoveries throughout the share list, bullish manipulation being renewed in some of the leading railway stocks. United States Steel shares received excellent support as a result of a final decision in New Jersey legalizing the bond issue plant. Some of the minor industrials were also inclined to be very strong. General conditions continue to be very favorable, and the underlying sentiment of the Street is still bullish as regards the ultimate effects of the good crops, the activity of trade and manufacturing and the enormous tonnage of the railways. Manhattan Railway advanced from 134 to 138¾ on confident talk about the favorable results which will follow the equipping of all the lines of the company with electric power. Metropolitan Street Railway closed at 147¼, which was ¼ point below the highest quotation of the week, the lowest being 144¼; the net gain was ¼ point and the shares sold aggregated ,348. Brooklyn Rapid Transit, after reaching 69¾, closed at 68¼, being a net loss of ¼ point, the lowest quotation being 67⅝. General Electric made a net gain of 3 points, closing at 195, this being ½ point lower than the highest price of the week, the lowest being 191½; 2,328 shares of this stock changed hands during the week. Western Union was well supported and quickly recovered its quarterly dividend, closing at 95½ ex-div., this being a ⅞-point gain. American Telephone & Telegraph made a net gain of 2 points, closing at 172, and American Telegraph & Cable 4 points, closing at 94. Both issues of Westinghouse closed at 225, representing a net loss of 3 points on the common stock and 5¼ points on the preferred. The common reached 228, the lowest quotation for the week being 223⅛. Following are the closing quotations of September 23:

NEW YORK.

	Sept. 16.	Sept. 23.		Sept. 16.	Sept. 23.
American Tel. & Cable.	—	—	General Electric	192	191½
American Tel. & Tel..	170½	171	Hudson River Tel.....	—	—
American Dist. Tel....	—	—	Metropolitan St. Ry...	145½	145
Brooklyn Rapid Transit	68⅝	65½	N. E. Elec. Veh. Trns.	—	¼
Commercial Cable	—	—	N. Y. & N. J. Tel....	—	—
Electric Boat	25	25	N. Y. E. V. T. Co....	11½	—
Electric Boat pfd......	40	40	Tel. & Tel. Co. Am..	—	—
Electric Lead Reduc'n..	2⅛	2½	Western Union Tel....	95⅞	92
Electric Vehicle	5¼	5¼	West. E. & M. Co.....	227	223¼
Electric Vehicle pfd....	15	14	West. E. & M. Co. pfd..	—	—

BOSTON.

	Sept. 16.	Sept. 23.		Sept. 16.	Sept. 23.
American Tel. & Tel..	170¼	170	Western Tel. & Tel. pfd.	100¾	—
Cumberland Telephone .	128	—	Mexican Telephone	2¼	2⅛
Edison Elec. Illum....	—	—	New Eng. Telephone...	141¾	140½
Erie Telephone	—	—	Westinghouse Elec.	112½	109½
Western Tel. & Tel....	29½	28¾	Westinghouse Elec. pfd.	112½	108

PHILADELPHIA.

	Sept. 16.	Sept. 23.		Sept. 16.	Sept. 23.
American Railways	52	54½	Phila. Traction	98¼	98¼
Elec. Storage Battery..	89¼	—	Phila. Electric	8¾	8¾
Elec. Storage Bat'y pfd.	88	—	Pa. Elec. Vehicle......	—	—
Elec. Co. of America..	9½	10¼	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	Sept. 16.	Sept. 23.		Sept. 16.	Sept. 23.
Central Union Tel.....	—	—	National Carbon pfd....	100½	103½
Chicago Edison	175	—	Northwest Elev. com...	—	—
Chicago City Ry.......	217	—	Union Traction	18	18⅞
Chicago Tel. Co........	—	175	Union Traction pfd....	47	58*
National Carbon	33	33			

* Asked.

MARCONI WIRELESS TELEGRAPHY.—The Marconi Wireless Telegraph Company of America has issued a circular stating that the company is now operating stations at Nantucket, Mass., and at Sagaponack and Babylon, L. I. The trans-oceanic station at South Wellfleet, Cape Cod, is practically completed, and on the arrival of Mr. Marconi within the next few weeks the feasibility of wireless messages between the Atlantic coast and England is expected to be demonstrated. Stations between Fort Gibbon and Bates Rapids, Alaska, are being erected, and an examination is to be made of a route to connect Alaska with the United States by the Marconi system. The United States Coast Survey, after a series of tests, has reported that regularly spaced signals sent in this manner can be utilized for longitude determinations at a greater distance than that obtained for verbal messages by the Morse method. An arrangement has been concluded with the Postal Telegraph Company by which messages will be accepted at Postal Telegraph stations for transmission to incoming and outgoing vessels, fitted with the Marconi system, by way of Sagaponack, L. I., at the rate of $2 per message of ten words, address and signature not counted, and twelve cents for each word over ten in addition to the regular commercial tolls to Sagaponack. Stations will soon be established for communication between the Pacific coast and islands north and south where the cost of maintenance prevents the use of land lines or of cables. Installations in the West Indies will also soon be established.

NANTUCKET LIGHTING.—Negotiations have just been completed by John W. Cowley, of Boston, for the purchase of the Nantucket Gas Light Company, whereby Mr. Cowley secures control of the entire lighting system of Nantucket, the plant of the Nantucket Electric Company having been acquired by him a short time since. Mr. Cowley plans to build a new electric plant. Most of the lighting throughout the island will be done by the electric plant, the gas being used principally for cooking and heating purposes. The new owner is treasurer and manager of the People's Gas & Electric Company, of Stoneham, Mass., a suburb of Boston. The assets of the Nantucket Electric Company amounted at the close of its last fiscal year in June, 1901, to $30,614.14. The capital stock is $25,000. Operating expenses at the station were $6,116.70. Income from sale of light and power was $6,841.38, and the profit and loss balance, $724.68. The Nantucket Electric Company's rates for incandescent lights are $10 per 16-cp lamp per year, with wiring and renewals at cost. Arc lamps are charged at $100 per lamp per year. There were 60 public lamps of 25 cp and 25 arc lamps of 1,200 cp. The assessed valuation of the plant was $10,000.

AMERICAN ELECTRIC VEHICLE RECEIVERSHIP.—The American Electric Vehicle Company has been placed in the hands of a receiver by Vice-Chancellor Emery, of New Jersey. The company was incorporated on December 13, 1899, with a capital of $6,000,000. The application for the receivership was made by John R. Hardin, counsel for George F. King, of East Orange, one of the stockholders. George P. Lister, of Hoboken, is the president and treasurer of the concern. Mr. Hardin in his prayer for the receiver, set forth that two promissory notes, one dated August 5, 1902, for $20,000, and the other dated September 15, 1902, for $10,000, have both been dishonored by the company. The president, when pressed for the liquidation of the claims, stated, according to the prayer, that the company had no funds with which to meet debts. Mr. Hardin's plea says that the assets of the company are more than $57,000, and the liabilities specified are $42,000, and notes aggregating $37,500. The bill also avers that the company is being sued for $2,000 damages by John W. Newbury. Charles J. Roe, of Jersey City, suggested as temporary receiver by Mr. Hardin, was appointed.

DETROIT TELEPHONE COMPANY.—The committee formed for the protection of holders of the Detroit Telephone Company's 6 per cent. gold mortgage bonds, due February 1, 1922, represent the owners of a majority of the bonds, and expect to ultimately represent the greater part of the issue. The interest on these bonds, due August 1, 1902, was defaulted. They were guaranted principal and interest by the Michigan Telephone Company, which defaulted on its bonded interest July 1. There were $1,000,000 of these bonds authorized, but only $600,000 were sold, all being $100 coupon bonds. They were principally placed in the West and in Canada, and there are a few held in England and Scotland. It is maintained by the committee that when the Michigan Telephone Company entered the Detroit field, it was obliged to acquire certain rights owned by the Detroit Company, and did so by guaranteeing the Detroit Telephone Company bonds as a part of the contract. The Michigan Company on January 1, 1902, raised its rates for telephone service, and it is said that it has not now a telephone out that is not paying a good profit.

DIVIDENDS.—Metropolitan Street Railway Company, New York, has declared a dividend of 1¾ per cent., payable October 15. The Hall Signal Company has declared a quarterly dividend of 1½ per cent., payable October 1. The North Chicago Street Railway Company has declared the regular quarterly dividend of 3 per cent., payable October 5. The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1¾ per cent. on its preferred stock, payable October 1. The American Telephone and Telegraph Company has declared a quarterly dividend of 1½ per cent. The directors of General Electric have declared the regular quarterly dividend of 2 per cent. on the common stock, payable October 15. The Union Traction and Electric Company, of Jersey City, has declared a dividend of 1¼ per cent., payable October 1. The directors of the Twin City Rapid Transit Company have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable October 1.

WESTERN UNION.—[illegible] with Western Union call attention to the fact that the company's books are now closed for the payment of the [illegible] consecutive quarterly dividend, pointing out that such a record justifies placing Western Union among the first-class investment securities, notwithstanding the fact that the stock is selling comparatively low. We are told that there has been considerable Western Union stock bought quite recently by important corporations for investment purposes. It is stated that according to the transfer books, nearly two-thirds of Western Union stock shows no change in ownership during the past five years. It is evtimated that the floating supply of stock amounts to no more than 60,000 shares. Since President Clowry took hold of the company, there has been an enormous saving effected in expenses. It is stated on authority that during the past two months the company has been earning at the rate of 8 per cent. per annum on the stock, with indications that this rate can be maintained or increased. The argument that the business of Western Union may be jeopardized by developments in the telephone field, is met by reasoning that should there ever be any new inventions in connection with either the telegraph of the telephone, it would be more than likely that Western Union would lose no time or expense in getting control of such inventions. Stress is laid upon the fact that Western Union owns a large amount of telephone securities, the amount being placed at approximately $10,000,000. On the other hand, the Western Union does not show the slightest inclination to acquire new inventions, and opposes machine telegraphy.

BOSTON WEST END.—The Massachusetts railroad commissioners have authorized the West End Street Railway Company, to issue $3,559,000 4 per cent 30 year bonds, dated August 1, 1902. The issue is for the following purposes: $3,000,000 to refund a similar amount of bonds maturing November 1, 1902, and $559,000 for permanent additions, alterations and improvements made on the property by the Boston Elevated Railway Company during the six months from October 1, 1900, to March, 1901, inclusive. The West End Company sold its last issue of bonds July 23, 1902, on a 3.51 per cent. income basis. The issue comprised $300,000 4 per cent. 13-year bonds. In December, 1901, the company sold an issue of $1,800,000 4 per cent. bonds on a 3.855 per cent. income basis.

BUFFALO UNDERGROUND TROLLEY.—The Central Crosstown Railroad, of Buffalo, has been granted permission by the Railroad Commissioners to issue a first consolidated mortgage for $3,000,000 to refund existing issues and equip the road for underground trolley service.

THE HUDSON AND MANHATTAN RAILROAD COMPANY has been chartered at Trenton, with a capital of $100,000, to construct and operate a tunnel under the North River, from Jersey City to New York.

BROOKLYN RAPID TRANSIT shows gross earnings of $11,525,202 for the year ending June 30, and a decrease in net earnings of [illegible].

Commercial Intelligence.

THE WEEK IN TRADE.—Continued activity is reported in jobbing distribution and retail business is improving, according to the reports to the mercantile agencies. There is a notably cheerful tone in reports from the South, and in the West and Southwest there is an unrestrained disposition to book Fall and Winter orders, due to the practically settled situation in the corn crop. It is stated that there is plenty of money in the interior and at all centers for ordinary trade purposes. Notable strength is reported in manufactured goods, the textiles leading in the volume of demand and in strength of prices, in keeping with the advance or firmness in the raw materials. The delay in ending the anthracite coal strike has had the effect of increasing the price of bituminous coal; the supply of anthracite, however, is gradually increasing as more mines and miners resume work. The "car famine" has somewhat relaxed as to coal and coke supplies, and, although the furnace situation in the valleys is somewhat more satisfactory, the Eastern mills are still complaining of delayed supplies. Foreign iron and steel are reaping the benefit Foreign steel is being bought for mills in the Central West, and large quantities of rails for next year's delivery are being bought abroad. In finished products, American mills have about all the business that they care to accept. Rails, plates and structural iron are all heavily sold ahead. The activity in the copper market noted in last week's issue was followed by a reaction, and last week's market was rather inactive. The closing quotations are 11¾ @ 11⅞c for Lake; [illegible] for electrolytic in cakes, ingots and wire bars; [illegible] in cathodes and [illegible] for casting stock. The number of failures for the week ending September 18, as reported by [illegible] aggregated [illegible] as against 167 the week previous, and 158 the same week last year.

ADIRONDACK TROLLEYS.—The long talked of trolley road from Saranac Lake, in the Adirondacks, to Westport, on Lake Champlain, via Lake Placid, Elizabethtown and Ausable Forks, seems now to be a certainty. The deal is being financed by R. L. Keen & Co. of 25 Broad Street, New York City. Twenty surveyors are now at work near Saranac Lake locating the route, and it is expected the road will be completed in time for next season's business. From Saranac Lake to Lake Placid the line is to follow the highway, but from Lake Placid to Elizabethtown it is expected that the company will purchase a right of way. From Elizabethtown through the Keene Valley to Ausable Forks and on to Westport the route has not been decided upon except in a general way. Whether the electric power used is to be generated by water power or by steam cannot be learned, but it is probable that the many water power facilities along the route will be utilized wherever practicable. The matter of keeping the tracks clear of snow and ice is one that has given the projectors much food for thought, but it is believed that this difficulty will be overcome and that the trolley road will handle the snow drifts easier than do the steam roads. The distance from Saranac Lake to Westport by this route is about 60 miles, and takes in some of the wildest and grandest scenery in the entire Adirondacks mountain wilderness, besides connecting several prosperous villages. The bulk of the income, however, would come from the tourist travel during the summer months. Anticipating this "trolleying" of the Adirondacks, Paul Smith, the far-seeing hotel man, more than a year ago bought up several of the best water-power privileges, including Union Falls and Franklin Falls on the Saranac, Wilmington Notch on the Ausable, and these, together with the one at the outlet of Lower St. Regis Lake, he still holds.

THE SYRACUSE RAILROAD CONSTRUCTION COMPANY, which is building a twenty-five-mile electric railroad between Auburn and Syracuse, N. Y., has recently closed a contract with the Westinghouse Electric & Manufacturing Company for two 650-kw engine-type alternators, delivering three-phase current at 360 volts and 3,000 alternations; also for five 400-kw rotary converters, together with raising and lowering transformers for operating a 15,000-volt transmission line to two sub-stations. A complete switchboard is included, and, in fact, everything for the operation of a complete railway line. The generators are to be direct connected to two 22 and 44 x 48-inch cross-compound, horizontal Corliss engines, purchased from Messrs. Westinghouse, Church Kerr & Co., and built by the Westinghouse Machine Company, of Pittsburg, Pa. The engines are to receive steam at 150 pounds, and to run at 100 r. p. m., and are rated at 1,000 hp. each, with a maximum rating of 1,800 hp.

ELECTRICITY AND COAL.—The coal strike is being very anxiously watched by some electrical companies, and several of them suffer from higher prices for fuel. An officer of the Electric Company of America says that his company has been very slightly affected by the coal strike. Most embarrassment would naturally have been felt at Scranton, and there the company owns a washer of 75,000 tons' capacity per annum, and a culm pile containing 750,000 tons.

A POCKET TELEPHONE.—A telegram from Lafayette, Ind., of September 21, says: A company has been formed here to manufacture a pocket telephone. The receiver is so shaped as to fit the mouth and ear. An aluminum box is fastened to a telephone pole; a key fits this box and when inserted calls the telephone exchange. The caller gives the number he wants, and the insertion of his key cuts off all persons on the line until he is through.

THE STEAM & ELECTRICAL EQUIPMENT COMPANY, of Pittsburg, reports these sales for the week: One 200-kw. General Electric M. P. 4, 550-volt street railway generator, to Gerstin Company, of New York; one order from the American Car & Foundry Company, of St. Louis, for a boiler 66 x 17, of Erie make. It reports difficulty in securing apparatus to fill the demand.

ENCLOSED ARC LAMPS.—The St. Louis office of the General Incandescent Arc Light Company closed recently another order with the American Car and Foundry Company for enclosed arc lamps for its Madison car works. With this order the General Incandescent Company will have equipped the works at St. Louis, Mo., St. Charles, Mo., and Madison, Ill., amounting in all to 526 lamps.

THE HYDRO DOUBLE BATTERY COMPANY, 70 Read Street, New York, has gone into the hands of a receiver. The assets are said to be $4,000 and the liabilities $62,000. The corporation was organized in January, last year, with a capital of $1,000,000, to manufacture a German semi-dry battery. Mr. Robert J. Raymond was appointed receiver in New Jersey.

WIRELESS IN CANADA.—The Thomas E. Clark Wireless Telegraph-Telephone Company, of Detroit, Mich., has just completed a wireless telegraph station at Fighting Island, Canada. It will be used as a testing station for the company's instruments, between that point and its Detroit station.

SUPPLY DEALERS DISUNITED.—A great deal of more or less sensational talk has been printed in the daily newspapers about the disruption of the eastern branch of the Electrical Supply Dealers Association, as a result of its meeting last week. The New York *Herald*, for example, says: "Its members angered by mutual accusations of treachery and by the unjust fines imposed upon the victims of "stool pigeon" orders, the big Electrical Supply Trust, a secret organization, which only last May was charged with being subject to prosecution under the Sherman law, went to pieces last Wednesday, when its subscribers, after a stormy meeting, resolved to disorganize and repudiate the agreements which had bound them together for three years. This end of a powerful combination, which is charged with having driven more than 5,000 dealers and manufacturers out of business, caused rejoicing or dismay, as the case might be, in all the electrical supply houses in the city yesterday." This is pretty strong language, which the facts hardly justify, but it is the fact that the ties which bound the organization together have been seriously loosened. Mr. Victor C. Gilpin, the secretary of the Electrical Supply Dealers Association is quoted as saying, that the men who compose the organization had organized for social purposes at first. Afterward it had been ascertained that it would be advantageous to many dealers in the electrical supply business if something were done to make the prices of the various articles uniform. An understanding was arrived at, and it was operative for some time past. Recently, he said, some dissatisfaction had arisen by jobbers, principally in the West. Therefore the organization decided to not attempt to control the prices of the manufactured articles. "The subject of ceasing to control prices had been under consideration for a considerable time," Mr. Gilpin said, "and we only did at the meeting what we had previously decided individually we would do. We still exist as a social organization." There are two divisions of the Electrical Supply Dealers Association—one in the West, in which 70 dealers are allied, and the one in the East, which is composed of about 61 dealers. Mutterings of discontent were first heard in the West last May. Independent dealers, particularly in the telephone field, there complained that the combination deliberately sought to drive every non-member out of business by refusing to sell him supplies direct and by preventing him, if possible, from obtaining any goods indirectly. Some of the parties in Chicago filed a complaint with Attorney General Knox that the Electrical Supply Dealers Association of the United States was a trust, and asked the Attorney General to proceed against the association under the Sherman law. So far as is known, nothing has since been done in that matter.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended September 12: Antwerp—22 pkgs. material, \$2,277; 9 pkgs. machinery, \$724. Argentine Republic—99 pkgs. material, \$1,994. Bremen—2 pkgs. material, \$50. Berlin—2 pkgs. machinery, \$410. British East Indies—4 pkgs. material, \$150. British Poss. in Africa—23 pkgs. machinery, \$2,730; 23 pkgs. material, \$1,012; 60 pkgs. material, \$2,162. British West Indies—39 pkgs. material, \$456. Birkenhead—50 pkgs. machinery, \$6,000. Brazil—136 pkgs. material, \$5,387; 7 pkgs. machinery, \$291. Cuba—11 pkgs. machinery, \$748; 26 pkgs. material, \$1,473. Chili—6 pkgs. material, \$397. Copenhagen—27 pkgs. machinery, \$3,307. Cowes—9 pkgs. machinery, \$735. Central America—26 pkgs. material, \$431. Derby—3 pkgs. machinery, \$27. Ecuador—21 pkgs. material, \$133. Glasgow—6 pkgs. machinery, \$350. Hamburg—41 pkgs. material, \$3,499. Havre—89 pkgs. material, \$1,367; 4 pkgs. material, \$205. Liverpool—289 pkgs. machinery, \$20,735; 39 pkgs. material, \$3,586. Leeds—2 pkgs. machinery, \$375. London—211 pkgs. machinery, \$13,848; 104 pkgs. material, \$7,273; 4 pkgs. machinery, \$2,140; 1 pkg. material, \$42. Mexico—238 pkgs. material, \$5,055; 41 pkgs. machinery, \$2,140; 340 pkgs. machinery, \$41,473; 48 pkgs. material, \$5,745. New Foundland—10 pkgs. material, \$200. Nova Scotia—21 pkgs. material, \$238. Patras—18 pkgs. machinery, \$2,000. Peru—8 pkgs. material, \$245. Rotterdam—19 pkgs. machinery, \$463. San Domingo—2 pkgs. material, \$32. Southampton—120 pkgs. material, \$120; 4 pkgs. machinery, \$215. Stockholm—18 pkgs. machinery, \$3,315. U. S. Colombia—7 pkgs. material, \$436; 6 pkgs. machinery, \$3,750. Venezuela—36 pkgs. material, \$148. Vienna—1 pkg. machinery, \$62. Zurich—1 pkg. material, \$38.

THE HAINES & NOYES COMPANY, manufacturers of telephone apparatus, Chicago and New York, announce the following sales during the past month: The McCoy Hotel, Chicago, large telephone system throughout the hotel; a private telephone system for Marshall Field's new residence, Chicago; a large private telephone system in the residence of Mr. David B. Jones, Chicago, consisting of flush telephones made up in special woods; a system of 50 telephones and central energy switchboards for the Union Special Sewing Machine Company, Chicago; a 400-drop central energy board and telephone apparatus for East Aurora, N. Y.; a 300-drop central energy board and telephone apparatus for Hamburg, N. Y., as well as a number of smaller exchanges; a telephone system for the apartment building of Mr. F. M. Lockwood, Evanston, Ill; a large shipment of telephones to the Compagnie Industriale, Mexico; to the Electrical Construction Company, London, and the Aurora Hospital, Aurora, Ill., through the M. B. Austen Electric Company, Chicago; one hotel system and one large office building system for Los Angeles, through the Woodill & Hulse Electric Company; a large order of telephones for H. B. Lee, Buffalo, N. Y., for McDonald & Willson, Toronto, as well as several large private telephone plants for well-known factories. The Haines & Noyes Company state that its September business has been the largest on record.

BALL ENGINE ORDERS.—Among recent foreign shipments of the Ball Engine Company, Erie, Pa., are two engines to Port Antonio, Jamaica, and one to Japan—all three being used for electric purposes. An additional unit is being furnished for the Security Building, St. Louis, Mo. This is the third direct-connected engine furnished by the Ball Engine Company for this building. A large and complete lighting and power plant has been purchased by Harry W. Oliver for the Lewis Block, Pittsburg. The engines will be of the vertical type in three units, each of 400-hp, direct connected to generators, and will be furnished by the Ball Engine Company. The Loveland Beet Sugar Company, Loveland, Colo., are installing an additional engine, built by the Ball Engine Company, direct connected to a Crocker-Wheeler generator. The Armour Elevator, New Orleans, are adding another unit to their electric plant, consisting of a Ball engine, direct connected to a Triumph generator. The Ball Engine Company have also recently sold to Evans, Almirall & Co., New York and Chicago, two engines direct connected to centrifugal pumps, for the new shops of E. P. Allis & Co., Milwaukee, Wis.

NEW PLANT AT NIAGARA.—George Baker Long, Charles H. Everett and George W. Morris, of Buffalo, have secured the contracts for the new manufacturing plant to be built by the Carter-Crume Company in the new manufacturing district of the Niagara Falls Hydraulic Power & Manufacturing Company at the north end of the city. The cost will be \$100,000. The contract calls for the erection of brick and steel structures that will cover three and a half acres. There will practically be 11 or 12 buildings in one, and when completed the new plant will be one of the finest in western New York. Work will begin immediately. The Carter-Crume Company is numbered among the most enterprising and substantial manufacturing industries of the city, and for years their plant has been located on the lands of the Niagara Falls Hydraulic Power & Manufacturing Company on Main Street. Each year has seen an important increase in the business of the company until, in order to meet the demand for its product, the company has realized the necessity of erecting a new plant.

THE EUREKA FIRE HOSE COMPANY, of Jersey City, N. J., has decided, it is said, to discard its present direct-current transmission system and to adopt an alternating-current system in order to reduce the cost of fire insurance where motors are used in the presence of inflammable material. This step has been taken on the advice of one of the largest insurance companies of this country. The new apparatus includes one 75-kw, belt-driven alternator, furnishing two-phase current at 7,200 alternations and 220 volts; also exciter, switchboard equipment, slide rails, rheostats, etc. Several induction motors have been purchased, including the following: Five of 15-hp; one of 10-hp; five of 5-hp, and three of 2-hp. With these there will be furnished a switchboard feeder panel, completely equipped with instruments and switches. The entire electrical equipment has been ordered from the Westinghouse Electric and Manufacturing Company.

APPARATUS WANTED.—Mr. Robert J. Boone, attorney, Mariana, Fla., writes us: "We shall shortly be in the market for machinery and general construction supplies for the erection and maintenance of an electric light plant at this place. We shall use about 1,000 incandescent lamps and 50 arc lights, and will need machinery of that capacity. We shall also require the necessary boilers and engines, and, in fact, all the equipment for the proper construction of an up-to-date electric light plant."

ALLIS-CHALMERS COMPANY, Milwaukee, Wis., notes among its sales for August, of Reynolds-Corliss engines: One 9 x 16 x 24, to the Armour Institute of Technology; one 18 x 42, to the Interurban Construction Company, Ottumwa, Ia.; one 32 x 68 x 60 and one 30 x 64 x 48, both cross-compound condensing, to the Denver Tramway Power Company; one 42 x 86 x 60, combined horizontal and vertical duplex, to the Southern Electric Light and Power Company, Philadelphia, Pa.

PLANT FOR SAN LUIS POTOSI.—The concession for the construction of an electric plant for power, light and heat in the city of San Luis Potosi, Mexico, to which some reference was recently made in these columns, has been awarded to Messrs. Waddill, of that place.

General News.

THE TELEPHONE.

[illegible]

[illegible]

[illegible]

[illegible] Company, recently organ[illegible]

[illegible]

[illegible] has been chartered here.

[illegible] of $1,000,000, filed its certificate of incorporation here.

[illegible]

PEKIN, ILL. The Citizens' Telephone Company is constructing a line [illegible]

FOREST CITY, ILL. The Forest City Telephone Company has increased [illegible]

MARENGO, ILL. The McHenry County Telephone Company has in[illegible]

EL PASO, ILL. The Central Union Telephone Company has purchased the franchise of the Peoria & Eastern Telephone Company in this city.

NUNDA, ILL. The Union Light & Telephone Company, capital $15,000, has been incorporated by E. G. McCullem, H. H. McCullem and J. A. Croll.

CORNELL, ILL.—The Cornell Telephone Company has been incorporated [illegible] H. W. Smith and [illegible]

SPRINGFIELD, ILL. The Ottawa Home Telephone Company, of Ottawa, has been incorporated; capital, $150,000. Incorporators: Roy C. Packard, Abram C. Godfrey and Andrew J. O'Conor.

SPRINGFIELD, ILL. The Cropsey Telephone Company, of Cropsey, has been incorporated; capital, $2,500. Incorporators: C. E. Hayward, R. T. Slater, [illegible]

MOLINE, ILL. A lively telephone fight is on in Moline and Rock Island. [illegible] the Central Union Telephone Company for its poor service and for its refusal [illegible] strikers. The company's franchise has expired and hereafter it will be compelled to pay or vacate the streets. The Union Electric Telephone Company is installing an up-to-date system with underground conduits, etc., and will pay two per cent of its gross earnings into the city treasury.

MARION, IND. The Lafontaine Telephone Company has increased its [illegible]

WABASH, IND. Fire partially destroyed the Home Telephone Company's exchange in this city recently. Loss, $3,000. No insurance.

[illegible] telephone exchanges. Arrangements have been made for free service between [illegible]

[illegible]

[illegible] utility in cities for policemen in summoning help or [illegible]

[illegible]

[illegible] Hereafter, dividends will be paid in quarterly [illegible]

[illegible]

[illegible]

[illegible] part of the independent system and passed [illegible] At a meeting of the directors [illegible] was elected president of both cor[illegible] made by the new management.

EVANSVILLE, IND.—One hundred thousand dollars of the necessary $190,000 of stock for the municipal telephone system has been subscribed. Neighboring towns are subscribing for stock for the reason that their independent local plants are unable to get connection with Evansville. They are anxious to have long-distance connection and they know that it will not be possible to do so until there is an independent telephone company in Evansville.

WABASH, IND.—The Eel River and the Warsaw Telephone Companies, which have reached this city over the Home Telephone Company's lines, were cut off recently by the latter company. The trouble arose over the Eel River Company building a rival exchange at North Manchester at an outlay of $20,000. The old exchange owned by the North Manchester Telephone Company had a contract for the sole use of the Home Company's system for toll messages. The Eel River Company appealed to the courts, and the Home Company for several weeks has received but has sent no Eel River messages. The North Manchester Company complained and then the Home Company cut off the Eel River and Warsaw Companies, the latter owned by the Straus Bros., bankers of Ligonier. As the Bell Company will have no relations with the Eel River Company, that line can handle no Wabash business, though it is doing the largest part of the service at North Manchester. An application for mandamus has been made to compel the Home Company to take the Eel River business. The question is of interest to the independent companies and the fight between them is the first of the kind in the State.

MARLOW, IND. TER.—The Fort Sill, Texas & Oklahoma Telephone Company has been granted permission to do business in Texas. The Texas office will be located at Fort Ringgold.

EDDYVILLE, IA.—The Eddyville Telephone Company will extend its line from Dudley to Chillicothe.

DAVENPORT, IA.—The Independent Telephone Company intends to extend its lines to connect with all the farmers' mutual lines.

SHENANDOAH, IA.—The Independent Mutual Telephone Company, of Shenandoah, has been organized and incorporated with an authorized capital of $50,000.

MARSHALL, MICH.—The Citizens' Telephone Company, of Grand Rapids, is building a long distance line between this city and Battle Creek to connect with the Marshall Telephone Company.

MANKATO, MINN.—The Minnesota Valley Telephone & Telegraph Company has been incorporated, with a capital stock of $100,000, by J. H. James, J. B. Meagher, of St. Paul, E. H. Moulton, of Minneapolis, and others.

JACKSON, MINN.—The Jackson Telephone Company is incorporating. About one half of the $20,000 capital stock has been subscribed. The local exchange will reach out in the rural districts for about twelve miles in all directions and connect with long distance companies. The new company hopes to buy the pole lines which belong to the Fairmont Company. The company is purely co-operative and expects to start with at least 400 telephones.

COLUMBUS, NEB.—The Platte County Independent Telephone Company has just been organized here with a capital of $15,000.

LE ROY, N. Y.—The Interocean Telephone & Telegraph Company has been granted a franchise in this place.

NIAGARA FALLS, N. Y. The Niagara County Home Telephone Company, of Niagara Falls, has been incorporated to operate in Erie and Niagara Counties, and Province of Ontario; capital, $130,000. Directors: William R. Campbell and Walter P. Horne, Niagara Falls, and Samuel B. Rawson, Elyria, Ohio.

AURORA, N. C. A new telephone company has been organized here to build a line from Washington to Blount's Creek, Edward, South Creek and this place. L. D. Bonner is president and R. T. Bonner, secretary.

MINERAL RIDGE, OHIO. The Bell Telephone Company has asked for a franchise here.

ADA, OHIO. The Ada Telephone Exchange Company has increased its [illegible]

BELLAIRE, OHIO. The Valley Telephone Company is installing a new Stromberg-Carlson central-energy board in the local exchange and several hundred telephones are being installed.

CHICAGO JUNCTION, OHIO.—The growth of the exchange of the Local Telephone Company at Chicago Junction has been remarkable. The company has 410 telephones in operation. This is claimed to be the best record of any town of the size in the State.

WAPAKONETA, OHIO.—The village of Minster has granted a fifty-year franchise to the Minster Home Telephone Company and the company will immediately construct an independent plant. The Bellefontaine Telephone Company was also an applicant.

CRESTLINE, OHIO.—The Crestline Local Telephone Com[illegible] incorporated, intends to put in 5,000 feet of cable and other [illegible] switchboard of 200-drop capacity. The officers are Jacob Babst, president; C. E. [illegible]

CUSTER CITY, OKLA.—The Custer City Telephone Exchange & Extension Company has been incorporated, with a capital stock of $5,000, by C. H. Dean, G. A. Noble, J. C. Stern and T. C. Lindsey.

ANDERSON, S. C.—The Bell Telephone Company is building a line from Greenville to this city.

CHESTERFIELD, S. C.—The Chesterfield Telephone Company will open its exchange on Oct. 1. It is installing apparatus of the Telephone Manufacturing Company, of Sumter, S. C., the switchboard having a capacity of 50 [illegible]

ABERDEEN, S. D.—The annual report of the Dakota Central Telephone Company shows that during the past year $120,000 has been expended in extensions, improvements and general equipments.

CLARKSVILLE, TENN.—The Cumberland Telephone Company has commenced extensive improvements on its system in Clarksville.

CLARKSVILLE, TENN.—The Clarksville Home Telephone Company, with a capital of $100,000, has been granted a charter. The incorporators are W. G. Nagel, Dancey Fox, B. F. Gill, W. J. Manning and Wesley Drane.

SHERMAN, TEX.—The Indianola Telephone & Telegraph Company of Sherman will extend its lines.

MOUNT HOREB, WIS.—The Mount Horeb Independent Telephone Company, capital stock $25,000, has been incorporated by F. E. Bell, M. F. Bell and others.

RACINE, WIS.—The Citizens' Telephone Company has decided to extend its lines to connect with Milwaukee, Madison, Appleton, Janesville, Oshkosh, Neenah, Menasha, Union Grove and other places.

OTTAWA, ONT.—Engineers are preparing estimates for lighting the farm buildings of Hon. Thomas Greenway, of Crystal City, Man., by electricity. The plant is to have a sufficient capacity to furnish light for the whole village.

ELECTRIC LIGHT AND POWER.

BIG PINE, CALIF.—It is reported that an electric power plant will be installed at Big Pine by the Reward Mining Company at an expense of $60,000. The Black Eagle mine and the Keeler Soda Works will probably take power from this source.

MARYSVILLE, CALIF.—The Bay Counties Power Company was recently awarded the contract to build a pole line and supply transformers for the electrical operation of the new pump that is to supply city water for Marysville. The contract price was $2,375.

SAN FRANCISCO, CALIF.—The McCloud River Electric Power Company's officials say that about 300 men will be at work on its electric power transmission system in Shasta County, Calif., by Oct. 1. It is proposed to install a 15,000-hp plant. Construction contracts were awarded some time ago to the San Francisco Construction Company and G. W. Elder.

SAN FRANCISCO, CALIF.—The Western Power & Water Company, composed of Los Angeles and San Francisco capitalists is doing some work on its property in Northern California. Water will be stored at Big Meadows. Natural water courses will be made use of to conduct the power water 30 miles to the Big Bend Tunnel near which the electric generating station will be located. It is proposed to transmit current nearly 200 miles to San Francisco.

GREENVILLE, ILL.—The local electric light company has completed the reconstruction of its plant. There is now sufficient power to run 3,000 lights, whereas formerly the capacity was only 1,200.

GRANITE CITY, ILL.—The electric plant at the American Car and Foundry Company's plant in Madison has been increased by the addition of several new dynamos. A large portion of the machinery of the plant formerly operated by steam will now be operated by electricity.

ALTON, ILL.—The cost of the incandescent arc lights for street use has been reduced by the Alton Railway, Gas and Electric Company from $90 to $50 a year. The city council received complaints because of the change in the form of arc lights on the streets, and it was then announced that the price had been voluntarily reduced by the company to $50 a year for each lamp.

MATTOON, ILL.—A movement is on foot here to merge all the electric companies in this city and Charleston with a capital of $500,000. The merger proposes to take in the Mattoon Electric Railway Company, the Mattoon Gas, Light and Coke Company, the Charleston Gas Company, and the Mattoon Heat, Light and Power Company. The merger is to be owned and controlled by one company, composed of capitalists from Chicago, Charleston and Mattoon.

BELLEVILLE, ILL.—The Belleville Electric Light and Gas Company, which was recently sold to an East St. Louis and Chicago syndicate, has been capitalized for $240,000. The following board of directors has been elected: Edward Abend, Sr., Henry A. Kircher, George Gaus, L. D. Turner of Belleville, M. M. Stephens and W. S. Forman, of East St. Louis; H. M. Biglesby, of Chicago. Edward Abend, Jr., was elected president and W. F. Kircher, secretary.

ALTON, ILL.—The engines for the new electric power plant to be erected at the plant of the Illinois Glass Company have arrived and are being set in place. The new plant will include two dynamos of 250-kw and 120-kw capacity. They will supply the electric power for all the motors in the glass works and the box factory, and will also supply current for lighting. It is expected to have the new electric plant in operation by October 15. Many new electric motors and fans will be installed for the convenience of the workmen in the glass works.

GOSHEN, IND.—A fifty-years' franchise granted to the Hawks Electric Light Company has been vetoed by Mayor Alderman. The council will now grant a franchise for 25 years, with a provision that the city may purchase the plant at any time after 15 years. The new franchise regulates the price of lights. However, the citizens generally are opposed to municipal ownership of the plant.

SOUTH BEND, IND.—In order to finish at the earliest date the great power dam enterprise on the St. Joseph River at the line between this and Elkhart Counties, a night and day force has been put on and the work is continuing by electric light. This dam is to cost about $1,000,000, and will furnish about 6,000-hp. It will furnish power to South Bend, Mishawaka, Elkhart and other places.

NEW ORLEANS, LA.—Admiral Mordecai T. Endicott, chief of the bureau of yards and docks, has authorized the construction of a temporary electric light plant and water system for the New Orleans naval station. Bids will be advertised for.

ADAMS, MASS. The Adams Gas Light Company has purchased the entire plant of the Adams Electric Light & Power Company and has petitioned the Gas & Electric Light Commissioners for permission to go into the electric lighting business.

NORTHBRIDGE, MASS.—The Northbridge & Uxbridge Electric Company is to furnish lights for the towns of Grafton, Millbury and the village of Rockdale. These towns have street lighting plants already, but they are to be discontinued and connection made with the power plant here. The power station has been greatly enlarged and in addition to the new electric lights will furnish power for the Uxbridge & Blackstone Street Railway.

GRAND RAPIDS, MICH.—The transfer of the Lowell electric power and lighting properties to the Grand Rapids Edison Company has been accomplished in the formal merger of the three companies, the West Michigan Electric Company, the Lowell Water & Light Company, and the Peninsular Light & Power Company. The Edison Company has added to its present plant a storage battery building 50x100 feet, constructed entirely of Portland cement and steel.

ST. LOUIS, MO.—The West St. Louis Construction Company, which owns a water franchise in the county, has been given permission by the county court to erect poles for electric wires along public roads on condition that it pay into the treasury of the county $1,000 before October 1.

BUTTE, MONT.—F. August Heinze, the copper king of Butte, has instructed his agents to buy a large tract of land lying along Race Track Creek, near Anaconda, Mont., on which he will establish a large electric power house. It is presumed the power will be used for mining operations in contemplation by the Montana Ore Purchasing Company, of which Mr. Heinze is president.

SANTA FE, N. MEX.—The Capital Light & Power Company, of Santa Fe, has been granted a franchise to construct an electric power plant on the Pecos river. It is the intention to transmit electric power to Santa Fe, Las Vegas and Albuquerque.

ELLICOTTVILLE, N. Y.—The Ellicottville Light, Heating & Power Company has been incorporated with a capital of $1,200. C. A. Case and E. E. Rust are among the directors.

FULTON, N. Y.—The Fulton Fuel and Light Company, Fulton, Oswego County, capital $125,000, has been incorporated. Directors: H. W. Noble and W. E. Moss, Detroit, and J. A. Frost, Fulton.

CAPE VINCENT, N. Y.—At a recent special election a sum not to exceed $10,000 was voted to establish an electric light plant at Cape Vincent. The village trustees will at once engage the services of an engineer to prepare plans and specifications.

ALBANY, N. Y.—Articles incorporating the Town of Huntington Light and Power Company have been filed with the Secretary of State. The capital stock is placed at $75,000. The directors for the first year are Willard N. Bayles, Harry S. Brush, Douglas Conklin, August Hechscher, W. J. Matheson and W. Wilton Wood, of Huntington; Robert W. de Forest, of New York City, and Walter Jennings, of Cold Spring Harbor.

NORTH AMHERST, OHIO.—The council has decided to build a municipal lighting plant and bonds to the amount of $10,000 will be issued.

COLUMBUS, OHIO.—Bids have been opened for the equipment of the new municipal lighting plant and are now in the hands of the city engineer for tabulation.

WARREN, OHIO.—Directors of the county infirmary recently received bids for an electric light plant, but the figures were unsatisfactory and new proposals have been called for.

CINCINNATI, OHIO.—The electric light plant at Wyoming has been formally transferred to the Cincinnati Gas & Electric Company. The plant will be remodeled and equipped with modern machinery.

XENIA, OHIO.—The Xenia Electric Light Company and the Xenia Gas Company are soon to be consolidated into a new company to be known as the Peoples' Gas & Electric Light Company. The capital stock will be increased to provide for necessary improvements to both the gas and electric lighting plants.

LANCASTER, PA.—The Lancaster Electric Transmission Company has been incorporated with a capital stock of $500.

MEMPHIS, TENN.—The council of Memphis has passed an ordinance granting the right to the Equitable Gas Light Company and the Memphis Light and Power Company to merge their interests.

DANVILLE, VA.—The Dan River Manufacturing Company, of Danville, has definitely selected a site for the large mills to be erected and has let the contract for the dam and power house. It is estimated that these will cost $300,000.

RICHMOND, VA.—The Passenger and Power Company, of Richmond, is preparing to expend $50,000 in giving a better light service to the city. This company was recently awarded a contract for five years to furnish the city with light at $35,000 per year.

SALT LAKE CITY, UTAH.—The Utah Light & Power Company, Salt Lake City, has added to the 7,500-hp already installed in its service, 1,000-hp from its present water power plant. The present steam plant is furnishing 1,500-hp and to this 1,500-hp more will be added by the new steam plant to be built at once. The company will soon have an aggregate of 12,000-hp.

SALT LAKE CITY, UTAH.—A power and irrigation company, capitalized for $300,000, has just been formed at Mountainhome, Idaho. It was promoted by W. J. Turner, of that place, and will generate 5,000-hp when plant is completed, and supply light and power for Mountainhome and tributary country. The power will be taken from Snake River, 12 miles distant.

THE ELECTRIC RAILWAY.

[illegible]

[illegible] plant will be nearly $1,000,000, includ- [illegible] which, however, will be installed at first. The [illegible]

[illegible] chased some additional property, which together with that it already owns, will [illegible]

DOVER, N. H.—The incorporators of the Dover, Northwood and Concord Street Railway have chosen the following directors: Elisha R. Brown, Arthur [illegible] tonville, Mass., Walter C. Chestry, of Northwood, and J. Frank [illegible]

[illegible] early in the morning of Sept. 17. The break was not [illegible]

[illegible] at a cost of $250,000 or more. The Jersey City, [illegible] ville, Roseville, Palisade Avenue, Jersey City, Hackensack [illegible]

SYRACUSE, N. Y.—The Rochester, Syracuse & Eastern Electric Railway [illegible]

[illegible]

[illegible] The Dayton & Western Traction Company has amended its charter to permit building a line from New Paris in Preble County to the Indiana State line.

MANSFIELD, OHIO.—W. W. Stark, C. E. Fitbinger, and Charles W. Fritz, of this place, have obtained a franchise from the county commissioners for the new Mansfield, Mt. Gilead & Delaware Railway which they are promoting.

[illegible] H. G. Hamilton, of Youngstown, and W. G. McIntyre, of Sharon, Pa., have secured the contract for building the new line of the East End Street Railway Company, of Sharon, from the latter place [illegible]

NEWCOMERSTOWN, OHIO.—The council has accepted the bid of Charles E. Mitchener for building an electric railway through this town and a franchise will be granted. Mr. Mitchener proposes to build a road from Newcomerstown to New Philadelphia.

[illegible] Valley Traction Company [illegible] Valley Crossing, at the [illegible] sions of the road. There will be substations at Canal Winchester, Carroll, Circleville and one or two other places.

TOLEDO, OHIO.—The directors of the Toledo, Fayette & Western Railway have completed arrangements for the construction of the new line which will be a western extension of the Toledo & Western Railway. The section from Fayette to Pioneer will be built at once.

EAST LIVERPOOL, OHIO.—The East Liverpool & Rock Springs [illegible] Company has a franchise application pending for a line from Chester to [illegible] Cumberland by way of Fairview and New Cumberland, a distance of 15 miles. J. R. Scott and others are also seeking a similar franchise.

ALLIANCE, OHIO.—The Akron-Alliance Connecting Railway Company has secured a franchise in Alliance, completing all the required right of way. The company will give a three-cent fare in town. R. D. Gibby, president of the company states that a contract has been let to commence work Sept. 22.

COLUMBUS, OHIO.—The Columbus, Marion, Tiffin & Toledo [illegible] Railway Company has amended its charter to enable it to build lines [illegible] its southern terminus at Urbana. The company will build a line from Marion to Tiffin.

DAYTON, OHIO.—Officers of the People's Railway Company have been [illegible] C. L. S. Tingley, assistant secretary and treasurer; Eugene Wuichet, secretary [illegible] Company of Philadelphia.

TOLEDO, OHIO.—Officials of the People's Rapid Transit Electric [illegible] Company announce that their project has been financed. It is proposed [illegible] a line from Toledo to Napoleon, Defiance, Paulding, Van Wert, Celina and Greenville to connect with lines to Cincinnati. J. Morgan is president and manager and L. J. Weadock, secretary.

COLUMBUS, OHIO.—The Ohio Central Railway Company, a new company, [illegible] it offers three-cent fares or forty tickets for $1.

TOLEDO, OHIO.—It is announced that contracts will shortly be closed for material and construction work for the building of the Toledo & Bryan Air Line Railway. Manager Brewer is at present in the East and when he [illegible] It is stated the project has been fully financed.

CLEVELAND, OHIO.—The project to build an electric street railway [illegible] in this city by capitalists interested in the enterprise. Denison, Prior & Co., [illegible] this city, W. H. Park, of Youngstown, and George F. Penhale, of New York [illegible]

HAMILTON, OHIO.—[illegible] Aurora Railway, is at the head of the project to build a railway system [illegible] Cincinnati to Richmond, Ind. The line from Cincinnati to the State [illegible] be known as the Cincinnati, Hamilton & Indiana Traction Company [illegible] Indiana section will be known as the Richmond & Ohio Traction Com[illegible]

[illegible]

[illegible] road, telegraph and telephone lines within the State of Utah.

HARRISBURG, PA.—The Jefferson Street Railway Company has been incorporated with a capital of $65,000. President, J. A. Whiteman, of Punxsutawney.

HARRISBURG, PA.—The Wellsville Street Railway Company, York County, has been incorporated to build a line from Dover to Wellsville, a distance of four miles; capital, $24,000.

HARRISBURG, PA.—The Sharon & West Middlesex Street Railway Company, has been incorporated to build a line four miles long; capital, $50,000. R. Montgomery, of Youngstown, Ohio, is president.

HARRISBURG, PA.—A charter has been issued to the Dillsburg and Allen Electric Street Railway Company to build a line from Dillsburg to Churchtown, a distance of six miles; capital, $50,000. President, Peter Sidle, Dillsburg.

SIOUX FALLS, S. D.—The Sioux Falls Traction & Electric Company, Sioux Falls, has been incorporated with a capital of $1,000,000.

MEMPHIS, TENN.—The Memphis Street Railway Company will expend $250,000 in building extensions to the growing suburbs of the city.

NASHVILLE, TENN.—It is said that plans by Pittsburg capitalists for building electric railways from Nashville to Mt. Pleasant and to Gallatin have been perfected. C. W. Ruth is vice-president of the company which it is said may effect a merger with the Nashville and Columbia Electric Railway.

SEATTLE, WASH.—Chas. H. Baker, president of the Snoqualmie Falls Power Company has applied for a street railway franchise in Tacoma, the road to be owned and operated by the Snoqualmie Company. The purpose of the project is to develop an extensive use of water power and to cover a section of the city which at present is without a good service. Construction will begin this winter.

NEW INDUSTRIAL COMPANIES.

THE ELBLIGHT COMPANY, of Chicago, has been incorporated with a capital of $10,000.

THE FISCHER ELECTRIC COMPANY, of East Orange, N. J., has been incorporated; capital, $50,000. Incorporators: F. R. Serles, Walter H. Bond, C. F. Smith.

CO-OPERATIVE FACTORY.—It is stated that the Telephone and Switchboard Workers' Union in Chicago has in contemplation the establishing of a co-operative factory.

THE RICHMOND ENGINEERING COMPANY, of Richmond, Va., has been chartered to do a general engineering business. Jas. O. Spear is president. The capital stock is $25,000.

THE MERKHOFER ELECTRICAL WORKS COMPANY has been incorporated at Cincinnati, Ohio, with $10,000 capital stock, by C. W. Ratterman, A. J. Merkhofer, L. H. Myers, H. Hamberg and others.

THE SIGNALPHONE COMPANY has been organized at Milwaukee, Wis., to manufacture signalphones, telephones, etc. Capital stock, $30,000. The incorporators are Charles D. Rogers, Wm. B. Weller and Elias H. Bottum.

THE CARLETON-CHASE ELECTRIC COMPANY, of New York, has been incorporated with a capital of $100,000. The directors are Henry G Carleton and C. E. Phelps, of New York, and S. A. Chase, of Philadelphia.

THE AMERICAN CONDUIT COMPANY has incorporated at Los Angeles, Calif., with a capital stock of $1,000,000, for the purpose of laying pipe lines and conduits for any purpose, and also to construct, own and operate telephone and telegraph lines.

THE COHEN AUTOMATIC ELECTRIC BLOCK COMPANY has been incorporated in Camden, N. J., to manufacture signals and appliances for railways; Capital, $1,600,000. Incorporators: George W. Cohen, George F. Neale, C. L. Stevens and John B. C. Wheller.

THE CONNELLSVILLE CONDUIT COMPANY has been incorporated at Connellsville, Pa., for the purpose of constructing and maintaining a conduit system in that place and the suburbs. The capital is $1,400, and the directors are A. D. Soisson, R. Vanetta, E. K. Dick and others

THE SELECTAPHONE COMPANY, of Wheeling, W. Va., with $100,000 capital; has been organized by Wheeling men to manufacture and market an invention for use on party line instruments to secure privacy. The incorporators are T. M. Garvin, A. F. Poole, Fred R. Huseman, Frank B. Hall and Ernest G. Smith, of this city. The company has paid up its capital, and will buy a site and erect a plant at once.

LEGAL.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY has received word from New Orleans that the injunction recently asked for by New Orleans parties to restrain the city from accepting the bid of Herbert Bullard to build a city electric light plant, has been refused by Judge King, of the Civil District Court. The Bullard bid was the only one received after due advertising and certain parties attempted to secure an injunction, claiming the bid was too high. Mr. Bullard represented the Bullock Electric Company in his bid.

TROUBLE OVER A LIGHTING PLANT.—In Pocatello, Idaho, the electric light war which has been waging for some time has been carried into the courts, the Bridge-Tupper Company commencing suit in the federal court against the City of Pocatello for an injunction to restrain the city from interfering with the operation of its steam plant under its water power franchise. In the complaint the plaintiff alleges its corporate existence under the laws of New Jersey and claims a franchise granted by Pocatello to erect poles within the city limits of that city for the purpose of conveying electric current for power and light. It is alleged that on August 20th, the defendant city council, through its agent, George Ross, broke into the works of complainant and turned off the current of power and prevented distribution of the same to the great damage of complainant. The complainant states that the plaintiff company was organized in 1900 and that it secured its franchise from Pocatello that year, which would not lapse until December 17, 1902, and that it has put in a temporary and auxiliary steam plant for furnishing light and power and has been in all things complying with the requirements of its franchise. The complainant also charges conspiracy and collusion between the council and the other light company to usurp and unlawfully interfere with complainant's rights in order that the other company might secure them. Irreparable injury is complained and an injunction both temporary and permanent is prayed to prevent defendants from interfering with the poles, wire, plant, machinery, operations, and electric current of complainant.

PERSONAL.

MR. GEORGE GOULD says: "It is true that Clarence Mackay is an intimate friend of mine, but the consolidation of telegraph interests in the United States is still far distant."

MR. SIGMUND BERGMANN, of the Bergmann Electrical Works, of Berlin, and formerly prominent in Edison manufacturing interests in this country, is again visiting the United States and renewing friendships and business connections.

THE STANLEY CLUB has been formed at Pittsfield, Mass., by the employees of the Stanley Electric Mfg. Co., and the management of the company has assigned the second floor of the gate house for club purposes. There will be a reading room, lectures, etc.

MR. A. N. PALMER, of the Southern Electrical Supply Co., Norfolk, Va., has sold out his interests to the Standard Electric Co., Charlotte, N. C. We are not informed as to Mr. Palmer's plans for the future, but hope he will not leave the electrical field in which he is so well known.

MR. M. F. MARQUES, of the electrical engineering and contracting firm of Julio V. Brandao & Co., Rio Janeiro, Brazil, has left for home after a short visit to the United States. It is reported that some important contracts will be placed in this market shortly as a result of Mr. Marques's trip here.

MR. A. HALL BERRY, formerly connected with the H. W. Johns Company, has become associated with F. H. Lovell & Co., as general manager, at 100 William Street, New York City, makinfig a specialty of insulations for lighting and railway work, enclosed fuses, fuse fittings, electrical brass castings, etc.

DR. JOHN A. MATHEWS, recently of Columbia University, New York, where he has done considerable experimental work on metals and their alloys, from the magnetic, electrical and other standpoints, has become connected with the experimental department at Syracuse, N. Y., of the Crucible Steel Company of America.

MR. DAVID LYNCH, well known for many years in connection with submarine cable work in New York City, has just accepted an appointment in the U. S. Signal Service as cable engineer in the Philippines, where he will be in charge of cable engineering work there. He will sail shortly to take up his new governmental duties.

MR. F. A. SCHEFFLER has taken hold, recently, of the factory of the Marine Engine and Machine Company, and is practically manager of the concern. Besides being a thorough electrical and mechanical engineer of long experience, Mr. Scheffler is very familiar with electric elevator work from his superintendence of the Sprague shops at Watsessing.

MR. FRANK J. SPRAGUE sailed on Tuesday of this week for London, on the "Kronprinz Wilhelm," to spend abroad a few weeks of needed leisure following the important negotiations and changes connected with the acquisition of the Sprague Electric Co., by the General Electric Co., a purchase which includes also the Sprague multiple unit patents in this country.

DR. S. S. WHEELER, president Crocker-Wheeler Company, Ampere, N. J., has returned from a long European trip, during which, accompanied by Mrs. Wheeler, he automobiled over a large part of the Continent. Dr. Wheeler is chairman of the technical committee of the Automobile Club of America, and has promised to give the club this winter an illustrated account of his touring experiences.

MR. P. SCHRIMPFF, one of the directors of the Allgemeine Elektricitäts Gesellschaft, who has been spending a few active weeks in this country, sailed for home last Thursday by the "Fuerst Bismarck." He went as far west as Chicago, and visited several factories, electric railways, lighting plants, etc. Mr. Schrimpff was a very keen and intelligent observer and critic of what he saw, and expressed much appreciation.

Trade Notes.

THE EUREKA ELECTRIC COMPANY, of Chicago, has increased its capital stock from $10,000 to $50,000 and corporation papers to that effect have just been issued by the Secretary of State at Springfield, Ill. This speaks very well for the progress of the Eureka Company during the time that it has been in business, as this is one of the youngest institutions among the larger manufacturers in the telephone business. The apparatus put out by this company has won for itself an excellent reputation that is to be envied. Its line embraces everything in exchange appliances from the making of a small rural farmer toll board to the largest exchange apparatus. The company is well situated in its buildings at 143, 145, 147 and 149 South Clinton Street, and is issuing a handsome catalogue of telephone apparatus. It will be glad to forward such matter in regard to its large line of apparatus to those interested.

THE PROMETHEUS ELECTRIC COMPANY, 60 Reade Street, New York, manufacturer of the well-known "Prometheus" electric heating and cooking apparatus, reports that its goods are finding much favor, and, judging from the number of orders received, it is apparent that the public is realizing the great advantages and high efficiency of the "Prometheus" apparatus. A catalogue is now in the press and will be ready in about ten days. It is a very elaborate production and portrays a full line of domestic and commercial heating apparatus and rheostats. A copy of the catalogue will be sent to anyone on application. The apparatus is most compact and ingenious and merits the attention

[illegible]

[illegible] facilities it is kept busy to keep up [illegible]

[illegible]

THE UNION [illegible] COMPANY [illegible] ifying results and is extending its plant to meet the requirements of a rapidly increasing business.

ELECTRICAL AND STREET RAILWAY MATERIALS.—[illegible] is also included the well-known "Scranton" [illegible] met with such a large sale and given success where- [illegible]

A COLOR CHART. A card device for displaying the colors of Dixon's Silica Graphite Paint in such manner as will permit of an exact idea of each color, is being issued by the Joseph Dixon Crucible Company, Jersey City, N. J. The color chart carries with it suggestions as to the class of construction [illegible] applying protective paint. It can be secured by request to the Joseph Dixon Crucible Company, Jersey City, N. J.

THE AMERICAN MINIATURE & DECORATIVE LAMP COMPANY, in issuing its 1902 catalogue, presents to the electrical field a splendid publication, illustrating and describing various sizes and styles of miniature incandescent lamps for all purposes, decorative and otherwise. This catalogue is the original publication which was subsequently reproduced in miniature, mention of which was made in the columns of ELECTRICAL WORLD AND ENGINEER a few weeks ago. It contains a great deal of useful information concerning miniature lamps, gives prices of them and describes an electric light sign which has some very advantageous features.

SECOND-HAND MACHINERY.—Edward H. Rollins, who has for a long time been connected with a company buying and selling electrical and kindred machinery, has opened an office at 26 Cortlandt Street, New York. His wide experience in this work has enabled him in a short time to secure control over a line of machinery, including engines, boilers, direct current generators and motors, alternators, induction motors, etc., as well as of a number of arc lamps and other supplies. Mr. Rollins's previous central station experience at once qualifies him to know central station needs and he is therefore peculiarly fitted to engage in this special work.

MR. CHOATE AND THE CUTLERS.—The American Ambassador to the Court of St. James, Joseph K. Choate, has accepted an invitation from Albert J. Hobson, Esq., Master Cutler, Sheffield, England, and a Director in Wm. Jessop & Sons, Ltd., to attend the dinner of the Cutlers Company, on Sept. 30, in Sheffield. This dinner is termed the "Cutlers' Feast," and this occasion is its two hundred and seventy-ninth annual gathering. This Cutlers Company is an old organization of great prominence in England, and with the exception of a similar organization in London, is the only association of its kind in England. The membership is strictly limited to a very few, and it is a great honor to be a member, and the Master Cutler, or head of the Association, is next in importance to the Mayor of the City. Many notable persons gather at the feast each year, among them the Lord Mayor of London, as well as many prominent dignitaries throughout the country, and also many foreign persons of prominence. This year, besides the American ambassador, Lord Kitchener, of South Africa fame, will be among the guests.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 16, 1902.

[illegible]

[illegible] PROCESS OF MANUFACTURING ELECTRICAL CONDUCTORS; [illegible] The process [illegible] to the wire and subjecting it to pressure, [illegible]

[illegible] STREET SIGN ILLUMINATING DEVICE; L. W. Lieb, Jr., and J. H. Tyler, New York, N. Y. App. filed Jan. 10, 1902. (See Current News and Notes.)

[illegible] COMBINED ELECTRIC AND GAS LIGHTING SYSTEM; E. C. Pickett, Kansas City, Mo. App. filed May 25, 1901. The object is to automatically light the gas upon the failure of the electric current and to extinguish the gas light upon the re-establishment of the current.

709,040. RAILWAY SIGNAL; J. D. Price, Aurora, Ill. App. filed March 21, 1901. Details of circuits and apparatus.

[illegible] ELECTRIC RAILWAY SIGNAL; C. D. Seaman, Topeka, Kan. [illegible]

[illegible] ELECTRIC RAILWAY SYSTEM; L. E. Walkins, Springfield, Mass. [illegible]

[illegible] the stylus operating mechanism is stopped and released by the writing impulses over the transmitting circuit.

709,168. TROLLEY; F. A. Merrick, Johnstown, Pa. App. filed Sept. 14, 1899. A contact shoe held by a spring against the hub of the wheel.

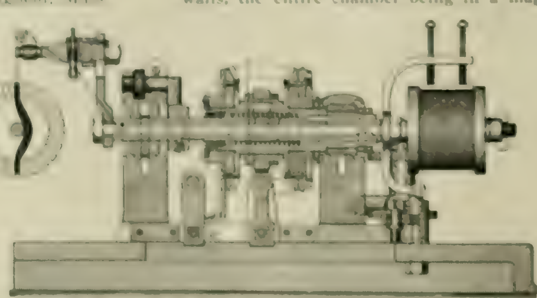
709,179. MACHINE FOR WINDING DRUM ARMATURES; H. Schulz, New York, N. Y. App. filed Sept. 17, 1900. Mechanism for intermittently rotating the armature core on its axis, a winding crank, means for feeding the coil forming wire to the crank, devices for reversing the motion of the crank after a full coil is wound and a loop-forming mechanism in the path of the wire.

709,182. CONTROLLER FOR ELECTRIC MOTORS; E. W. Stull, Johnstown, Pa. App. filed June 10, 1901. A rheostatic switch, a mechanically independent series-parallel switch, actuating means for the latter operated by currents derived from one of the motors temporarily acting as a generator for that purpose and restraining devices for the series-parallel switch controlled by the rheostatic switch.

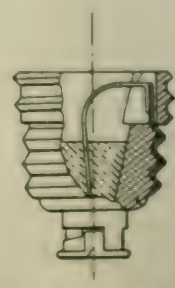
709,216. ELECTRIC HOSE COUPLING; M. C. Goodwin, Portland, Me. App. filed Jan. 2, 1902. Details.

709,232. CIRCUIT BREAKER; F. A. Merrick, Johnstown, Pa. App. filed March 21, 1900. The contacts are located in a chamber having insulating walls, the entire chamber being in a magnetic field.

[illegible]—Electric Railroad Switch.



709,179.—Machine for Winding Drum Armatures.



709,334.—Lead Fuse for Electric Circuits.

[illegible]

[illegible] TROLLEY GUARD; [illegible]

[illegible] TROLLEY POLE; [illegible]

[illegible] ELECTRIC RAILROAD SWITCH; [illegible]

[illegible] FOR STORAGE BATTERIES; [illegible]

[illegible] FACSIMILE TELEGRAPH; [illegible]

709,234. ELECTRIC CLOCK; C. J. Moberg, Jersey City, N. J. App. filed May [illegible]. Details.

709,243. RAILWAY SIGNAL; J. D. Price, Aurora, Ill. App. filed Sept. [illegible] Details of circuits and apparatus.

709,295. ELECTRICAL SELF-PLAYING MUSICAL INSTRUMENT; H. E. Beach, Newark, N. J. App. filed Sept. 3, 1901. A construction whereby certain adjustments of the moving parts can be effected without altering [illegible]

709,334. LEAD FUSE FOR ELECTRIC CIRCUITS; F. H. Krebs, Copenhagen, Denmark. App. filed Oct. 25, 1901. A fuse plug having a conical opening in one end adapted to receive a fuse wire having a conical plug for insertion in the opening.

709,427. OZONIZING APPARATUS; A. Vosmaer, Haarlem, Netherlands. App. filed Oct. 4, [illegible]. (See Current News and Notes.)

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CONTENTS.

OUTLOOK AND INLOOK.

Aside from flurries in Wall Street, due to excessive stock speculation and manipulation, the conditions of the country at the present moment are every way encouraging, and could hardly be better. Capital is well employed; labor is in demand, and yet so far from over production are the markets that manufactured goods show a tendency to rise in price the moment output is slackened. It would appear that some time must yet elapse before the country has reached in facilities the full measure of its needs, and where producers must call a halt, for lack of demand. Indeed, if it were not for the large supplies brought in from beyond seas, some lines of industry would be suffering, and thus American trade activity has done much to brighten the situation in Europe, beclouded by German depression and by the strain endured in England through the long struggle in Africa.

While the home outlook, therefore, is encouraging, there would be more satisfaction in it if the beginnings made of export trade in many branches were not nipp d in the bud by a prosperity which tempts the manufacturer to neglect foreign markets. That this check has been felt is not to be denied, and it implies, unfortunately, a certain amount of wasted time and effort, with the consequent difficulties of renewing broken connections and affiliations. Complaints have reached us from parties abroad with whom a start had been made, but who find now that they must wait months for apparatus, or that it is not particularly cared whether their orders are filled or not. On the contrary, we are glad to know that some manufacturers are nursing and pushing their foreign trade steadily and persistently, knowing how intrinsically valuable it is in increasing the volume of production, and in providing new outlets.

Under all the circumstances, it is at least encouraging to find that the export trade in August was excellent. It is shown by the figures of the Treasury Bureau of Statistics that exports of manufactures have increased $2,000,000 and more, for August, over the same month last year, and are not less than $12,000,000 better for the eight months. We are inclined to consider this a good showing, for it really would not have been surprising if there had been no export manufactures at all. Factories are, moreover, still increasing their imports of raw materials, which have come to constitute a striking proportion of the import movement.

THE DETROIT CONVENTION.

Anyone who has had the experience of the editors of this journal in attending conventions this year—or most years for that matter—might be forgiven for thinking they were a bit overdone. In fact, we have heard in many quarters, from manufacturers, engineers, dealers and others, a complaint that conventions were becoming so numerous as to be a burdensome tax on time and a growing expense that showed little increase in return. There may be some truth in all this, and we note even now a tendency for different bodies of similar or allied interests to get together at the same time and place with economy in many directions as the result. Thus the centrifugal and centripetal forces balance again, and busy people are rejoiced when they thus find that they can kill several birds at the one convention, instead of spreading themselves and their ammunition thinly over several in succession in all parts of the country. The convention habit is, indeed, an overmastering one, and has made a deep mark

[illegible] life. There are [illegible] of folk who go to the conventions merely for the badges, the souvenirs, the entertainments and the "good time," but in the main conventions are attended because certain lines of policy are to be defended or attacked, because certain common interests need discussion, because interchange of experience is necessary, because professional and business ties must be maintained, because a representative body can command more influence and respect than does a man who puts himself forward to advocate his own pet views and projects or air some special grievance that does not hurt any public interest.

The meeting of the American Street Railway Association at Detroit next week is one of the conventions that could not be spared. While others might go off our list without much harm to anybody, if such a convention as this had not been instituted it would be forthwith called into existence. We are glad to know that in every respect the meeting promises to be up to the standard of recent years. The papers and discussions have risen in value, and concurrently the allied meetings of the street railway accountants have done much to determine and universalize the best practice in their branch of the industry. In other words, the annual meeting of the Association marks each year a stage of progress and improvement, and we trust it will be a long time before any other criticism can be passed.

The Long Arm of the Trolley.

The electric railway development that has taken place around Detroit, where the street railway convention meets next week, is far more striking than that which has taken place within the city. It is not to be forgotten, to the honor and credit of Detroit, that the fame and memory of Charles J. Van Depoele are connected with pioneer electric railway work within her limits, and that other experimental work was done there, going back to the earliest stages of the present development. In fact, it might be said that few, if any, cities could claim priority over Detroit in favoring and fostering the new motive power and in providing an opportunity for the trolley to prove what it could do in giving the public cheap, swift and improved transportation within city limits. If in some respects Detroit may not have kept abreast of the times, though we opine she is well up in all save conduit trolleys, her early patronage of electric railways gives her a good claim to the gratitude of all who now benefit by such methods of traction. It is a little curious, as to conduit trolleys, that in Detroit they had one of their earliest and most hopeful exemplifications. We have personally a very clear and pleasant recollection of riding over a conduit trolley road in Detroit about 1886, at a time when in the same vicinity Mr. Van Depoele was still working at the aerial [illegible] trolley that preceded the under-running trolley wheel contact.

But [illegible] pages this week show, it [illegible] around Detroit and all over the fair State of Michigan that the most notable trolley development has taken place. The boon that the trolley can be, and already is to rural communities on the outer side of the suburbs, is very striking[illegible] exemplified in the work to which Detroit serves as a center. Many visitors to Detroit will find special interest and profit in studying this important development and aspect of the art on the spot; and their time thus occupied will be well spent.

President Scott's Address.

We commend to all of our readers the admirable presidential address delivered by Mr. C. F. Scott at the recent meeting of the American Institute of Electrical Engineers, which is reprinted in full elsewhere. For its including a concise but comprehensive statement of the achievements and present status of the electrical industry and profession it will be of interest to everyone laboring in the electrical field; and as pointing out how the usefulness of the Institute may be extended, it carries a message not only to all of the present members of that body, but also to the many who are eligible to membership and whose adhesion would so materially aid in furthering the aims of the Institute and in spreading its activity over a greater area. The engineer will, we believe, read with especial pleasure the address, for in it he will find expressed a lofty sense of the real dignity and usefulness of his profession. In this day when—momentarily only, we hope—commercialism is rampant and the doctrine of *force prime le droit* does not lack open exponents, it is refreshing to realize that the technical professions not only cling to the highest ideals but, in comparison at least, have outdistanced in many respects the so-called learned professions. Mr. Scott does not enter into the reasons for this, but undoubtedly one cause is the engineer's constant touch with Nature and her laws as systematized in science. In the words of Prof. John Perry, but recently president of the sister British society, "To utilize the forces of Nature, to combat Nature, to comprehend Nature as a child comprehends its mother, this is the pleasure and the pain of the engineer." The laws of nature admit of no quibbling but call for absolute rectitude of thought, and inculcate that truth alone will stand. Such mental environment can not have other than a wholesome effect on character—on right thinking in all matters.

President Scott touched upon the subject of engineering education, which, it will be recalled, formed the topic of Mr. Steinmetz's presidential address in June at Pittsfield. The views of these two leaders in their profession are so similar and so completely in harmony with the thought of many educators not in direct touch with practical engineering, that they merit special attention. Mr. Steinmetz maintained that it is not the function of the schools to turn out full-fledged engineers ostensibly equipped to handle engineering problems of any magnitude; for to do this successfully a very great deal of practical experience is required which cannot be imparted by the schools. All the educational institutions can do and should do, is to fit the student to take up practical engineering work as efficiently as possible. Their true rôle is to give the student a thorough understanding of the fundamental principles of electrical engineering and allied science, and a good knowledge of the methods of dealing with engineering problems. He pronounced memorizing an entirely useless waste of energy, since when needed formulas can be derived from the fundamental principles or looked up in the literature. President Scott considers the best education is that in which theoretical training in fundamental principles predominates; that the true function of practical work in a broad engineering education is not to produce skilled workmen or full-fledged engineers, but it is to supplement theoretical work, making it definite and certain, so that the student may properly assimilate the instruction which he receives. That a student should not make his mind a storehouse of facts, but he should learn where facts and information can be obtained and how to use them; that logical thinking and clear expression and general culture are indispensable in a profession that comes in touch with so many departments of science and engineering, as well as industrial and commercial and social activity; and that he must be a broad man with a broad educational foundation who would aspire, with any well-founded hope, to the fullest usefulness and success.

The address contains a number of valuable suggestions as to specific ways in which the work of the Institute may be broadened and advanced, perhaps the most important of which relate to local meetings in various parts of the country, and at universities and

technical schools with electrical engineering departments. A step in this direction was taken by including in the new constitution a provision for State and District organizations, but thus far this has been without effect. This has probably resulted not from lack of approval of the measure, but because of want of leadership. In the case of organizations like the American Institute of Electrical Engineers, the concern of all is apt to be considered the concern of no one in particular, and unless one or several persons take the initiative, nothing is usually done. It is, therefore, gratifying to know that Mr. Scott would make the organization of local bodies a feature of his administration, and all who may help should consider it a duty to lend their aid in the good work. If in each locality one or two members were to put a shoulder to the wheel, success would be assured; for no expense to the local membership is involved, and the benefit to be derived is so obvious that once started, a movement should be sure of attaining its end. The suggestion to organize meetings at schools, though an innovation here, is fortified by the fact that such a practice has been long established in Great Britain, where, we believe, all of the more important professional bodies have a student class of membership. Aside from the benefit to the students, such a measure would be of great value to the Institute through the increase of membership that would result, since upon graduation few would feel like severing the bond established at school with the organization representing the profession in which they are to gain a livelihood.

New Westinghouse Railway System.

While Mr. Lamme's Institute paper, which is reprinted in full elsewhere in our columns, gives some interesting details of the alternating-current system to be used on the Washington-Baltimore line, it falls far short of being an adequate engineering presentation of the subject. It is particularly disappointing with respect to details as to the manner in which sparking is obviated at the commutator of the type of motor to be used—a matter of supreme interest in view of the fact that this has been an obstacle that heretofore has baffled all attempts to utilize in any line of work the series-wound commutator alternating-current motor, if we except small fan motors and fleeting use of its properties in starting. The system as a whole is, however, certainly a striking innovation in railway practice, worthy of serious consideration. We have again and again urged the necessity of getting to work on an alternating-current system of some sort, and we take great pleasure in the prospect of really thorough tests on a large scale, such as will soon be made with the Arnold and this latest system. As to the particular methods to be used in this instance, they must stand or fall on their own merits. We do not feel, however, that Mr. Lamme has fully expressed the relation of alternating to direct-current methods in railway working. The modern railway motor is, truly enough, a series-wound machine, but it is far from possessing the typical field characteristics of a series-wound constant-potential system. As railway motors are actually constructed, the fields are pretty well saturated at all working loads to secure efficient use of the material, and as a matter of fact their strong point is not the connection of the fields but the beautifully effective way in which they have been adapted to series-parallel control, which is the keystone of modern interurban practice. So far as speed control is concerned, it can be obtained by rheostats in the secondaries of polyphase motors quite as well as in pure rheostatic control of direct-current railway motors, but the former do not yet lend themselves readily to the series-parallel arrangement, and hence are at a disadvantage. Obviously, a single running contact is highly desirable with any type of motor, and this the new Westinghouse scheme has to its credit, although in its first application it has to face the annoyance of installing a double trolley and using it over part of the proposed route.

The series-wound, low-frequency, alternating-current motor is a rather old acquaintance, although it has never before been worked out on apparently so business-like a scale. The late Rudolf Eickemeyer built several interesting machines of this type, and a little later they were proposed by Prof. Forbes in connection with the Niagara plant. The trouble heretofore met in the premises has been, as stated before, irremediable sparking, which Mr. Lamme says has been averted in the present instance. If this contention is substantiated the result reflects infinite credit on the designer, and will open up an entirely new field in alternating-current practice. The hysteretic losses in such motors are obviously serious even at low frequency if the iron is worked at anywhere nearly as high saturation as is the rule in direct-current motors, and while no figures on the weights of the new motors are given, we shall be surprised if they are not greatly in excess of current practice. Their characteristics under brake tests, given in the paper, are excellent, and particularly the high average power factor and efficiency. It is to be regretted that the efficiency at low speeds obtained by the inductive regulator, and including the apparatus, were not added, since in railway working this is a very important matter. Ordinary direct-current equipments have in virtue of the series-parallel arrangement a very economical low-speed point, and if the alternating-current device can show a similar advantage it has certainly scored an important point. We would much like to see a comparative set of efficiency tests at car speeds of, say, ten to twenty-five miles per hour, and during acceleration, obtained from the new alternating equipment and from a standard four-motor car equipment of the ordinary kind. But, after all, the main thing is the high voltage of distribution possible when using alternating-current methods, and one could well afford some loss and inconvenience in the motors to secure so valuable an end.

The new plan has a material advantage over the polyphase railway systems developed abroad in the use of a single running contact, albeit the initial road cannot reap the full benefit in the case. Whether this advantage compensates for the need of a commutating motor is a question that experience only can answer. In this country there is a deep-rooted objection to double trolley systems that no ordinary considerations can overcome and certainly, other things being equal, a single-phase system will have a great advantage. But to obtain a firm hold on railway practice, an alternating system of any character must show operative qualities of a higher order than have yet been in evidence here or abroad. There are now a number of polyphase roads scoring at least limited successes, and besides the Arnold system soon to be tried, there is in an experimental stage the system proposed by Emil Huber, based upon the Ward Leonard system of motor control, which, despite obvious complication, promises a delicacy and efficiency in speed control far greater than has yet been practically shown by any system employing alternating motors. The new Westinghouse apparatus must run the gauntlet of all these as well as get the better of the direct-current system with converter substations, before it can take a prominent place in the art, and the task is not a light one. But a simple alternating-current railway system has so many points in its favor that daring experiments are amply justified, and we trust that the new system will fully realize the hopes of its organizers. It is relatively simple, easy of installation, and aside from the motors themselves, is composed of well-tried elements. While the motors are of a type that has not hitherto been successful, and which has been assiduously shunned by constructors, the art of design has advanced, and the very low frequency chosen is favorable to commutation, so that it would be rash to predict difficulties. Certainly the project is in most competent hands and merits the closest attention on the part of engineers. We shall watch it with the greatest interest, and hope for early and successful results.

Large Gift to A. I. E. E. Library.

At [illegible] meeting of the American Institute of Electrical Engineers, President Scott announced that the Library Committee had received from Mr. C. O. Mailloux a check for $1,028.23, representing the cost of purchase and binding of a number of valuable sets of [illegible]ns of French scientific societies, and other books. The announcement was also made that Mr. Mailloux will donate to the Library a sum of money, the annual proceeds of which will be sufficient to pay the future cost of subscriptions to each of the periodical publications he has presented to the Library that are yet current, and also defray the cost of binding the same. The above donation, it may be added, is in addition to a full set of *Comptes Rendus* from 1835 to 1897 (130 volumes), which Mr. Mailloux presented to the Library about eighteen months ago, the cost of which, including new half-morocco binding, was $317. Following is a list of Mr. Mailloux's latest donation: Histoire et Memoires de l'Academie Royale des Sciences. 1666-1778; 171 vols. Memoires de l'Academie [illegible] New Series. 1816-1900; 45 volumes and General Index. Memoires Presentes par Divers Savants a l'Academie des Sciences. New Series. 31 volumes. 1827-1894. Abridgement of Histoire et Memoires de l'Academie Royale des Sciences. 1666-1718; 1 volume. The Philosophical History and Memoires of the Royal Academy of Sciences at Paris. English Abridgement. 1699-1720; 5 vols. Historie de l'Academie des Sciences. By Maindron. 1888; 1 vol. Collection Academique. Memoires read before leading European scientific societies. 1755-1770; 9 vols. Recueil de Memoires. Memoires read before leading European scientific societies. [illegible]; 4 vols. Annales de Chimie et Physique. 1789-1900; 303 vols. and 9 vols. indexes. Journal de Physique. 1872-1900; 29 vols. Zeitschrift des Oesterr. Ingenieurs und Architekten Verein. 1855-[illegible]. Both weekly and monthly editions. Zeitschrift fur Instrumentenkunde. [illegible]-1901; 21 vols. It is understood that Mr. Mailloux has authorized the Library Committee to complete at his cost the set of French Memoirs, which requires only the volumes from [illegible] to 1816, to make it complete from 1666 to date.

Electric Cars for New York Underground.

As the time approaches for the equipment of the underground road in New York City, details of the cars become interesting. The following data compares them with the cars on the Manhattan Elevated:

Length over platforms—Interborough, 50 feet 1 inch; Manhattan, [illegible] feet [illegible] inch.

Length over car body—Interborough, 42 feet 7 inches; Manhattan, [illegible] feet 10 inches.

Wheel-base of motor truck—Interborough, 6 feet 8 inches; Manhattan, 6 feet.

Width over window sills—Interborough, 8 feet [illegible] inches; Manhattan, 8 feet [illegible] inches.

Width over sheathing—Interborough, 8 feet 9¾ inches; Manhattan, [illegible] feet [illegible] inches.

Width over deck eaves moulding—Interborough, 8 feet 5 inches; Manhattan, 8 feet [illegible] inches.

Width over [illegible]—Interborough, [illegible] feet [illegible] inches; Manhattan, [illegible] feet [illegible] inches.

Height top of rail, center draw-bar—Interborough, [illegible] feet [illegible] inches; Manhattan, [illegible] feet [illegible] inches.

Height top of rail over platform—Interborough, [illegible] feet 8 inches; Manhattan, [illegible] feet [illegible] inches.

Height top of rail over roof—Interborough, [illegible] feet; Manhattan, [illegible] feet [illegible] inches.

The cars have been framed to be extra strong in all respects; the underframing is a composite one of steel [illegible]. The platforms are vestibuled with stationary end partition, provided with anti-telescoping steel bars set on edge and running from the under side of platform end sill to the car roof. These steel bars are framed into a continuous end plate underneath the platform in such a way that in order to have one platform ride over the other eight square inches of steel will have to be sheared off. The platforms are also arranged with the patented coupler and buffer, giving a continuous [illegible] between the cars at all times.

The platform vestibules are provided on these sample cars with various types of doors and mechanism for operating the same in order that the most serviceable arrangement may be decided upon after comparison of the various devices. In all cases the platforms will be closed, providing absolute safety for passengers on high-speed trains. It will be noted from the dimensions given above that the car is narrower at the eaves than at the floor line. This was done to give the greatest possible width of car for comfortable seating and at the same time to conform to the clearance of subway [illegible].

Various arrangements and types of seats have been tried in these cars, with a view to making a selection of the most comfortable and serviceable seats. In general, the seating arrangement is very similar to that used on the Manhattan Elevated road, this arrangement having been found by experience to be best adapted for the class of service contemplated. The cars are arranged to seat 52 passengers, the Manhattan cars seating 48.

The trains will be made up of motor and trailer cars as the requirements of the service demand, the interior of the cars being the same for either. The motor cars will be equipped with two motors mounted on one truck at one end, whereas the trailer cars will have no motors. The cars will be equipped with automatic air brakes, electric lights, head lights, heating apparatus, and the ordinary equipment required for operation. Model cars have been submitted by manufacturers, and it is said that the Interborough Company will order 800 as a first equipment.

Advertising for Telegraph Business.

That even the old business of telegraphy may be stimulated and benefitted by advertising, as are telephony and electric lighting, has hardly been suspected by some of the gray-beards and conservatives, but we give below the experience of Mr. G. Herbert Wright, manager of the Postal Telegraph office in Danvers, Mass. When the Postal office was established in Danvers it was practically against the judgment of the company, but was instituted by request of the town officials, as reciprocation for certain municipal privileges. Mr. Wright says: "I first took charge of the local office of the Postal Telegraph-Cable Company as its manager on the afternoon of January 22, 1897. Up to this time the Western Union Company had enjoyed the monopoly of the telegraph business and had fought hard to keep the new competitor out, but without success, and I was placed in charge of the new enterprise. It was something of an experiment on the part of the Postal Company, and I realized that much depended on my personal attention to and hustling for business, if the experiment was to be a success in a town the size of Danvers.

"Our office was opened at first in the Danvers *Mirror* printing office, on the second floor of the Ropes Block. I had a good chance to study advertising in all its phases, and decided to try it as a means of getting business. I placed an advertisement in the *Mirror*, changing its subject from time to time. I also ran catchy ads now and then in the daily paper. I was very careful to avoid any reference to my competitor, simply booming my own company. Only a few months passed before things began to get interesting. The Western Union were losing business to a great extent, and it was coming my way. I was centrally located, and hammered away on that fact. They were not. In the summer of 1898 they moved their office to a drug store a few doors below me on the same side of the street, on a ground floor. About this time I had a wire placed in my residence, enabling me to handle business at all hours of the night, and I advertised this extensively. During the summer of 1899 it became evident that our quarters were inadequate, and I secured much larger space in the Colcord-Richardson Company's store on a ground floor.

"It was at this time that I began more extensive and systematic advertising. I also took the agency for a number of steamship lines, and in advertising them always made it a point to work in the Postal Telegraph office. Starting at practically nothing five years ago, I have, in the face of persistent opposition, built up a good business for the office, and placed it on a paying basis."

Naval Wireless Telegraphy.

Letters and words were successfully transmitted on September 2[illegible] from the Naval Academy at Annapolis to Washington, D. C., by means of the Slaby-Arco system.

Detroit Electric Railways.

As one of the first cities to earnestly take up the electric railway, and one of the very earliest to enter the interurban field, Detroit, Mich., was a fitting selection for a meeting place of the American Street Railway Convention. In view of the increasing interest in interurban railways it would indeed be a problem to find a locality where the current developments in this branch can be better observed than in the vicinity of the City of the Straits.

The railway systems centering in Detroit are, with the exception of the Ypsilanti, Ann Arbor & Jackson road—a purely interurban line—controlled by the Detroit United Railway Company. In addition to the city lines there are five interurban systems, as follows: Detroit & Pontiac Railway (Pontiac Division), 36.52 miles; Detroit, Rochester, Romeo & Lake Orion Railway (Flint Division), 85.31 miles; Detroit & Northwestern Railway (Orchard Lake Division), 58.77 miles; Wyandotte & Detroit River Railway (Wyandotte Division), 10.78 miles, and Detroit & Port Huron Shore Line Railway, 109.57 miles. The last mentioned is operated independently and known popularly as the Rapid Railway System. The total interurban mileage is thus 301.15, which added to 187 miles of city lines gives the United Company a total mileage of 488.15.

The independent interurban company above mentioned operates 100 miles, thus making the total length of interurban line terminating in Detroit 401.5 miles. The interurban roads serve about 60 towns and cities, the most distant being Jackson on the Ypsilanti road, 76 miles, the fare being $1.05 and the running time 3 hours and 45 minutes; Port Huron, on the Rapid Railway, 73 miles, the running time 3 hours and 25 minutes, and the cost 90 cents for the trip; and Flint on the Flint Division of the United Railway, the distance being 68 miles, the fare $1, and the running time 3 hours and 15 minutes. The population of the towns and villages served by the interurban system is about 130,000; if to this is added the rural population of 20,000 the population per mile is 374.

The service, with some few exceptions, is hourly. While the city speeds average about 20 miles per hour, a maximum speed as high as 40 to 45 miles per hour is made, and in exceptional cases as high as 50 miles. The present equipments comprise 4 motors of 60 to 75 horse-power per car, the car seating from 50 to 60 people. The capitalization of the interurban lines averages about $40,000 per mile of track, about equally divided between stock and bonds. The annual earnings per mile of track average about $3,500. An interesting development in the Detroit interurban service has been a preference for the purchase of right-of-way instead of relying upon franchises, which experience has shown are apt at one time or another to give rise to embarrassment.

The operation of such long lines of interurban railroad naturally brought forward many problems for solution. The situation is quite different with respect to steam railroads, owing to the many turn-outs, short curves and the constant stopping for passengers. On the Rapid Railway System much care is giving to the training of the operating personnel, an apprenticeship of four to six weeks being required for a motorman. This system employs about 80 motormen and conductors for regular service, with from 10 to 20 extra men. On this system the average ride per passenger is 12 miles.

We give below a general description of the generating and distributing plants of the Detroit United Railway System, of the Rapid Railway System and of the independent line, the Ypsilanti, Ann Arbor & Jackson Railway. Elsewhere appears a description in detail by Mr. S. T. Dodd, of the Flint Division of the United Railway.

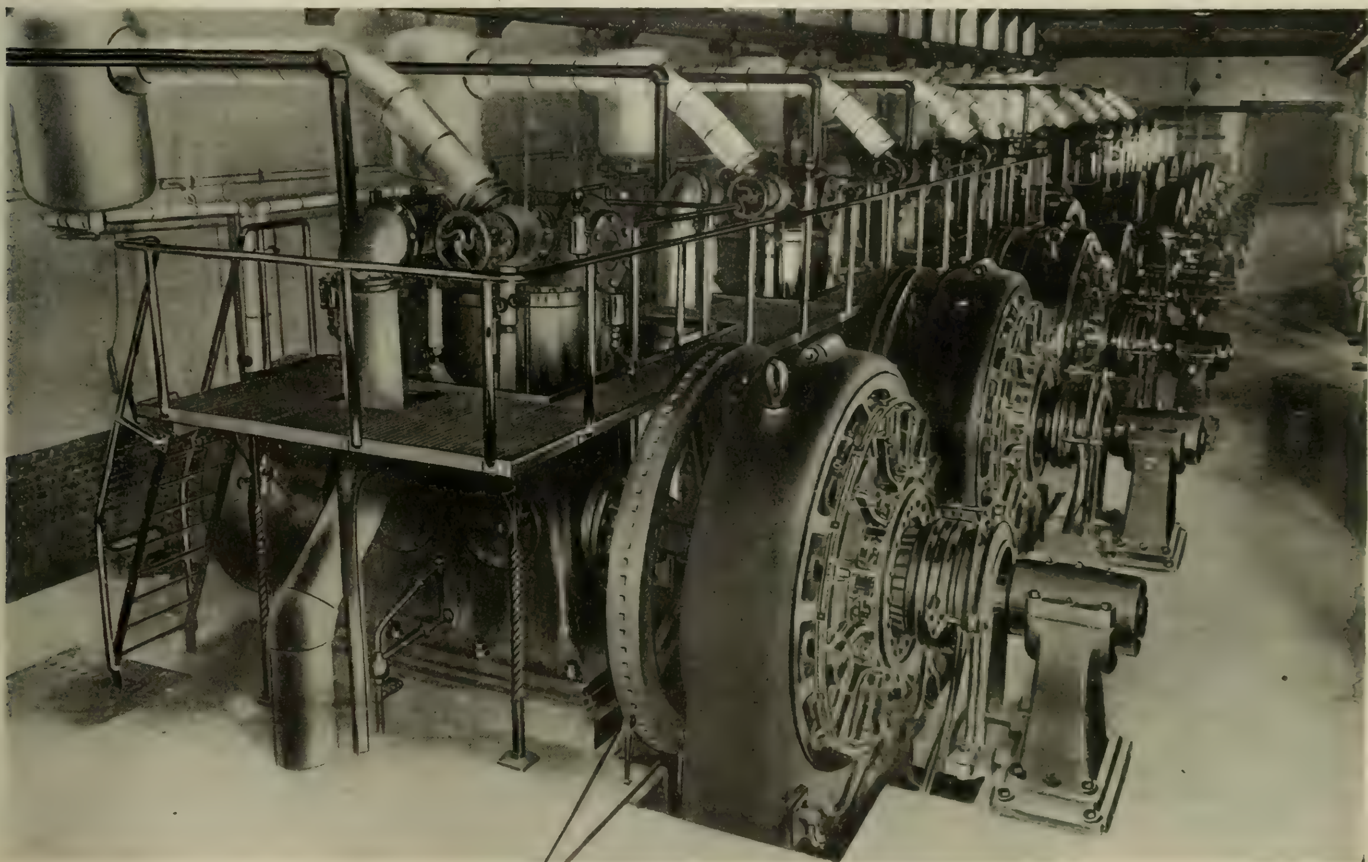

FIG. 1.—POWER PLANT DETROIT, YPSILANTI, ANN ARBOR AND JACKSON SYSTEM.

Owing to the short interval of time that has elapsed since the United Railway took over the four suburban lines which it operates directly, no comprehensive plan has yet been applied with respect to the generation and distribution of power, the several plants taken over being utilized at present as far as possible. On the Orchard Lake division running to Farmington, Northville and Orchard Lake the power distribution is all by direct current with boosters from a power house at Farmington Junction. On the Pontiac division the distribution is all by direct current from a power house at Birmingham. On the Flint division, running from Royal Oak Junction to Rochester, Romeo, Lake Orion and Flint, there is a direct-current power house, at Rochester, which, with the aid of a booster, feeds south 14.6 miles towards Detroit as far as Royal Oak, and also to Romeo and toward Lake Orion. A description in detail of this power house and the distribution therefrom is given in Mr. Dodd's article, above referred to. The interurban line to Wyandotte is run from the city power houses with the aid of a booster and a 280-ampere hour storage battery at Ecorse.

The city power distribution of the Detroit United Railway Company is all by direct current from two power houses, located diagonally across the street from each other near Riopelle Street and the river front. One of these power houses was originally built by the Detroit Citizens' Street Railway Company, and is called Station A. The other was built by the Detroit Railway Company and is called Station B. Since the consolidation the operation of these two power houses has been combined in a rather unusual manner. The switchboard for both power houses is centralized in one power house, and the two power houses are operated electrically just as if they were one, although the engines and generators are under different roofs with a street intervening, and nothing but telephonic means of quick communication between them. The positive generator switchboard leads and shunt field leads in Station B are run across the street to the other power house, and there terminate on regular generator panels. No switches are located in the Station B, save the equalizing switches on the generators, and these are on the negative side. The negative leads have no switches, but are connected permanently to the negative and ground. All other switches are in Station A.

The average length of the leads from the Station B generators to their switchboard panels in the other power house is about 600 feet. The generator leads between the two power houses are carried on poles just as if they were feeders. Only the positive leads are brought to the switchboard in any case, and consequently all switching is on the positive side. The equalizing switches being on the machines the only main switch needed on a generator panel is a positive switch and circuit breaker. This arrangement has worked to the entire satisfaction of all concerned. It makes it easy to shut down either one of the power houses at night, and practically makes one power house of them, as far as carrying the load is concerned. The number and capacity of the generators in operation can be adjusted to the load so as to give the generators a more economical load with this arrangement than if they were supplying different sets of feeders.

Another feature of interest about the switchboard is the use of three sets of bus-bars, which makes it possible to run feeders on any one of three different voltages. Two sets of bus-bars are run the entire length of the feeder board, and a third bus-bar runs part of the length. Part of the feeders can be connected to either the high or low bus-bars, and part can be thrown on the low or medium bus-bars. Each feeder has a double throw single-pole switch for connecting to either set of bus-bars. There is a paralleling switch between the medium and high voltage bus, so that these can be thrown together. The voltage of the highest bus is about 625, that of the medium 575 and that of the lowest 550 when operated independently. Generators 1, 2, 3 and 4, which are located in Station A (the one in which the switchboard is located) are arranged to connect with the low-voltage bus-bar as shown. Generators 5, 6, 7 and 8 in Station B, across the street, have their main switches arranged to connect the medium or 575-volt bus. Generator 9 in Station B has on its switchboard panel two single-pole single-throw main switches, by which it can be connected to either the medium bus in parallel with 5, 6, 7 and 8, or on the high-voltage bus-bars, by itself as a 625-volt machine.

When the two switches on the panel of No. 9 are closed the effect is that of throwing the medium and high-voltage bus-bars in parallel just as if the paralleling switch between the two were closed, and, in fact, both the paralleling switch and the two generator switches are usually closed when these busses are to be run in parallel. The 625-volt bus is run separately when the load is heavy on outlying trolley sections. When there is not such a load, and for purposes of economical loading of machines, it is desirable to run the high and medium voltage bus-bars in parallel, they are so connected. Out of 32 feeders leaving this board, 22 are arranged for connection to the high and medium bus-bars, and 10 can be connected to the low or medium bus. One matter which influenced the arrangement of the switchboard as it exists at present was the fact that the generators 1 to 8 cannot be raised as high as 625 volts. With the present arrangement they can be run on the shorter feeders, while generator 9, in power house B, supplies the feeders requiring the higher voltages when necessary.

In connection with this company's direct current distribution in the city of Detroit, two sets of storage batteries are employed, and on the Wyandotte and Trenton interurban line, which is fed by direct current and boosters from these city power houses, there is also a storage battery. One of these city batteries is located at Station A and the other in the northern central part of the city.

The Rapid Railway System was among the first of the interurban electric roads of the country to adopt an extensive system of alternating-current distribution. The power house which generates all the electrical energy used by the Rapid Railway system is located at New Baltimore, on Lake St. Clair, close to the line of the road, and supplies about 110 miles of city and interurban line. There are three units of 500 kilowatts each, the generators being three-phase, 390-volt machines, and the engines Westinghouse tandem compound condensing 21½-inch and 37-inch by 22-inch stroke. The two exciters are 35-kw, 125-volt direct-current generators, direct connected to Westinghouse compound engines. In the boiler plant four Babcock & Wilcox water-tube boilers are equipped with Roney mechanical stokers. A centrifugal pump raises the water about 21 feet for use in the Worthington jet condensers, which are located just under the boiler-room roof. Induced draft is used, there being two steam-driven draft fans, either one of which is sufficient to maintain draft for the plant. Before passing to the draft fans and the low stack, the flue gases are put through Green economizers, which reduce the temperature of the stack gases from about 520 degs. to 440 degs. A continuous record of flue-gas temperature is kept on the power-station log.

The three alternating-current generators are connected to a com-

FIG. 2.—MAP OF STREET RAILWAY SYSTEM OF DETROIT AND ENVIRONS

mon set of three-phase bus-bars through single-throw, three-pole switches. From the 390-volt, three-phase bus-bars two rotary converters of 200-kw capacity each are operated directly, and supply the trolley lines near the power house. There are two sets of step-up transformers also operated from the alternating-current bus-bars. One set supplies the 16,000-volt high-tension transmission lines running north and the other set the high-tension line running south. There are, therefore, six transformers in regular service, with a seventh as reserve. Each bank of three transformers has a low-tension panel, though which the current to it passes. The frequency of the alternating current in this station is 28 cycles, which is rather unusual. The high-tension lines extend 40 miles north to Port Huron, and 21 miles south toward Detroit, as far as Roseville sub-station. In addition to the current supplied to the trolley line from the rotary converters at New Baltimore power station, there are sub-stations at Mt. Clemens, at Roseville, at Algonac, at St. Clair, and at Port Huron. The latter supplies city lines in Port Huron. The majority of the sub-stations are equipped with 200-kw rotary converters.

The arrangement for feeding direct current from the sub-stations to the trolley lines is of interest. The trolley line is sectioned opposite each sub-station, as is customary in alternating-current transmission practice for interurban lines, and, as usual, there are two feeders leaving the direct-current bus-bars at the sub-station,

one for supplying the trolley line in one direction and the other for supplying the trolley line in the other direction. Each trolley section, therefore, is fed by the sub-station at each end, so that the sub-stations can, to a certain extent, help each other in carrying the load, and as long as all the feeder-panel switches and circuit breakers are closed all the trolley-wire sections on the road are connected together. In case of short circuit on one section the feeder-panel circuit breakers in the sub-station at each end will open.

The peculiar thing about the direct-current feed on the Rapid Railway System is that instead of connecting the feeders directly to the trolley line at the sub-station no tap is made to the trolley line until about a mile from the sub-station, the argument being this does not throw so great a strain on the sub-station machinery in case there is a ground or short circuit near the sub-station. The current that will flow in case of a short circuit is reduced somewhat by the resistance of the feed wire between the sub-station and the first trolley tap, and, even though this resistance may be small, it serves in a measure to reduce the current which may flow. After a direct-current feeder has been tapped into the trolley line about a mile from the sub-station, taps are made to the trolley line after that every twelve to fifteen poles.

On the lines between Mt. Clemens and Port Huron the direct-current copper consists of two No. 00 trolley wires supplemented by a 450,000 cm. feeder. From Mt. Clemens to Detroit along the Shore Line there are two No. 00 trolleys supplemented at Mt. Clemens by a 450,000-cm. feeder from the Mt. Clemens sub-station, and at the Detroit end by a 450,000-cm. feeder run across country from the Roseville sub-station. On the Shore Line between Mt. Clemens and Detroit where interurban traffic is the heaviest, there are two No. 00 trolleys and three No. 000 running each direction.

Before the Port Huron and city lines were operated from the New Baltimore power house a good opportunity was afforded for determining the power required per car mile for interurban cars of the kind used on the Rapid Railway. Most of the cars on the Rapid Railway are geared for a maximum speed of about 45 miles per hour, some of them being four-motor equipments, and some two-motor. The four-motor equipments usually reach maximum speed sooner than the two-motor equipments, although when up to speed they run about the same. It was found that the power required per car-mile for the interurban cars as measured at the low-tension bus-bars at the power house, and which includes, therefore, the losses in step-up and step-down transformers, high-tension lines, rotary converters and direct-current feeders, was about 3 kw-hours. In a trial to determine the maximum load coming upon the power house when running interurban cars alone, there were in operation eight 29-ton passenger cars, four-motor equipment; six 21-ton passenger cars, two-motor equipment; three 25-ton freight cars, four-motor equipment; two line construction cars, and two 8-ton city cars in Mt. Clemens, or 21 cars in all.

The output for a run of twenty hours was about 14,000 kw-hours, or an average of 700 kw. This represents an average input of 33.3 kw per car in service. Of course, for the interurban passenger cars which are in motion a greater part of the time the input per car would be considerably more than this, as the above list includes the freight cars, line construction cars and two light city cars. In fact, the power required by the city cars is probably in the neighborhood of 15 kw average, or less than one-half that of an interurban car. With the above list of cars in operation, the maximum evening load, when nearly all the cars would be moving, was about 1,384 kw, a maximum of 65.9 kw per car.

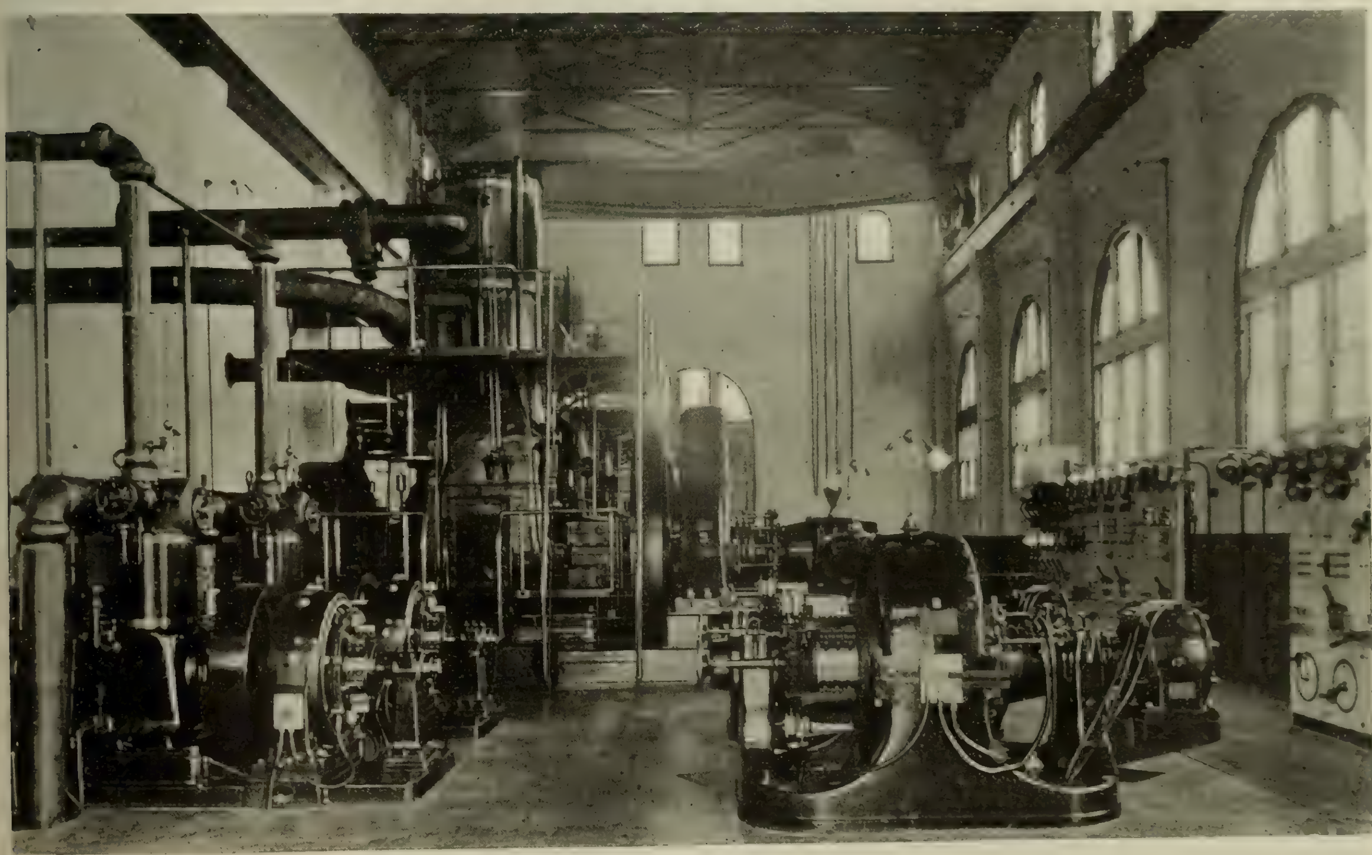

Fig. 3.—New Baltimore Power House, Detroit Rapid System.

The Detroit, Ypsilanti, Ann Arbor and Jackson Railway operates the longest continuous line of interurban electric road out of Detroit, extending from the Detroit city limits to Jackson, a distance of 76 miles, with a branch to Saline. It was formerly operated by two power houses, but these have recently been combined into one combination alternating and direct-current power station at Ypsilanti, which is the most modern of any in the vicinity of Detroit.

In the boiler room are eight 225-hp Babcock & Wilcox boilers, carrying 160 lbs. steam pressure, and employing induced draft. The flue gases pass through Greene economizers, and the boiler firing is done by Roney mechanical stokers divided in two sections, four boilers on each section.

The main engines, of which there are eight, are all the same size, being Westinghouse high-speed compound condensing 18-inch and 30-inch by 16-inch stroke, running 200 r. p. m. Each engine has one Worthington compound jet condenser. To five of these engines 250-kw three-phase alternators are connected. These are 390-volt machines, operating at the usual frequency of 29 cycles per second. The remaining three engines have 250-kw double-current generators, giving 650 volts on the direct-current commutator, or 390 volts at the alternating-current collector rings. The two exciters are 50-kw,

125-volt machines, driven by Westinghouse compound engines, running condensing or non-condensing. These are also used to light the [illegible].

All the alternating-current generators are operated in parallel, and there is no provision for other than parallel operation. On the switchboard, there are eight alternating-current generator panels, each of which has a three-pole knife switch for breaking the main generator circuit, a double-pole field switch, the rheostat in the generator field circuit, three alternating-current ammeters, one indicating wattmeter, synchronizing lamps and voltmeter and synchronizing plug receptacles. Generators connect through their three-pole main switches without any further circuit breaking devices, directly to the low-tension alternating-current bus-bars.

The entire alternating-current output is delivered to one bank of three delta-connected step-up transformers. The only automatic circuit breakers in connection with the low-tension switching in the station are in the three legs of the circuit supplying these transformers. Each leg of this main circuit has a switchboard panel, upon which is an alternating-current automatic circuit breaker with a time limit is placed. The time limit is put on these breakers, so that in case there is a short-circuit at one of the substations the circuit breakers at the substations will open before those at the main station, the idea being that frequently this will save shutting down the whole system by the opening of the circuit breakers in the main power house, where opening the substation breakers would do as well. In each leg of the circuit there are also single-pole knife switches of 3,000-amperes capacity. The total output is measured by a polyphase induction integrating wattmeter at one end of the low-tension switchboard just described, which contains the generator and transformer panels. There are two voltmeters on brackets at the end of the board. One of these is connected permanently to the bus-bars, the other to any generator which is being prepared for connection to the bus-bars. Along with the voltmeters there is also a Westinghouse synchroscope for use in getting generators in step with the bus-bars before connecting them in. This indicates directly the amount that the generator is out of step, and it is a much more accurate guide than synchronizing with lamps.

The step-up transformers raise the voltage from 300 volts to 21,000 volts. The high-tension leads from the transformers are taken to plug switches, which serve simply to transfer or open connections, and then to static interrupters, from which they pass to a long-break combination switch and fuse. The lightning arresters are connected between each leg of the high-tension line and ground. All the high-tension apparatus is in a bay or tower, built on one side of the generating room and providing not only a wire tower for the entrance of the high-tension lines, but containing galleries for the high-tension switches and lightning arresters. The high-tension apparatus is therefore isolated to a certain extent from the rest of the plant. This same idea is carried out in the substations, which have towers on a smaller scale for the high-tension apparatus.

The direct-current terminals of the double-current generators are connected to the ordinary direct-current generator panels and supply lines adjacent to the power house through three direct-current feeder panels. These generator panels have three single-pole main switches —for positive, negative and equalizer. The automatic circuit breaker is on the negative side. The feeder panels have the usual equipment of an ammeter, circuit breaker and single-pole switch. The direct-current output is also measured by recording wattmeter.

The substation buildings are of steel and brick, with towers, as mentioned, and each is laid out to contain three [illegible]-kw transformers and two 250-kw rotary converters, with room for one extra rotary converter. There are, of course, switchboard panels for the alternating-current side of the rotaries and direct-current side. There are two feeder panels at each substation, one feeding east and the other west.

The trolley lines are sectioned in front of each substation. The cars operated regularly are: 13 interurban passenger cars; 4 local city cars at Ann Arbor; 4 freight cars, and 1 construction car; a total of 22. On this road five of the [illegible] units are run. The new cars have a seating capacity of [illegible] people, and a motor equipment of four Westinghouse motors, taking from 150 amperes to 200 amperes, running at the maximum speed of about [illegible] miles per hour. The accelerating current is from 150 amperes to 200 amperes, with motors in series, and from 300 amperes to 350 amperes when they are thrown in parallel, making ordinary starts. This acceleration current sometimes reaches 450 amperes, though not frequently.

The cars were formerly equipped with Westinghouse automatic air brakes, but these have been changed to Westinghouse straight air brakes, because of the greater ease and accuracy with which a motorman can regulate exactly the pressure on the brake-shoe with a straight air brake.

The regular schedule calls for cars every half hour east of Ypsilanti, and cars every hour west of Ypsilanti. When special traffic is handled from Jackson, the western terminus of the road, cars are run every half hour, the fact that these cars will be run being advertised in the local papers. It is found that this is sufficient to prevent overloading of the regular cars running on the one-hour intervals. Special cars can be chartered when ordered, and the charge is made on the mileage basis.

About 70 conductors and motormen are kept on the pay roll. All runs less than eight hours are termed "extra runs," and the men having them are given chances at the ordinary runs whenever the regular men are off. The road is not operated in divisions, but train crews make the entire run through from Jackson to Detroit and return. Twelve freight offices with regular agents are maintained.

Train Lifting by Electricity.

It is stated from Baltimore that a tremendous enterprise is contemplated by the Gould-Wabash system on the line of the West Virginia Central. Plans have been drawn by which it is expected to lift whole trains loaded with coal or merchandise up the side of a precipitous slope of the Great Backbone Mountains, in Tucker County, W. Va., by means of electric power, and by that method make a double track road with an easy down grade both ways. The plan, which is said to have been thoroughly worked out by the engineering corps of the railroad, is a most remarkable one in many ways. At present the line, going westward, after leaving Cumberland, runs through Keyser, Piedmont and Fairfax, and thus on into the Blackwater Canyon, where the scenery is wild and magnificent, but where it is impossible to maintain more than a single track. From Fairfax down on through this deep gorge the road descends a steep grade to Hendricks, and then makes a detour to Parsons, and from thence on up a slight grade to Elkins. Thus it can be seen that there is a big handicap at present, with a one-track road through the gorge and a tremendous grade coming east.

At first it was planned to make a considerable detour around the mountain range so as to get an even grade. To do this the line would have to follow the Cheet Run and extend from Fairfax to Hendricks, and this would involve a great loss of time. To overcome this it was decided to use the present gorge route for the westbound trains and build a unique eastbound track. It would be possible to have a double track road on a fair grade from Elkins to Parsons, and there the trains would run on a platform. It is then proposed to have this entire platform and its freight, a full train, move by electric power up a tremendous grade right to the highest elevation on the mountains. From that point an easy down grade can be found on the other side all the way to Fairfax. The operation of this great platform is, of course, a gigantic undertaking, but it is believed it can be successfully worked. The whole would be operated by electric power. To provide this power the large plant of the road at Cokeland would be drawn upon. The electric plant at that place at present supplies electric lighting and power for a large territory and furnishes electricity for the mines. There would be ample power, however, to move the platform and its freight up a sharp incline to a height of about 1,000 feet.

Wireless Telegraphy for Yachts.

It is noted from Larchmont, on Long Island Sound, that with a view of establishing wireless communication between the different yacht clubs along Long Island Sound stations were established at Larchmont and New Rochelle Yacht clubs last week, and the yachtsmen amused themselves by sending and receiving messages. Operators were stationed on the verandas of both clubhouses. Augustin Monroe, chairman of the house committee of the Larchmont Club, said that the test was a success. It is said that a number of wealthy yachtsmen intend to have their steam and big schooner yachts fitted out with the wireless telegraph outfits, so that they can communicate with their friends at the clubs at any time.

Flint Division of Detroit United Railway Company.

By S. T. Dodd.

IN the early days of electric railroads, when a five-mile road was considered long, a generator voltage of 550 was sufficient for operation at all points of the system. As the length of the roads gradually increased, they soon reached a length at which it was impossible, with the system then in use, to transmit power economically to the extreme points of the line with a reasonable investment in feeders.

To meet this condition, the booster was evolved and proved a practical success, from the operative standpoint, but not profitable, except where its function was required but a small percentage of the time, not exceeding two or three hours out of the twenty-four.

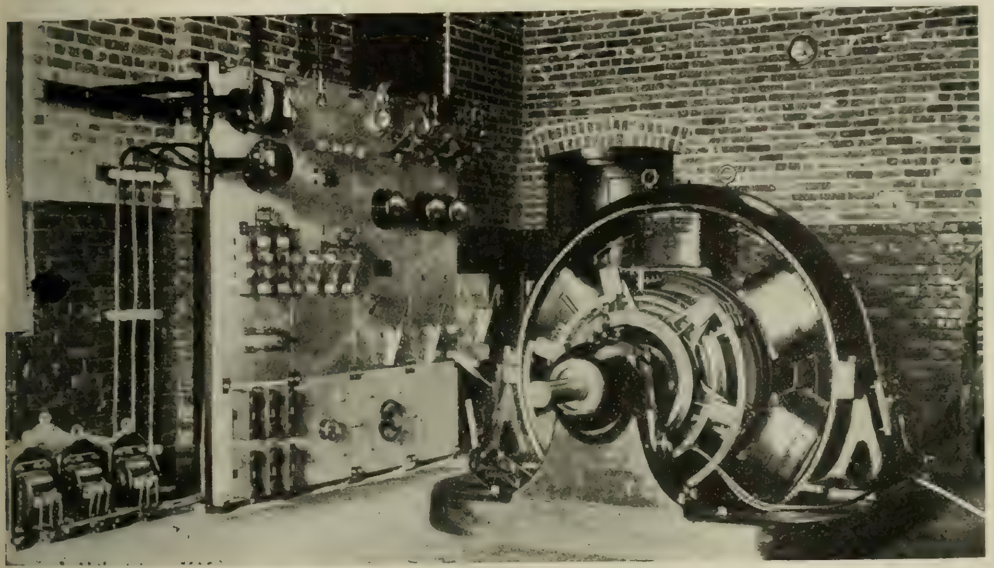

FIG. 1.—LOW-TENSION SWITCHBOARD, OXFORD SUBSTATION.

The storage battery has proved of value in equalizing the load on stations and in special cases. Where, for example, an excessive amount of current is required at a heavy grade located some distance from the power house, a storage battery located at such point is often the best means of meeting such conditions. But the storage battery has not served the purpose of maintaining the original voltage at distant points of the system.

The next step, when roads reached the length where they could not be operated from one direct-current power house, was to operate from two or more such stations, but the heavy operating expenses entailed through the necessary attendance for each of such stations, soon made it apparent that a means must be found to obviate the bulk of this expense, and further to take advantage of the economics resulting from the use of larger generating units and labor-saving power station equipments not found profitable with small stations.

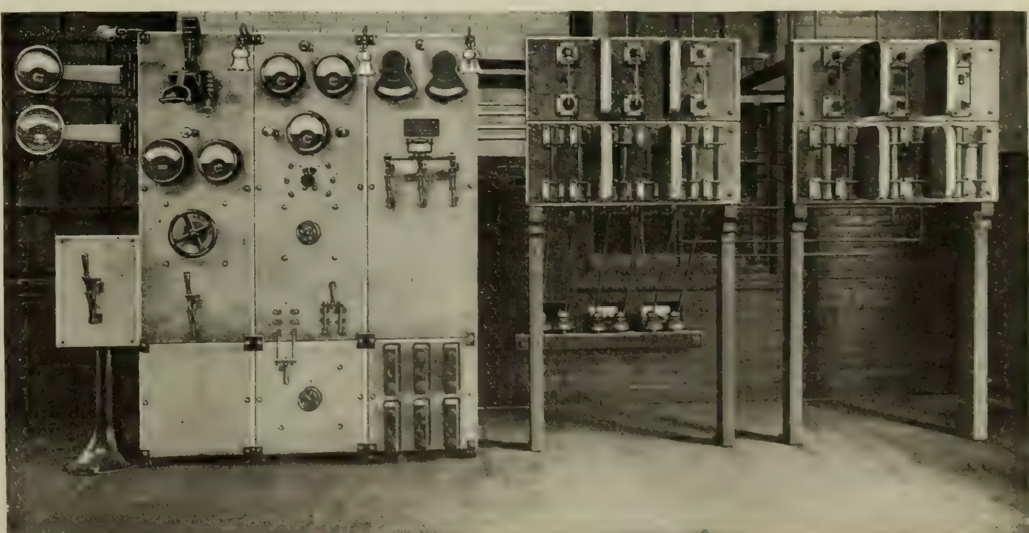

FIG. 2.—SWITCHBOARD IN ROCHESTER POWER HOUSE.

The modern method of operating a long electric railroad, which experience both in this country and abroad has thus far shown to be the only practicable method, is to install one main power station with alternating-current generators, the alternating current being transmitted generally as a three-phase current at 10,000 to 25,000 volts, to substations located every ten to twenty miles, each substation being equipped with suitable step-down transformers and rotaries for transforming and converting the energy to direct current at a potential of from 550 to 600 volts.

A successful plant of rotaries in the neighborhood of Detroit is found on the Flint Division of the Detroit United Railway. This line extends northwesterly from Detroit to Flint, a distance of 66 miles. The alternating-current transmission was installed in 1901, and S. K. C. rotaries are in use, both in the power house and in the substations.

The cars of the Flint Division leave from in front of the City Hall every hour. The route lies directly northwest through the center of the city, and out Woodward Avenue to the city limits. Within the city limits the regular city cars of the Woodward Avenue line run on the same tracks, but beyond this point the large interurban cars of the Flint and Pontiac Divisions have the tracks to themselves. A great part of the road for the first six miles beyond the city is double-tracked, as cars of two divisions operate over it.

Royal Oak Junction, 12½ miles from the center of the city, is reached in 40 minutes. At this point the two divisions separate, the Pontiac line keeping on toward the west, while the cars for Flint turn more toward the north. Beyond Royal Oak the road is single track, running along the side of the highway with bracket construction overhead. A feature of the construction that strikes the observer is that the mileage is marked on the poles. Every fifth or sixth pole is marked with a broad white band, upon which, in black figures, is given the distance in miles and tenths from Royal Oak. There is no need of speculating long on the speed of the car. With an ordinary watch, the passenger can timethe miles as he goes along, and can quickly settle any question as to speed, and one always knows the distance he has traveled and the distance to his destination.

The power for the first 12 miles of theroad is furnished from the power houses at Detroit and Pontiac. The stretch of 14½ miles from Royal Oak to Rochester is fed with direct current from the Rochester power house, the section furthest from the power house being fed through a booster. s one notes the heavy feeder lines upon the transmission poles and contrasts this with the type of construction, he finds beyond Rochester, where the power is transmitted through a high-tension, alternating-current system, he realizes that this section of the road could have been equipped more economically if the alternating-current transmission plan had been adopted when the road was first built. The road runs through a level, fertile farming country, to which it affords both freight and passenger service. It is a beet sugar country, and in the fall the freight sidings along the road are occupied by freight cars loading with sugar beets for the factory at Rochester.

Rochester, 27½ miles from Detroit, is reached in one hour and 20 minutes, the distance from Royal Oak, 14½ miles, being covered in 40 minutes. Here is situated the power house and car barn of this

division. The power house shows evidence of that characteristic of so many of our suburban roads—the growth of the demands of traffic far beyond the original resources of the road. At one end stand two horizontal high-speed engines, direct connected to 200-kw, 600-volt, direct-current generators. With increased development of the road, a vertical engine direct connected to a 400-kw, direct-current generator has been added to the equipment. With the extension of the road to its present limit, the direct-current system has proved inadequate, and so a three-phase current equipment has been installed for

FIG. 3.—ROCHESTER POWER HOUSE.

the sections of the road beyond Rochester, with S. K. C. rotaries in the power houses and substations.

The rotary in the power house stands directly in front of the door as the visitor enters. It is rated at 250 kw and runs inverted, taking direct current from the 600-volt board and converting it into alternating current for the transmission line. The liberal design of the rotary arrests the attention. The commutator is 33 inches in diameter and has three carbon brushes per holder. The collector rings are 18 inches in diameter and are 2¼ inches broad, and carry two copper-leaf brushes per collector ring. These brushes are each 2 inches broad by ⅞ of an inch thick. There are three ½-inch ventilating ducts, through the body of the armature, and the splendid ventilation obtained keeps the armature at a low temperature in spite of the heavy overloads. The shaft is 7 inches in diameter at the armature and 5½ inches at the bearings. These bearings are each 22 inches long and are equipped with two oil rings dipping into ample oil cellars below the bearings. The flat, wide frame casting gives a steady and substantial appearance to the whole machine. The armature winding is thoroughly subdivided and a large number of slots used. This prevents local heating, conducive to good commutation, gives a wave of electromotive force free from harmonic, prevents eddy-current loss in pole faces and allows the use of desirable magnetic constants.

The machine is often heavily overloaded, as it has to furnish current for two substations, each of which is equipped with a 250-kw rotary. The violent fluctuations of the load are what might be expected on an interurban road running heavy cars on an hourly schedule. When the station was first equipped, an ammeter reading to 600 amperes—sufficient to indicate overload of 50 per cent.—was installed on the switchboard. The needle struck the end of the scale so often that an instrument reading to 1,000 amperes was substituted. From the reading of this instrument it is evident that the rotary is frequently called upon to develop [illegible] to [illegible] kw, and it does so without flashing overheating or other trouble.

To the right, as one stands in the doorway, is the old direct-current switchboard, from the bus-bars of which is delivered the current for the trolley circuits of the adjacent sections of the road and also the current for the rotary. In sharp contrast with this board, there stands on the left the modern switchboard, installed by the Stanley Electric Manufacturing Company for operating the inverted rotary and the high-tension transmission line. This switchboard is shown in Fig. 1.

The panel on the left is the direct-current panel. The current from the direct-current bus-bars for the rotary comes to this panel and passes in succession through the circuit breaker, ammeter, starting-box and switch. The only other instrument upon this panel is a 25-ampere ammeter, which indicates the field current of the rotary and gives the operator an opportunity to make a very close approximation as to its speed. Voltmeters for both alternating current and direct current are supported on swinging brackets from the side of this panel.

The next panel upon the board may be called the controlling panel. This has three ammeters at the top of the board, one in each of the three phases coming from the alternating-current end of the rotary. Two rheostats mounted upon the board control the voltage of the exciter, and the current passing from the exciter armature through the fields of the rotary. Two field switches are mounted upon the board, one of which excites the fields of the rotary from the 600-volt bus-bars when starting up, while the other connects the fields to the exciter after starting. A three-pole voltmeter switch upon the board enables the operator to read the voltage on the line and the voltage across the fields when charging from 600-volt excitation to the 120-volt excitation.

The next panel of the board is the alternating-current panel. This carries at the top two S. K. C. ground detectors. These ground detectors are connected to the low-tension side of the condensers which are carried upon the high-tension lines. A ground upon any one of these is indicated directly by one or both of the ground detectors. Below these instruments is a three-pole main switch connecting the leads from the rotaries to the transformers. Separate leads are run from each transformer to the board and the delta connection between them is made at the board. This arrangement makes it possible to place fuses in each one of the leads. These six fuses are placed at the bottom of the board. By this means of connection it is possible, in case of a defective transformer, to remove the two fuses from the same and thus cut this transformer out of circuit, leaving the other two transformers maintaining the three phases between the lines.

The board is lighted by nine incandescent lamps, six of which are connected to the rotary side of the switch, while the other three are connected to the transformer side of the switch. By this means, in case the main switch is opened, the operator can tell at a glance whether his transformers are being charged from the high-tension lines; that is, whether some other rotary is running upon the line or

FIG. 4.—INTERIOR VIEW OF OXFORD SUBSTATION.

whether his line is dead. This prevents accidents which might occur if the inverted rotary was shut down for any reason and was thrown back upon the line while the other rotaries were still connected to it.

The transformers for this station are in a small separate building outside the power house. There are three of these of 250 kw each, of the oil-filled, self-cooled type, made by the Stanley Electric Manufacturing Company. Separate leads run from each transformer both

to the low-tension and high-tension boards shown in Fig. 2.

The high-tension panel stands beside the board already described, and carries upon the lower panels six high-tension ball fuses which are inserted in the separate leads running from the transformers. Above these fuses are mounted emergency switches for connecting the transformers to the high-tension lines. No instruments are mounted upon this board, as it is the practice of the builders to do all operating and controlling of the circuits from the instruments and switches upon the low-tension board. The alternating current is transmitted to the substations at a pressure of 15,000 volts.

The interval between cars has allowed ample time for an inspection of the power house. In order to inspect the substation, we board the next car running north to Oxford. Beyond Rochester there are deep cuts and heavy grades, and the road runs for most of the way over private right of way. It was originally constructed for 600-volt, direct-current transmission, with poles of the usual height. In installing the alternating-current transmission, the high-tension wires have been placed on cross-arms above the 600-volt feeders. Had the road been constructed for alternating-current transmission, the poles would have been longer, but it is an example of construction which is frequently adopted in the development of short suburban roads to greater distances than they were at first designed to cover. Above the high-tension wires is strung a barbed wire, grounded at frequent intervals, for protection against lightning.

The high-tension lines consist of six No. 4 aluminum cables. These constitute duplicate sets of three-phase transmission lines, which are ordinarily operated in parallel. In case of trouble, however, any line or a set may be cut out and the road operated over the remaining wires. Oxford, 27½ miles from Royal Oak, and 12 miles from the power house at Rochester, is reached in 40 minutes. The substation is located on the outskirts of the town.

The substation is a substantial brick building. At the front as we enter is the waiting room and express and ticket office. Next to this is a freight room, extending clear across the building, with doors opening on either side. From one of these a platform extends to the car track, where freight is unloaded from or delivered to the freight car, which makes trips night and morning over the road. At the other door wagons can drive up for receiving and delivering freight. Although the Michigan Central and Pontiac, Oxford and Northern Railroads have stations in Oxford, a considerable quantity of all classes of freight is daily handled by the electric line. Next to the freight room is the rotary station proper, which is open day and night. The work is divided between three shifts whose hours overlap so that during the busy hours of the day a dynamo tender and an express agent are on duty, while at night one man handles the station.

Examining the instruments in the rotary room, we find six high-tension lines enter the room on one side, pass directly across, supported on insulators from the rafters, and leave on the opposite side. The lines are provided with emergency switches in the middle of the room, which make it possible to cut out any line which is in trouble beyond Oxford, and operate all six lines as far as there.

Taps lead from each line to a high-tension switchboard which stands in the gallery. This board is equipped with air-break plug switches and compression ball fuses. As in the power house, leads are brought from the transformers directly to the board, and each transformer separately fused. The transformers being connected in delta between the fuses and the switches, the blowing of the fuses in one transformer leaves the load on the other two, the three-phase relation remaining undisturbed.

Fig. 6.—Substation at Oxford.

The transformers are of 100-kw capacity each, of the S. K. C. oil-filled, air-cooled type. They stand on the main floor below the gallery. From them the 360-volt current is carried by lead-covered cables to the low-tension switchboard, shown in Fig. 1. The trolley circuit is opened near the station, and one switch feeds north and the other south. In order to economize the load on the alternating-current line, the station ordinarily feeds north. When cars are behind schedule time south of the station, the other breaker and switch are closed, and the station helps out the line toward the power house. In starting up the plant after a shut down, the north breaker is left open so that only the cars between Oxford and Rochester can pull on the line and affect the voltage until the rotary is synchronized and on the line. As soon as this is done, the north switch is closed and the next station receives current and is allowed to start.

The rotary itself is similar in every respect to that in the power house, except that it is not equipped with a separate exciter, but is

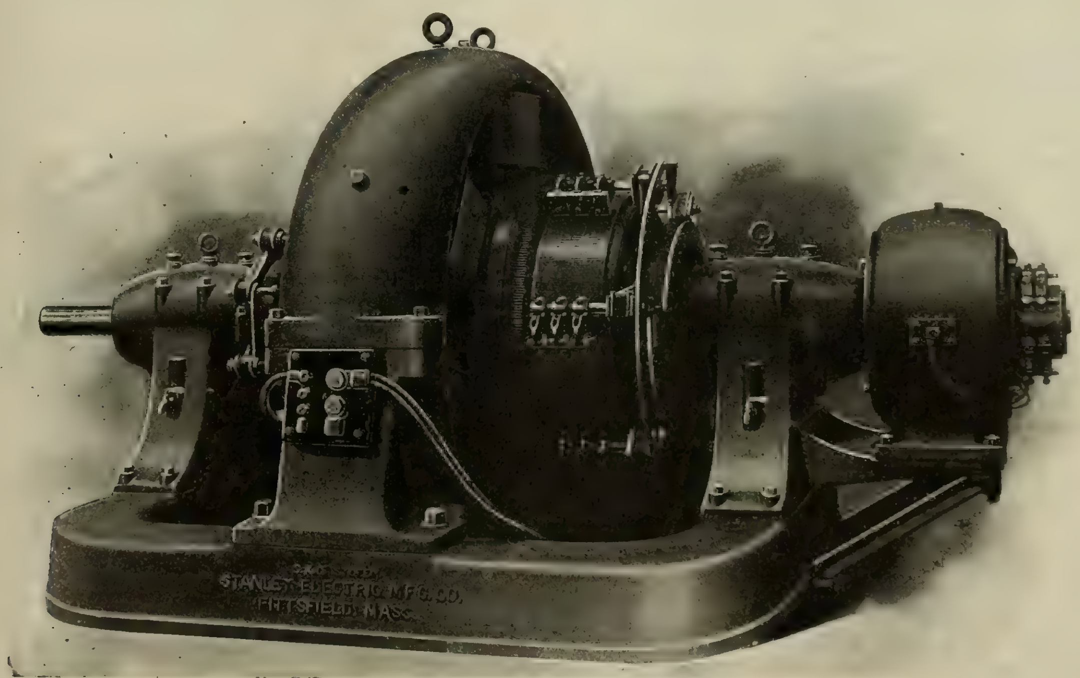

Fig. 5.—Inverted Rotary, Rochester Power House.

excited directly from its own direct-current voltage, 600 volts. The same characteristics of design and operation are to be noted on this machine as on the other. The method of connection of the transformers to the board, which has already been described, renders it possible to take one transformer out of the circuit without disturbing in any way the phase relations of the alternating-current lines or the operation of the rotary. In case of necessity, two transformers can be cut out and the rotary operated as a single-phase machine. The need for this seldom arises, but, as a matter of fact, during a heavy storm one evening last winter, four out of the six transmission lines came down early in the evening, and the road was operated until the usual closing time on two high-tension wires with one transformer to each rotary.

The next substation is at Atlas, 18 miles north of Oxford and 45½ miles from Royal Oak. The run from Oxford occupies an hour. Some of the best construction on the road is to be found on this section. The poles are all 35 to 40 feet in length, carrying the high-tension wires safely out of the way of the 500-volt circuits. The two sets of transmission lines are carried on opposite sides of the poles, one wire of

FIG. 7.—LINE CONSTRUCTION BETWEEN OXFORD AND ATLAS.

each set being on the upper cross-arm and the other two on the lower arm at equal distances from each other and from the upper wire.

The road runs over private right of way, and as the country is quite level, long, straight stretches of track occur where speed of 40 to 50 miles per hour are frequently attained. The Atlas substation is a duplicate of the one just described, except that it being located in a small station, the freight and waiting rooms have been omitted in design of the station, and the freight business is handled in the rotary converter room.

The alternating-current transmission ends at Atlas, but the substation feeds over the 600-volt lines, nine miles further to the city of Flint. However, it is to be noted that further extensions of the road are not limited by the transmission system. Further demand for power in Flint or for more distant extensions can be met by an extension of the high-tension system to new substations, and the installation of additional generators in the power house.

The Cost of Street Opening.

President Cantor, of the Borough of Manhattan, New York, will bring before the Board of Estimate and Apportionment the question [illegible] to construct a pipe gallery in lower Broadway. William R. Corwine, secretary of the Merchants' Association, in advocating the proposed improvement yesterday, quoted a report made by [illegible] Martin, engineer of [illegible] showing that such openings for [illegible] services and for repairs for electricity, gas, steam and water [illegible] amount to about 44,880 square yards in a year, and that the cost [illegible] The same report also showed that in the opening of streets for the laying and overhauling of mains 171,887 square yards [illegible] were removed, at a cost of $345,700 a year. "We have, therefore," said Mr. Corwine, "a gross total of 170,471 square yards removed at a total yearly cost of $445,470. That is in the Borough of Manhattan [illegible] The use of pipe galleries for pipes now under ground will [illegible] save the city a great deal of money. It would certainly save a great deal of the inconvenience now caused to people using the streets [illegible] pipes were in galleries access could be had to them through manholes [illegible] openings in the Rapid Transit structure."

Telephony in Street Car Dispatching.

Those who attend the American Street Railway convention at Detroit, next week, will have an excellent opportunity to study the application of telephony to the important work of car dispatching. The work done there exemplifies what can be done elsewhere and what has already been successfully attempted under corresponding conditions in other cities. All the electric interurban railways radiating from Detroit operate under dispatcher's orders given by telephone. The methods used by the three different managements which operate these lines are very similar and differ only in detail. In each case telephones are located in cabins or booths at sidings along the line, and no attempt is made to carry telephone instruments on the cars. The orders are all received orally, and no written record is

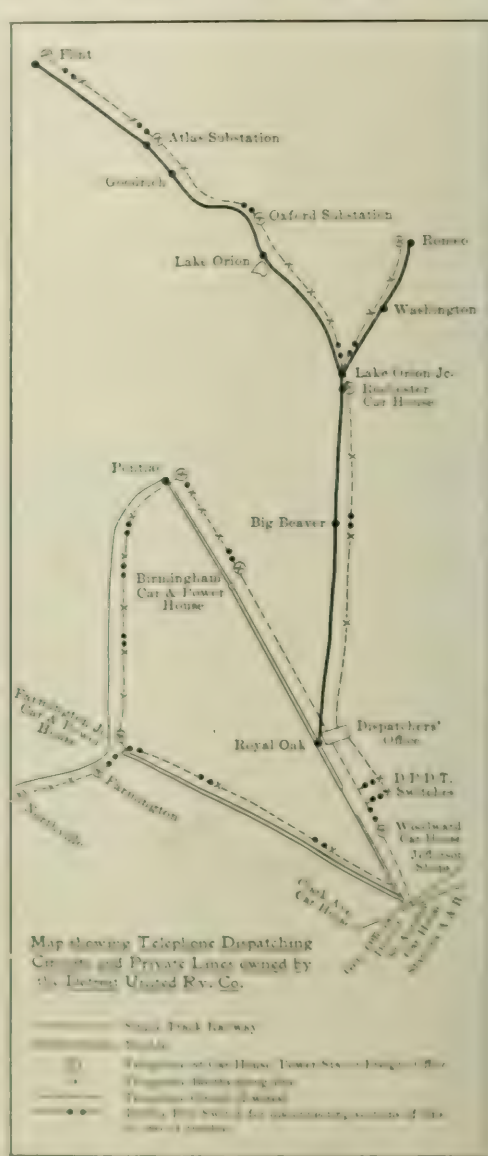

FIG. 1.—MAP OF TROLLEY TELEPHONE SYSTEM.

kept on any of the lines. The Detroit United Railway system operates all its interurban lines, except the Wyandotte Division, from one dispatcher's office, located at Royal Oak Junction, 14 miles from Detroit. From this point the dispatcher has telephonic communication with the whole interurban system controlled by the Detroit United Railway. His office is on the second floor of the freight office and waiting room at that point, and commands a good view of the interurban lines which approach it from three directions. The location of this office with reference to the Detroit United system can be seen from the map, Fig. 1, which shows the telephone dispatching system of that company, except the Wyandotte Division, which has Bell telephone lines and instruments. From this map the location of all the telephone booths is shown, booths being located at every siding on the system. Although the telephone lines are essentially for train dispatching, they are also used in a limited way for trans-

action of general business. Their use, however, for this purpose is not encouraged, and it is understood that train dispatching business has the right of way over anything else on these telephone lines. Should a line be in use for a conversation other than dispatching, the employees have strict orders to cease talking the instant a train crew calls up the office for orders, and not to resume conversation until orders have been given. The dispatchers work in three watches. They are men thoroughly familiar with the business as carried on by steam railroads, and keep regular train sheets.

Orders are received at the telephone booths of this company by the conductors and are repeated to the dispatcher by the conductor.

FIG. 2.—CAR DISPATCHER'S OFFICE.

The motorman must be within hearing to hear the order repeated back. The telephone lines are mainly No. 10 Washburn & Moen gauge B. B. iron wire. In the city and when passing through trees, a waterproof insulator is used, and the lines outside the city are run on brackets with pony insulators, and are transposed every ten poles, except under high-tension, alternating-current lines, where they are transposed every five poles. The Hemingray transposition insulator is employed for this purpose. The standard telephone equipment for booths consists of Stromsberg-Carlson telephone instruments, with an 1,800-ohm ringer, a five-bar magneto generator, which will ring through 60,000 ohms' resistance. The instrument in each booths are connected with the line through a double-pole, single-throw baby switch. This switch is open when the telephone is not in use, and strict orders are given that it shall be so opened, in order

FIG. 3.—INTERIOR OF TELEPHONE CAR DISPATCHING OFFICE.

that the line may not be rendered inefficient by having a large number of instruments bridged across it. At the dispatcher's office, shown in Figs. 2 and 3, there are two duplicate switchboards, so that in case anything goes wrong with one the other can be switched in. The dispatcher has four dispatching lines entering his office, and connection with any one is established by simply throwing an operator's switch. The plugs on the operator's switchboard are for making connections between different dispatchers' lines when they are used for general business. In the ordinary operations the dispatcher has only to throw his keys to connect his head telephone with the various lines. As seen by the map, Fig. 1, communication can be had with many points on the system from two directions. Double-pole switches are placed in a line at frequent intervals, as shown. In case a line is short-circuited or grounded at a certain point, the switches on both sides of the trouble can be opened and the work of dispatching can then be carried on without interruption.

In the city the telephone lines are often suspended from the electric railway span wires by means of porcelain insulators. In some cases a common porcelain insulator is used tied to the span wire with the telephone line wire pulled through the hole in the center, and in other cases a porcelain insulator especially made for this kind of work has been put up. This location for the telephone wire keeps it from interference with the heavy foliage. The greatest care is exercised to maintain telephonic communication without interruption, and in case there is trouble on any of the telephone lines, its repair has the preference over any other work. The dispatcher not only governs the operation of cars on interurban lines, but is very helpful to all departments because he is in closer touch than anyone else with the actual operation of the entire system. He receives the first reports of troubles along the line, both large and small, and is of great assistance to track and overhead departments by reporting to them defects reported by trainmen.

The number of passenger cars dispatched on the interurban lines on the ordinary schedule is 22. On special occasions this may be increased to 40. To this should be added the work cars, freight cars and supply cars, which, being irregular, run as extras, and so add to the dispatcher's cares much more than in proportion to their numbers. On the Rapid Railway system the telephones used for dispatching are rented from the Bell Telephone Company and are maintained by that company. The orders are received by the motorman, and are carefully repeated back to the dispatcher. The conductor stands close at hand, while the motorman repeats the order back, and then the conductor also steps to the telephone and repeats back the order. On the Detroit, Ypsilanti, Ann Arbor and Jackson Railway, the orders are received and repeated back by one man (the motorman), who repeats them afterward to the conductor.

Electrical Supply from Water Power.

By ALTON D. ADAMS.

MASSACHUSETTS is not so liberally provided with great water powers as are some of the other New England States. Furthermore, the high density of population in this State and its numerous manufacturing interests tended to an appropriation of its most important waterfalls for other purposes, before electrical supply systems grew to be of importance. In spite of these facts, the considerable elevation of a large portion of the area of the State, which includes two watersheds, each extending across its entire width from north to south, and with a height above tidewater of 1,000 to 2,000 feet, and the numerous small rivers that flow down its slopes, offer many moderate water powers for the use of electric systems. These powers, often distant five to twenty miles from important centres of population, are rendered doubly available by the ease with which electrical energy is transmitted.

The object here is to point out the extent to which these small water powers, and, in a few cases, parts of the larger ones have been applied to systems of electrical supply in Massachusetts. No mention is here intended of those numerous cases where an electric plant, devoted to the service of a factory or other private purpose, is driven by water power, but only those water-driven electric plants are considered which operate for purposes of public supply. In a discussion of these plants it seems desirable to consider the steam engine capacity as well as the horse-power of waterwheels included by each of them. Accordingly the accompanying table has been constructed to show the number and location of electrical supply systems in Massachusetts, that use water power, and the capacity of steam engines and waterwheels in each.

Inspection of this table shows that eighteen electrical supply systems, distributing energy in a somewhat greater number of towers and cities, are now operated entirely or in part by water power. Four companies, the Franklin, Great Barrington, Medway and Shelburne, depend entirely on water power, and have wheels with an aggregate capacity of 990 horse-power. The largest of these purely water-driven plants is that at Great Barrington, with wheels

[illegible] tion of water power to a public electrical supply system in the State is that at Springfield, where the wheels have a capacity of 2,835 horse-power. Of the fourteen plants using both steam and water power, seven have greater capacities each in waterwheels than in steam engines, indicating probably that much the greater portion of the total load, [illegible].

[illegible]

Name of Company	Place Located	Power Steam Engines	Power Water Wheels
[illegible]	[illegible]	50	[illegible]
[illegible]	[illegible]	750	79
[illegible]tts Electric Co.	Palmer, Monson, Warren	[illegible]	[illegible]
[illegible]	Turner's Falls	.	[illegible]
[illegible]	Great Barrington	. .	[illegible]
[illegible]	Grafton, [illegible]	[illegible]	[illegible]
[illegible]	Holyoke	800	[illegible]
[illegible]	Lawrence, North Andover, [illegible]	2,415	1,691
[illegible]	Lee	[illegible]	[illegible]
[illegible]	Medway	....	[illegible]
[illegible] & Electric Co.	Natick, Wayland, Wellesley	875	[illegible]
[illegible]	Orange	[illegible]	408
Rawson Light & Power Co.	Leicester	[illegible]	30
Shelburne Falls Elec. Lt. & Power Co.	Shelburne Falls	....	85
United Electric Light Co.	Springfield	1,650	2,835
[illegible]	Weymouth	820	400
[illegible]	Winchendon	125	150
[illegible]	Middleborough	150	[illegible]

This conclusion seems to follow from the fact that where the capacities of wheels are such that they require the entire flow of a stream during periods of high water, they cannot be operated at their full power for the whole year. If the load of electric generators on waterwheels is kept nearly up to the full capacity of the latter, as is desirable, it follows that quite a large per cent. of the total waterwheel capacity must be represented in the power of reserved steam engines. Where the engine capacity is less than that of waterwheels in a plant, and a large per cent. of the engine power must be held in reserve for periods of low water, the capacity of engines for which a load can be found during periods of ample flow must be relatively small, under ordinary conditions.

For the seven plants where the capacities of waterwheels exceed those of engines in each case, the total for engines is 4,700, and for waterwheels 7,048 horse-power. In the seven plants where the engines have the grater capacities, their total is 3,060 horse-power, and that of the waterwheels 1,519 horse-power. Engines aggregating 7,760, and waterwheels 8,567 horse-power are included in the fourteen plants, a total of 16,327 horse-power. If the powers of these wheels are reduced one-third in times of scant water, $8,567 \div 3 = 2,855$ horse-power of the engine capacity must be held as a reserve, so that the maximum load for these plants in the dry season may only be $16,327 - 2,855 = 13,472$ horse-power. Of this maximum the waterwheels will then furnish 42 per cent., and the engines [illegible] per cent.

For periods when the flow of water is ample, which is true during about two-thirds of the year, if the maximum load remains the same as before, the waterwheels carry 64 per cent., and the engines 36 per cent. of the load. Considering the output of energy for the entire year on this basis, the waterwheels supply $.33 \times .42$ [illegible] per cent., and the steam engines [illegible] per cent. of the total. It is good practice to provide steam power in excess of the maximum load, to an extent exceeding one-third of the capacity of the waterwheels, in order to be sure of sufficient reserve in very dry seasons. This practice would tend to increase the portion of the total year's output of energy supplied from waterwheels in these cases. Including the four electrical systems operated entirely by water power, the total capacity of the wheels engaged in this service in Massachusetts is 9,557 horse-power. With efficiencies of 75 per cent. for the turbines and 90 per cent. for the electric generators, this wheel capacity is sufficient for an output of [illegible] kilowatts.

Application of water power to electrical supply has gone on much faster than the general growth of the industry. In Massachusetts, during the fiscal year of 1889, water power was employed in four systems of electrical supply, but in 1901 this number had increased to eighteen systems. In the former year the total capacity of water wheels in use by electric lighting systems was only 545 horse-power. For 1901 this total stood at 9,557 horse-power, or 17.5 times the capacity in the earlier year. Up to and including 1894 the application of water power went on rather slowly, the total being 2,085 horse-power in that year, but since then progress has been more rapid.

Horse Power of Water Wheels.

	1889	1890	1891	1892	1893	1894
Holyoke	[illegible]	370	370	1,120	1,120	[illegible]
Middleboro	125	125	125	125	125	[illegible]
Turner's Falls	....	40	40	100	[illegible]	[illegible]
North Attleboro	30	30	30	30	40	[illegible]
Lee	....	[illegible]	60	60	[illegible]	[illegible]
Leicester	[illegible]	60	60	60	[illegible]	[illegible]
Natick	....	....	....	....	140	[illegible]
Palmer	....	....	....	....	....	[illegible]

	1895	1896	1897	1898	1899	1900	1901
Middleboro	[illegible]	125	125	125	125	125	[illegible]
Holyoke	1,120	1,120	1,120	1,120	1,120	[illegible]	[illegible]
Turner's Falls	[illegible]	[illegible]	100	100	[illegible]	[illegible]	[illegible]
Lee	[illegible]	60	60	60	145	145	[illegible]
Leicester	[illegible]	[illegible]	30	30	30	[illegible]	[illegible]
Natick	[illegible]	[illegible]	430	430	430	[illegible]	[illegible]
Palmer	[illegible]	360	360	[illegible]	[illegible]	735	[illegible]
Grafton	116	109	109	[illegible]	[illegible]	[illegible]	[illegible]
Gt. Barrington	640	640	640	[illegible]	750	[illegible]	[illegible]
Attleboro	[illegible]	79	79	79	79	[illegible]	[illegible]

Horse Power of Water Wheels.

	1896	1897	1898	1899	1900	1901
Orange	150	408	408	408	408	408
Springfield	....	1,890	2,835	2,835	2,835	2,835
Shelburne Falls	....	85	85	85	85	85
Townsend	....	....	....	30	30	30
Medway	....	....	....	56	55	[illegible]
Winchendon	....	....	....	150	150	150
Lawrence	....	....	....	....	1,691	1,691
Weymouth	....	....	....	....	400	400

During the five years from 1889 to 1894, the capacity of waterwheels added to electrical supply systems was 1,540 horse-power, or an average of 308 horse-power yearly. In the seven years from 1894 to 1901 the added waterwheels amounted to 6,472 horse-power, or 924 horse-power in each year on an average.

Up to 1896 the electrical system at Holyoke had the largest capacity of waterwheels of any in the State, namely, 1,120 horse-power; but in 1897 Springfield installed wheels of 1,890 horse-power and took first place. It is a notable fact that no system which has once used water power has abandoned it. The small plant at North Attleboro up to 1894 was moved to Attleboro thereafter, but continued to use water power. Of the eighteen plants recorded, ten have increased the capacity of their waterwheels since first installed. The three plants at Holyoke, Springfield and Lawrence represent a combined capacity of 5,646 horse-power in waterwheels. And this is only the beginning of water power in electrical supply.

Anglo-Belgian Telephony.

A dispatch from London says: About Nov. 1 the longest submarine telephone line in the world will opened between England and Belgium. The principal part of the cable has been laid, terminating on the English side in St. Margaret's Bay, near Dover, and on the Belgian side in the little harbor of La Panne. It now only remains to make shore connections. The length of the cable is 63 miles; it is on the double circuit plan, and cost about $5,000,000, while its complete installation will take nearly twice as much. The entire enterprise was conceived and has been carried through by the General Post Office of London. Its distinct advantage over other lines between the Continent and England is that, through the Anglo-Belgian communication, telephone subscribers all over Belgium will be able to speak from their homes with subscribers in any part of England. The expense of maintaining the new line will be equally borne by the governments of England and Belgium. Although on the surface this Anglo-Belgium enterprise appears to have no political significance, still, it should not be forgotten that the status quo of Belgium is guaranteed by Great Britain, who regards the "low country" in question as a sort of buffer state separating her from Germany and Russia. At any rate, the line will be in perfect accord with the present attempt of the British Government, working in sympathy with certain East England industrial interests, to have Dover regain something of her old-time importance as a commercial center.

Metallic Conduction and the Constitution of Alloys.

BY JOHN ALEXANDER MATHEWS, PH. D.

IN a paper recently presented by the author, before the Iron and Steel Institute[1], this subject was touched upon to a slight extent, and it was stated therein that "the evidence thus far, though insufficient, leads me to hope that a law will be found connecting atomic concentrations and the specific conductivities of added metals with the resulting change in the conductivity of the principal metal. Before this can be possible, more must be learned about the intermetallic chemical relations of alloys." This opinion was based upon the recent work of Barrett, Brown and Hadfield[2], Le Chatelier[3] and the classic researches of Matthiessen, together with some recent measurements by myself. For the most part steel alloys have been studied. It was also pointed out that a study of quenched, rather than annealed materials, might be profitable, for if alloys are to be considered as solutions, it is probable that some atomic relation affecting their resistivity exists. Now quenching tends to keep all the constituents of an alloy in a homogeneous condition, resembling that which existed while the alloy was molten, while annealing, particularly of steels, promotes segregation of the constituents in a way analogous to precipitation in ordinary solutions. The constitution of alloys has been very fully discussed in two recent papers by the author[4], and the perusal of either of them by readers not familiar with recent work upon this subject may help to make clear what follows.

Nearly simultaneously with the presentation of my paper to the Institute, there appeared in England a later paper by Prof. Barrett[5], the distinguished physicist, whose name is associated with the discovery of the phenomenon of recalescence in steel, and one in Germany, by Mr. Carl Benedicks[6], both of which tend to confirm in part the opinion quoted at the beginning of this article. At the same time, however, they lead to the conclusion that it is not a new law, but the extension of an old law to a field in which it was not known or supposed to apply—the law of Mendelejeff and Newlands that "the properties of the elements are a periodic function of their atomic weights."

It will be remembered that in studying the effect of various elements on gold, Roberts-Austen[7] found that the mechanical properties of that metal were, in general, changed in a manner proportional to the atomic volumes of the added element. The larger the atomic volume, the more deleterious was its effect upon gold. This law only applies to small percentages of added impurities, *i. e.*, to those which may be supposed to yield a single solid solution, and its general applicability is further interfered with by the individual chemical behavior of the added metal toward the principal metal. The formation of a definite intermetallic compound by the two metals would naturally produce a different effect than a simple solution of one metal in the other, but such a condition in no way invalidates the law, for it was only supposed by its discoverer, Sir William Roberts-Austen, to apply to dilute, solid solutions. Osmond's work seems to show that the influence of elements on iron is in accordance with the periodic law. The close relation between the periodic law and Roberts-Austen's law of atomic volumes is seen when we recall that atomic volume = atomic weight ÷ specific gravity.

In Professor Barrett's recent paper, he points out a relation existing between the increase of electrical resistivity in iron alloys and the specific heat of the added element. But the specific heat multiplied by the atomic weight, in most cases, gives a constant; hence, the increased resistivity is as closely related to one as to the other. The alloys studied by Prof. Barrett were the very excellent series prepared by Hadfield, and included a large number of alloys of many elements with iron. In their earlier paper on the conductivity of these alloys, Messrs. Barrett, Brown and Hadfield state that, "an approximate estimate of the quantity of carbon in any specimen of carbon-steel might be quickly obtained by a determination of the electrical conductivity of the particular sample, provided that the other constituents, especially silicon and manganese, were practically uniform throughout the specimens. On the other hand, from the electrical conductivity of samples of steel, in which the percentage of carbon only is known, we can infer the purity or otherwise of the samples." This very interesting observation might often be applied advantageously in testing materials.

In discussing the relation between conductivity and specific heat, Prof. Barrett says: "From the conductivities of the specimens their specific resistances were calculated; these were plotted against the percentage of the added element. A series of fairly smooth curves were thus obtained for each alloy." There is obviously no connection between the curves thus obtained and the conductivities of the added metal—for example, aluminum produced the greatest effect and tungsten the least; and aluminum, which is a better conductor than nickel, produces a greater increase in resistance than nickel. Neither is there any connection—as Prof. Barrett observes—between physical hardness and the conductivity; the hard manganese and tungsten steels are better than the soft silicon and aluminum steels for equal percentages of impurity. The following table, from his paper, shows the approximate increase in resistance (in microhms per cubic c.c. at 18° C.) of annealed iron by adding to it the metals named in the first column of the table:

TABLE I.—(BARRETT).

	Per cent. of Added Metal.		
Alloys of Iron with:	2.	3.	5.
Tungsten	4.0	5.0	6.0
Nickel	7.0	9.0	13.0
Chromium	10.0	11.5	14.0
Manganese	16.0	18.0	24.5
Silicon	26.0	34.0	49.0
Aluminum	28.0	36.0	54.0

From this table it will be noticed that the increase of resistivity decreases with each addition. In a second table, Prof. Barrett shows the approximate increase of resistance for one per cent. of added

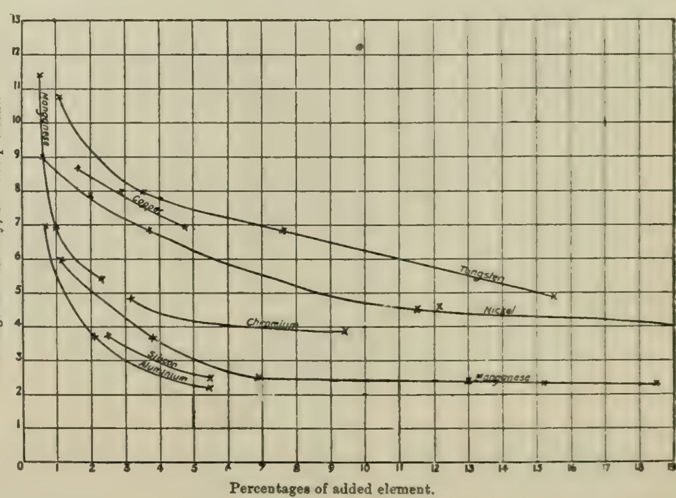

FIG. I.—BARRETT CURVES.*

metal, and compares this with the specific heat of the added metal. I have modified this table by the omission of carbon and by the introduction of more recent values for the specific heats of chromium and aluminum, the new values in both cases agreeing more closely with those required by the law of Dulong and Pettit.

TABLE II.—(BARRETT).

Alloy.	Inc. in Res. 1%.	Spec. Heat.	Atomic wt.
Tungsten	2.0	.035	184.
Cobalt	3.0	107	59.
Nickel	3.5	.109	59.
Chromium	5.0	.121	52.
Manganese	8.0	.122	56.
Silicon	13.0	.183	28.
Aluminum	14.0	.227	27.

It must be recalled that in dealing with percentages as high as those of the first table, we are not sure that the added metal remains in solution, especially in the annealed samples.

Some of Prof. Barrett's curves are shown herewith. In the diagram I (Fig. 1) the added elements are expressed in ordinary percentages, as given by him originally. The second diagram shows the result of replotting them in atomic percentages, the calculations being made upon the basis of the number of atoms of added metal in 100

[1] "A Comparative Study of Some Low Carbon Steel Alloys." J. I. & S. I., 1902, vol. I.

[2] Sci. Trans. Royal Dublin Soc., vii, p. 67.

[3] Bull. Soc. d' Encouragement.—III, p. 743.

[4] "Alloys as Solutions." The Mineral Industry. Vol. X, or "Upon the Constitution of Binary Alloys." J. Frank. Inst., Jan.-March, 1902.

[5] Proc. Royal Soc., LXIX, p. 480.

[6] Zeits. f. physikalische chemie, 1902, vol. 40, p. 545.

[7] Phil. Trans. of the Royal Soc., CLXXIX, p. 339.

atoms of iron. The dotted portions of diagrams (Fig. 2) have no connection with the subject immediately at hand.

In studying the relation of electrical resistance to the constitution of the conducting alloy, we must always bear in mind what a complex substance a steel alloy is: that it always contains carbon, manganese, silicon, sulphur and phosphorus; that the iron itself may exist in two or three allotropic conditions; that the limits of solubility of various elements in iron are in most cases unknown, and that the intermetallic compounds of iron with another metal, or of two metals with carbon forming a double carbide, have been very imperfectly worked out.

Yet, notwithstanding these complications, a broad view of the existing evidence leads to the idea that the atomic law is in some way connected with the problem. Prof. Osmond, in discussing the author's paper to the Iron and Steel Institute, takes this view of the subject when he says: "It was remarkable that Mr. C. Benedicks should have arrived independently and simultaneously at the conception of the idea of atomic equivalents of dissolved bodies. It was true there was some considerable discrepancies between the results of Benedicks and Mathews, but there was nothing very surprising in these discrepancies, any more than in those on which the author (Mathews) commented as existing between results of M. Le Chatelier and other physicists in the case of tungsten, molybdenum and chrome-steels.

"If the law of atomic weights was exact, it was applicable, as its very enunciation implied, only to the dissolved fraction of the alloyed

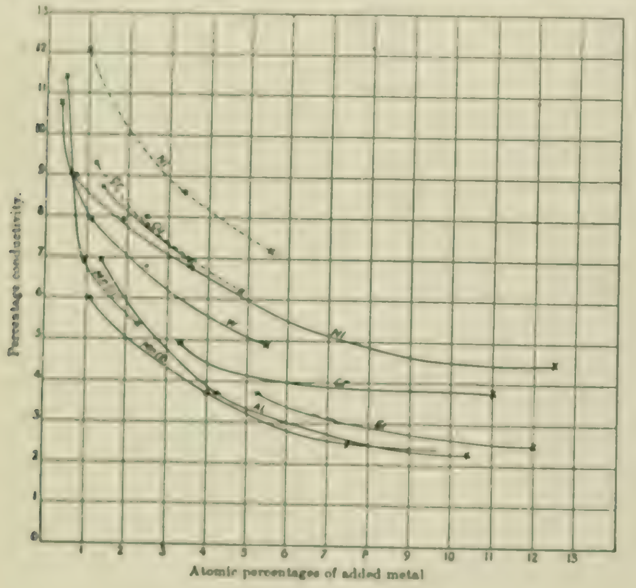

FIG. 2.—MATHEWS CURVES.

substances, but this fraction varied according to the treatment, and was unknown in many cases. Notably chromium and tungsten, and probably molybdenum, too, would form double carbides, which, when liquated, would have but a very weak influence. Before concluding, it would be necessary to know in each particular case what was dissolved and what was not, and also what was the state of the substance in solution. These were questions to which one could but seldom find an answer, and much investigation, as Dr. Mathews rightly said, was still necessary." It was in the hope of stimulating further work upon this interesting problem that we venture to bring it to the attention of electricians, hoping—as we have elsewhere stated in regard to these essays—to "provoke discussion, and, more especially, thought and research in this important field. Their confirmation would be of great interest; their refutation upon experimental evidence would doubtless produce some other and correct explanation."

At the time that remark was made, Mr. Benedicks, in the University of Upsala, was bringing forth the most conclusive evidence that for small concentrations the increase in resistivity of steel is a function of the atomic weight, i. e., equi-atomic solutions of metallic elements in iron produce equal increase in electrical resistance.

Mr. Benedicks determined the electrical resistance of a number of samples of steel which had been carefully analyzed. They contained varying quantities of carbon, silicon, manganese, sulphur and phosphorus, the last two elements being low and fairly uniform. The steels were tested in both the hardened and annealed state. From his determinations, the author found that one atomic per cent. of various elements dissolved in iron produces an increase in resistance which is equal to 5.9 microhms per cm^2. The author also calculated that the resistance of absolutely pure iron would be 7.6 microhms per cm^2, but this value is lower than has ever been obtained experimentally, for perfectly pure iron has not been investigated. By means of the following formula, it was found possible to calculate the resistance of steel with considerable accuracy:

$S = 7.6 + 26.8\ \Sigma C$, in which $S =$ resistance in microhms per cm^3, and $\Sigma\ C = \%$ foreign substances calculated as equivalent quantities of carbon.

But in order that this formula be applicable, it was necessary to ascertain the effect of carbon itself upon the conductivity. This Mr. Benedicks has done very skillfully. It is now generally understood that carbon combines with iron to form a carbide, F_3C. This exists in annealed steels in a condition easily recognizable under the microscope, and is known to metallographists as "cementite." When steel is heated to temperatures above 700° C. and cooled suddenly, no cementite appears, but under the microscope, at high magnification, a structure known as "martensite" is seen. The carbon in this condition may be combined or simply dissolved without combination. Prof. Arnold thinks that a sub-carbide, $F_{24}C$, exists in hardened steel.

However, when hardened steel is reheated and slowly cooled, cementite appears, and the other micrographic constituent is known as "ferrite." This has usually been considered to be *pure* iron, and the combined ferrite and cementite, when existing in alternate bands or layers, constitute the "pearly constituent" of Dr. Sorby, now called "pearlyte." Mr. Benedicks shows that ferrite is not carbon-free iron, but that annealed steels, containing from .40 to 1.70 per cent. carbon, consist of cementite and iron containing about 0.27 per cent. of dissolved or hardening carbon. This constituent may be identical with the "sorbite" of Osmond. The segregated carbon, in the form of cementite exerts little influence upon the conductivity. This statement does not seem to accord with that of Le Chatelier, who gives the resistance of ferrite as 9.5, and cementite (Fe_3C) as 45.

When a low carbon steel—less than 0.40 per cent. carbon—is annealed, cementite separates, but the accompanying ferrite contains less carbon than 0.27 per cent. For example, Mr. Benedicks states that the ferrite of a .20 carbon steel would contain 0.06 — 0.07 per cent. of dissolved carbon. Benedicks' work confirms the chemical researches of Osmond and Werth, Carnot and Goutal, Brustlein, Arnold, and Stansfield in regard to the existence of 0.27 per cent. of hardening carbon in solid solution in annealed high-carbon steels. All this work strengthens the author in the opinion he has held and expressed repeatedly, that in the separating or crystallizing out of the constituents of any alloy, no pure metal ever separates but metal containing more or less of the other constituents of the alloy in solid solution. It seems, too, that in Benedicks' confirmation of the atomic equivalence of the elements in their effect upon conductivity, we have presented some new evidence in favor of the opinion expressed by Professor Ramsey, in 1889, "that it would appear legitimate to infer that in solution, as a rule, the atom of a metal is identical with its molecule."

As regards the exact nature of the phenomenon of conductivity in metals and alloys, very little is known. The beautiful theory of electrolytic conductivity in ordinary liquid solutions seems to have nothing in common with metallic conduction. In a way, these two kinds of conductivity seem to be opposed to each other, for while the conductivity of a pure liquid is increased by the presence of dissolved matter in it, a pure metal becomes a much poorer conductor if another element is added to it. Dewar and Fleming's researches showed that the resistance of pure metals decreased with falling temperatures, and there was evidence that at the absolute zero the resistance would be *nil*. In the case of alloys, no such evidence was afforded; they seem to follow some other law. What is true in regard to electrical conductivity probably holds for thermal conductivity as well. Kohlrausch showed that for high carbon steel, low carbon steel and wrought iron the ratio between these two kinds of conductivity is close.

The electrical resistance of steel at high temperatures furnishes one of the evidences of the allotropy of iron. Le Chatelier found two reversible transformations in the conductivity of a certain sample of malleable iron at 730° C. and 855°C. These temperatures correspond closely to the "breaks" in the cooling curve of mild steel.

designated by Osmond as *Ar* 2 and *Ar* 3, *i. e.*, in slowly cooling such a sample of steel there occur two evolutions of heat at certain temperatures. These evolutions of heat occur in the purest carbonless iron. In iron containing carbon, their point of occurrence is affected by the presence of that element, but since its presence is not the cause of their occurrence, they have been thought to indicate molecular or allotropic changes in the iron itself. As has been shown for iron, the first additions of any other element produce greater increase in resistance than any subsequent additions. It is these first small additions that may be supposed to remain in solid solution, and to act most deleteriously upon the conducting power of the iron. Matthiessen showed that the conductivity curves for most pairs of metals—excluding the metals lead, tin, zinc and cadmium—is of the shape of the letter U. Alloys whose compositions lie along the part of the curve where it is nearly vertical, are those in which a single solid solution is most likely to occur. Intermediate compositions usually consist of at least two constituents crystallizing together in some sort of a conglomerate of solid solution, intermetallic compound, eutectic, etc. However they crystallize, each constituent is more or less saturated with the other at the temperature of solidification. All such alloys conduct poorly, but it is not known that the size of the grain or the number of boundary faces between contiguous grains influences the conductivity directly. The presence of such constituents, microscopically discernable, has suggested to Lord Kelvin the idea that the increased resistance may be due to thermo-electric effects, caused by the passing of the current. He says, "the temperature thus arising increases until the conduction of heat through the laminæ balances the Peltier effect at the junctions, and it gives rise to a thermo-electric force opposing the passage of the current." Now, if such effects take place at points of contact between laminæ of relatively large size and of different compositions, why might not the same phenomenon occur between much smaller laminæ, and why might they not occur between the atoms themselves—in other words, why will not the explanation hold good for solid solutions? This would account for a greater effect from a dissolved than from a segregated substance.

In the case of non-ferrous alloys, there is some evidence in favor of the existence of an atomic relation governing conductivity. These alloys would be the easiest to study by way of confirmation of the evidence afforded by steel, because they can be obtained in a greater degree of purity. From existing data, however, something in favor of the atomic theory as applied to metallic conduction has been gathered. This we will summarize briefly in conclusion. The only two metals which we know to be perfectly soluble in each other, and which never separate into two microscopic constituents, are silver and gold. The highest degree of mutual solubility of which we can conceive would be afforded by an alloy of the composition, *Au-Ag*, *i. e.*, an equi-atomic alloy. It is precisely this one which has the highest resistance. Alloys whose compositions are represented by the atomic values Au_4Ag and Ag_4Au conduct about equally well. In the investigations of the Reichsanstalt upon the conductivity of nickel-copper alloys, it was found that the alloy consisting of almost equal atoms of nickel and copper had the highest resistance. In the case of copper-silver alloys this does not hold good, but, nevertheless, the solution theory in regard to resistance is confirmed. Matthiessen found the highest resistance of silver-copper alloys to be afforded by Levol's alloy, which contains about 28 per cent of copper.

This is the one alloy of copper and silver, which on slow-cooling in mass, does not segregate, but is of uniform composition throughout. It is, in fact, the eutectic alloy, and a microscopic examination of it reveals the fact that it is composed of two constituents. One of these we believe to be a saturated solid solution of copper in silver, and the other a saturated solid solution of silver in copper. Hence, we have two, instead of one, saturated solid solutions crystallizing side by side, and the lowest conductivity is afforded by them just as an alloy of the composition *Au-Ag* gives the lowest conductivity of all gold-silver alloys. Any addition of silver or copper to Levol's alloy is equivalent to diluting one or other of the solid solutions of which it consists, and the conductivity is improved thereby.

If the conductivity of a series of steels containing practically a constant percentage of manganese, but varying in carbon, be measured in both the hardened and annealed conditions, and the results plotted, it will be found that the quenched steels not only have a higher resistance, but that the curves diverge from each other directly in proportion to the carbon content. The hardening of steel changes the carbon from a segregated to a dissolved condition. This explains the divergence of the curves for the increasing amount of dissolved carbon, increasingly augments the resistance. If, however, steels of constant carbon and varying manganese be similarly treated, the curve of the quenched specimens will fall below that of the annealed specimens, but will be practically parallel to it.

The difference between the two curves in this case is due to the retention of all the carbon in the dissolved state, but the effect due to increasing manganese is the same in both conditions, for it crystallizes isomorously with the iron, and—for low percentages—is contained in the iron crystals, whether they are quenched or not.

From what has preceded, it will be seen that although electrolytic and metallic conductivity are so different in nature, yet the question of solubility seems to affect or control metallic conduction, and there exists an atomic relation between the effect of different dissolved substances upon the conductivity of the principal metal or solvent. All the recent work upon alloys tends to strengthen the idea that alloys in many of their properties resemble liquid solutions, and with a brief summary of these points of resemblance we will close. Graham and Roberts-Austen have shown that at temperatures much below their melting points, metals diffuse into one another, like a salt into water. Like liquids, metals may or may not be perfectly miscible. In the latter case, Dr. Alder Wright has shown that a fused mass of two immiscible metals on cooling separates into layers, and that the layers do not consist of pure metals, but that each metal retains a little of the other in solid solution..

In general, solubility increases with the temperature. Professor Spring and others have shown that metals will flow under pressure, and that by the same means, mixed metals may or may not react chemically when thus brought into intimate association. Molecular mobility increases with the temperature in metals as well as in liquids. Upon cooling molten binary alloys, the phenomena attending solidification are strongly suggestive of the behavior of freezing salt solutions. It has been shown by Heycock and Neville that the depression of the freezing point of one metal by the addition of another to it follows the laws of Coppet and Raoult. The eutectic alloy, of Guthrie, is the analogue of the "cryohydrates" of physical chemistry, and Roozeboom, Le Chatelier and others have shown that the phase rule of Gibb applies quite as well to the explanation of questions of equilibrium in alloys as it does to the explanation of similar problems in regard to liquids and gaseous mixtures.

In view of all this evidence, it may not be surprising, but it is, nevertheless, a very interesting coincidence that almost simultaneously three workers of different nationalities in three different countries should have observed independently another confirmation of the periodic relation of the elements and of the general applicability of the solution theory to the explanation of the properties of alloys.

Telpherage Mails in Italy.

By CESARE PIO.

The Minister of Posts and Telegraphs of the Italian Government is at present devoting great attention to a new system of postal communication invented by Mr. Piscicelli, an engineer from Naples. Tests on this new system have commencea, and features of it are exhibited on the Margherita Hall under the Main Arcade in Naples. The idea of Mr. Piscicelli is a very simple one, and his system is destined perhaps to revolutionize all systems of land and rural postal communications in the world. Mr. Piscicelli's invention consists in building up a small aerial railway whose track is made of steel wires, supportea at the height of 45 feet on poles 300 feet apart. Small motor cars run suspended to these wires, and are fed with electric current. The motors are designed so to communicate to the car a speed of 400 km. (250 miles) an hour. With a speed of this kind, all the Italian post offices would be in communication on a very rapid schedule.

In Rome a main post office is to be installed in conjunction with eight or ten sub-stations, each sub-station consisting in a tower 75 feet high, provided with a mailing box at the bottom. All letters mailed are automatically stamped with indications of the month, day, hour and minute at which the letter was mailed. The letter is then conveyed to the top of the tower, where a special employee is in charge of putting all the mail in the small motor car, which is then sent to the General Post Office. Thence the mail is then forwarded to the different cities of Italy in less than two hours. Each

steel wire of the size is designed for carrying a weight of two tons. The motor cars for letters weigh 11 pounds and the cars for printed matter are able to carry 60 small newspapers. With this scheme, it will be possible to read at 10 o'clock in Milan all newspapers printed at 8 o'clock in Rome. This would, of course, revolutionize the journalistic field. The cost of installation of this kind of plant reaches 3,000 lires ($600) per kilometer, or about $950 per mile. This is not very much when one thinks of the great economy realized in reducing the number of employed and the better facilities afforded to the public.

Proposed Developments of the Institute.*

By Charles F. Scott.

Mr. Scott opened his address by saying that the day marked the entry of the Institute's newly elected officers on their duties, and the beginning of another year; and that it would be well to pause before entering upon the routine of regular work and to consider the functions of the Institute, its present status and its future possibilities.

The position occupied by the electrical engineer is unique. The science underlying his work is most fascinating and most fruitful. The applications of electricity are not confined to a limited field; they are almost universal—there is scarcely a branch of human activity that has not received a quickening touch. So rapidly have electrical novelties become commercial necessities and simple experiments evolved great systems that a new branch of engineering has been developed in a score of years. The scope of the electrical engineering profession has developed from trivial beginnings until it includes works of the greatest diversity and magnitude and far-reaching consequences, in industrial, commercial and social life. This development has been the result not of mere chance, but of a combination of favoring conditions. Faraday and Maxwell laid the foundations of electrical science and the general mechanical, industrial and scientific evolution of the nineteenth century gave the necessary opportunity and impetus to its commercial application. Electricity is usually a means, an agency, and is not in itself an end. In order that electricity may be applied, there must be that to which it can be applied. The electric motor, for example, would be of little consequence if there were no field for it—if there were no machine shops or mills, no elevators or street cars. It is because the steam engine has for a century been training men to use mechanical power, and because the existing methods of transmitting and distributing power have such fixed and narrow limitations, that the electrical system has so quickly taken its place between engine and lathe, between the waterfall and the loom. It is because the science of electrochemistry was advancing that the dynamo found a place in electrochemical industries, and, in turn, cheap electrical energy has accelerated electrochemical development. It is notable that the greater part of the power developed at Niagara Falls is used in electrochemical and allied processes in the manufacture of aluminum, carborundum, sodium, chlorine, caustic soda, calcium carbide, phosphorus, graphite and barium hydrate, while in almost every case even the discovery of the process itself as well as the development of the industry has occurred since the work upon the power plant has begun.

It is a hackneyed theme—the infancy of electricity; and yet to obtain a just view of his position the electrical engineer must realize how brief compared with other branches of engineering is the experience upon which his work is based. Even the oldest of the electrical inventions, the telegraph, had its beginning when men now living were well-grown boys. The man who has been called the "Father of Electrical Engineering," whose theoretical and mechanical skill made the ocean cable a success, is still a vigorous worker, and quite recently the Institute was privileged to tender a reception to him, its honorary member, Lord Kelvin. It is not yet 27 years, the age required for full membership in the Institute, since the Centennial Exposition at Philadelphia gave an impetus to electrical invention and the telephone was made public. It was not until 1884, the year of the Philadelphia International Electrical Exposition, that measures were taken for establishing a national organization among electrical men, and the American Institute of Electrical Engineers was established. Its first president, Dr. Norvin Green, and half of its vice-presidents and managers were identified with the telegraph. The practical electricians of those days were telegraph men, but now a new generation has arisen to whom the click of the sounder is unintelligible.

The past 50 years, and notably the past decade, have witnessed a general activity of such magnitude that it marks an epoch in the world's history. And in this development, electricity has been foremost. I will not attempt to recount and catalogue what has been accomplished, in how many ways electricity has proven useful, the various purposes for which it is employed in industrial and manufacturing enterprises, nor to what extent the telephone, telegraph and cable have affected domestic, commercial, social and national life; I will not mention the results which the railway motor in city, suburban and interurban service is effecting in the cheapening of travel and the redistribution of population; I will not dwell upon the far-reaching effects in the economic world of an agent which makes possible the combination of formerly diverse interests by operating in one great system local and interurban railways, mills, shops, elevators, street lighting and indoor illumination; nor will I even attempt to sum up all these achievements and estimate by how much the results of human activity are increased through the agency of electricity. The point I do make is the magnitude of the work and the far-reaching responsibilities which have so quickly devolved upon the electrical profession.

Consider for a moment the financial aspect. It is estimated that the total investment in electrical applications outside of telegraphy and telephony at the time this Institute was founded, did not exceed $1,000,000. At the present time the estimated capitalization of electrical applications in the United States approximates $4,000,000,000. In other words, electricity represents about one-third the value of that represented by the investment in our steam railway systems. Speaking generally, this enormous expansion has been made possible by the electrical engineer, and, furthermore, the successful outcome of these investments depends upon his work. Even these figures, although they indicate the vast responsibilities which are entrusted to the electrical engineer, do not fully measure that responsibility, since they take no account of the importance of his work in the many industries and enterprises which use electrical apparatus in a subsidiary or auxiliary way, although it may be essential to their efficiency and success.

The work which the future has in store for the electrical engineer seems even greater. Scarcely a plan for future progress is proposed either by the practical and conservative business man, manufacturer or engineer, or by the sanguine promoter or the imaginative writer who portrays an Utopian civilization, which does not involve some application of electricity.

We are now at a time of general prosperity. Will this continue? Is prosperity a normal condition, or are successions of prosperity and depression inevitable? Continued prosperity requires high efficiency. Effort must not be wasted or dissipated. The ordinary activities and functions of industrial and commercial life must be efficiently performed, and energy must not be lost through great undertakings which fail in the execution or accomplish no useful result. Think for a moment how different the condition of Italy might be, had the energy which was expended in the construction of cathedrals been devoted to school-houses and an educational system. Consider what a drain upon the resources of a country, both in wealth and in men, are a large standing army and navy. Imagine the results had the hundreds of millions of pounds expended by England on the South African war been devoted to the development of the country, by establishing electrical railways and lighting and power plants. Even granting that pyramids and cathedrals and wars have been legitimate factors in the world's history, and that on the whole they have been beneficial, nevertheless they indicate how vast are the forces which have directly retarded rather than advanced material prosperity. There is no doubt but that the forces at hand are ample to maintain a constantly increasing condition of prosperity if they be wisely directed. A great responsibility rests upon the intellectual classes.

As a factor in maintaining prosperity, the work of the electrical engineer is of great consequence. Applied electricity so increases the efficiency of industrial and commercial life that better results and higher efficiency can be secured with a given expenditure of energy. The electrical engineer is called upon to advise and direct in many large undertakings, and upon the soundness of his judgment depends success or failure. Electricity occupies a vital place in the affairs of the present, it will be an increasing element in the future.

*Presidential address delivered at the [illegible] Meeting of the American Institute of Electrical Engineers, New York, September [illegible], [illegible].

nd the electrical engineer will be an important agent in avoiding depression and maintaining prosperity.

We have considered in a somewhat general way the electrical engineer, and the engineering profession. In a profession where there are so many workers, where the majority of them are young men, where their work is so closely connected with scientific investigation and with what is being done in allied professions, when the rate of advance is so great in scientific discovery, in invention, in application to processes which are new, and in undertakings of increasing value, and particularly in a country which is recognized as foremost in electrical development, there is a unique field for a national organization such as the American Institute of Electrical Engineers.

Electrical interests are so diversified and so extended that electrical workers should be brought together. They should have a common meeting place. Here discoveries may be announced, inventions described, engineering schemes criticized and new undertakings presented and discussed. Here the student and professor, the investigator, the inventor, the manufacturer, the operator and the consulting engineer may meet upon common ground. The engineer who is tempted to ridicule scientific work finds that it is the foundation upon which his own work rests. The professor who regards slightly the work of the designing or constructing engineer may find that his own cherished formulæ are derived from the rules and contain the constants which the practical man has determined for himself. Association leads to mutual understanding, it curbs eccentricity and one-sided development, and promotes symmetrical advancement.

It is the function of the American Institute of Electrical Engineers to bring individual workers into a common unity, to join them in a community of interest, which is called the electrical engineering profession. It should place the profession of electrical engineering above suspicion of corruption and chicanery, and should call for high standards of dignity and honorable accomplishment. It should counteract the spirit of blind partisanship and of depreciation of others' efforts among those who are divided by commercial interests, whether they represent competitors or buyer and seller. While each has his individual interests, there is a general interest which is common to all. All share in that which discredits the profession as well as in that which elevates and advances it.

It is the function of the Institute to continually bring together the diversified achievements of many workers, which, taken altogether, constitute a single total of accomplishment, which is called progress. It should discriminate between that which is substantial and that which is not. It should place the stamp of recognition and approval upon all that is meritorious and marks an advance in the art.

It is the function of the Institute to take the lead in such measures as will promote the general interest of the profession and the efficiency of electrical work.

The American Institute of Electrical Engineers has represented the profession in various ways:

It has taken a prominent part in establishing uniform insurance rules in a National Code.

It has been conspicuous in representing American engineers at international expositions and international congresses, both in America and abroad. In the same connection it has been active in establishing international standards, and through its advocacy the name Henry, in honor of an American electrician, has secured a place in the list of electrical units.

It prepared, in 1890, the standard wiring table for lighting and power purposes, which has been of great service in standardizing electrical calculations.

It has established a code of standardization covering names, definitions, methods of rating, tests and the like, which is of the greatest service in unifying and simplifying electrical practice.

It has established through the generosity of a few individuals a library which in historic value is unequaled.

Let us now turn our attention to the future and consider the specific ways in which the works of the Institute may be advanced during the coming year:

1. The membership should be increased. The power and influence of the Institute is dependent upon the number, character and activity of its members. There are many engineers eligible to membership who are not members, because they do not fully appreciate the scope and the work of the Institute. There are many electrical workers who would become worthy associate members if they realized the value of connection with the Institute.

Is it not the privilege and the duty of an electrical engineer to give his best support to the Institute which stands for the highest interests of his profession? Are not the advantages which membership in the Institute affords such that no progressive engineer can afford to be without them? If these things are so, then it rests upon the present members to build up the Institute by making its work known to those who should become members.

During the past year the membership has increased 25 per cent., and reached 1,546. This is less than one-half the membership in the British Institution of Electrical Engineers. If American Institute membership bore the same relation to the kilowatt capacity of the electrical power stations of the country as does that of the British Institution, our membership should be 25,000.

There are to-day cities in which are located engineering schools and large electrical interests, which have but three or four members. Five States east of the Mississippi River have but one or two members each, and there are three of the New England States that have but three members each.

2. Papers and discussions should be contributed from a larger proportion of the membership. The transactions of the Institute should be a record of the advance in electrical work, and should contain only that which is of material value to the advancement of the art. I submit that even their present high standard does not adequately represent American electrical progress. If it is true that our papers do not fully present the advance thought and best achievements of the time, it is simply because our advance workers do not contribute more.

Material may be presented in formal papers, in original communications or in discussion. Some subjects do not provoke general discussion; others depend for their value upon the experience or the opinions of a large number of members. While the Institute is not as a body responsible for the statements or the opinions of its members, there is nevertheless an obligation resting upon its members not to leave unchallenged inaccurate and misleading statements.

Our last volume shows that 5 per cent. of the membership took part in the meetings, and that 2 per cent. furnished papers. Of these papers 10 per cent. came from miscellaneous sources, 20 per cent. came from college professors, 25 per cent. from operating and consulting engineers, and 45 per cent. from engineers connected with manufacturing companies.

These figures indicate that electrical matters are advancing so fast that even the teachers in the great technical schools fall behind the pace, because the problems come first to the manufacturer. To the manufacturing companies must be given credit for substantially advancing scientific investigation as well as practical development.

Further examination of the last annual volume shows that although one-fourth of the members reside in New York, and the monthly meetings are held there, yet only one-fifth of the papers were presented by New York members. The Institute is national in its scope, and there should be united effort throughout the entire membership to increase the quantity as well as the quality and the usefulness of its published proceedings.

3. Local meetings of the Institute in various cities will broaden the interest in its work and generally extend its benefits. Some local organizations have been formed, but this department of our work should be greatly extended. While such organizations should be conducted in harmony with the general methods and purposes of the Institute, synchronizing as far as practicable with its general meetings, they should also become "self-exciting" centers of local electrical activity. There is so much material available and there are so many subjects of local and general interest that a small amount of well-directed effort in organization will produce great results.

4. Universities and technical schools with electrical engineering departments may organize local meetings of the Institute, which would be of benefit to both instructors and students in keeping them in touch with the most recent developments and practice in electrical work. Meetings may be under the direction of the professor of electrical engineering and may be conducted in various ways to conform best to the local conditions. Local Institute members may join with the school meetings. A school should be the natural center for engineers of its vicinity. It supplies a suitable meeting place, and the discussion of Institute papers by engineers, instructors and student should be of benefit to all.

In the thesis work of students the Institute may be helpful in recognizing and publishing in abstract or in full, theses which are noteworthy. This would give an impetus to the preparation of theses and

[illegible] rivalry among different institutions and would add to the [illegible] of our Transactions.

The present education of the engineer is a problem to which various solutions are offered. All, however, will doubtless agree that the profession has already reached a stage and is advancing so rapidly that the purely "practical man" cannot hope to maintain himself in the front rank. The rate at which development is progressing demands a thorough grounding in fundamental principles, in order to impart the power for grasping and meeting new conditions.

My predecessor spoke truly when he said that the educational institutions should give the young men "a thorough understanding of the fundamental principles of electrical engineering and allied sciences, and a good knowledge of the methods of dealing with engineering problems."

The best education is that in which theoretical training in fundamental principles predominates. The true function of practical work in a broad engineering education is not to produce skilled workmen or full-fledged engineers, but it is to supplement theoretical work, making it definite and certain, so that the student may properly assimilate the instruction which he receives. Again, a student should not make his mind a storehouse of facts, but he should learn where facts and information can be gotten, and how to use them. The principal purpose for bringing the work of the Institute directly to the student and putting him in touch with practical work, is that it will assist him greatly in keeping in touch with actual things and in giving him a definite idea of the kinds of work which lie before him, and for which he is preparing.

Fortunate will it be if we can lead him to see that in the training of an electrical engineer there should be something besides technical books—that logical thinking and clear expression and general culture are indispensable in a profession that comes in touch with so many departments of science and engineering as well as industrial and commercial and social activity, and that he must be a broad man with a broad educational foundation, who would aspire to the fullest usefulness and success.

5. The collection of engineering data and the establishing of standard practice in electrical engineering is one of the important functions of the Institute. The present years are formative years. Electrical engineering is crystallizing. Electrical theory and laws and electrical measurements are more definite than those relating to the allied professions; for example, consider the relative accuracy in the predetermination of the efficiency of a dynamo with that of an engine, or the ease and precision of measurement of dynamo output by a wattmeter with that of an engine by a mechanical dynamometer or brake. Electrical engineering practice, however, is now being established. The apparatus and the methods, both in detail and in general, which characterize present work are radically different from those of five or ten years ago. It is of the highest importance to the profession that definitions and principles and laws pertaining to engineering practice should be determined and adopted as rapidly as circumstances will permit. General investigations should be made in various lines of electrical engineering work, not primarily for the purpose of devising theoretical standards or undertaking original investigations, but for the purpose of determining what is best in present practice and of formulating and crystallizing it into what may be recognized as standard practice.

We must not fail to realize the value of standards. An English engineer in a distant part of the British Empire in specifying the apparatus for a large electrical railway, strongly recommended that American standard apparatus be purchased as "England has no standard." In Europe to-day there is a confusion of systems and frequencies and voltages, and a wide diversity in types of construction. Many foreign engineers pride themselves on devising that which is novel instead of adopting that which is standard. American engineers are not divided by nationality and by language as are those of Europe; they have that unity in which there is strength; they appreciate the advantage of adhering to standard practice; they realize that the manufacture of dynamos and motors as well as shoes and clocks, engines and bridges will be cheaper and quicker if made in quantity.

Do you realize the relative magnitude of American electrical work? The United States with only one-fifth the population of Great Britain and Europe has two and one-third times the kilowatt capacity in power stations and electric railways, and three and one-half times the mileage of electric railways. The power houses in operation and under contract in New York City would replace all the central stations for lighting and power in Great Britain or in Germany; they would operate all the electric railways of Great Britain and Europe combined; one alone would be sufficient for the railways of Germany, and the output of a single generator would run all the railways of Switzerland. American designs, methods and practice are being introduced into half a dozen factories in foreign countries. Electrical progress and leadership can be promoted by this Institute, as it draws together and unites the efforts of electrical workers and as it aids in establishing the standards of the future.

6. Our library merits a cordial support. Through good fortune and the generous assistance of Dr. S. S. Wheeler we have the Latimer Clark library as a foundation. Mr. Carnegie's kindly contribution has enabled the library to be catalogued and otherwise made useful. Various members, notably Messrs. Mailloux, Hutchinson, Wetzler, Arnold, Keith, Caldwell, Jenks, Fish and Clarke, as well as the American Bell Telephone Company, the New York Electrical Society, and others, have contributed valuable sets of books, such as the proceedings of scientific societies, the records in patent litigation and the like. At least one member has provided by his will that a part of his technical library shall pass to the Institute, and another is proposing an endowment for the future continuation of the sets which he has presented. The policy decided upon by the library committee is to place upon our shelves every book relating to electricity in the English language, and every book of any value in the French, German and other languages. The 7,000 volumes, mostly of rare books, which we now have is a magnificent beginning. Let all who are able cooperate in this important work of building up a complete reference library.

7. Permanent quarters for the Institute should be an object of plans and anticipations. An organization which is so closely connected with so many vital interests of such vast commercial value, and which possesses such possibilities for promoting the best interests of the profession should not be hampered for want of the most convenient accommodations. Personal acquaintance and social intercourse are influential factors in unity of sentiment and of action. Our library is all but inaccessible in its present cramped quarters, which do not permit normal growth.

8. Co-operation with similar institutions in other countries will be mutually beneficial in various ways. In certain lines they may learn from us, but there is a great deal that we can learn from them.

In addition to general co-operation, such as is promoted by international congresses, much is to be gained in less formal ways. For example, different institutions may at times discuss the same subject. Again, they may do a great service to electrical progress by harmonious working in the adoption of standards. The members of one institution may broaden their outlook by becoming members of other bodies. It is the hope and expectation of our Institution to have as its guest, within the next few years, the Institution of Electrical Engineers of Great Britain. The scope of our profession is worldwide. Let us welcome this coming opportunity to extend our acquaintance and broaden our ideas.

In conclusion, I have realized the responsibilities which rest upon the president of this Institution, and it was with reluctance and misgiving that I yielded to some urgent friends and consented to become a candidate. I fully appreciate the confidence you have expressed by your votes, and I now ask your co-operation in continuing the high standard of work attained during the past year under my honored predecessor.

If, my fellow-members, the objects I have outlined are worth while, each of us can well afford to do his share towards realizing them.

Submarine Cable Laying Perils.

The cable steamer "Newington" secured the St. Lucia end of the St. Vincent cable on September 21, four and a half miles from the Soufrière volcano, on the island of St. Vincent, and had just finished buoying it, when there was a violent eruption of the volcano without the slightest warning. The steamer thereupon headed away from the land, followed by dense clouds of smoke. She had a narrow escape, and it is considered inadvisable for her to engage in further operations there, especially as the cable was found to be greatly mangled. The "Newington" will proceed to St. Thomas for a cable to complete the repair of the St. Lucia-Grenada section.

Single Phase Electric Railway System.*

By B. G. Lamme.

THE Washington, Baltimore and Annapolis Railway is a new, high-speed electric line extending from the suburbs of Washington to Baltimore, a distance of about 31 miles, with a branch from Annapolis Junction to Annapolis, a distance of about 15 miles. The overhead trolley will be used, and schedule speeds of over 40 miles per hour are to be attained. This road is to be the scene of the first commercial operation of an entirely new system of electric traction.

The special feature of this system is the use of single-phase alternating current in generators, transmission lines, trolley car equipment and motors. It constitutes a wide departure from present types of railway apparatus, and while retaining the best characteristics of the present standard direct-current motor system, the use of alternating current makes it possible to avoid many of the bad features. The standard direct-current railway equipment possesses several characteristics which fit it especially for railway service. These characteristics have been of sufficient importance to overbalance many defects in the system. In fact, a far greater amount of effort and engineering skill has been required for overcoming or neutralizing the defects, than for developing the good features possessed by the system. By far the most important characteristic possessed by the direct-current system is found in the type of motor used on the car. The direct-current railway motor is in all cases a series-wound machine. The series motor is normally a variable field machine, and it is this feature which has adapted the motor especially to railway service. Shunt-wound motors have been tried and abandoned. All manner of combinations of shunt, series and separate excitation have been devised and found wanting, and in many cases the real cause of failure was not recognized by those responsible for the various combinations. They all missed to a greater or less extent the variable-field feature of the straight series motor. It is true that a variable field can be obtained with shunt or separate excitation, but not without controlling or regulating devices, and the variation is not inherently automatic, as in the series motor. Polyphase and single-phase induction motors do not possess the variable field feature at all, as they are essentially constant-field machines. They are equivalent to direct-current shunt or separately excited motors, with constant field strength, which have been unable to compete successfully with the series motor. The variable field of the series motor makes it automatically adjustable for load and speed conditions. It also enables the series motor to develop large torques without proportionately increased currents. The automatically varying field is accompanied by corresponding variations in the counter e. m. f. of the armature, until the speed can adjust itself to the new field conditions. This feature is of great assistance in reducing current fluctuations, with a small number of steps in the regulating rheostat. Any increase in current, as resistance is cut out, is accompanied by a momentary increase in the counter e. m. f., thus limiting the current increase to a less value than in the case of constant field motor.

Next to the type of motor, the greatest advantage possessed by the direct-current system lies in the use of a single current or circuit, thus permiting the use of one trolley wire. The advantages of the single trolley are so well known that it is unnecessary to discuss them. For third rail construction, the use of single current is of even greater importance than in the case of overhead trolley. It is seen, therefore, that it is not to the direct current that credit should be given for the great success of the present railway system, but to the series type of motor and the fact that up to the present time no suitable single-phase alternating-current motor has been presented.

Some of the undesirable features of the direct-current railway system should also be considered. The speed control is inefficient. A nominally constant voltage is supplied to the car, and speed control is obtained by applying variable voltage at the motor terminals. This variation is produced by the use of resistance in series with the motors, with a loss proportional to the voltage taken up by the resistance. By means of the series-parallel arrangement, the equivlent of two voltages is obtainable at the motor terminals without the use of resistance. Therefore, with series-parallel control, there are two efficient speeds with any given torque, and with multiple control there is but one efficient speed with a given torque. All other speeds are obtained through rheostatic loss, and the greater the reduction from either of the two speeds, series or parallel, the lower will be the efficiency of the equipment. At start, the rheostatic losses are always relatively large, as practically all the voltage of the line is taken up in the rheostat. For heavy railroad service, where operation for long periods at other than full and half speeds may be necessary, the rheostatic loss will be a very serious matter.

The controlling devices themselves are also a source of trouble. An extraordinary amount of time and skill has been expended on the perfection of this apparatus. The difficulties increase with the power to be handled. The controller is a part of the equipment which is subjected to much more than ordinary mechanical wear and tear, and it can go wrong at any one of many points. The larger the equipment to be controlled, the more places are to be found in the controller which can give trouble. The best that can be said of the railway controller is that it is a necessary evil.

Another limitation of the direct-current system is the trolley voltage. Five hundred volts is common at the car and 650 volts is very unusual. By far the larger number of the railway equipments in service to-day are unsuited for operation at 600 volts, and 700 volts in normal operation would be unsafe for practically all. The maximum permissible trolley voltage is dependent upon inherent limitations in the design of motors and controllers. The disadvantages of low voltage appear in the extra cost of copper and in the difficulty of collecting current. In heavy railroad work, the current to be handled becomes enormous at usual voltages. A 2,400-hp electric locomotive, for example, will require between 3,000 and 4,000 amperes at normal rated power, and probably 6,000 to 8,000 amperes at times. With the overhead trolley these currents are too heavy to be collected in the ordinary manner, and it is a serious problem with any form of trolley or third-rail system which can be used. It is evident that for heavy service, comparable with that of large steam railways, a much higher voltage than used in our present direct-current system is essential, and the use of higher voltage is destined to come, provided it is not attended by complications which more than overbalance the benefits obtained. A further disadvantage of the direct-current system is the destructive action known as electrolysis. This may not be of great importance in interurban lines, chiefly because there is nothing to be injured by it. In city work its dangers are well-known, and very expensive constructions are now used to eliminate or minimize its effects.

From the above statements it is evident that an alternating-current railway system, to equal the direct-current should possess the two pripcipal features of the direct-current system, viz.: A single supply circuit and the variable field motor, and to be an improvement upon the direct-current system, the alternating current should avoid some of the more important disadvantages incident to the present direct-current railway apparatus.

The system must, therefore, be single-phase. The importance of using single-phase for railway work is well known. The difficulties and complications of the trolley construction are such that several alternating-current systems have been planned on the basis of single-phase supplied to the car, with converting apparatus on the car to transform to direct current, in order that the standard type of railway motors may be used. Such plans are attempts to obtain the two most valuable features of the present direct-current system. The polyphase railway system, used on a few European roads, employs three currents, and, therefore, does not meet the above requirement. The motor for the alternating-current railway service should have the variable speed characteristics of the series direct-current motor. The polyphase motor is not suitable, as it is essentially a constant-field machine, and does not possess any true variable speed characteristics. Therefore, it lacks both of the good features of the direct-current railway system. A new type of motor must, therefore, be furnished, as none of the alternating-current motors in commercial use are adapted for the speed and torque requirements of first-class railway service. Assuming that such a motor is obtainable for operation on a single-phase circuit, the next step to consider is whether the use of alternating instead of direct current on the car will allow some of the disadvantageous features of the direct-current system to be avoided. The direct-current limits of voltage are at once removed, as transformers can be used for changing from any desired trolley voltage to any convenient motor voltage. Electrolysis troubles practically disappear. As transformers can be used, variations in supply voltage are easily obtainable. As the motor is as-

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sumed to have the characteristics of the direct-current series motor, speed control without rheostatic loss is obtainable when voltage control is obtained. This combination, therefore, allows the motor to operate at relatively good efficiency at any speed within the range of voltage obtained. If the voltage be varied over a sufficiently wide range, the speed range may be carried from the maximum desired down to zero, and, therefore, down to starting conditions. With such an arrangement no rheostat need be used under any conditions, and the lower the speed at which the motor is operated, the less the power required from the line. The least power is required at start, as the motor is doing no work and there is no rheostatic loss. The losses at start are only these in the motor and transforming apparatus, which are less than when running at full speed with an equal torque. Such a system, therefore, permits maximum economy in power consumed by motor and control. This economy in control is not possible with the polyphase railway motor, as this motor is the equivalent of the direct-current shunt motor, with which the rheostatic loss is even greater than with the series motor.

The use of alternating current on the car allows voltage control to be obtained in several ways. In one method a transformer is wound with a large number of leads carried to a dial or controller drum. The Stillwell regulator is a well-known example of this type of voltage control. This method of regulation is suitable for small equipments with moderate currents to be handled. The controller will be subject to some sparking, as in the case of direct-current apparatus, and, therefore, becomes less satisfactory as the car equipment is increased in capacity. Another method of control available with alternating current is entirely non-sparking, there being no make-and-break contacts. This controller is the so-called "induction regulator," which is a transformer with the primary and secondary windings on separate cores. The voltage in the secondary winding is varied by shifting its angular position in relation to the primary. With this type of voltage controller, very large currents can be handled, and it is especially suitable for heavy equipments, such as locomotives. It is thus seen that there is one method of control available with alternating current, which avoids the troubles inherent to the direct-current controller. The induction regulator is primarily a transformer, and all wear and tear is confined to the supports which carry the rotor. Therefore, the objectionable controller of the standard direct-current system can be eliminated, provided a suitable alternating-current motor can be obtained. This ideal type of controller is not applicable to the polyphase railway motor, in which speed control can be obtained only through rheostatic loss. The polyphase control system is even more complicated than the direct current, as there must be a rheostat for each motor, and two or three circuits in each rheostat. It is thus apparent that by the use of single-phase alternating current with an alternating-current motor having the characteristics of the direct-current series motor, the best features of the direct-current system can be obtained, and at the same time many of its disadvantages can be avoided.

This portion of the problem, therefore, resolves itself into the construction of a single-phase motor having the characteristics of the direct-current series motor. There are several types of single-phase, alternating-current motors which have the series characteristics. One type is similar in general construction to a direct-current motor, but with its magnetic circuit laminated throughout, and with such proportions that it can successfully commutate alternating current. Such a motor is a plain series motor, and can be operated on either alternating or direct current, and will have the same torque characteristics in either case. Another type of motor is similar in general construction to the above, but the circuits are arranged in a different manner. The field is connected directly across the supply circuit with proper control appliances in series with it. The armature is short-circuited on itself across the brushes, and the brushes are set at an angle of approximately [illegible] degrees from the ordinary neutral point. The first of these two types of motors is the one best adapted for operation in large units.

This is the type of motor which is to be used on the Washington, Baltimore and Annapolis Railway. Several motors have been built and tested with very satisfactory results, both on the testing stand and under a car. The results were so favorable that the system was proposed to the Cleveland Engineering Company, representing the Washington, Baltimore and Annapolis Railway, and after investigation by their engineers, the system was adopted. A description of the apparatus to be used on this road will illustrate the system to good advantage.

Single-phase alternating current will be supplied to the car at a frequency of $16\frac{2}{3}$ cycles per second, or 2,000 alternations per minute. The current from the overhead trolley wire is normally fed in by one trolley at approximately 1,000 volts. Within the limits of the District of Columbia two trolleys are employed, as by Act of Congress the use of rails as conductors is prohibited in this District, presumably on account of electrolysis. In this case the trouble, of course, will not exist, but the contracting company has been unable to obtain permission for the grounded circuit.

The alternating current to the car is carried through a main switch or circuit breaker on the car, to an auto-transformer connected between the trolley and the return circuit. At approximately 300 volts from the ground terminal, a lead is brought out from the auto-transformer and passes through the regulator to one terminal of the motors. For starting and controlling the speed, an induction regulator is used with its secondary winding in series with the motor. This secondary circuit of the regulator can be made either to add to, or substract from the transformer voltage, thus raising or lowering the voltage supplied to the motors. The regulator, therefore, does double duty. The controller for direct-current motors merely lowers the voltage supplied to the motors but cannot raise it, but an alternating-current regulator can be connected for an intermediate voltage, and can either raise or lower the motor voltage. In this way the regulator can be made relatively small, as it handles only the variable element of the voltage and the maximum voltage in the secondary winding is but half of the total variation required.

In the equipments in question, the range of voltage at the motor is to be varied from approximately 200 volts up to 400 volts or slightly higher. The transformer on the car will supply 315 volts, and the secondary circuit of the regulator will be wound to generate slightly more than 100 volts when turned to the position of its maximum voltage. This voltage of the regulator is about one-fourth of that of the motors at full voltage. The regulator can consequently be made relatively small, in comparison with the motor capacity of the equipment. It has been found unnecessary to use much lower than 200 volts in this installation, as this voltage allows a comparatively low running speed, and approximately 200 volts will be necessary to start with the required torque. The greater part of this voltage is required to overcome the e. m. f. of self-induction in the motor windings, which is dependent upon the current through the motor and is independent of the speed of the armature.

There will be four motors of 100 hp on each car. The full rated voltage of each motor is approximately 220 volts. The motors are arranged in two pairs, each consisting of two armatures in series, and two fields in series, and the two pairs are connected in parallel. The motors are connected permanently in this manner. As voltage control is used, there is no necessity for series parallel operation, as with direct-current motors. To ensure equal voltage to the armatures in series, a balancing or equalizing action is obtained by the use of a small auto-transformer connected permanently across the two armatures in series with its middle point connected between them. The fields are arranged in two pairs, with two fields in series and two pairs in multiple. This parallels the fields independently of the armatures, which was formerly the practice with direct-current motors. It was a defective arrangement with such motors, as equal currents in the field did not ensure equal field strengths in the motors, and the armatures connected in parallel would be operating in fields of unequal strength, with unequal armature currents as a direct result. With alternating currents in the fields, the case is different. The voltage across the fields is dependent upon the field strengths, and the current supplied to the fields naturally divides itself for equal magnetic strengths. The chief advantage in paralleling the fields and armatures independently is, that one reversing switch may serve for the four motors and one balancing transformer may be used across the two pairs of armatures. The usual direct current arrangement of armatures in series with their own fields can be used, with a greater number of switches and connections.

The general arrangement of the auto-transformer, regulator, motors, etc., is shown in Fig. 1.

The induction regulator or controller, resembles an induction motor in general appearance and construction. The primary winding is placed on the rotor, and the secondary or low voltage winding on the stator. The rotor also has a second winding which is permanently short-circuited on itself. This function of this short-circuited winding is to neutralize the self-induction of the secondary winding as it passes from the magnetic influence of the primary. The regulator is wound for two poles, and, therefore, is operated

rough 180 degrees for producing the full range of variation of oltage for the motors. One end of the primary winding of the reguitor is connected to the trolley, and the other to a point between e regulator and the motors. It thus receives a variable voltage as e controller is rotated. There are several advantages in this arangement of the primary in this particular case. First, the reguitor is worked at a higher induction at start, and at lower induction hen running, the running position being used in these equipments or much longer periods than required for starting. Second, when

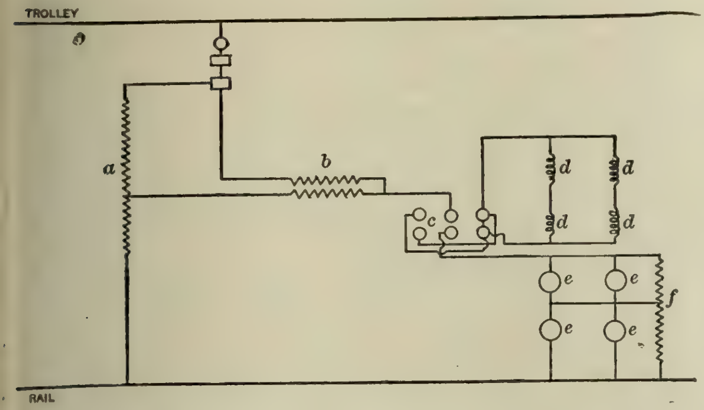


FIG. 1.—*a*. AUTO-TRANSFORMER. *b*. INDUCTION REGULATOR. *c*. REVERSING SWITCH. *d*. FIELD OF MOTORS. *e*. ARMATURE OF MOTORS. *f*. EQUALIZING TRANSFORMER.

the motors are operating at full voltage the current in the primary of the regulator passes through the motors but not through the autotransformer or the secondary of the regulator. This allows considerable reduction in the size of auto-transformer and regulator. The motors on the car are all of the straight series type. The armature and fields being connected in series, the entire current of the field passes through the armature as in ordinary series direct-current motors. The motor has eight poles, and the speed is approximately 700 revolutions at 220 volts. The general construction is similar to that of a direct-current motor, but the field core is laminated throughout, this being necessary on account of the alternating magnetic field. There are eight field-coils wound with copper strap, and all connected permanently in parallel. The parallel arrangement of field-coils assists in the equalizing of the field strength in the different poles, due to the balancing action of alternating circuits in parallel. This arrangement is not really necessary, but it possesses some advantages and, therefore, has been used. With equal magnetic strength in the poles, the magnetic pull is equalized even with the armature out of center. The armature is similar in general construction to that of a direct-current motor. The fundamental difficulty in the operation of a commutator type of motor, on single-phase alternating current lies in the sparking at the brushes. The working current passing through the motor should be practically no more difficult to communicate than an equal direct current, and it is not this current which gives trouble. The real source of trouble is found in a local or secondary current set up in any coil, the two ends of which are momentarily short-circuited by a brush. This coil encloses the alternating magnetic field, and thus becomes a secondary circuit of which the field-coil forms the primary. In the motors of the Washington, Baltimore and Annapolis Railway, this commutation difficulty has been overcome by so constructing the motor that the secondary or short-circuit current in the armature coil is small, and the commutating conditions so perfect that the combined working and secondary currents can be commutated without sparking. This condition being obtained, the motor operates like a direct-current machine and will give no more trouble at the commutator than ordinary direct-current railway motors. Experience covering a considerable period in the operation of motors of 100-hp capacity indicates that no trouble need be feared at the commutator.

An extended series of tests were made at the Westinghouse shops, at East Pittsburg, both in the testing room and under a car. Fig. 2 shows curves of the speed, torque, efficiency and power factor plotted from data from brake tests.

It should be noted that the efficiency is good, being very nearly equal to that of high-class direct-current motors. The power factor, as shown in these curves, is highest at light loads and decreases with the load. This is due to the fact that the power developed increases approximately in proportion to the current, while the wattless component of the input increases practically at the square of the current. The curve indicates that the average power factor should be very good. The calculations for the W. B. and A. Railway show that the average power factor of the motors will be approximately 96 per cent.

The average efficiency of these equipments will be much higher during starting and acceleration than that of corresponding direct-current equipments, and rheostatic losses are avoided. When running at normal full speed, however, the efficiency will be slightly less than with direct current. This is due to the fact that the alternating-current motor efficiency is slightly lower than the direct-current, and in addition there are small losses in the transformer and the regulator. The alternating-current equipments are somewhat heavier than the direct-current, thus requiring some extra power, both in accelerating and at full speed. Therefore, for infrequent stops the direct-current car equipment is more efficient than the alternating-current, but for frequent stops the alternating current shows the better efficiency. Tests on the East Pittsburg track verified this conclusion. But the better efficiency of the direct-current equipment with infrequent stops is offset with the alternating current by decreased loss in the trolley wire, by reason of the higher voltage used, and the elimination of the rotary converter losses. The resultant efficiency for the system will, therefore, be equal to or better than that of the direct current.

In the W. B. and A. Railway contracts the guarantee given by the Westinghouse Electric and Manufacturing Company states that the efficiency of the system shall be equal to that of the direct-current system with rotary converter substations.

There is one loss in the alternating-current system which is relatively much higher than in the direct-current. This is the loss in the rail return. Tests have shown that at 2,000 alternations this is three to four times as great as with an equal direct current. This would be a serious matter in cases where the direct-current rail loss is high. But the higher alternating-current trolley voltage reduces the current so much, that the alternating-current rail loss is practically the same as with direct current at usual voltages. In many city railways the direct-current rail loss is made very low, not to

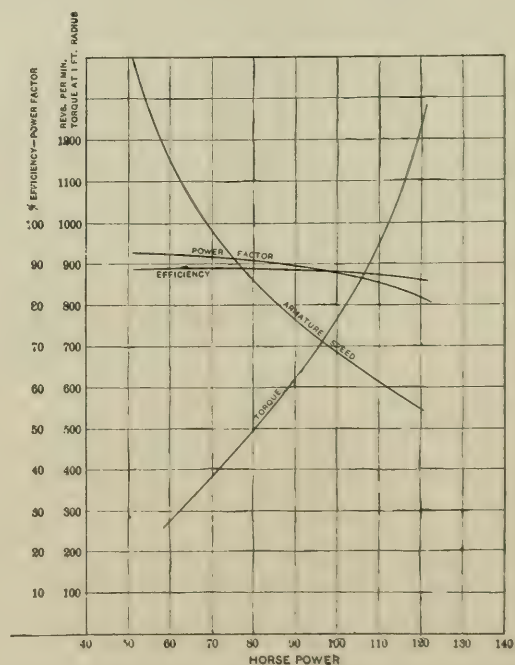


FIG. 2.—CURVES OF SPEED, TORQUE AND POWER FACTOR.

lessen waste of power, but in order to reduce electrolysis. In such cases the alternating-current rail loss could be higher than direct current, thus decreasing the cost of return conductors. More frequent transformer substations, with copper feeders connected to the rails at frequent intervals will enable the rail loss to be reduced to any extent desired. As a frequency of 2,000 alternations per minute is used, the lighting of the cars and the substations was at first considered to be a serious difficulty, due to the very disagreeable winking of the ordinary incandescent lamps at this frequency. Two methods of overcoming the winking were tried, both of which were successful. One method was by the use of split phase. A two-phase

induction motor was run on a single-phase, 2,000 alternating circuit, and current was taken from the unconnected primary circuit of the motor. This current was, of course, at approximately 90 degrees from the current of the supply circuit. A two-phase circuit was thus obtained on the car. Currents from the two phases were put through ordinary incandescent lamps, placed close together. The resulting illumination a few feet distant from the lamps showed about the same winking as is noticed with 3,000 alternations. With two filaments in one lamp the winking disappears entirely. A three-phase arrangement would work in the same way.

A much simpler method was tried, which worked equally well. This consisted in the use of very low-voltage lamps. Low voltage at the lamp terminals allows the use of a thick filament with considerable heat inertia. Tests were made on lamps of this type at a frequency of 2,000 alternations, and the light appeared to be as steady as that from the ordinary high-frequency incandescent lamp. The low voltage is not objectionable in this case, as a number of lamps can be run in a series, as in ordinary street railway practice, and any voltage desired can readily be obtained, as alternating current is used on the car.

There will be an air compressor, driven by a series alternating-current motor, on each car, for supplying air to the brakes and for operating the driving mechanism of the controller. The details of this mechanism are not near enough to completion to permit a description of it. The method used will be one which readily allows operation on the multiple-unit system.

The generating station contains some interesting electrical features, but there is no great departure from usual alternating-current practice. There will be three 1,500-kw, single-phase alternators. These are 24-pole machines, operating at 83 revolutions, and wound for 15,000 volts at the terminals. They are of the rotating-field type, with laminated magnetic circuits and field-coils of strap on edge. The field-coils are held on the pole-tips by copper supports, which serve also as dampers to assist in the parallel running. The armatures are of the usual slotted type. The armature coils are placed in partially closed slots. There are four coils per pole. The proportions of these machines are such that good inherent regulation is obtained without saturation of the magnetic circuit. The rise in potential with non-inductive load thrown off will be approximately 4 per cent. An alternative estimate was furnished for the generators proposing 20,000 volts instead of 15,000. The simplicity of the type of winding used, and the low frequency, are both favorable for the use of very high voltage on the generator. As 15,000 volts was considered amply high for the service, the engineers for the railway considered it unadvisable to adopt a higher voltage.

There are to be two exciters, each of 100-kw capacity at 250 revolutions. The exciters are wound for 125 volts normal. The armature of each exciter has, in addition to the commutator, two collector rings, so that single-phase alternating current can be delivered. It is the intention to use the exciters as alternators for supplying current to the system for lighting when the large generators are shut down at night. The main station switchboard comprises three generator panels, one load panel, and three feeder panels. High-tension, oil-break switches are to be provided, operated by means of controlling apparatus on the panels. The switches, busbars and all high-tension apparatus will be in brick compartments separate from the board. In each generator circuit there are two non-automatic, oil-break switches in series; and on each feeder circuit there are two overload time-limit oil-break switches in series. The two oil-break switches in series on the same circuit can be closed separately and then opened to test the switches without closing the circuit. With the switches in the closed position they are both operated at the same time by the controller, to ensure opening of the circuit, and to put less strain on the switches, although either one is capable of opening the load. There will be nine transformer substations distributed along the railway line. Each station will contain two 250-kw, oil-cooled, lowering transformers, supplying approximately 1,000 volts to the trolley system. The transformers are used in each station so that in case of accident to one transformer the station will not be entirely crippled. It is the intention of the railway company to operate a direct-current road already equipped with the direct-current system. The present direct-current car equipments are to be retained, but the current will be supplied from a rotary converter substation fed from the main system of the W. B. and A. Railway. As this system is single-phase, it is necessary that single-phase rotaries be used in the substation. There are to be two kw 550-volt, rotary converters. These are 4-pole, 500-revolution machines. The general construction of these machines is very similar to that of the Westinghouse polyphase rotary converters. The armature resembles that of a polyphase rotary, except in the number of collector rings, and in certain details of the proportions made necessary by reason of the use of single-phase. The commutating proportions are so perfect that any reactions due to the use of single-phase will result in no injurious effect. The field construction is similar to that of a polyphase rotary. The laminated field-poles are provided with dampers of the "grid" or "cage" type, a form used at present in the Westinghouse polyphase rotary converters. This damper serves to prevent hunting, as in the polyphase machines, and also to damp out pulsations due to single-phase currents in the armature. The damper acts to a certain extent as a second phase. Each rotary converter is started and brought to synchronous speed by a small series alternating-current motor on the end of the shaft. The voltage at the motor terminals can be adjusted either by loops from the lowering transformer or by resistance in series with the motor, so that true synchronous speed can be given to the rotary converter, before throwing it on the alternating-current line.

From the proceeding description of this system and the apparatus used on it, some conclusions may be drawn as to the various fields where it can be applied to advantage. It is evident that a good field for it will be on interurban, long-distance lines, such as the W. B. and A. Railway. On such railways, high trolley voltage and the absence of converter substations are very important factors.

For heavy railroading also, this system possesses many ideal features. It allows efficient operation of large equipments at practically any speed and any torque, and also avoids the controller troubles which are ever present with large direct-current equipments. It also permits the use of high trolley voltage, thus reducing the current to be collected. In this class of service the advantages of this alternating-current system are so great that it is possible that heavy railroading will prove to be the special field for it.

For general city work, this system may not find a field for some time to come, as the limitations in the present system are not so great that there will be any great necessity for making a change. It is probable that at first this system will be applied to new railways, or in changing over steam roads rather than in replacing existing city equipments. One difficulty with which the new system will have to contend is due to the fact that the alternating-current equipments cannot conveniently operate on existing city lines, as is the present practice where interurban lines run into the cities. It will be preferable for the alternating-current system to have its own lines throughout, unless very considerable complication is permitted. When the alternating-current system applied to interurban and steam railway systems finally becomes of predominant importance, it is probable that the existing direct-current railways will gradually be changed to alternating current as a matter of convenience in tying the various railway systems together.

As was stated above, alternating-current equipments cannot conveniently be operated on direct-current lines. It does not follow that the motor will not operate on direct current. On the contrary, the motor is a first-class direct-current machine, and if supplied with suitable control apparatus and proper voltage it will operate very well on the direct-current lines. This would require that the motors be connected normally in series, as the voltage per motor is low. A complete set of direct-current control apparatus would be needed when the alternating-current equipment is to be run on direct current, and considerable switching apparatus would be necessary for disconnecting all the alternating-current control system and connecting in the direct current. The complication of such a system may be sufficient to prevent its use, at least for some time to come.

In some cities, very strict laws are in force in regard to the voltage variations in various parts of the track system. The permissible variations are so small in some cases that an enormous amount of copper is used for return conductors; and in some cases special boosters are used in the return circuits to avoid large differences of potential between the various parts of the track system. The object in limiting the conditions in this manner is to avoid troubles from electrolysis. The alternating-current system will, of course, remedy this.

For city work, it is probable that voltages of 500 or 600 would be employed instead of 1,000 or higher. The transformers and controllers can be designed to be readily changed from full to half voltage, so that low voltage can be used on one part of the line and high

voltage on another. As the car equipments of such railways are usually of small capacity, it is probable that speed control will be obtained by means of a transformer with a large number of leads carried out to a control drum, rather than by means of the induction regulator, as the latter device is much more expensive in small units. This is chiefly a question of cost, and if the advantages of the induction regulator are found to over-weigh the objections of high first cost, then it will be used even on small equipments.

In the W. B. and A. Railway, the generators are wound for single-phase. In the case of large power-stations with many feeders, the generators may be wound for three-phase, with single-phase circuits carried out to the transformer substation, or three-phase transmission may be used, with the transformers connected in such a manner as will give a fairly well-balanced three-phase load.

There are many arrangements and combinations of apparatus made possible by the use of alternating current in the car equipments, which have not been mentioned, as it is impracticable to give a full description of all that can be done. But enough has been presented to outline the apparatus and to indicate the possibilities of this new system which is soon to see the test of commercial service.

DISCUSSION.

The discussion of Mr. Lamme's paper was participated in by Messrs. Steinmetz, Mershon, Goldsborough, Arnold, Franklin, Roe, Mailloux, Sachs, Gotschall, Wagner and Ries. Mr. Steinmetz referred to the enthusiasm abroad with respect to polyphase traction, which he says has to a large extent affected the American technical press. He said, however, that the engineers of American electrical manufacturing companies had gone over the polyphase traction field experimentally years ago and satisfied themselves that the polyphase induction motor is no more fitted for railway work than is the direct-current shunt motor; and since then they have gone over the matter again and again, and always arrived at the same conclusions. He felt disappointed in reading the paper by learning that after all the new motor is no more than our old friend, the direct-current series motor adapted to alternating currents by laminating the field. He said that when he was connected with Mr. Eickemeyer, in 1891 and 1892, a great deal of time was spent in building such motors, investigating their behavior and trying to cure them of their inherent vicious defect of inductive sparking at the commutator. No success was achieved, however, but Mr. Steinmetz expressed the hope that Mr. Lamme would have better fortune. He considered that there is some chance for this, as in the ten years that have elapsed since the work at Yonkers, engineering has advanced a great deal, and the experiments there were conducted with higher frequencies than used by Mr. Lamme. Such a motor inherently has a very poor power factor, and to get a reasonable power factor it has to be run at a very high speed, and it, therefore, was gratifying to see that Mr. Lamme operates his 16-cycle motor at three time synchronous speed, and therefore gets a good power factor. Mr. Steinmetz said that he considered the Thomson repulsion type of motor superior to that described. In this type the armature is connected to a commutator and brushes, but the supply current does not pass through the armature, which is short-circuited upon itself through the brushes, which latter are shifted by a certain angle. The repulsion motor gives a speed and torque characteristic very closely resembling that of the direct-current series motor. In conclusion, Mr. Steinmetz said that alternating-current traction will only be feasible when the single-phase motor is developed to start with a maximum torque, the torque decreasing with increase of speed.

Mr. Mershon said that although in this case alternating-current traction has apparently been achieved by means of a single-phase motor, he has not by any means lost hope for the polyphase motor, but feels confident enough to predict that the time will come when an induction motor for variable speed will be developed having properties just as efficient as the motor described, and, perhaps, more efficient; that it will develop power at speeds below the maximum in more or less proportion to the speed, which power will not require to be graded by means of rheostats, but will be taken from the supply circuit power in an amount closely in proportion to the power the motor develops. Mr. Mershon asked Mr. Lamme to state the means for reducing the sparking and also the method of design by which the high-power factor stated is obtained. Prof. Goldsborough expressed the opinion that in a few years from now there will be a standard single-phase, alternating-current railway equipment, but that he does not think anyone knows at present what the system as eventually developed will be.

Mr. Arnold expressed his pleasure that Mr. Lamme, representing one of the large manufacturing companies, had come out in favor of single-phase traction. He took exception to the statement in the paper that the Washington-Baltimore road would be the first single-phase railway in this country. In February, 1899, he had taken a contract to built 60 miles of single-phase railroad. The line has been built, tracks laid, the trucks and cars have been finished, and as the road will soon go into operation he believes that it will be the first railway equipped with single-phase motors. He hoped to present a paper at the October or November meeting giving an engineering account in detail of the system. In conclusion, he said that if Mr. Lamme is able to make an alternating-current, single-phase commutator motor operate without sparking at the commutator, he is entitled to the greatest credit.

Mr. C. O. Mailloux in referring to the backwardness of Americans in alternating-current traction, said that this follows from the fact that the alternating-current system must undergo a great deal of development before it can hope to contend with the direct-current sysem. One of the first things is to do away with more than one trolley, and the system described by Mr. Lamme possesses this advantage. The motor proposed, however, is nothing but a series direct-current motor adapted to alternating currents, and unfortunately the paper does not tell the manner in which it is proposed to obviate the defects of such a motor. The paper does not give indication that any radically new feature is introduced. It would appear that Mr. Lamme depends more upon features of design and proportioning than upon original ideas, either in regulation or control. Mr. Wagner said that he had always been an advocate of the single-phase, alternating-current motor, and spent a great many years in developing such a motor for stationary work. He considered that there is a very promising future for the type of motor known as the Thomson repulsion motor. He has experimented with this type a great deal and knows that sparking, especially at low frequencies, can be overcome. He asked Mr. Lamme if it was not necessary in his design to have a very small air-gap in order to obtain a high-power factor; he also asked if the field of the motor is constructed with the ordinary polar projections of the direct-current motor or whether it is a slotted ring, and if the field winding is distributed or a single coil winding. Mr. Elias E. Ries referred to some work which he did in 1894 in connection with a single-phase, alternating-current railway between Baltimore and Washington. He designed a system for operating the line by means of single-phase, alternating-current motors, which he said in many respects is similar to that proposed by Mr. Lamme.

Mr. Lamme said that the apparatus described for the Baltimore-Washington road is not an experimental apparatus, but that the contract for the Washington-Baltimore has been actually taken and that the apparatus is now being built. He had considered the use of the repulsion type of motor, but came to the conclusion that it was not as good for the work as the type adopted; the construction is more complicated because reversal of the direction of rotation is not so easily accomplished as in the plain series motor, and there would be more weight. Referring to the opinion expressed that the new system practically goes back to a well-known old type of motor, he said that it accomplishes a result which has never been accomplished before, which indicates that there are some features in the apparatus which have not been utilized in former apparatus. Referring to Mr. Arnold's remarks, he said that the Washington-Baltimore road is the first single-phase road that he knew of. In reply to the requests for further information concerning his system, Mr. Lamme said that at present there are reasons why he does not care to give out further information, but when the proper times comes this will be done.

A Battleship Plant.

The new United States battleship "Connecticut" is to be lighted throughout by electricity. The electric plant on the ship will consist of eight 100-kw steam-driven generating sets, all of 125 volts at the terminals, disposed in two separate and independent dynamo rooms. Six electrically-driven generators will supply current to turret turning motors. There will be 1,100 electric fixtures, complete, with necessary incandescent lamps and outlets; ten inclosed arc lamps located in engine and fire rooms; six 30-inch searchlights mounted on platforms on bridges, with spare parts; two truck lights, with controller and stand complete; electric night signaling sets, diving lamps, ventilating sets, desk and bracket fans, etc. It is to be hoped she will also have a wireless telegraph outfit.

(Oct. 4, 1902)

Apparatus of the Braun-Siemens & Halske System of Wireless Telegraphy.

THE accompanying series of cuts illustrate the electrical and mechanical equipment of the Braun-Siemens and Halske system of syntonic wireless telegraphy, the general theory and construction of which was published in the ELECTRICAL WORLD AND ENGINEER, of June 14, 1902. A complete standard station set for transmitting and receiving wireless messages, such as are now being produced by the Gesselschaft fur Drahtlose Telegraphie, of Berlin, is shown in Fig. 1, and includes all the necessary devices for selective signaling by electrical resonance using high-frequency, high-potential currents of predetermined periodicity. In Fig. 7 the instruments are shown detached, and after careful testing they are arranged in regular order prior to packing for shipment. Beginning at the left, it will be observed that the parts are numbered consecutively.

For instance 1 (Fig. 1) illustrates the transformer operating the open and closed circuit; the adjustable condensers, 2, are arranged like a test-tube stand; 4 is the inductorium or Ruhmkorff induction coil, the spark-gap of which is not shown in this figure, but on referring to Fig. 4, it will be seen standing out in relief from the adjustable condensers; the suspended metal cylinders with the bases or ends elliptical, 5 and 13, are capacity areas, employed instead of the earth. The key 6 is arranged for breaking the heavy primary currents which excite the inductor of the Ruhmkorff coil, and 7 represents an electrolytic interrupter of the Wehnelt type; this with the exception of the source of current completes the transmitting apparatus. The receiving apparatus begins with 8, which is the transformer and condenser employed in the resonator open and closed circuits. The switch, 9, is employed to cut in and out the transmitting and receiving apparatus from the antennæ; the Morse register, 11, is connected with a polarized relay, which is enclosed in a cylindrical metal box to exclude all extraneous waves; the coherer and tapping device are arranged on top of the box 11, while a case of coherers is shown at 14. Usually a receiving apparatus, 15, employing a microphonic self-restoring coherer with a pair of head telephones, is included, so that in case of any untoward occurrence by which the standard recording instruments might be disabled, messages may still be received without interruption.

The high tension transformer employed in the compound oscillator is shown in Figs. 2 and 3. It consists of an inductor having four turns of heavy wire wound outside a secondary coil formed of 30 or 40 turns of fine wire, so that the oscillations set up in the closed circuit may be stepped-up in the open circuit radiator emitting the waves. The transformer removed from the jar shows more clearly its internal construction, and is simply an air-core induction coil with the primary well insulated and its relative position to the secondary reversed; when in use, the whole is immersed in oil.

The oscillator balls forming the spark-gap are arranged within a cylinder of glass, having ebonite ends and filled with oil (Fig. 4), thus causing the disruptive discharge to take place in a dielectric having a greater specific inductive capacity than that of free air. The spark-gap is in series with the adjustable capacities and the primary of the transformer.

As shown in Fig. 4, the capacities are arranged in two divisions, and each half is connected on either side of the spark-gap and the primary of the transformer. By removing or adding to the miniature Leyden jars, a variable capacity is obtained, by which the closed circuit oscillator is tuned not only to the period of the open circuit radiator, but to its own natural frequency of oscillation; the inductance of the closed circuit is supplied by the primary of the transformer, and the resistance may be made to conform to these coefficients by increasing or decreasing the length of the spark-gap.

The induction coil is designed especially to fulfill the heavy demands required of a commercial wireless telegraph generator. The soft iron core is large in diameter considering its length, which is a great advantage when an electrolytic interrupter is employed in connection with it, since the B H curves are described with little retardation even when the frequency of interruption reaches a value of 10,000 per minute. The secondary coil is of comparatively thick wire and doubly insulated, thus eliminating the weakest point generally found in this type of high-tension generators; and by this extra precaution to exclude air and moisture, the electrostatic bombardment caused by oscillatory currents, which result in caloric effects and the final disruption of the coil is precluded.

FIG. 1 BRAUN SIEMENS & HALSKE WIRELESS TELEGRAPH TRANSMITTING AND RECEIVING APPARATUS

With the Braun induction coil and electrolytic interrupter no condenser is required, for the reason that the "break" more nearly approaches the ideal interruption of the current, *i. e.*, an absolutely instantaneous "break," than in any other form of interrupter. The key designed by Braun for arbitrarily making and breaking the heavy primary currents used in the operation of these large and powerful coils is shown in Figs. 5 and 6. In Fig. 5 the key proper is illustrated and Fig. 6 is a view of the interior showing the magnets for blowing out the spark formed on breaking the primary current between the platinum points of the key. This device is due primarily to Davy's discovery of the effect of a magnetic field upon the voltaic arc, and as a means of preventing injurious discharges it has been the subject of much litigation in the United States, in the Thomson "magnetic blow-out" suits.

The complete equipment of the Braun-Siemens and Halske system is shown in Fig. 7, set up and connected ready for operation. The connections may be followed almost as readily as in the previously published diagrams. A current from a 110-volt circuit or a storage battery—according to specifications—is led from the outside to the switchboard and thence through the plug cut-outs, ammeter, voltmeter, small switch and electrolytic interrupter to the primary winding or inductor of the coil on the floor. From the secondary terminals of the induction coil, conductors lead to the spark-gap, condensers and primary of the transformer. From the secondary of the

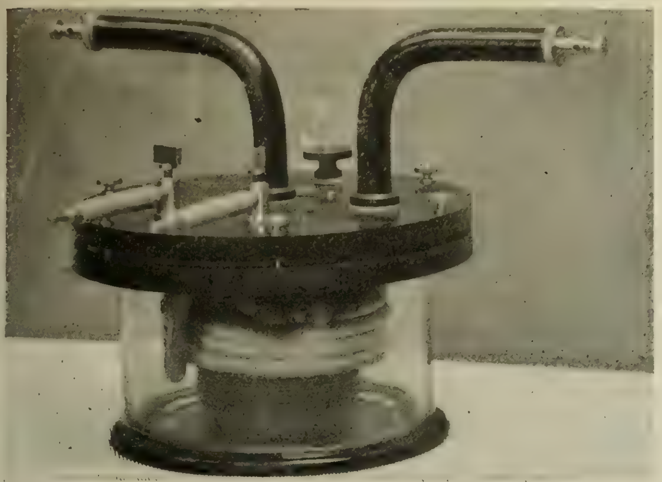


FIG. 2.—TRANSFORMER FOR WIRELESS TELEGRAPHY.

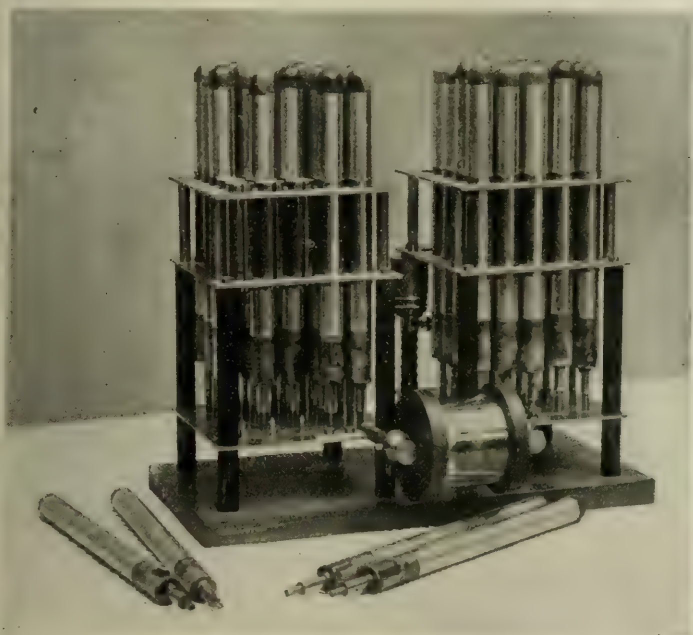
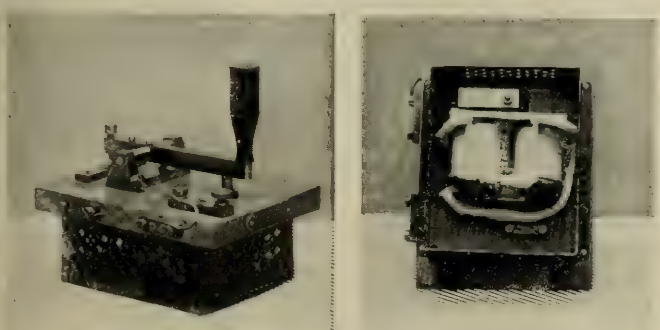


FIG. 4.—ADJUSTABLE CAPACITIES.



FIGS. 5 AND 6.—SPECIAL KEY FOR HEAVY CURRENTS.

FIG. 9.—CONDENSER APPARATUS FOR RECEIVING SYSTEM.

FIG. 3.—HEAVY-CURRENT TRANSFORMER.

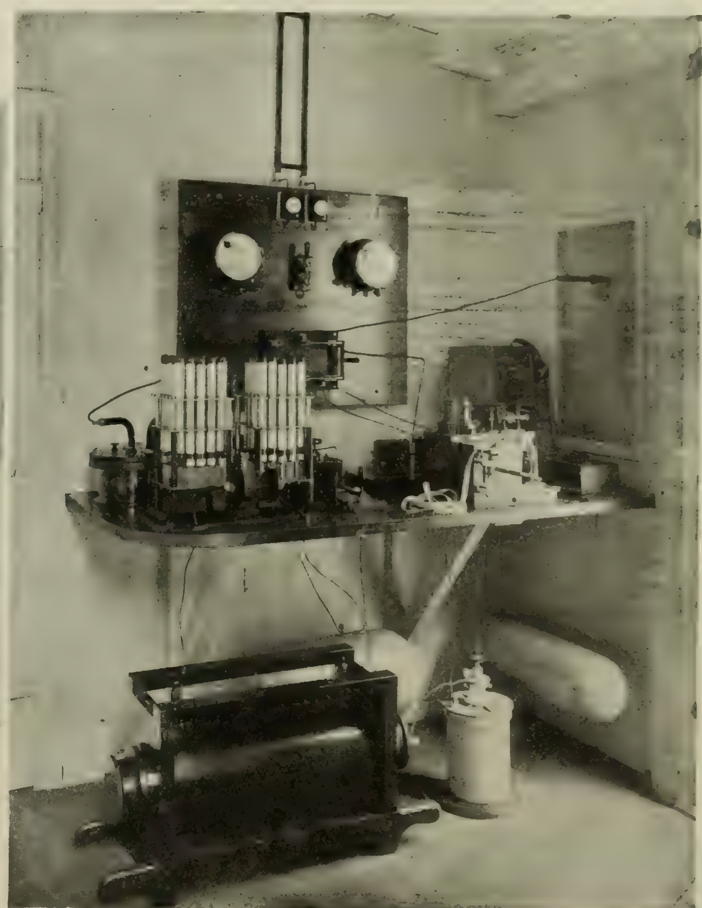


FIG. 7.—INTERIOR OF STATION.

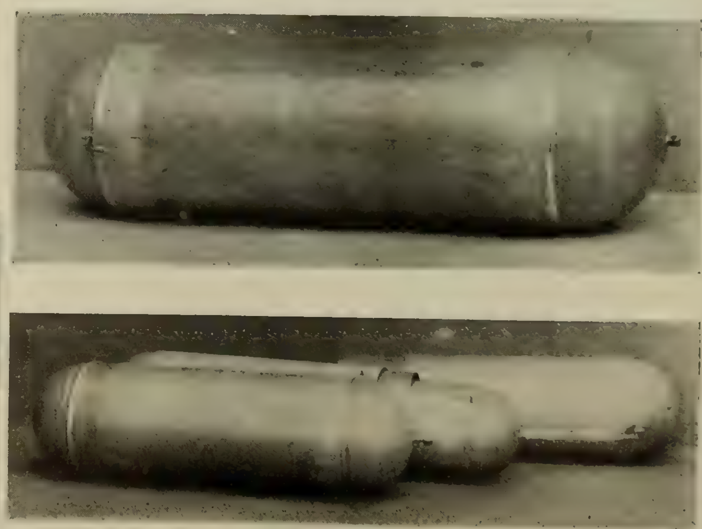


FIG. 8.—CYLINDERS ACTING AS CAPACITY AND REPLACING OPENING WIRE.

APPARATUS OF THE BRAUN-SIEMENS & HALSKE SYSTEM OF WIRELESS TELEGRAPHY.

transformer one terminal will be seen to connect with one of the contacts of the large double-throw, double-pole knife switch; the other terminal of the transformer secondary connects with the cylindrical capacity suspended under the table. The purpose of the switch is to put the antennæ into electrical connection with the receiver or transmitter as desired. The switch is shown connecting the antennæ with the receiving apparatus, the antennæ passing via the window to the yard-arm of the mast. The wire connected to the upper right hand

FIG. 10.—ELECTRIC WAVE DETECTOR AND PARTS.

contact of the switch leads to the primary of the receiver transformer and condenser, the opposite terminal ending in the second suspended cylindrical capacity under the table. One terminal of the secondary coil of the receiver transformer is coiled up loosely and in the opposite a coherer intervenes, the relay tapper and Morse register working on an internal battery circuit.

The two wires from the lower contacts of the switch are connected direct to the coherer, so that when the switch is open or when it is thrown into contact with the transmitter, the receiver is not only disconnected but the coherer is cut out entirely from all other portions of the apparatus. The cylindrical capacity areas to which the lower arm of the open circuit oscillator and closed circuit resonator are attached, instead of to the earth as in all other commercial systems, are shown more clearly in Fig. 8. Each capacity is really formed of two cylinders, arranged to slide telescopically, one within the other, so that the value of capacity may be varied within certain limits.

The transformer of the compound resonator circuits, together with its condenser, Fig. 9, is made on a much smaller scale than the transformer and condenser of the oscillator circuit, since the impressed e. m. f. in the resonator circuit must be necessarily smaller than in

FIG. 11.—POLARIZED RELAY, TAPPER AND COHERER.

the oscillator emitting the waves, though the periodicity of oscillation may be much higher, since the resonator will respond to oscillations having a frequency of some multiple or sub-multiple of the emitted wave length. The condenser is of the standard mica-and-tinfoil type, and is not adjustable.

The electric wave detector is one of the especial features of the Braun system, and is shown completely dissected, as well as the various parts assembled in the finished coherer in Fig. 10. The differentiating element in this coherer lies in the fact that it is not exhausted, and its mechanical construction is therefore based on widely divergent lines from detectors of the orthodox type.

The adjusting screw having a lock nut follows, and immediately below it is shown the upper plug-end, which is threaded and screws into the containing tube, whilst at the bottom is the lower plug-end with a set screw. The smaller ebonite tube, containing hardened and sieved steel powder, slides within the containing tube; the two conductor plugs, made of polished steel, are shown to the extreme right. The lower conductor-plug is held firmly in place by the set screw in the lower end-plug. The spiral spring is now passed over the upper conductor plug with the washer, and these into the containing tube with the end of the conductor plug pressing against the filings. The upper end-plug, the bore of which is tapped, is now screwed into the containing tube, and the adjusting screw inserted until its point comes in contact with the upper conductor plug. The degree of sensitiveness desired may be arrived at by the careful manipulation of the adjusting screw, the spring forcing the conductor plug away from the filings, and the screw pressing it toward the opposite plug. When the proper adjustment is secured, the jam nut is tightened and the coherer is ready for use.

The polarized relay, tapper and coherer are clearly defined in Fig. 11; the relay is of the Siemens type, with permanent magnets made of the finest grade steel, the magnet coils being wound to high sensibility, and the whole forming an instrument of the highest efficiency.

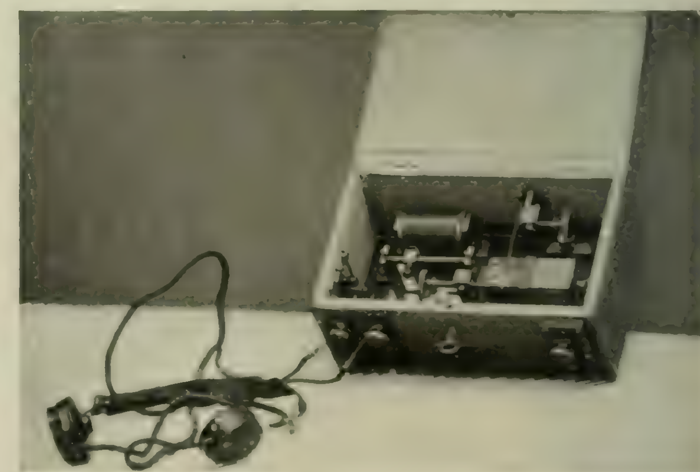


FIG. 12.—PORTABLE RECEIVING SET.

It is enclosed in a metal case, which is dust-proof as well as wave-proof.

A glass cover is provided as well as a screw extending through the case, thus permitting the adjustment of the various contacts to be made outside without difficulty.

The coherer, together with an electro-mechanical tapping device, employed to decohere the filings, is also shown in Fig. 11. This arrangement renders the operation of tapping the tube entirely independent of the derived circuits, the spring mechanism actuating the hammer when the register is receiving a message. It is evident that the force with which the blows are delivered by the decohering striker is always uniform, and that the filings will be rearranged after each successive stroke, in relatively the same position. The instant cohesion of the filings is effected, a trip-catch is released electrically, and the mechanism is set in motion; when decohesion takes place, the catch drops automatically, stopping the spring motor. The relay and coherer are operated by means of a single dry cell. The coherer may be easily and quickly placed in electrical connection with the relay circuit and the secondary of the receiver transformer by slipping it into place between the opening clutches forming the contacts.

The portable receiving set, shown in Fig. 12, may be kept close at hand in emergency cases, for signaling over longer distances than is possible with the Morse registering apparatus, or again it may be employed for field use where a receiver of extreme lightness is desired. In any event it forms a most necessary auxiliary appliance for a wireless telegraph system, aiming to give first-class service under the varying and trying conditions such as are imposed upon commercial systems.

Efficiency of Electric Furnaces.

One of the more practical papers read at the recent Niagara meeting of the American Electrochemical Society was presented by Prof. J. W. Richards, Ph. D., with the above title. Below we print a fuller abstract of the paper than appeared in our report of the meeting:

An electric furnace is a furnace for accomplishing a physical or chemical change in materials by means of the agency of heat, said heat being supplied by the transformation of electrical energy. The cases where electrolysis takes place in fused electrolytes are left out of consideration, because they are essentially electrolytic processes in which the heating of the current is unavoidable and incidental to the main process of electrolysis, and must be excluded from the terms "electric furnace processes" if that term is to retain its individuality and stand for a definite class of operations. If this limitation is understood, the output of an electric furnace is more or less proportional to the amount of heat energy developed in the furnace. It is necessary to say "*more* or *less* proportional," because, although the amount of heat necessary to produce the change in a given amount of material may be a perfectly definite quantity, yet the proportion of the heat developed in the furnace which is actually absorbed or applied in producing this change is a variable one, being always less than 100 per cent., and frequently very much less. The proportion of the heat energy of the electric current thus applied to producing the useful change in the charge is called the *efficiency* of the furnace.

The usefully applied heat will include one or both of two factors. The first is the amount of heat necessary to heat the charge up to the temperature of the furnace. The second is the heat absorbed in chemical reactions between the constituents of the charge when they are heated to the reacting point. This second part of heat can be calculated from thermochemical data, while the former part of heat—that required for the purely physical charges—can be calculated from the mass of the charge, the specific heats in the solid and liquid states, the latent heat of fusion and the temperature of the furnace.

The efficiency of an electric furnace operation depends on many factors, among which are the following: size of furnace, temperature of reaction, protection from radiation, management of the terminals, feeding and tapping, general management. Of these the most important, in commercial practice, is the size of the furnace. The volume or contents of a furnace increase approximately as the cube of the linear dimensions, while the radiating surface which conditions the loss of heat, increases as the square of the linear dimensions; therefore, the proportion of radiating surface to unit of contents *decreases* approximately in proportion as the linear dimensions are increased. It is probable that if a 100-hp electric furnace works at an efficiency of 50 per cent., with the other 505 lost by radiation and conduction, then an 800-hp furnace of the same design working the same process at the same temperature, should give an efficiency nearer to 75 per cent. Most of the desiderata of commercial success of electric furnace work lie in the direction of increasing the size of the furnaces to the furthest limit set by mechanical or physical consideration.

While electric furnaces are generally classified into the resistance type and the arc type, it is better for the present purpose of calculating the efficiency to use a different classification. All furnaces are divided into two large classes. The first class includes these furnaces in which the charge is simply heated without any *chemical* change taking place; the second class includes those in which besides the heating of the charge there is also a chemical change. Each class may be again subdivided into two sub-classes according to whether the heating takes place with or without a melting or fusion of the charge.

Heating Without Fusion and Without Chemical Change.—An example of this is the conversion of anthracite coal into graphite in the Acheson furnace. It is true that some chemical changes probably occur during the conversion, such as the progressive formation and decomposition of carbides, but these are negligible because of their plus and minus heat quantities neutralize each other; the change from amorphous carbon to graphite is a heat *evolving* reaction, and, therefore, must be reckoned as really *assisting* the current or, practically, diminishing in our figuring the calculated efficiency. The data* are as follows: 1,000 hp in 20 hours convert 12,000 lbs. of anthracite into 10,000 lbs. of graphite. The heat gained in conversion into graphite is about 10 per cent. of the heat supplied by the current; hence the real amount of heat is 110 per cent. of the heating power of the current, of this 82.5 per cent. are utilized, giving an efficiency of $82.5 \div 110 = 75$ per cent. In the Acheson process of graphitizing electrodes by placing them crosswise, embedded in a resistant material, 1,000 hp graphitize 7,000 lbs. of electrodes, embedded in 7,000 lbs. of granular carbon and lining; the net efficiency of the operations is 38 per cent.

Heating With Fusion, but Without Chemical Change.—The Jacobs process of fusing calcined bauxite is an illustration. The process is simple fusion by the arc, in a cylindrical pot. With a charge of 3,000 lbs. the efficiency is 74 per cent.

Heating Without Fusion, but With a Chemical Change.—The manufacture of carborundum is a good example. A mixture of carbon, silica sand and salt is heated by the incandescence of a conducting carbon core, until the salt is volatilized, carrying off most of the metallic impurities as chlorides, the silica is reduced and combines with the excess of carbon present to form silicon carbide. The furnace is 20 feet long and 1,000 hp is passed through for 36 hours. The calculation of the efficiency gives 76.5 per cent.

Heating With Fusion and With a Chemical Change.—There are numerous instances of this kind of electric furnace operations, in which particularly reductions to metal or other metallic compounds are operated. An example is the production of calcium carbide, for which the calculation gives a net efficiency of 62 per cent. There is, however, a distinct experimental gap in the lack of knowledge of the specific heat of such products of the electric furnace, at high temperatures. When these are known, calculations of the efficiency can be made with much greater exactness.

The net result seems to point to a commercial efficiency of 60 to 75 per cent., calculating with furnaces of 200 to 1,000 hp. The value of such an approximate figure is that anyone starting an electric furnace operation should be able to calculate the approximate output to be expected or if planing, or designing for a given output, will have a guide to indicate the approximate size and capacity of the furnaces needed.

* Concerning the exact calculations the reader is referred to the complete paper, which will be published in Vol. II of the "Transactions of the American Electrochemical Society."

CURRENT NEWS AND NOTES.

CABMEN AND TROLLEYS.—The cab drivers of Washington have been trying to break up the business of a concern that is running what is termed "Seeing Washington" cars in a continuous trip over all the lines of one of the street-car companies in order to take in all the sights of the capital. The cabmen allege that the cars are run in violation of the charters of the street-car companies and of the general law regulating such traffic. The District Attorney has rendered a decision sustaining the concern running the cars in dispute.

U. S. PATENT OFFICE.— The report of the Commissioner of Patents for the year 1901 shows total receipts of $1,449.398 and expenditures of $1,297,385, leaving a balance of $152,012, which goes to a surplus fund already amounting to $5,177,458. The total number of applications was 52,912, and the total number of patents issued was 27,292. Connecticut led in concrete invention, having obtained one patent to every 1,198 inhabitants. Then comes District of Columbia with 1,296; Massachusetts with 1,472, and New Jersey with 1,572. In South Carolina the number is over 28,000, and in Alaska over 31,000. Of foreign countries, Germany comes first, as 1,045 of her citizens took advantage of our patent laws. England is next with 986, Canada 376, France 306 and Austria 156.

LIGHTNING RESEARCH.—Mr. Killingworth W. Hedges honorary secretary of the Lightning Research Committee, organized by the Royal Institute of British Architects and the Surveyors' Institution, is making a short visit to the United States in the interest of the work of the committee. The committee was appointed for the purpose of obtaining trustworthy information on disasters from lightning with a view to improving, if possible, the means of protection. In pursuance of this inquiry, the committee seek the co-operation of competent observers, in order to obtain accurate details, noted on the spot, of the effect of lightning strokes on buildings, whether fitted with lightning-rods or not. A schedule of questions is supplied to observers, on which to make their report. Those willing to act as observers are requested to investigate any disaster occurring from lightning in their neighborhood, and communicate the results to committee, at 9 Conduit Street, London, W. Copies of the schedule will be forwarded upon application at the above address.

[illegible]

WIRELESS TELEGRAPHY AT CHERBOURG.—A wireless telegraph station, it is said, will shortly be erected at the Auberville [illegible] will be received and transmitted, [illegible] of great service to the steamship companies making Cherbourg a port of call.

ELECTRIC WORK AT NAPLES.—The new electric station at [illegible] alternators of 500 kilowatts each. At present only two of them are installed by Gio. Ansaldo, of Cornigliano, Ligure. These are the largest generators ever built in Italy. They are direct connected to Neville triple-expansion steam engines. The maximum voltage is 8,650 volts.

INTERNATIONAL WIRELESS TELEGRAPH CONFERENCE.—Germany, according to a special despatch, is initiating an international conference on wireless telegraphy. The practical working of the system being assured, it is held that rules similar to those of the international telegraph convention should govern the new method of transmitting intelligence. It is suggested that the conference be held during October.

WIRELESS TELEPHONY.—A cable dispatch from Berlin, of September 20, says: Encouraging results of wireless telephony have been obtained on the Wannsee Lake by Ernest Ruhmer, the psychist, who followed the line of Prof. Graham Bell's experiment with light. Clear and comparatively loud sounds were heard a distance of four and even seven kilometers, respectively, about two and a half and [illegible] Herr Ruhmer's invention is said to act on the principle of the transformation of light waves by using a search-[illegible]

ELECTRIC ROADS IN ITALY.—Ganz & Co. write us as follows from Buda Pest, under date of September 13: "We beg to inform you that traffic on the Sondrio-Colico-Chiavenna line of the main electric railway, which we have built in upper Italy was opened on September 4, and that since that time the regular express, passenger and freight traffic on the line has been carried on without the least hitch. There are 30 trains daily running on the line. The electrical working of the branch line Lecco-Colico, will begin in a few days." This is a three-phase induction motor system, in regard to which details have been given in these pages from time to time.

MECHANICAL TRACTION IN PARIS.—Consul Thornwell Haynes writes from Rouen, August 29, 1902, as follows: According to last year's census, Paris had 96,008 horses which could be [illegible] the average figure for many years; but this year the number has suddenly fallen to 90,796. This considerable diminution is said to be due to mechanical traction. The Paris Omnibus Company had last year 16,579 horses in its service; now it employs nearly 2,000 less. In all the companies which compete with the tramways and the Metropolitan Railway, the diminution of horses has been 2,727. The remaining 3,175 horses [illegible] service have, therefore, it is said, been replaced by automobiles.

AN ELECTRICAL TRADE DIRECTORY.—In neat and handy [illegible] Engineer a useful directory, which hereafter will be published regularly in January of each year, and will contain the names of the cur-[illegible] tion. Including practically all the American manufacturers and [illegible] apparatus and material, the directory will serve a useful purpose as a reference list for inquirers and prospective buyers. No charge is made to advertisers in the journal for this additional service, which will, we venture to believe, be appreciated both at home and [illegible]

CUTTING A FRENCH CABLE.—News has been received from Venezuela that Gen. Velutini, acting as special delegate of the Caracas Government, has caused the arrest of the manager of the office of the [illegible] as well as the company's clerks at that point. The French consular agent at Carupano, who intervened on behalf of the manager and clerks of the cable company, was also placed under arrest. The cable office at Carupano is closed, and coastwise cable communication has been interrupted for the last five days. The Venezuelan cruiser "Restaurador" is suspected of having cut the French cable in order to prevent the revolutionists from using it. The managers of the office of the cable company, at Caracas and La Guayra, have protested against what they term the "arbitrary action of the government." M. Quieveux, French Consul at Caracas, has also protested strongly against the arresting of the cable employees at Carupano and the cutting of the cable without notice. U. S. Minister Bowen, under date of September 28, has cabled from Caracas to Washington his belief that the Venezuelan Government intends to cut all the cable lines this week.

A SWIFT MILE.—World's records were smashed at Narragansett Park during the second annual race meeting of the Rhode Island Automobile Club. Despite execrable weather, Mr. George C. Cannon was the sensation of the day. He clinched his title to the steam championship of the world by driving the famous car of his own construction in 1:05¼, the fastest mile ever made over the Narragansett Park track. The previous world's record was 1:07⅗, held by Mr. Cannon himself. Then, to complete his fame, the young Harvard student set a new world's record for steam cars for five miles, at 6:05 flat, reducing the previous mark from 6:43, made recently at Cleveland, by Rollin White. Cannon's time by quarters for his world's record was 0:16½, 0:33, 0:49½, 1:05¼. His five-mile record was 1:12½, 2:26¾, 3:41½, 4:54, 6:05. The open class for electric carriages, two miles, was won by Mr. Knight Neftel, in a car of his own make. His time was 4:23. Mr. Alexander Winton and his "bullet" in the five-mile race broke the track gasolene record, the first time around in 1:06½. The second mile was in 1:05¾, the third in 1:06½, the fourth in 1:06¼, and the fifth, the fastest, in 1:05⅘.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—Secretary Cahoon reports the following new members since August 18, 1902: Albion, N. Y., Albion Steam Power Company; Attleboro, Mass., Attleboro Steam and Electric Company; Athens, Ga., Athens Electric Railway Company; Beverley, Mass., Beverley Gas and Electric Company; Brookline, Mass., Brookline Gas and Electric Company; Carbondale, Pa., Lackawanna Valley Electric Light and Power Supply; Cohasset, Mass., Cohasset Electric Company; Duluth, Minn., Duluth General Electric Company; Doyleston, Pa., Doyleston Electric Company; Elwood, Ind., Elwood Electric Light Company; Everett, Wash., Everett Railway and Electric Company; Lee, Mass., Lee Electric Company; Lynn, Mass., Lynn Gas and Electric Company; Oneonta, N. Y., Oneonta Light and Power Company; Oil City, Pa., Citizens' Light and Power Company; Southern Pines, N. C., Biscoe Electric Light Plant; Telluride, Col., Telluride Electric Light and Power Company; Walla Walla, Wash., Walla Walla Gas and Electric Company; Warren, Ohio, Warren Electric Light and Power Company; Westboro, Mass., Westboro Gas and Electric Company; Whitman, Mass., Whitman Light and Power Company.

LETTER TO THE EDITORS.

Paralleling of Alternators.

To the Editors of Electrical World and Engineer:

Sirs.—The letter from Mr. G. Rosenberg which appears in your issue of August 2, and your abstract of Mr. Longwell's paper to which it refers, interests me very much, as I have for some time been of the opinion that the usually accepted ideas as regards the influence of uneven turning moment on parallel running are erroneous

I called attention to this point in a contribution to the discussion on a paper read before the (British) Institution of Electrical Engineers, and published in Vol. XXX of the *Proceedings* (May, 1901), and subsequently in an article appearing in the London *Electrical Review*, April 4 and 18, of the present year, I entered more closely into the matter, and showed by a method different to that of Mr. Longwell the important result which he has so clearly put forward, namely, that the effect of the synchronizing force is to *increase* the phase displacement and therefore the irregularity of angular speed of an engine instead of to diminish it. I am glad to know that Mr. Rosenberg has also arrived at the same result, and I look

forward with interest to reading his paper as soon as the translation referred to by him is published.

Mr. Longwell does not in his paper bring out clearly the dependence of this effect on the moment of inertia of the flywheel, etc. In the article referred to above I showed that this increase in the cyclic irregularity only takes place provided the moment of inertia exceeds a certain amount depending on the conditions of the case, but though the data I possess are not conclusive, I am inclined to think that, with the flywheel proportions which are usually adopted, this limiting moment of inertia is exceeded.

In conclusion, I should like to draw attention to the question of frequency in relation to parallel running, concerning which it is commonly held that the parallel running of generating sets of a given flywheel power is facilitated by low frequency, and one sometimes sees it stated that it is obvious that this should be so.

But if the reasoning on which this statement is based, as given in many textbooks and papers, be examined it will be seen that it involves the assumption that the phase displacement of a generating set when running in parallel is not greater than when it is running alone on a load offering constant torque. It has been shown that this assumption is not tenable, and it would therefore appear that the usual statement that the parallel running is facilitated by low frequency is not justified in the present state of the theory.

Newcastle-on-Tyne, England. H. C. Leake.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Heating of Toothed-Core Armatures.—Davies.—A discussion of the reason why in practice toothed-core armatures are sometimes found which show an excessive heating. He has found that such overheating is more marked in machines of the multipolar than of the bipolar type, especially in the smaller sizes, and that the temperature rise is not at all proportional to the load in the machine, but is more marked at light load than at full load. Sometimes it occurs that the overheating is brought about by insufficiency of iron in the teeth. Furthermore, the hysteresis and the eddy current losses are the greater, the greater the number of cycles of magnetization through which the iron passes per second; hence the frequency must be kept as low as possible, and herein lies one of the advantages of a slow-speed machine; moreover, to keep the frequency low, it is advisable to have as few magnet poles as possible. There is also another reason why the iron losses are greater the greater the number of poles in a machine for a given speed; the number of teeth embraced by a magnet pole is not exactly in inverse proportion to the number of magnet poles, but is rather less than this, becoming less and less as the number of poles is increased. For this reaon, the magnetic induction in the teeth become greater as the number of poles is increased. This will not matter much if, as should always be the case in the armatures for multipolar machines, the radial depth of the armature core, and, consequently, the radial depth of the teeth is proportionately less, for then the teeth will be proportionately wider at the roots. It is, therefore, always necessary to carefully calculate the watts lost in the armature teeth. For the purpose of estimating these losses, the mean average magnetic induction in the armature teeth may be taken as being equal to that at one-third the length of the teeth, measured from the roots. As a set-off against the increased losses in this direction which accompany an increase in the number of poles, the current density in the conductors and, therefore, the Joulean heat loss is usually smaller in the larger sizes of machines, in which an increase in the number of poles is permissible.—Lond. *Elec.*, September 12.

Commutation.—Punga.—An illustrated mathematical article on the theory of commutation. While formerly the commutation was assumed to depend only upon the e. m. f. induced in the short-circuited coil, it has since been assumed that the transition resistance from the commutator segments to the brushes, has a great influence. The author discusses the principles of commutation and develops a formula for practical use. He claims that it is less the transition resistance itself which influences the commutation, but its combination with a non-uniform distribution of the current density under the brushes.—*Zeit. f. Elek.*, July 27, August 3, 10.

Squirrel-Cage Armatures of Induction Motors.—Osnos.—A brief illustrated article. In general, the copper bars of a squirrel-cage armature are connected at both ends by short-circuiting metal rings. As the air gap is often small and the armature bars have a small electric resistance, a small eccentricity of the rotor can be of a great disadvantage. This disadvantage can be greatly diminished if the short-circuiting ring is not made of one single piece but consists of several segments insulated from another; it is best to use a number of segments equal to half the number of the poles of the primary. It is possible to divide into segments only one instead of both short-circuiting rings, and to make the other of one piece, as usually. A small insulation is sufficient, even a layer of oxid may be enough. Another arrangement in a four-pole motor is to divide both rings into two halves, but the diameters along which they are cut are perpendicular to each other at the two ends; this arrangement is said to have given good results in practice and to have improved the starting torque.—*Zeit. f. Elek.*, August 10.

Transformer Reactance.—An anonymous article on a practical method of calculating the short circuit reactance of transformers of ordinary design. The fundamental fact made use of is that when the secondary winding of a transformer is short circuited and an alternating current is passed through the primary, then the induced secondary ampere turns are equal and opposite to the primary ampere turns, which fact holds good for any transformer not having unreasonably high reactance. The short-circuit reactance may then be considered as due to the magnetic leakage flux in the region between the primary and secondary sections, which is induced by the primary and secondary ampere turns. The total reactive voltage is equal to the effective cutting of the primary and secondary windings by this flux, the e. m. f. being generated half in the secondary and half in the primary. The problem is to determine the short-circuit reactance as a function of the following quantities: primary current, primary turns and frequency; dimensions of windings and sheath; relative arrangement of primary and secondary windings; disposition of the induction. The respective formulas are given.—Lond. *Elec. Rev.*, September 5.

References.

Voltage Drop in Alternators.—Westphal.—A long mathematical article, illustrated by diagrams. He gives a highly analytical solution of the following two problems: To determine the voltage drop of an alternator, when loaded, and to determine the excitation required to compensate for this voltage drop. The general formulas which are given look very complicated, but he gives a numerical example to show that they can be used in practice. He also shows that this method can be used to obtain information concerning secondary phenomena in alternators.—*L'Eclairage Elec.*, August 2.

Electromechanical Compounding.—Guilbert.—A very long and well illustrated description of the method of electromechanical compounding of electric generator sets by means of the Routin regulator, the characteristic features of which are the use of a single device to control the mechanical regulation and the electric regulation, and the use of a special device for automatic control.—*L'Eclairage Elec.*, August 9, 16.

Tramway Motors.—Field.—The conclusion of his long illustrated paper, the first parts of which were recently abstracted in the Digest. He deals with acceleration and braking.—*Lond. Elec. Eng.*, September 5.

Efficiency of Transformers.—Ballard.—An illustrated article on methods of testing the efficiency of transformers. The determinations of the core loss and of the copper loss are described.—*The Eng.*, September 15.

Regulator of Shunt Dynamos.—Dick.—An illustrated article on

the determination of the number of steps and their resistances, for the regulator of a shunt wound dynamo with self-excitation.—*Zeit. f. Elek.*, August 10.

Lights and Lighting.

Osmium Lamp.—Ziegenberg.—A review of recent progress made with the Nernst lamp and the osmium lamp. A number of patents for the Nernst lamp are described, and it is pointed out that for practical purposes a compromise must be made between the requirement of cutting the heating body out of the circuit when the lamp is lighted, on the one hand, and the requirement to avoid complicated construction on the other hand. The trouble with the osmium lamp is that osmium is rare and expensive and is very difficult to work economically. The osmium lamp will be rented only, and not sold, by the Welsbach Company for some time, so that the company retains possession of the osmium and can use it again. The following method of Deville and Debray for making the osmium wire is described. It is based upon the observation that if osmium vapors are sent through a tube of clay, the inner side of which is coated with an adherent layer of carbon, the tube being heated to incandescence, then osmium is deposited and replaces the carbon, *i. e.*, the carbon layer is changed into an osmium layer. By this method there is only a very small loss of osmium. For making osmium wires, carbon threads are placed in a case of clay; the air is driven out by means of nitrogen, and $Os\ O_4$ is introduced either in solid form or by means of a current of inert gas (nitrogen); the case is then heated to a high temperature, causing the carbon threads to change gradually into osmium threads, the change taking place in the direction from the outside to the center. Very thin osmium threads can be made in this way, which is of importance, as it facilitates making lamps for the higher voltages. Another trouble is that the osmium filament has a relatively great length and must be supported. Mixtures of certain refractory oxides are recommended for the supports. Another solution of the problem of making osmium filaments for normal voltage and of such a rigidity that the incandescent filament does not change its form, is due to Auer von Welsbach. He uses the osmium wire in the form of a spiral of fine wire. This spiral must consist of windings of very small diameters, only a few millimeters. This spiral is supported and held in its form by means of a thread of mixtures of refractory oxides. The osmium wire is made by preparing a paste of osmium and certain other materials, and forcing it through a die. Single windings of this spiral of fine osmium wire may be in direct contact, without diminishing the incandescence of this winding, *i. e.*, the contact does not represent a serious shunt. —*Zeit. f. Beleucht.*, August 30, September 10.

REFERENCE.

Lighting of a Freight Station.—Jordan.—An illustrated description of the electric equipment for lighting a freight station of an Austrian railway. The three-phase system is used with 950 volts between two phases, the frequency being 42. There are 62 arc lamps of 20 amperes and 12 of 16 amperes.—*Zeit. f. Elek.*, August 10.

Power.

Australian Power Scheme.—Crocker.—An article on the power plant, the principal purpose of which is to supply electric current to the mines in the Kalgoorlie district for power and lighting purposes. The plant is now rapidly nearing completion, and the tramways have already been supplied with power. The electric portion of the plant consists of three 500-kw, 600-volt, 40-cycle, three-phase generators, direct coupled to steam engines. For supplying the tramway system, two 250-kw synchronous converters are used. The general distribution to the mines for lights and stationary motors will be direct from the 550-volt, 40-cycle, three-phase system. As the equipment of each portion of the plant is divided into three or more units, one of which is always to be held in reserve, the power supply will be of a reliable character. With the machinery at present installed, the company is able to supply some 2,000 hp in motors, in addition to the power required by the tramways. The entire electric equipment is by the General Electric Company of this country.—Lond. *Elec.*, September 5.

Colorado Power Transmission.—Jones.—An illustrated article on the Pikes Peak power transmission in Colorado. There will be three hydro-electric stations, one of which is completed. It contains four 400-kw, 600-volt, 30-cycle, three-phase alternators, direct connected to water wheels. The line voltage is 12,600. The line leads to the substation, adjoining the Gold Coin ore house in Victor, which supplies current to the city and mine. The high-pressure lines leave the substation in various directions to other mines and mills.—*Jour. of Elec.*, September.

Traction

Direct 3,000-Volt, Three-Phase Traction in Italy.—A note stating that as the Colico-Sondrio and the Colico-Chiavenna sections of the Valtellina Railway in Northern Italy have now been running for some months past as experimental lines, the government has granted the necessary permission to operate a daily regular service of pasenger and goods trains. The feature of the installation is the use of 3,000-volt, three-phase, alternating currents as the working pressure of the motors, power being supplied to the line from a generating station which utilizes the water power of the falls of the Adda River, the transmission line pressure being 20,000 volts. The length of the lines now actually working is about 100-km, and it is only on account of the goods results shown by the tests, that they have at last been officially sanctioned. One of the worst dangers anticipated was in respect to fire consequent on the high-tension trolléy wire snapping and falling on the trains, should the safety device fail to act. During the test, however, the automatic cut-out has given great satisfaction, the 3,000-volt trolley wire having been allowed to fall on the roof of the train without doing the slightest damage.—Lond. *Elec.*, September 12.

City and Surburban Electric Traction.—Mommerque.—An abstract of a report to the French Ass. Adv. Sc., in which he reaches the following conclusions. The simplest system of electric traction are the third-rail system for railways and the trolley system for tramways. Although the trolley automotor system (cars not running on rails, but taking current from overhead wires by means of special devices) starts from the same principle, it can be used in cities only in exceptional cases. Storage batteries on tramway cars too heavy are too expensive; they should be used only in exceptional cases where the batteries can be replaced after a relatively short run and charged slowly under good conditions of supervision. Where it is impossible to run a trolley system throughout, a combined trolley and conduit system is recommended.—*L'Eclairage Elec.*, July 26.

Installations, Systems and Appliances.

Agricultural Electric Installation.—Roth.—An illustrated description of an installation of an Austrian farm where electric power is used for ploughing, and also for lighting 300 lamps and driving a pump and an agricultural machine. As the latter two are only working at long intervals, they are on the lighting circuit, while for ploughing a separate circuit is used. There is a small water power available giving 500 liters per second at a height of 8 meters; a 40-hp turbine is used, running at 275 r. p. m. To improve the uniformity of revolution, a 1,000-kg flywheel is mounted on the shaft of the turbine. With the turbine is connected two sets, each consisting of two electric machines. The larger set is of a 65-kw, 2,100-volt, three-phase dynamo and a 40-kw, 110-volt, direct-current dynamo, while the smaller set is a 10-kw, 2,100-volt, three-phase dynamo and an 11-kw, 110-volt, direct-current dynamo. There is also a battery of 60 cells of accumulators, giving 987 amp.-hours in seven hours. The 65-kw, three-phase machine gives the current for ploughing, the 10-kw, three-phase machine for lighting. While current is used for ploughing, the 65-kw, three-phase machine is coupled with the 40-kw, direct-current machine, and the latter is connected with the storage battery. As long as the whole power is not required for ploughing, the battery is charged from the direct-current machine. When more power is required for ploughing than the turbine can give, the battery drives the direct-current machine which then runs as a motor and supports the turbine. If during ploughing, current is required for lighting, the smaller machine set is used, which, however, is then disconnected from the turbine, in order to avoid fluctuations of the light, due to sudden changes of the ploughing load; the 11-kw direct-current machine is then driven as a motor from the battery, and drives the 10-kw, three-phase machine which gives the lighting current. When the ploughing is finished, the 10-kw, three-phase machine and either of the two direct-current machines are driven by the turbine, the former gives the current for lighting, the latter for charging the battery. For ploughing, the following system is used. At one side of the field is placed the car with the motor, which drives a steel rope along which the plough is running. The speed can be reduced to 10 per cent. of full speed by means of a regulating resistance. The steel rope runs from the car with the motor to another car at the other side of the field and back. The progress from one furrow to the next takes place nearly

automatically by means of only two switches. The installation is said to work very satisfactorily.—*Zeit. f. Elek.*, August 31.

REFERENCES.

Electric Installation in a Theatre.—An illustrated description of the application of electric current for power purposes and for lighting at the Covent Garden Opera House in London.—Lond. *Elec. Rev.*, August 29.

Sparklet Fuse.—Some illustrations, with brief description, of the breaking of a 10,000-volt, 1,000-kw arc by means of a "sparklet" fuse, which was recently noticed in the Digest.—Lond. *Elec.*, August 29.

Wires, Wiring and Conduits.

Pressure Rise in High-Tension Transmission.—Woodhouse.—An article in which he first describes the use and construction of lightning arresters on overhead lines and then discusses the pressure rise which may occur alike in cables and overhead lines, due to switching on and off, and to a change of the current flowing. The stresses of a high-tension system are due to the manner in which the circuit is made or broken; the choice of the switch gear is also of importance. Air-break switches become useless above 10,000 volts, due to the long arc formed and the possibilities of resonance effects. The oil-break switch also breaks the circuit suddenly, but without a long arc; this does not stress the system unduly. The ideal switch-gear should make or break the circuit when the current wave passes through zero. Judging from the fact that disconnected cables are always found to be charged, no switch gear does this. Charging devices, such as a switch by which pressure is gradually applied to the mains, may be effective, but are unnecessary. He thinks the system will be fully protected if spark-gaps be fixed between lines and earth, both on cables and overhead lines, the gaps being set to discharge at from one and a half to twice the working pressure, the lower value for extra high pressures. Transformers and the stators of induction machines—both possessing considerable inductance—should not be switched directly on to the line, but should be shunted by a condenser at the moment of switching in or out. In some experiments which he recently made on spark-gaps, it was found that a row of gaps, arranged to discharge at 3,500 volts, kept the pressure of a line at about that voltage when a pressure of 5,000, 10,000, 15,000 and 20,000 volts was applied for several seconds. At the lower voltage the discharge was spread along the cylinders and was uniform. The higher the applied voltage the greater was the tendency to form large sparks, blistering the metal. Apart from such voltages as might occur from lightning discharge, the gaps acted effectively.—Lond. *Elec.*, September 5.

Electro-Physics and Magnetism.

Electron Theory of Magnetism.—Voigt.—A paper in which he attempts to apply the electron theory to magnetism. The idea that Ampere's molecular currents consist of electrons revolving around the remainder of the atom was at once suggested by the Zeeman effect, and the author clothes this supposition in a mathematical form. If the electrons are, however, supposed to have a free orbit, then according to the electron theory, no induced magnetism would be possible. The alternative is to suppose that the revolutions or oscillations of the electrons are damped, and this assumption leads at once to the following theorem: "When the electrons of a body move in a constant magnetic field, they produce magnetic effects when their motion (against a resistance) is always interrupted by any irregular impulse and thus maintained at a constant mean energy. The body will then show paramagnetic or diamagnetic properties accordingly as to whether the motion of the electrons after these impulses show, on the whole, a surplus of potential or kinetic energy, respectively." Such impulses must result from collision with neighboring molecules and electrons, since the electromagnetic heat waves sent out in consequence of such collision are compensated.—*Ann. d. Thys.*, No. 9; abstracted in Lond. *Elec.*, September 5.

Deviable Rays of Radioactive Substances.—Rutherford and Grier.—An account of an investigation which gave the following results. The three well-recognized radioactive substances, urarium, thorium and radium, all emit both deviable and non-deviable rays. In this respect they differ from polonium, which gives out no deviable rays; there is little doubt that polonium cannot be considered as a permanently radioactive substance, for its radiation steadily diminishes with the time. Uranium gives out more deviable rays than radium or thorium, compared with the amount of non-deviable, but the ratio of the amounts of the two types of rays is of the same order. It seems probable that most of the deviable rays from uranium and thorium are given out by a secondary product produced by a disintegration of the uranium or thorium atom or molecule. These secondary products differ in chemical properties from uranium and thorium, and can be separated from them by chemical means, and thus give rise to the products "Uranium X" and "Thorium X." The non-deviable radiation may be either due to the other secondary product of the reaction, or may be due to an action of the product responsible for the deviable rays in the mass of the radiation material.—*Phil. Mag.*, September.

Temperature and Ionic Shock.—Stark.—An article in which he compares the mean velocity of the charged ions in a gas with that of the neutral molecules. The velocity of a negative electron capable of ionizing a molecule is about 1.9 times the 8th power of 10 in cm. per second, and that of a positive ion 8.6 times the 6th power of 10, while for a temperature of 225° C. the neutral gas molecules of hydrogen, nitrogen and carbonic acid has a velocity of the order of magnitude of the 4th and 5th power of 10. The ionizing ions move, therefore, from 100 to 1,000 times faster than the neutral molecules, and the latter may, therefore, be regarded as at rest with respect to the former. Anything which reduces the density of a gas, such as reduction of pressure or increase of temperature, increases the free path of the ionizing ions. This implies that the absorption of kinetic ionic energy diminishes with increasing temperature and constant pressure, as noticed in the absorption of Lenard rays by gases. He makes some interesting applications of this principle to the fall of the discharge potential and to luminous effects in vacuum tubes. Thus the extinction of the glow near a hot body is explained by the increase of the free path, and the consequently smaller absorption of energy from the moving ions.—*Ann. de Phys.*, No. 8; abstracted in Lond. *Elec.*, September 5.

Tesla Discharges.—Wesendonck.—A paper in which he criticized the work of Moehlmann on Tesla discharges by ordinary means (Digest August 30). He points out that there is a great difference between a static and an oscillatory discharge; in the former there is a greater negative discharge from a point, while in the latter there is a greater positive discharge. This difference cannot be brought out by placing a plate opposite the point, since the side discharges are too important. Even with an apparently pure negative discharge positive electricity streams out from the sides of the conductor. It is, therefore, necessary, in order to get at the total discharge, to surround the point with a hollow conductor. He describes an experiment with one of Himstedt's Tesla transformers. An Exner electroscope showed nothing but a positive discharge. When the point discharged freely into space a probe or flame collector, mounted on one side, showed no negative electricity, unless an earthed disc was placed pretty close in front of the point at the same time. Here, therefore, the central positive discharge was surrounded by a kind of negative sheath. But a hollow conductor completely surrounding the point only acquired a positive charge, evidently due to an excess of positive electricity.—*Phys. Zeit.*, July 15; abstracted in Lond. *Elec.*, August 29.

Electricity in Raindrops.—Schmauss.—An account of an investigation of the behavior of a jet of water falling through ionized air. Lenard has found that water falling through ordinary, not ionized air upon a metallic plate communicates positive electricity to the plate and negative electricity to the air. The present author finds that on ionizing the air, this effect is obtained by another. The metal plate receives a negative instead of a positive charge, and only after several minutes does Lenard's effect regain ascendancy. Zeleny has shown that when a stream of ionized air is directed against a conductor, the latter, owing to the greater speed of the negative electrons, acquires a negative charge. In the water jet the conductor is moved against the ionized air, and the effect is the same. Moisture seems to favor the absorption of negative ions. The explanation of the earth's negative charge seems now pretty complete. Wilson has shown that negative ions are more effective as nuclei of condensation than are positive ions. His new experiments, as well as those of the present author, show that drops already formed are capable of transporting negative electricity to the earth. All experiments of this kind are complicated by Lenard's effect, which is probably of an electrochemical nature.—*Ann. d. Phys.*, No. 9; abstracted in Lond. *Elec.*, September 5.

Radio-Active Rain.—Wilson.—An account of experiments made to explain why a negatively charged body exposed to the atmosphere becomes radio-active; as this apparently indicates the presence of some

radio-active substance in the atmosphere, he tested whether any of this radio-active substance is carried down in rain. He boiled down freshly fallen rain to dryness and found a radio-active residue. The radio-activity rapidly disappears.—*Proc. Cambridge Phil. Soc.*, Easter, 1902; abstracted in Lond. *Elec.*, September 5.

Sparking Gap Between Plates for Extremely Small Distances.—EARHART.—A paper giving an account of measurements of the sparking distance between plates when very close together. He formerly experimented with direct current, and has now used alternating current of a frequency of 60 cycles. He used nickel-plated surfaces, and also steel surfaces. Curves are given showing the sparking distance as a function of the potential. The curve for the direct current is almost identical with that for the alternating current. Hence he concludes that a given potential is required to cause a spark to pass between such surfaces, and that the character of the potential difference is unessential. The curves show an "elbow," as there is a change in the law at a distance of about "three wave lengths." At distances less than this, the p. d. required to cause a spark to pass seems proportional directly to the distance of separation, but above this point the relation between potential and distance follows a different law. He also made some experiments, in which capacity was introduced into the circuit; the effect of capacity seems to round out the elbow of the curve.—*Phys. Rev.*, September.

Electrical Properties of the Diamond.—ARTON.—An article in which he states that while density, hardness and quantitative combination with oxygen, are at present accepted as the necessary and sufficient distinguishing qualities of the diamond, there should be added certain electrical properties, some of which are quite characteristic. The conductivity of the diamond is about the same as that of ordinary glass; graphite has a conductivity about the 15th power of ten times as high. Under the action of Röntgen rays the conductivity of the diamond is doubled, but the original resistance is restored at once on removing the rays. Like ice, diamonds possess a dielectric constant largely in excess of the value warranted by its refractive index. Theoretically, it should be about 7, but in reality it is anything from 10 to 17; he takes this as an indication that the diamond, like ice, retains the dielectric constant it had in a previous liquid state; possibly, also, certain hydrocarbons may be present in small quantities to raise the dielectric constant. Diamonds show residual polarization, and consequent electric hysteresis. It is feebly paramagnetic and pyroelectric.—*Accad. Sc. Torino. Atti.*, 1902; abstracted in Lond. *Elec.*, September 5.

High Pressure Spark Gap.—JERVIS SMITH.—An account of experiments which show that the use of a high-pressure spark-gap makes the discharge very effective when used to excite the Röntgen effects in exhausted tubes and bulbs having no terminals. He also found that the high-pressure spark-gap, when placed in the secondary of an ordinary induction coil, increases its effects considerably when used as a generator of Hertzian waves.—*Phil. Mag.*, August.

REFERENCES.

Electric Waves.—MORTON.—A long and highly mathematical paper on the forms of the lines of electric force and of energy flux in the neighborhood of wires leading electric waves.—*Phil. Mag.*, September.

Luminescence of Metallic Vapors.—LEWIS.—An account of experiments, in which he studied the fluorescence of metallic vapors under the influence of cathode rays.—*Phys. Zeit.*, August 1; abstracted in Lond. *Elec.*, August 22.

Hysteresis.—HIECKE; DOERY.—A communication in which the former criticizes several points in Doery's recent article on the mathematical deduction of Steinmetz's hysteresis law; also Doery's reply. *Zeit. f. Elek.*, August 17. Another critical communication by Hiecke in *Zeit. f. Elek.*, August 31.

Change of Length by Magnetization.—HONDA AND SHIMIZU.—An account of an experimental investigation of the change of length of ferromagnetic wires under constant tension by magnetization; soft iron, wolfram steel and nickel steels were tested.—*Phil. Mag.*, September.

ELECTRO-CHEMISTRY AND BATTERIES.

Electric Smelting of Iron Ores.—A note stating that the possibilities of the electric furnace as a rival of the blast furnace, for the smelting of iron ores, are now being tested at several places in Europe. At Darfo, in Northern Italy, the Stassano process has been under trial, in a plant of 1,500-hp capacity. Dr. Goldschmidt, of Essen, after inspecting the furnaces in operation about a year ago, reported favorably on the prospects of the undertaking. From figures published by those financially interested in the Stassano process in 1899, it would appear that 2.7 hp-hours were expected to yield 1 kg. steel in the electric furnace, and that a saving of $7 per ton of steel was estimated as compared with the cost by the ordinary smelting process in Italy. Whether the liquidation of the company is due to the failure of the Stassano process to attain these results or is simply due to a shortness of working capital is not known. Similar trials of the electric furnace for the reduction of iron ores are being conducted at Prague, in Austria; at Le Praz, in France, and at Gysingen, in Sweden, and at the latter place 1,200 kg. steel are said to be produced per day by the Kjellin process. If steel of good quality can be produced in a single operation by the electric furnace from iron ores of average composition, it is possible that these new processes of one reduction may have an important future.—Lond. *Elec.*, September 5.

Electric Furnace for Making Steel.—SEIDENER.—An article on a plant in Sweden, for making steel in the electric furnace. The first experimental electric furnace was installed two years ago, and now a larger one has been built. It is said that with a 300-hp turbine directly coupled with a generator, the new furnace will give 1,500 tons per year, which means that 72 hp give 1 ton per day. It is suggested to use the wasted gases of blast furnaces to drive gas engines, and, if the power cannot be used otherwise, to utilize it in electric steel furnaces.—*Zeit. f. Elek.*, August 24.

Rapidity of Electrolytic Decomposition of Oxalic Acid.—AKERBERG.—An account of an investigation in which he found that a solution of sulphuric acid, containing oxalic acid, is electrolyzed better between platinized than between polished platinum electrodes, and concludes that the decomposition is, therefore, a secondary process.—Lond. *Elec. Eng.*, September 5.

REFERENCES.

Electrolytic Analysis.—ARTH.—A description of the method of Bindschedler for the electrolytic estimation of mercury; the method of Brunck for the estimation of bismuth, and the method of Moltke-Hansen for the separation of lead and manganese.—*L'Eclairage Elec.*, August 2.

Competition of Storage Batteries.—REYVAL.—A long account of the detailed results of the recent competition of electric storage batteries by the French Navy, the main conclusions from which have already been noticed in the Digest.—*L'Eclairage Elec.*, August 16.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Milammeter.—SCHAEFER.—The conclusion of his long, illustrated article on the capabilities of the milammeter and the galvanometer in general testing and in submarine cable testing. He remarks that the Weston direct-reading milammeter now leaves nothing to be desired in the way of portability, compactness and reliance, and can even withstand the rough usage that sometimes is inevitable. He makes some suggestions regarding the selection of an instrument, and sums up the general conditions which must be fulfilled, and discusses the use of the instrument as a direct-reading voltmeter. He says that for the greater refinement required in the measurement of currents in the order of a few microamperes, the supreme excellence of the Sullivan galvanometer is indisputable, both for laboratory and ship work, provided care be taken to avoid the Gerard effect. He describes a special shunt which he has constructed and used, and which has the advantage of being a universal one for all Sullivan or other copper-wound proportional deflection galvanometers, while its resistance is also practically constant.—Lond. *Elec.*, September 5.

REFERENCE.

Measuring Instruments.—ARMAGNAT.—An illustrated description, mainly taken from patent specifications or from descriptions in other journals, of new measuring instruments, among which are meters of Blathy-Japy, Japy, Halsey, Hookham, Wright; Tinsley's form of the cadmium standard cell; the hot-wire wattmeter of Bauch; the faradmeter of Wallyoung.—*L'Eclairage Elec.*, August 2, 16.

MISCELLANEOUS.

Education of Engineers.—PERRY.—The first part of his presidential address to a section of the British Assn., and at the same time the opening of a general discussion of this subject. A mere scientific man analyzes nature, takes a phenomenon, dissects it into its simpler elements, and investigates these elements separately in his laboratory. The engineer takes nature as she is, in all her complexity. He must

have all the knowledge of the scientific man and ever so much more. He uses the methods of the scientific man, and adds to them methods of his own. The name given to these methods of his own or their results is sometimes common sense, or character, or individuality, or faculty, or business ability, or instinct. They come to him through a very wide experience of engineering processes, of acquaintance with things and men. No school or college can do more than prepare a young man for this higher engineering education, which lasts through life. The first essential requirement of a boy who is to become an engineer is that he wants to become one, that he loves his profession. The author then recalls his own studies in his young years, and expresses his obligations to his teachers, especially James Thomson. "To come in contact with any of them, even for a little while, as a student, altered forever one's attitude to Nature. It was not that they gave us information, knowledge, facts. The syllabuses of their courses of study were nothing like so perfect as that of the smallest German polytechnic. And yet if a youth with a liking for physical science had gone to a German gymnasium to the age of 19, and had become a walking encyclopædia on leaving one's polytechnic at the age of 24, the course of that life-study would not have done for him as much good as was done by a month's contact with one of these men. People call it personal magnetism, and think there is something occult about it. In truth, they revealed to the student that he himself was a man, that mere learning was unimportant, that one's own observation of some common phenomenon might lead to important results unknown to the writers of books." Such men teach one "to see that the very commonest phenomenon has still to reveal important secrets to the understanding eye and brain, and that no man is a true student unless he is a discoverer." He is opposed to the study of Latin, and condemns the public school education in England. "What we want to see is that a boy of 15 shall be fond of reading, shall be able to compute, and shall have some knowledge of natural science; or, to put it in another way, that he shall have had mental training in the study of his own language, in the experimental study of mathematics, and in the methods of the student of natural science. Such a boy is fit to begin any ordinary profession." To be versed in experimental mathematics means that "he will use logarithms, and mere multiplication and division will be a joy to him; he will have a working power with algebra and sines and cosines; he will be able to tackle at once any curious new problem which can be solved by squared paper, and he will have no fear of the symbols of the infinitesimal calculus. . . . To many men it will seem absurd that a real working knowledge of what is usually called higher mathematics, accompanied by mental training, can be given to the average boy. In the same way it seemed absurd 500 years ago that power to read and write and cipher could be given to everybody. These general beliefs of ours are very wonderful."—*Lond. Elec.*, September 12.

New Book.

The Generators at the Paris Exhibition of 1900. By C. F. Guilbert. Paris: C. Naud. 766 pages, 615 illustrations, 118 plates, and 20 separate tables. Price, 30 francs.

The great work before us is a monument of able and patient labor, and a perfect mine of valuable information. The fact that almost all the prominent manufacturers in the world exhibited some of their generators and motors at the Paris Exposition, lends this work special interest and importance. The clear illustrations and the accurate drawings in connection with reliable experimental results, the addition of a chapter on wave-shapes taken by a Blondel oscillograph, and finally the tables summing up in a clear and well-arranged manner the most important electrical data, these features give a unique appearance to M. Guilbert's work. The expert, the teacher, and the student will profit by, and enjoy, a work of this nature, as it is of the greatest interest to see how different engineers have solved the same problems. Furthermore, Mr. Guilbert's work embodies descriptions of the latest inventions made in the field of generators, motors, and transformers, and to the American reader this will be of great value.

The work is divided into different chapters treating successively of revolving field alternators, which the author distinguishes from the induction type alternators by calling their fields "discontinuous," while the fields in the induction type generator are called "continuous." Next the induction type compounded alternators of which Boucherôt's machine with exciter with a sine winding is described at length. Next inductor machines are illustrated and described. The second part of the work is occupied with the description of stationary and rotary transformers, and the third part is devoted to direct-current machines.

The whole field of the present status of the art of dynamo design is laid before the reader in this work, and the labor of reading it is greatly eased by excellent type and illustrations, while the difficulty of the French text is to a great extent done away with by M. Guilbert giving the head lines of chapters and the descriptions on the illustrations side by side in French, English and German.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Next meeting Oct. 24; paper by C. P. Matthews on "An Integrating Photometer for Glow Lamp and Sources of Like Intensity."

American Street Railway Association, Secretary, T. C. Penington, 2020 State Street, Chicago, Ill. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

International Association of Municipal Electricians, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

Northwestern Electrical Association, Secretary, Thos. R. Mercein, Milwaukee, Wis.

Ohio Electric Light Association, Secretary, J. H. Perkins, Youngstown, Ohio. Next meeting, Columbus, Oct. 14, 15 and 16, 1902.

A New Industrial Centre at Trafford City, Pa.

The great growth of the affiliated Westinghouse industries was recently signalized by the creation of a new city and the building of another Westinghouse manufacturing plant. The new industrial center is located about 17 miles east of Pittsburg, on the Pennsylvania Railroad, and is to be known as Trafford City. Extensive factory sites have been laid out here to provide for the overflow of the several Westinghouse industries, a number of which have already used up all the available building room at their present locations and are still pressed for space. The first of the Westinghouse companies to erect buildings in the new city is the Westinghouse Foundry Company, which is at present putting up an extensive and model foundry plant and pattern shop. This addition is necessitated by the rapidly increasing business of the Westinghouse Machine Company, especially in connection with very large steam and gas engines and steam turbines.

The new town is connected with Pittsburg by the Pennsylvania Railroad, over which there are 46 local passenger trains going each way daily, and reaching the center of the city in from 25 to 35 minutes. In addition a trolley line has been built, connecting with the Pittsburg Railways Company's line at Wilmerding, 2½ miles distant. This street railway passes over the steel viaduct into Trafford City and forms a loop through the principal streets.

The new foundry and pattern shop of the Westinghouse Foundry Company are located at the extreme southern portion of the factory site, and near the steel viaduct mentioned above. The pattern shop and storage building, which has already progressed well towards completion, is a steel and brick structure, 605 feet long and 80 feet wide, with a height to the eaves of the roof of 47 feet. The pattern shop occupies 160 feet at one end of this building. It is divided into two floors, the second floor being suspended from the roof trusses in order that the first story may be entirely free from columns, thus providing ample space for handling the largest patterns. The remaining 447 feet of the building is to be used for the storage of patterns and has three floors, the two upper floors being supported on steel columns, and the entire space being divided by interior fire walls into three separate compartments.

The foundry building is 611 feet 8 inches long and 184 feet 3 inches wide outside of the brick walls, which are 36 feet high at the eaves and 80 feet at the peak. As in the case of the pattern shop, the foundations are built of concrete, and the superstructure of steel and brick. The foundry is divided transversely into three bays, the

[illegible] between centers of columns, runways being provided for traveling cranes of [illegible]-foot span and [illegible]-tons lifting capacity. The cranes will be electrically driven. The two side bays are each 50 feet 6 inches wide from center to center of columns and are provided with runways for traveling cranes of 47 feet 2½ inches span and 50-tons lifting capacity. At one side of the foundry building runways are provided for yard traveling cranes of 100-foot span, and a lifting capacity of 75 tons.

The plans for the buildings were prepared under the supervision of the Westinghouse Machine Company. The Security Investment Company, of Pittsburg, Pa., is the financial agent and general contractor for the entire works, and Messrs. James Stewart & Co., of St. Louis, Mo., and Pittsburg, Pa., are the managers of construction. The Real Estate Trust Company, of Pittsburg, Pa., successfully handled the extensive sale of city lots adjoining the new works.

Electric Heating and Cooking.

The Prometheus Electric Company, 60 Reade Street, New York, is introducing in this country an electric heating system, which was first developed in Europe and has been in successful use in Germany for the past seven years. In Austria the well-known Siemens & Halske Company has introduced the system, and in Switzerland, England and France it is extensively used for domestic and com-

FIG. 1.—MELTING POT AND SOLDERING IRON.

mercial purposes. The Prometheus Electric Company has Americanized the apparatus in many of its details, and is now manufacturing a complete line of cooking utensils and heating apparatus, including chafing dishes, tea kettles, hot water boilers, coffee machines, hot water urns, plate warmers, broilers, stoves, laundry irons, laundry machines, pleating machines, curling irons, soldering irons, glue pots, street car heaters, radiators, sterilizers, medical appliances, motor rheostats, controlling devices, theatre dimmers, etc. The accompanying illustrations show some of these. Fig. 1

FIG. 2.—AUTOMATIC LAUNDRY IRON STAND.

representing a melting pot and soldering iron; Fig. 2 a laundry iron; Fig. 3 a rheostat; Fig. 4 a car and stateroom heater, and Fig. 5 some cooking utensils.

In most, if not all, systems except the "Prometheus," the heating is effected by wire coils or ribbon conductors embedded in some insulating material, generally enamel. In the present system, however, no wires are used. The heating device itself consists of a

FIG. 3.—RHEOSTAT.

strip of mica on which a layer of metal has been deposited, or more properly speaking, fired. This conducting strip is protected by another piece of mica, and the whole is enclosed in a metallic casing.

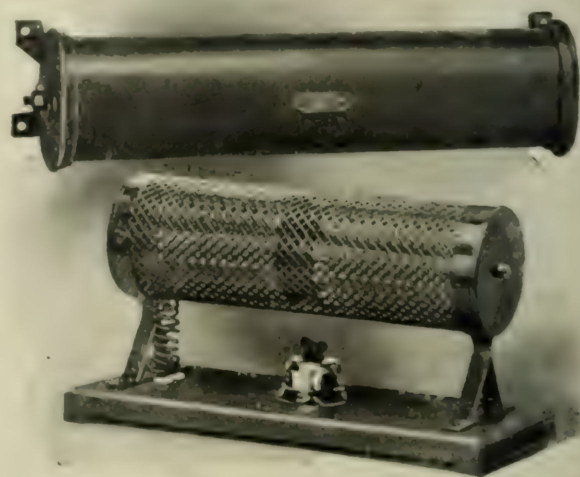


FIG. 4.—CAR AND STATE ROOM HEATERS.

This unit or "heating element" can be painted to any desired resistance. The paint is an alloy composed of non-oxidizable metals, insuring the element's life. The element may be either straight or circular, according to its usage, and may be inserted into or removed from a piece of apparatus with the greatest ease by an unskilled person in case of a break-down, an advantage heretofore denied by any other known method.

FIG. 5.—COOKING EQUIPMENT.

As stated above, in this system the utensils themselves are equipped with the heater, thus dispensing with a stove, which means not alone the purchase of a single piece of apparatus, say a pot or chafing dish, instead of a pot or chafing dish and stove on which to place it; but the inefficiency of the latter device is obliterated. It is claimed that by actual tests 87 per cent. of the heat sent into a utensil is utilized therein for the heating of food. This may be illustrated by holding in the hand a pot in which water is boiling, the escape of heat being so slight that this can be done without discomfort.

S. K. C. Railway Motor.

We illustrate herewith a type of railway motor manufactured by the Stanley Electric Manufacturing Company, which is designed for city and suburban service and has a rating of 37½ horse-power, based on the usual shop test of 75 degrees F. rise at the expiration of one hour's run at full load. On account of the superior ventilation of the motor, however, the temperatures actually reached in service are considerably below those that might be expected in view of this rating.

The frame is approximately cylindrical in shape and is divided horizontally into two halves, which are held together by four bolts. On the side furthest from the axle there are two eye-bolts on the lower half which fit on hooks cast in the upper half. The lower half can be swung down by taking out the two bolts nearest the axle, leaving it hanging on the two eye-bolts and their hooks. If it is desired to remove the lower half entirely, all four bolts are removed and the lower frame dropped into the pit by suitable jack or tackle. The pole pieces are made up of soft laminated steel punchings, riveted together and attached to the frame by bolts passing through the frame and tapped into a large rivet in the center of the pole piece. Each pole piece has a flare or offset at the armature end which, besides holding the field coil in place, also effects that distribution of the magnetic flux entering the armature which results in the best commutation.

The armature bearings are babbit-lined cast-iron shells. These are of ample size, the commutator bearing being 6⅛ inches long and the pinion bearing 7¾ inches, so that the wear of bearings which has been such a frequent source of trouble is here reduced to a minimum. They are held in place by bearing caps bolted to grease boxes cast in the upper half of the frame. The caps themselves are entirely separated from the lower half of the frame, so that the lower half may be removed, leaving the armature supported by the upper half. If desired, however, the caps may be removed before the frame bolts and the armature lowered with the lower half of the frame. The caps are deep and hollow, furnishing ample oil cellars; and the bearings are kept lubricated by wicks bearing against the shaft. Grease boxes fitted with spring-closed covers are cast in the upper half of the frame and project over the bearings, furnishing an additional source of lubrication in case the oil runs out or the bearing begins to heat from other causes.

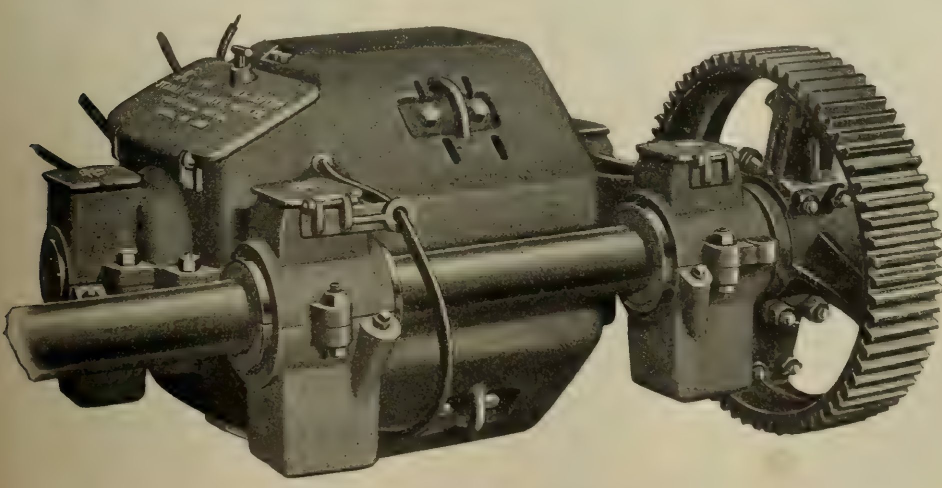


FIG. I.—RAILWAY MOTOR CLOSED.

A space is left between the bearing cap and the frame, through which projects the oil guard on the armature shaft. Any oil escaping from the bearing is thus thrown outside of the motor and prevented from reaching or injuring the field or armature. The axle bearings resemble the armature bearings in their general construction.

The field coils are wound of square wire thoroughly insulated.

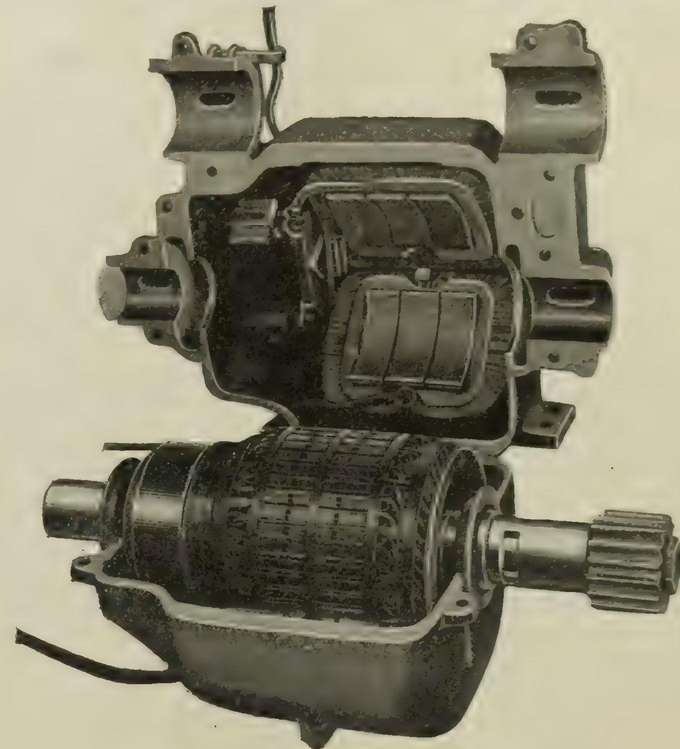


FIG. 2.—MOTOR OPEN.

Allowance of ample room in the frame casting enables a flat coil to be used, so that it is not necessary to bind the wire after it is removed from the form on which it is wound. The method of bringing out the terminals of the field coils is a feature which will be appreciated by those who have had experience in the repairing of street railway motors. The inner end of each coil is attached to a flat flexible copper strip which is brought out through the insulation, and the strips from the several coils are clamped together., The outer end of each coil is attached to a rubber-covered flexible wire several feet in length. These wires are brought through appropriate holes in the frame and are attached to the car wiring on the outside. The removes the danger of broken field wires at the terminals inside of the motor and makes it impossible for a repair man in replacing the coils to connect them in wrong order.

The coils after winding are dried in an oven, and while hot dipped in an insulating compound which fills the spaces between the wires and prevents the entrance of oil or moisture. The coils are then wrapped in layers or rope-paper, mica and tape, with leatheroid protection where the is a liability or chafing, and are finally thoroughly japanned and baked. The experience of the Stanley Company in the insulation of high-voltage coils is applied and lends assurance of the very best results in insulation of both field and armature coils.

The armature is unusually well ventilated. Large ducts parallel to the shaft allow the air to enter the body of the armature; and ventilating ducts perpendicular to the shaft allow the heat to escape from the interior of the iron. The magnetic densities of armature core and teeth are so proportioned as to ensure good commutation at heavy overloads, and the ample ventilation protects the insulation from injury by reason of these overloads. The armature end cast-

ing projects above the level of the coils so as to protect the end windings from injury. This casting being well cored out and well ventilated, is light and allows ample access of air to the windings. The armature coils are form-wound, dipped and thoroughly insulated with oiled linen and tape. The band wires holding the coils in place lie in grooves below the general surface of the armature, so that even if the bearings wear down, the face of the iron protects the armature bands from injury and thereby avoids a source of trouble frequently experienced in earlier types of motors.

The commutator bars are clamped together in a jig with micanite insulation between, and baked to soften or remove the shellac or other cementing material. The clamping screws are then tightened and the bars drawn solidly together. The ends are then turned to gauge and the insulating heads and end clamps fitted into place, after which it is again baked and the end clamps set up and locked into position. A neat cover over the commutator permits inspection of the same and replacing of brushes. Another hand hole at the bottom of the motor allows inspection from below. This hole is fitted with a ventilated cover filled with a sponge, which prevents the entrance of dust, but allows any water in the bottom of the motor to escape.

The motor is not water-tight in the sense that the entrance of water into its interior is absolutely prevented. The object has been to design a well-ventilated motor from which the heat from the interior, as well as any water, can readily escape. There are ventilating spaces under the cover of the motor, as well as at the opposite end, through which the air can enter the armature body to be thrown out through the perpendicular ventilating ducts in the armature. Ventilating ducts are also provided in the pole pieces, corresponding to those in the armature, an arrangement which results in a very free circulation of air in the interior of the motor.

New Type of Enclosed Arc Lamp.

A new type of arc lamp has been brought out by the Dayton Fan & Motor Company, Dayton, Ohio, in which, while the multiple system of gas chambers remain the same as in all types of "Belden" lamps, a new controlling mechanism has been introduced. Unlike in other lamps, the solenoid is pivoted to one end of a walking beam (instead of being rigidly connected to the lamp frame), and to the other end of the walking beam is pivoted the moveable carbon tube. The principal advantages claimed for this construction are that the weight of solenoid tends to balance the weight of movable carbon and tube; the solenoid has a double power when energized by a direct upward pull on the tube and downward pull on solenoid or opposite end of walking beam, any change in ampere-turns, due to changes at the arc, has a double effect of making the lamp very sensitive, and each ampere-turn having double power, allows the use of a very small solenoid, thus reducing the cost of manufacture and expense of repair parts.

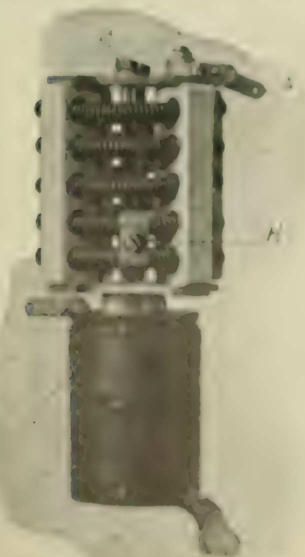


FIG. 1.—MOVABLE MECHANISM.

FIG. 2.—OUTDOOR LAMP.

FIG. 5.—SPOOL AND SOLENOID.

FIG. 4.—DASHPOT.

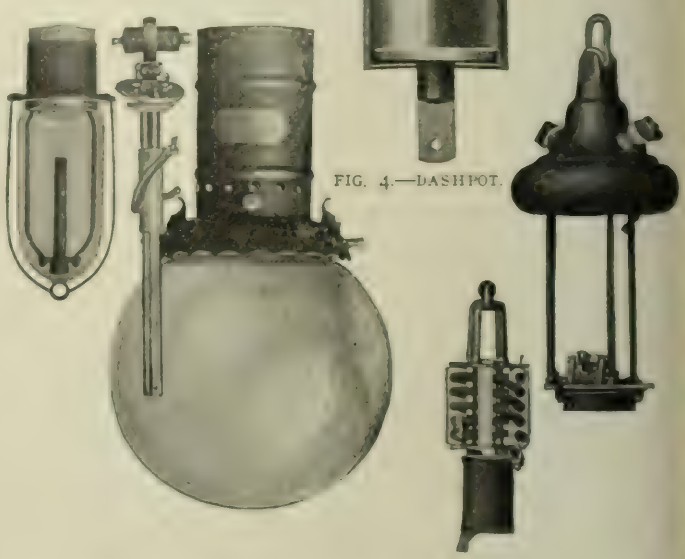
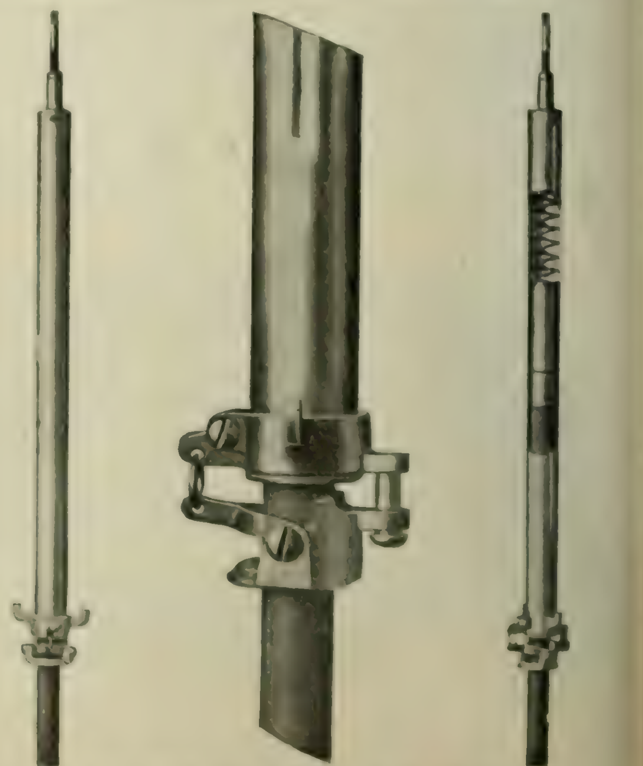


FIG. 3.—LAMP DISSEMBLED.

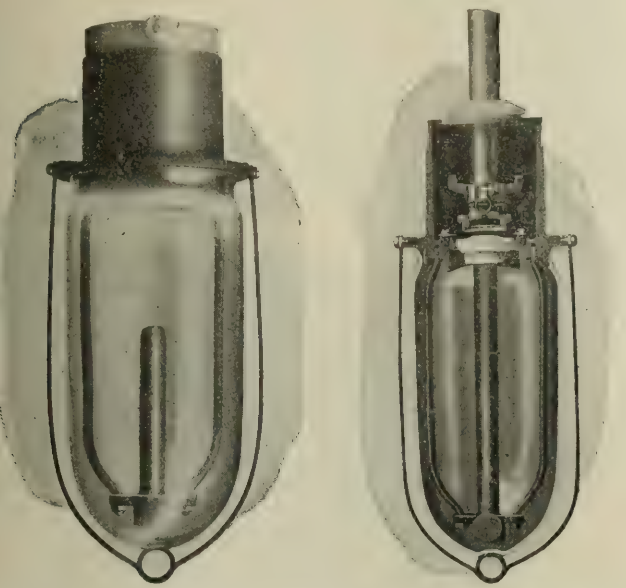
Fig. 1 is a view of the movable mechanism, which is pivoted to walking beam at *D*, the upper end being movably connected to lamp frame at *A*. Loops are brought out on the solenoid at *G F E* for ampere adjustment. A clamp is shown at *H* for voltage adjustment. This entire mechanism is assembled as one piece by the use of but two nuts, shown at *B*. Fig. 2 shows a lamp for outdoor use. This lamp is but 25 inches long over all; the body of case is 4½ inches



FIGS. 6, 7 AND 8.—UPPER CARBON TUBE AND CLUTCH.

in diameter, the outer globe 11 inches in diameter, and the standard carbons 12 x ½ inches for 5 or 6 amperes, and 12 x ⅜ inches for three amperes.

Fig. 3 shows lamp disassembled into five sections, this requiring the removal of but two cotter pins and the breaking of but two connections, and can be accomplished in 30 seconds' time. Fig. 4 shows the dash pot. The valve in the top is a 3-16-inch ball, made of a special metal to prevent rust and corrosion. The plunger is made of a very fine high-grade graphite. The upper part or casing is



FIGS. 9 AND 10.—ENCLOSING GLOBE, SHOWING GAS CHAMBER.

pivoted to the movable mechanism and the plunger to the walking beam, which causes them to move in opposite directions, giving a very long, rapid movement, and controlling the lamp perfectly with a very loose fit, which obviates trouble from expansion and contraction common to snug-fitting dash pots. Fig. 5 shows the removable stamped metal spool and solenoid.

Figs. 6, 7 and 8 show upper carbon tube with the clutch at its lower end. In one view the tube is represented cut away to show

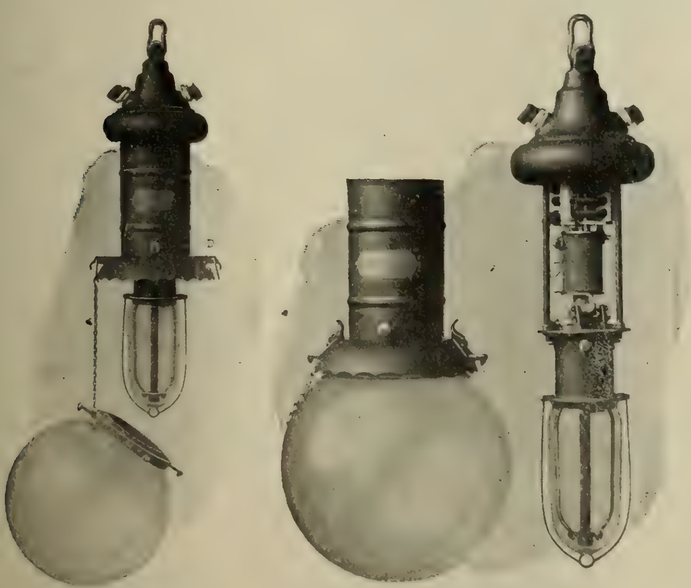


FIG. 11.—READY FOR TRIMMING. FIG. 12.—GLOBE AND CASE REMOVED.

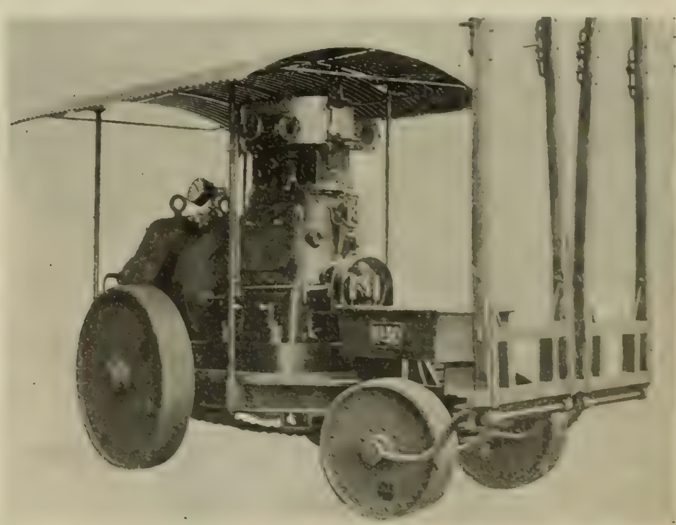
carbon clamp and flexible copper cable, which make a continuous electric path through lamp, without sliding contacts. One of the cuts shows a larger view of lower end of tube and clutch. The dog on left side of the clutch moves in the same direction of carbon when feeding, thus doing away with all friction. Figs. 9 and 10 represent arc enclosing globe and its holder, as well as the second or intermediate gas chamber. The sectional view shows the lava gas caps and clutch. It is claimed that the life of the carbon is greatly increased and the amount of deposit on globe decreased by this construction, as the gas has to pass through one gas cap, then through the second chamber, then through a second gas cap before escaping, and fresh air has to go through the same difficult path to get in, which keeps the combustion perfect. The inner globe holder is in keeping with the simplicity of construction throughout the entire lamp. The inner globe is the closed bottom type with large opening at the top for convenience of cleaning. Fig. 11 shows the outer globe lowered to trim, and Fig. 12 the globe and case removed as one piece, giving access to all moving parts.

Westinghouse Building in London.

The new Westinghouse building in London and its annex are well lighted. The building consists of seven floors and basement, each floor being designed for about 14 rooms. Three-wire service mains are brought into the building by the Charing Cross and Strand Electricity Supply Corporation, the supply being by continuous current at a pressure of 200 volts at the lamps. The main distribution board is of enamelled slate mounted in a massive teak frame, and provides for a separate circuit to each floor of the building. From this main board a separate circuit is run to each of the local distribution boards for supplying the various floors, where all the fuses are. All lamp circuits are run back direct to distribution board, no fuses being employed locally. The maximum number of incandescent lamps supplied from any sub-circuit is eight, and with few exceptions every lamp is furnished with a separate switch. The wiring is carried out in simplex brazed tube, all the tubes being fixed in position as the building work proceeded and the wires drawn in afterwards. The "Westinghouse" building contains upwards of 700 lights, together with a very elaborate and extensive system of electric bells for the tenants and service, gas fire points, speaking tubes, etc.

Portable Electric Lighting Plant.

To meet the need of an electric light plant which can be readily transported from place to place in military or naval service, the portable generating set shown in the accompanying illustration has been designed and manufactured by Messrs. W. H. Allen, Son & Co., Limited, Bedford, England. As will be seen the plant consists of one of this firm's high-speed, enclosed, compound, forced lubri-



PORTABLE ELECTRIC LIGHTING PLANT.

cation engines directly coupled to a six-pole dynamo of the same firm's manufacture and mounted on a transporting carriage.

The combination is capable of giving an output of 105 volts and 600 amperes when running at a speed of 400 r. p. m., steam being supplied at a pressure of 110 pounds at the engine stop-valve.

The particular plant shown is one of several which have been constructed by Messrs. Allen for the temporary lighting of any part of British dockyards. It is intended to be drawn by horses, the

carriage being rigidly built and mounted on four wheels with broad treads and substantial axles, the whole being sufficiently stable to enable the plant to be transported over rough ground without injury to any part. The baseplate of the engine and dynamo is arranged so that it can be lifted off the carriage and bolted down on a fixed foundation if required. The carriage is covered with a roofing of galvanized corrugated iron, with water-proof curtains hanging from rails on the sides and ends. Boxes fitted with water-proof lids with padlocks and keys are provided for stowing tools, spare parts and stores. The weight of the complete plant is 8 tons 19 hundredweight.

It is somewhat interesting to record that one of these sets was lately fitted on board the royal yacht "Victoria and Albert." It was found that the engines and dynamos which were already there created too much vibration, and as the plant we illustrate is a silent working engine it was decided to fit this type on the yacht. The work was undertaken and completed in less than seven days, which is a record for the large amount of work necessary. The trials took place on Sunday, July 13th, and it was gratifying to all concerned to find that with the engine working at full load and delivering 60 kilowatts not a sound could be heard in the royal apartments. Stringent tests were made by the dockyard and other authorities to ascertain the vibration, and bowls of water were placed in various parts of the ship, but not a trace of vibration could be detected.

A Conduit Terminal Frame.

The cuts shown herewith illustrate an adjustable terminal frame for ending underground conduit in manholes. This frame serves not only to give the work a more finished and neater appearance, but allows a better arrangement of the cables, as they can be placed closer to the walls without kinking the lead sheath and without being damaged by sharp corners. The common practice in ending conduit in manholes has been to bring the ducts flush with the face

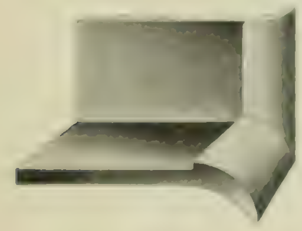


FIG. 1.—SECTION OF FRAME.

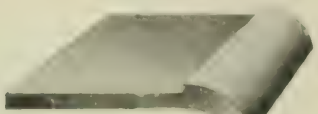


FIG. 2.—CORNER PIECE OF TERMINAL FRAME.

of the wall, thereby causing a sharp corner, which is encountered when drawing in cables and is liable to cut or scrape the lead cable sheath so as to cause serious injury.

In shaping the cables to the walls a good arrangement cannot be obtained without kinking the sheath where the ducts are flush with the wall. The adjustable terminal frame seems to be a radical im-

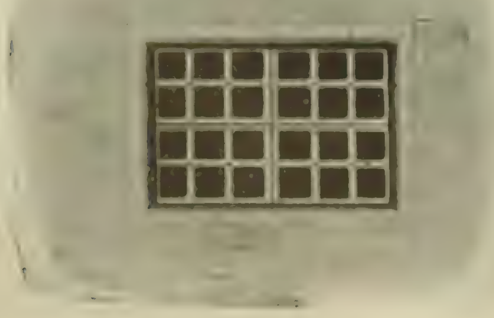


FIG. 3.—FINISHED MANHOLE SHOWING CONDUIT TERMINAL.

provement over the old method, and being smooth and having no sharp edges or corners, offers no obstruction to the drawing in of cables. The frame is adjustable to a run of any number of ducts, and is one of the many specialties now being placed on the market by G. M. Gest, the well-known subway contractor of New York and Cincinnati, who has of late addressed his attention to subway physical problems with conspicuous success.

Gas Engine Igniters.

The Holtzer-Cabot Electric Company, Boston, Mass., has supplemented its line of gas engine igniters with a larger size, a machine exceeding, it is said, in size and output anything else of the magneto type on the market. It weighs 30 lbs., and has a capacity momentarily of 50 watts, and continuously of about 25 watts.

The armature is of the slotted drum type, with laminated core. A compound winding is provided, which holds up the field under load, making possible a much greater output than could be obtained in a magneto of the usual construction. Particular attention is directed to the brush-holder, which is of the box type, with parallel

LARGE MAGNETO IGNITER.

feed, substantially constructed, allowing a brush of relatively large cross section to be used. A sliding base is provided with thumb screw for tightening the belt.

The machine is used to advantage with large engines and those whose "make-and-break" device is of such construction as to require a relatively large quantity of current. It combines the large output of the dynamo igniter with the advantages of the magneto type, namely, reversibility, independence of speed fluctuations, and ability to deliver a spark at a very low speed. These features also make the igniter useful in connection with automobile work, where the weight would not be a disadvantage.

Electric Glue Pot.

A useful application of electric heating is furnished in an electric glue pot manufactured by the United Electric Heating Company, of Detroit, Mich., which is shown in the accompanying illustration. That it may withstand the hardest usage, the pot is made of cast iron throughout. Among a number of new features embodied in the construction are an enclosed self-contained switch, slow-changing water level and the absence of surface contacts or connections. The heating coil is so placed that the glue will heat to the proper consistency very quickly without possibility of the pot burning out. The advantages claimed for this pot are that it will not dent or break, requires less refilling than the ordinary pot, heats more quickly, and is free from all danger of short-circuit or disarrangement of parts.

GLUE POT.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was very scarce during the week, 6 per cent. being the rate for all periods. Under the influence of the acute pressure in the money market stock prices declined throughout the list. The movement was attended by a great deal of liquidation by pools and large interests, and the market without becoming demoralized, was exceedingly weak. At the end of the week, however, a steadier tone asserted itself, although the market remained sensitive. The industrials were quiet, the United States Steel stocks selling off with the rest of the market and receiving support at the decline. Tractions also declined under the same influences, Brooklyn Rapid Transit closing at 66¼, being a net decline of 2 points. Metropolitan Street Railway, after having reached 146¾, closed at 142, a net loss of 3½ points, the lowest quotation on this stock being 140½. General Electric, Western Union and Westinghouse, common, suffered declines, but Westinghouse preferred made a net gain of 1¾ points, being the only exception in the electrical list. General Electric closed at 190, a net decline of 3 points; Western Union 94, a net loss of 1½ points, and Westinghouse common 223, a net loss of 2 points. The closing price of Westinghouse preferred was 225, which was the ruling figure throughout the week. The greatest loss in the electrical list was that of American Telephone and Telegraph, which amounted to 8 points; the closing price was 169, after having been 171. Other closing quotations were: American District Telegraph, 37, a net gain of 1¼ points, and American Telegraph and Cable, 94. Following are the closing quotations of September 30:

NEW YORK.

	Sept. 23.	Sept. 30.		Sept. 23.	Sept. 30.
American Tel. & Cable.	—	—	General Electric	191½	187
American Tel. & Tel..	171	—	Hudson River Tel.....	—	—
American Dist. Tel....	—	—	Metropolitan St. Ry...	145	142¼
Brooklyn Rapid Transit	65½	66	N. E. Elec. Veh. Trns.	¼	¼
Commercial Cable	—	—	N. Y. & N. J. Tel....	—	157
Electric Boat	25	25	N. Y. E. V. T. Co....	—	13
Electric Boat pfd......	40	40	Tel. & Tel. Co. Am..	—	—
Electric Lead Reduc'n..	2½	3¼	Western Union Tel....	92	93⅞
Electric Vehicle	5¼	5¼	West. E. & M. Co.....	223¼	218
Electric Vehicle pfd....	14	14	West. E. & M. Co. pfd..	—	—

BOSTON.

	Sept. 23.	Sept. 30.		Sept. 23.	Sept. 30.
American Tel. & Tel..	170	167	Western Tel. & Tel. pfd.	—	100
Cumberland Telephone .	—	—	Mexican Telephone....	2⅛	2⅛
Edison Elec. Illum....	—	277	New Eng. Telephone...	140½	139
Erie Telephone	—	—	Westinghouse Elec.	109½	108
Western Tel. & Tel....	28¾	28	Westinghouse Elec. pfd.	108	108

PHILADELPHIA.

	Sept. 23.	Sept. 30.		Sept. 23.	Sept. 30.
American Railways	54½	52½	Phila. Traction	98¼	98
Elec. Storage Battery..	—	—	Phila. Electric	8¾	8⅞
Elec. Storage Bat'y pfd.	—	—	Pa. Elec. Vehicle......	—	—
Elec. Co. of America..	10¼	10	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	Sept. 23.	Sept. 30.		Sept. 23.	Sept. 30.
Central Union Tel.....	—	—	National Carbon pfd....	103½	101
Chicago Edison	—	—	Northwest Elev. com...	—	36½
Chicago City Ry.......	—	215	Union Traction	18⅞	17½
Chicago Tel. Co........	175	—	Union Traction pfd....	58*	48⅝
National Carbon	33	32			

* Asked.

TELEPHONE DEEDS OF TRUST.—At Wilmington, Del., on September 25, in the office of the Recorder of Deeds Josiah Marvel, attorney for the International Telephone Company, recorded a deed of trust for $1,000,000, to secure an issue of bonds amounting to $100,000,000, the greater part of which has been underwritten by capitalists in New York, Baltimore and Washington. The company expects to enter the telephone business as a rival of the present systems, and place the cost of telephone calls the same as the charge for mailing a letter. The International Telephone Company was incorporated through Mr. Marvel, on May 15 of this year, with a nominal capitalization of one million dollars. In a few days an amended certificate will be filed increasing the capital stock to $20,000,000, and the fees from it to the State of Delaware will be about $30,000. Of the $200,000,000 capital stock, it is understood that $170,000,000 of it has been subscribed for or underwritten. The officers of the company are: President, S. B. Rhinehart, a banker of Waynesboro, Pa.; treasurer, Ehlem B. Harrison, of Baltimore; secretary, Henry F. Fahey, of New York; assistant secretary, J. Miller Kenyon, of Washington.

CUBAN ELECTRIC RAILWAY.—At a meeting, held in New York a few days ago, the Cleveland, Youngstown, Chicago and New York capitalists who are interested in the building of an electric line in Cuba, organized the company as the Havana and Jaintos Railroad Company, with capital stock of $2,500,000. The stockholders elected the following directors: W. H. Whipple, New York; W. J. Hayes and L. W. Prior, Cleveland; C. S. Fairchild, New York; M. A. Devitt, Chicago, H. A. McCoy, Chicago; George F. Penhale, New York; Thomas Vaughan and Judge Mandelay, of Havana. The directors elected W. H. Whipple, president, and W. J. Hayes, vice-president. It was decided to commence construction work at once, and contracts were closed with Park & Hamilton, of Youngstown. The New York Security and Trust Company will act as financial agents. It is stated that President Palma and the Cuban cabinet have given assurances that the company will be fairly treated, as it is the desire to induce American capitalists to invest in Cuba.

VENANGO POWER AND TRACTION COMPANY is offering its first lien 5 per cent. gold bonds, of a total $1,000,000. The capital stock is the same amount. Daniel O'Day is one of the directors. Half of the issue has already been sold. The Venango Power and Traction Company is a consolidation of all the electric railways in Venango County, Pennsylvania, embracing the following properties: Citizens' Traction Company, Franklin Electric Railway Company, Oil City Street Railway Company, Oil City; Rouseville and Franklin Railway Company, Station Railway Company, which are operated as one continuous road of 32 miles, serving a population of 30,000, and the Citizens' Light and Power Company, which serves lighting to a population of 17,000. The company also owns Monarch Park. During the fiscal year ending July 1, 1902, the company earned a surplus over all fixed charges. Recent net earnings are in excess of twice the interest charges.

NEW YORK AND NEW JERSEY TELEPHONE.—The New York and New Jersey telephone directors have authorized an issue to stockholders at par of $3,125,000 in proportion to their present holdings. The company's present stock amounts to $9,375,000. Payment will be required, 40 per cent. November 1, 1902, 30 per cent. May 1, 1903, and 30 per cent. August 1, 1903. Stockholders, if they prefer, may pay in full November 1, at 101.50 per share. The object of this increase in stock is to provide for general development of the company's business in Long Island and New Jersey. The rights were quoted last week at 18 to 20.

MICHIGAN TROLLEYS.—A company will be formed with a capital of from $30,000,000 to $40,000,000 to amalgamate all electric lines in the lower peninsula, with the exception of Detroit United Railways and the Monroe & Toledo Company. It is said the new company may be formed within thirty days. Westinghouse interests, Hawkes, Angus and New York bankers are in the deal.

MICHIGAN TELEPHONE BONDS.—The Boston Stock Exchange has stricken from the list Michigan Telephone Company consolidated mortgage 5 per cent. bonds of 1929, and admitted in their place, upon the unlisted department, the certificates of deposit for the Michigan Telephone 5 per cent. bonds, issued by the Old Colony Trust Company, transfer agent.

OTIS ELEVATOR.—The stockholders have had the privilege of subscribing to the new $2,000,000 issue of preferred stock, at par, to the extent of one share for each ten shares of stock, preferred or common, held by them as of record on September 25. Subscriptions were to be paid on or before October 1.

AUGUSTA, GA., TROLLEYS.—It is stated that the Augusta street railway and electric lighting plant, owned principally by the Jarvis-Conklin Syndicate, has been bought by the North Augusta Electric and Improvement company, and will be merged with the Augusta-Aiken Railway.

BOSTON ELEVATED ISSUE.—The stockholders of the Boston Elevated Railway have taken practically the entire issue of 33,000 shares of new stock at $155 per share. A large part of the stock was absorbed by small stockholders.

UNITED RAILWAYS AND INVESTMENT.—Application has been made to the Stock Exchange to list $15,000,000 preferred stock and $10,000,000 common stock of the United Railways and Investment Company.

MACON (GA.) TROLLEYS.—It is announced that the merger of the three street railway lines of Macon, Ga., has been completed. The deal involves about $1,000,000.

DIVIDEND.—The directors of Central and South American Telegraph have declared a quarterly dividend of 1½ per cent., payable October 8.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports of the most favorable character as to trade and industry continue to be made to the mercantile agencies. Large yields of nearly all crops have been secured, [illegible] trade activity is unabated, manufacturing industry in nearly all lines is running at full speed, retail demand is improving, and railway and water transportation interests are pushed to handle business offered. The only unfavorable feature in the situation is the growing tension exerted by the anthracite coal strike, which now finds cool weather almost here and industry in many lines threatened with interruptions because of the enhanced price of bituminous coal. Among the industrials the feature of transcendent interest was the enormous demand, greatly in excess of the supply, for iron and steel in its cruder forms. Buying of foreign iron and steel is liberal, notwithstanding advices from the Central West that consumers find difficulty in utilizing some of that already imported. There is still a marked scarcity of steel plates, and a premium of $5.00 per ton is reported for the quick delivery of structural steel. Producers are crowded with orders and the announcement is made that some orders for bridge material have been secured for delivery in 1904. Some large orders for rails in this country and Canada have been placed with German and English manufacturers, because of the inability of American mills to accept the business. Foreign coal, iron and steel have advanced as the result of American demand or inquiry. Among the other metals copper is mildly weaker in price. While consumers did not seem to care to enter the market to any large extent, producers on the other hand have not pressed sales. The quotations are [illegible] for Lake, 11⅜ @ 11½c. for electrolytic in cakes, wire bars and ingots, [illegible] @ 11¼. for cathodes, and 11⅜c. for casting copper. The business failures for the week ending September 25, as reported by *Bradstreet's*, numbered 172, as against 182 the week previous and [illegible] the same week last year.

CROCKER-WHEELER CONVENTION.—The Crocker-Wheeler Company held at its works, at Ampere, N. J., on September [illegible] and [illegible]th, its annual managers' convention. On the evening of the 25th the annual banquet was held at the Engineers' Club. Those present were the officers of the company, Schuyler S. Wheeler, Gano S. Dunn, W. L. Brownell, Putnam A. Bates, C. N. Wheeler and F. V. Henshaw, and the branch managers, Samuel Russell, Jr., Julian Roe, J. Hally Craig, Louis P. Hall, W. H. Wissing, Francis B. DeGress, Henry J. Sage, William A. Dobie and Harold [illegible]. At this dinner there were many interesting speeches made by the branch office managers, who came from the various districts throughout the entire United States. During the evening, Mr. Francis B. DeGress, of the company's New York office, having been in the service of the company longer than any of the other branch office managers, presented in their name to the general sales manager, Mr. Putnam A. Bates, a token of their esteem and an acknowledgement of his efforts in their behalf. To this Mr. Bates responded in his usual happy manner. The purpose of the convention is to bring all of the men closer together and give them an opportunity of comparing notes and planning methods for handling the largely increased business of the Company.

POWER IRRIGATION IN TEXAS.—A special dispatch from New Orleans, of September 23, says: Messrs. Wahl and Graybill came here yesterday from Houston, Tex., for the purpose of securing material for the purpose of construction and equipment of a large electrical plant for irrigation purposes on a tract of 10,000 acres of rice land near Houston. They have expended considerable money, and propose to erect a centrally located electric power plant on the plantation, which will operate a series of pumps in wells that are to be put down at proper intervals throughout the tract. A rice mill will be erected and operated with the same power, and the good-sized town near by will be lighted. In short, every portion of the motive power on the plantation will be furnished from the electric plant. They calculate that the cost of equipping the 10,000 acres with the electrical plant will be $[illegible]. This will be just $[illegible] per acre. This estimate will include the rice mill, which will be entirely modern. They have made the water tests and are prepared to demonstrate that an inexhaustible supply of water underlies their land at a depth of from only [illegible] to [illegible] feet. "Our electrical pumping and milling plan will be far cheaper than the ordinary canal irrigation plan," said Mr. Wahl. "We shall never be at the mercy of the dry weather."

INDEPENDENT TELEPHONY.—A special dispatch from Philadelphia, of September [illegible], says: Charles E. Wilson, manager of the Keystone Telephone Company in this city, to-day confirmed the report that his company and other independent telephone systems had united in a traffic arrangement, by which they meant to begin a war on the Bell Telephone Company. He said further that it was the purpose of the allied independent interests to gain an entrance into New York, Boston, Chicago, Cincinnati and other cities. The line of battle has been drawn secretly during the last few months. New York will be the initial point of attack. From there a forced march will be made against Boston. "We shall have an independent system of telephones in operation in New York within a year," said one of those in command of the Keystone and its allied forces. "Boston and other large cities in the East and Middle West will soon be within our field of operations."

SHOSHONE FALLS POWER.—The Shoshone Falls Power & Irrigation Company is putting in a General Electric plant for the utilization of the Shoshone water power, including ten units of 1000-hp each run by De Remer turbines. There will be 180 miles of circuit, and 20 large transformers. Motors are to be installed for pumping and other purposes, and the company proposes to furnish electric light and power to all the towns between Red Cliff and Grand Junction, Colo. A granite power house is being built. The capital stock of the company is $500,000 and the officers are: J. R. De Remer, president and manager; Elmer E. Lucas, secretary; M. H. Dean, treasurer; C. W. Darrow, counsel; H. J. Holmes, first vice-president; W. Cardnell, second vice-president. It is estimated that 20,000-hp. can be obtained from the falls.

THE SOUTHERN PACIFIC RAILWAY COMPANY, in conjunction with the Rock Island, has adopted the Consolidated "Axle Light" system of electric lights and fans for electrically lighting and ventilating all the new cars to constitute the Golden State Limited, which goes into service between Chicago and California on November 1. This is the same system of electric car lighting that is used on the Twentieth Century Limited of the New York Central & Lake Shore, the Pennsylvania Limited and on the best trains of many other leading railway lines, as well as on all private Pullman cars.

PASS & SEYMOUR, incorporated, of Solvay, N. Y., whose New York City address has hitherto been 23 Dey Street, have moved to more extensive premises at 34 Dey Street. D. Brewster Hall, formerly in charge of the sales department of the factory territory, comprising 15 states, will be in charge of the new office. It is intended to make a serious bid for export trade. F. M. Hawkins, who has heretofore represented the Pass & Seymour people in New York City, will now confine his attention to the interests of the Crouse-Hinds Electric Company.

EQUIPMENT FOR NATAL RAILWAY SHOPS.—The South African General Electric Company, which concern looks after the interests of the General Electric Company in that territory, has been awarded an important contract for the electrical equipment of the new Natal Government railway machine shops. The contract calls for the installation of no less than 119 motors, varying in size from ⅙-hp to 15-hp; six dynamos of 300-hp each; three electric cranes; six electric capstans, etc.

THE LOCAL SUPPLY DEALERS' ASSOCIATION, of Philadelphia, will hold a banquet Tuesday evening, October 7, at the Hotel Walton. This fact is significant, since it is another indication of the harmony prevailing in that body. All of the members are expected to be present, and a very enjoyable evening is anticipated. The committee of arrangements for the occasion consists of Messrs. T. L. Townsend and Frank H. Stewart.

ROSARIO ELECTRIC TRACTION PROJECT.—A company is reputed to be under formation by capitalists in Rosario, for the purpose of constructing an electric traction system, to operate from that South American city towards the north of the Oeste Santafecino line, passing by Juarez Celman station and reaching Elisa station, on the Central Railway line. The length of the line would be about eight miles.

SWITCHBOARD CONTRACTS.—The contract for a seven-panel, alternating switchboard for the Poughkeepsie (N. Y.) Light, Heat and Power Company has been awarded to S. B. Condit, Jr., & Co., Boston. Mr. Condit states for his firm that they have during this year been awarded the contracts for a majority of the large alternating, high-potential switchboards built in the East.

MEXICAN WATER-POWER PROJECT.—Still another Mexican water-power project is heard of. It is proposed to construct a hydraulic plant on the Jalacingo River, located in the Canton of Jalacingo, State of Vera Cruz. Some 50,000 liters of water will be utilized per second. Andres Lefebre, of Vera Cruz, is primarily interested in the scheme.

THE MOSCOW ELECTRIC LIGHT AND POWER COMPANY, Moscow, Idaho, has just installed a 150-hp Ball tandem-compound engine and 60-kw Stanley alternator, thus doubling the capacity of the plant. Mr. E. S. Aldrich is manager of the company, and reports business increasing very rapidly.

STEEL FOR SYDNEY POWER STATION.—The American Bridge Company, 100 Broadway, New York, has just made shipment of the last lot of structural material, which is to be utilized in the erection of the central power station of the Sydney city and suburban tramways, New South Wales.

EXPORTS OF ELECTRICAL MATERIAL.—The following re the exports of electrical material from the port of New York or the week ended September 20: Argentine Republic—46 pkgs. naterial, $1,209. Antwerp—4 pkgs. machinery, $290; 22 pkgs. maerial, $1,471. Barcelona—24 pkgs. machinery, $3,000. Bremen—2 kgs. material, $107. British West Indies—9 pkgs. material, $399. Brazil—76 pkgs. material, $1,321; 48 pkgs. machinery, $3,300. British East Indies—23 pkgs. material, $902. British Possessions in Africa—14 pkgs. machinery, $3,248; 24 pkgs. material, $463. British Australia—30 pkgs. machinery, $4,223; 199 pkgs. material, $5,002. Cuba—1 pkg. machinery, $238; 73 pkgs. material, $1,233. Central America—24 pkgs. material, $993. Copenhagen—1 pkg. material, 12; 4 pkgs. machinery, $470. Dutch West Indies—4 pkgs. maerial, $57. Dutch Guiana—4 pkgs. material, $200. Florence—1 pkg. machinery,, $60. Glasgow—91 pkgs. machinery, $4,205. Genoa—31 kgs. material, $354. Havre—9 pkgs. machinery, $465. Hamburg— pkgs. machinery, $336; 18 pkgs. machinery, $1,700. Hayti—5 kgs. material, $56. Liverpool—203 pkgs. machinery, $21,168; 32 kgs. material, $1,756. London—16 pkgs. machinery, $1,442; 318 kgs. material, $8,905. Mexico—36 pkgs. material, $414; 5 pkgs. machinery, $860. Manchester—5 pkgs. machinery, $750. Nova Scotia—7 pkgs. material, $69; 10 pkgs. machinery, $864. Newcastle —6 pkgs. machinery, $1,100. New Zealand—1 pkg. machinery, $113; pkgs. material, $87. Portuguese Possessions in Africa—17 pkgs. machinery, $813; 13 pkgs. material, $150. Peru—2 pkgs. material, 44. U. S. Colombia—70 pkgs. machinery, $6,280. Venezuela—10 kgs. material, $784. The following are the exports of lectrical material from the port of New York for the week nded September 27: Argentine Republic—59 pkgs. machinery, 9,109; 158 pkgs. material, $4,222. Antwerp—19 pkgs. material, $1,-43; 2 pkgs. machinery, $450. Amsterdam—4 pkgs. machinery, $150. British West Indies—5 pkgs. material, $153. Brazil—80 pkgs. maerial, $4,976; 5 pkgs. machinery, $405. British Possessions in Africa —33 pkgs. machinery, $530; 217 pkgs. material, $9,509. British Guiana —8 pkgs. material, $165. Bristol—6 pkgs. machinery, $396. British East Indies—38 pkgs. machinery, $3,085; 11 pkgs. material, $821. Belfast—3 pkgs. material, $158. British Possessions, all others— pkg. material, $20. Berlin—1 pkg. material, $40. Bilboa—7 pkgs. naterial, $100. Cuba—249 pkgs. material, $894. Colchester—6 pkgs. naterial, $383. Copenhagen—1 pkg. material, $15. Chili—7 pkgs. naterial, $110. Dutch West Indies—3 pkgs. material, $64. Glasgow —6 pkgs. material, $309; 13 pkgs. machinery, $342. Genoa—58 pkgs. naterial, $975. Hamburg—4 pkgs. machinery, $270; 44 pkgs. maerial, $1,150. Hong Kong—11 pkgs. material, $76. Havre—82 pkgs. naterial, $1,748; 1 pkg. machinery, $75. Hayti—2 pkgs. material, $31. Japan—17 pkgs. machinery, $2,640; 20 pkgs. material, $1,278. Liverpool—174 pkgs. machinery, $10,250; 10 pkgs. material, $1,343. London —38 pkgs. machinery, $2,631; 172 pkgs. material, $6,196. Mexico— 7 pkgs. material, $1,500; 7 pkgs. machinery, $237. Marseilles—1 kg. machinery, $33. Manchester—1 pkg. material, $30; 190 pkgs. nachinery, $29,962. Milan—1 pkg. material, $45. Madrid—1 pkg. naterial, $256. Newfoundland—1 pkg. material, $14. Nova Scotia— 1 pkgs. material, $329. Peru—6 pkgs. material, $255. Philippine slands—32 pkgs. machinery, $2,500; 96 pkgs. material, $4,127. Southmpton—22 pkgs. machinery, $1,500; 1 pkg. material, $60. San Domingo—15 pkgs. material, $322. Turin—4 pkgs. material, $33. Uruguay—6 pkgs. material, $162. U. S. Colombia—3 pkgs. material, 222; 21 pkgs. machinery, $7,500. Vienna—36 pkgs. material, $3,019.

PAWLING & HARNISCHFEGER, Milwaukee, Wis., advise us hat the demand for electric cranes and hoists remains very satisfacory. They state that buyers are now more inclined to specify hoistng apparatus better conforming to standard designs, while the averge capacity per crane appears somewhat less, yet this seems acounted for through a much more general demand. They quote reent sales as follows: Davenport Foundry and Machine Company, Davenport, Ia., one 5-ton crane; Alan Wood Iron and Steel Comany, Conshocken, Pa., one 13-ton crane; Smeeth Copper and Bronze Co., Chicago, one 10-ton crane; Copper Queen Consolidated Mining Company, Bisbee, Ariz., three 10-ton cranes; American Sheet Steel Co., Cambridge, Ohio, one 30-ton crane, with 5-ton auxiliary hoist; nternational Harvester Company, Deering Division, Chicago, two pecial 5-ton hoists; Vulcan Crucible Steel Company, Alliquippa, Pa., ne 15-ton crane with 3-ton auxiliary hoist; American Sheet Steel Company, McKeesport, Pa., one 30-ton crane with 5-ton auxiliary oist and one 10-ton crane; Greenslade Foundry Company, Milwauee, one 15-ton crane; American Foundry and Construction Company, Pittsburg, one 3-ton crane; Reading Iron Company, Reading, Pa., ne 10-ton crane; Canonsburg Steel and Iron Works, Canonsburg, Pa., one 25-ton crane with 5-ton auxiliary hoist; The Holthoff Mahinery Company, Cudahy, Wis., one 3-ton hoist; Allis-Chalmers Company, Milwaukee, for Sanitary District of Chicago, one 15-ton rane; The McConway & Torley Company, Pittsburg, Pa., one 2-ton rane; Brown Corliss Engine Company, Corliss, Wis., one 30-ton rane with 5-ton auxiliary hoist; Gisholt Machine Company, Madison, Wis., one 10-ton crane; The Milwaukee Electric Railway and Light Company, Milwaukee, one 5-ton special hoist; The Standard Steel Works, Burnham, Mifflin Company, Pa., one 10-ton crane; Christensen Engineering Company., Milwaukee, two 10-ton cranes; Hanson & Tunelius, Chicago, one 1½-ton hoist-crane; Sterritt-Thomas Foundry Company, Pittsburg, one 10-ton crane; The Elyria Iron and Steel Company, Elyria, Ohio, one 15-ton crane.

VOUGHT-BERGER NEW TELEPHONE CONTRACTS.—The Vought-Berger Company, of La Crosse, Wis., has just moved into a new large manufacturing plant, occupying three buildings, with a floor space of 20,000 square feet, making its factory one of the largest of its kind in the country. Mr. D. T. Foley, formerly superintendent and purchasing agent of Western Telephone Construction Company, has recently accepted a similar position in the company. Among switchboards and complete exchange equipment recently sold by the concern are: Western Wisconsin Telephone Company, Arcadia, Wis.; Kiester Telephone Company, Kiester, Minn.; Alexander Telephone Company, Alexander, Ia.; La Crosse Telephone Company (toll board); Peoples' Telephone Company, Houston, Minn.; Redwood County Rural Telephone Company, Redwood Falls, Minn.; Walnut Grove Telephone Association, Walnut Grove, Minn.; Farmers and Merchants Mutual Telephone Company, for Le Sueur and Rush River, Minn.; Harris-Jewell Telephone Company (Pendant telephones used exclusively), Coon Rapids, Ia.; Victor Mutual Telephone Company, Harvey, Ia.; Havelock Telephone Company, Havelock, Ia.; Davis Telephone Company, Goodwater, Ala., and the Golden Rod Telephone Company, for both Mead and Ceresco, Neb.

THE OTIS ELEVATOR COMPANY has recently closed a contract with the Subway Construction Company for an escalator, or moving stairway, to be installed at the Manhattan Street Station of the new rapid transit road. At this point, the "subway" crosses the Manhattan Valley on a viaduct, the tracks being about 40 feet above the level of the street. The escalator will carry passengers both up and down, the two tracks being arranged in the same vertical plane. The guaranteed carrying capacity of the device is 20,000 people per hour; 10,000 in each direction. A motor of 35 hp will be sufficient to operate the mechanism when working at its maximum capacity.

WATER POWER DEVELOPMENT IN THE SOUTH.—The Atlanta Water Power & Electric Company is carrying out a large water power project at a point on the Chattahoochee River, 13 miles from Atlanta, Ga. A dam, 50 feet high and 1,100 feet long, is being built at a cost of $450,000. The electric generating equipment will consist of seven 1,500-kw. Westinghouse generators, to be driven by turbines of the S. Morgan Smith Company, of York, Pa., which concern has the contract for the entire hydraulic equipment. It is expected that the plant will be completed in about 18 months.

ELECTRIC HEATING FOR STEAMSHIPS.—Mr. James I. Ayer, manager of the Simplex Electric Heating Company, reports that the new White Star liner, companion to the "Oceanic" and "Celtic," launched last month at Belfast, has all of its state rooms equipped with its "Enamel" state-room heaters, the same as were furnished for the "Celtic," for two large ships of the Cromwell Line, and for other vessels. The Simplex Company also equipped the "Oceanic" and the "Deutschland," but those had its American type heaters, not the enamel.

THE DICKEY-SUTTON CARBON COMPANY, incorporated and organized about the beginning of last month, at Lancaster, Ohio, It will be ready by December to make carbons for open and enclosed arcs; motor brushes, telephone carbons and carbon supplies. The officers of the company are: H. M. Sutton, president and treasurer; Edmund Dickey, vice-president and general manager; S. S. Wilson, secretary; Robert Dickey, superintendent. The above are directors, with Richard Sedgwick, of Richmond, Ind.

AN AUTO FOR THE DUCHESS.—The Duchess of Marlborough has purchased an electric victoria of American make from the Electric Vehicle Company, of Hartford, Conn. The vehicle is one of regular type, and was shipped last week to Blenheim, the ducal residence in England. Her grace will operate the automobile herself.

PAPER MILL POWER PLANT.—The new plant of the Millers Falls Paper Company, in New England, will be driven throughout electrically. Contract for the entire equipment, including generators, motors, arc and incandescent lamps, etc., has been placed with Sargent, Conant & Co., of Boston, Mass.

POWER PLANT FOR GOLDENDALE, WASH.—J. A. Cranston, the General Electric Company's manager at Portland, Ore., is, it is stated, preparing estimates for an electric power plant to supply Goldendale, Wash.

OTIS ELEVATORS.—During the month of August the New York office of the Otis Elevator Company closed contracts for 63 electric elevators.

General News.

THE TELEPHONE.

[illegible] Company, [illegible] J. M. C. [illegible] The company will have [illegible] Los Angeles, Bakerfield [illegible]

[illegible] has applied for a [illegible]

[illegible] granted a franchise to the Sanford Telephone Company to construct and operate a telephone line in this place.

WAYCROSS, GA.—The Southern Bell Telephone Company was given a twenty-year franchise by the city council and will put in a complete new system at once. The Bell Company recently purchased the local exchange, but was dissatisfied with the franchise.

TAYLORVILLE, ILL.—Dr. A. T. Bridges, of Stoughton, and Dr. R. E. Henshie, of Taylorville, have been granted a franchise for a telephone system here.

PEORIA, ILL.—The Citizens' Telephone Company has secured the right of way between East Peoria and Lacon and its line will be extended to the latter city.

ROCK ISLAND, ILL.—The telephone operators in the Rock Island and Moline exchanges of the Central Union Telephone Company struck recently, owing to failure to reach an agreement with the company on the scale of wages. The telephone service in both places was badly crippled as a result of the strike. The strikers are circulating petitions for signature among the business men demanding that the company settle the differences or remove its instruments from their premises.

CHICAGO, ILL.—The development of the telephone system in the farming sections is remarkable. Farmers in Illinois and Iowa are now connected by wire with Chicago, in many instances, and it is a common occurrence for them to talk daily with Chicago live stock commission merchants.

LAFAYETTE, IND.—The Pocket Telephone Company, of Lafayette, has been incorporated to manufacture pocket telephones and instruments for police and fire alarm service. Capital stock, $18,000. Directors: Evan Shelby, George D. Haywood and Charles A. Burnett, of Lafayette.

NEW CASTLE, IND.—The New Castle Independent Telephone Company has 170 telephones in working order and the entire plant will soon be completed. Five hundred feet more of cable is to be put up.

RIVERSIDE, IA.—The Iowa Telephone Company is building a line direct to Iowa City from here.

RICHMOND, KY.—Bids will be received in the near future for a telephone franchise in this place.

LOUISVILLE, KY.—The Cumberland Telephone and Telegraph Company has issued a statement of its business for the month of August, 1902, and the growth of the business is shown as follows: Number of subscribers August 1, 1902, 85,318. Net increase of subscribers for the month, 905. Total [illegible]

PITTSFIELD, MASS.—The New England Telephone Company will erect an exchange building on Pearl Street.

DORR, MICH.—A telephone line is being erected between this village and Moline. A line is also to be run from Moline to North Dorr, New Salem and [illegible]

YPSILANTI, MICH.—Mayor Dawson will veto the Independent Telephone [illegible] situation at Lansing and Jackson, where both Michigan and independent systems are in operation. He has come to the conclusion that it would be a mistake for Ypsilanti to have two systems.

ALMA, MICH.—The Michigan Telephone Construction Company has been organized here. The capital stock is $75,000, fully subscribed. The directors are W. A. Bahlke and G. S. Ward, of Alma, Fred R. Mossinger, of Stanton, [illegible] The officers are W. A. Bahlke, president, [illegible]

[illegible] Telephone [illegible] elected as follows: President, J. M. [illegible] treasurer, [illegible] W. G. Yerkes and R. C. Yerkes. A fifteen per cent. dividend was declared and ex[illegible] and east into Livonia.

[illegible] Telephone Com[illegible] with the [illegible] gets con[illegible] State. [illegible] Con[illegible] system of [illegible]

[illegible] Exchange is sur[illegible]

[illegible] has been organized here.

KANSAS CITY, MO.—The Williamsburg Telephone Company, of Williamsburg, [illegible]

KANSAS CITY, MO.—A stockholders' meeting of the Home Telephone Company [illegible] to increase the stock from $50,000 to $3,000,000. The intention of the managers is to [illegible] Already something like $50,000 has been spent by the company in starting the plant.

SOUTH OMAHA, NEB.—The Interstate Independent Telephone Company has [illegible], capital $100,000. Incorporators: A. A. Wright, Thos. Healy, L. C. Gibson and others.

ORD, NEB.—The Ord Independent Telephone Company has been incorporated with a capital of $10,000. Fred J. Bell is president; H. M. Davis, secretary; S. E. Bell, treasurer. Two hundred subscribers have already contracted for the service in Ord.

PINEVILLE, N. C.—S. L. Meachem, of Fort Mill, S. C., has received a franchise for a telephone system at this place.

BATH, N. Y.—The Century Telephone Company is extending its lines to this place from Corning.

CALEDONIA, N. Y.—The Inter-Ocean Telephone & Telegraph Company is building a line between this point and Avon.

ONEONTA, N. Y.—The Oneonta Telephone Company has been incorporated. Capital, $10,000. Directors: E. W. Elmore, Wm. H. Smith, F. J. Ives and others.

CAMBRIDGE, N. Y.—The Buskirks & South Cambridge Telephone Company has been incorporated, capital $400; directors: Chas. King, E. B. Chase and W. C. Chase, of Buskirks Bridge.

ALBANY, N. Y.—The Northwestern Telegraph and Stock Company, of Troy, has been incorporated to operate lines of telegraph and telephone between New York, Chicago, Philadelphia, St. Louis, San Francisco, Montreal and other cities: capital, $40,000. Directors: Michael J. Duffy, Peter Curley and Thomas Hendrickson, Troy.

MADISON, OHIO.—The Madison Telephone Company has decided to extend its lines in Lake, Geauga and Ashtabula Counties this fall.

BATAVIA, OHIO.—The Bell Telephone Company has reduced its rates in Clermont County, placing toll charges on an equal basis with Cincinnati subscribers.

WAUSEON, OHIO.—The Northwestern Telephone Company will add another section to its board in the near future. The company has more orders than can be taken care of with present facilities.

NORWALK, OHIO.—The Local Telephone Company has ordered material for a new line to be built from Monroeville to Morehead and will build another to Fitches Corners. A large number of farmers are subscribing to the service.

COLUMBUS, OHIO.—The Columbus Citizens Telephone Company has concluded a contract with the Automatic Electric Company of Chicago for the installation of an automatic system in the local exchange. The system will have an immediate capacity of 7,000 and an ultimate capacity of 19,000 main-line telephones. It is proposed, for a time at least, to operate a duplex system; the present system to be continued and operated until it is fully demonstrated that the automatic exchange in actual service will give satisfactory results. The new exchange at Dayton, owned largely by the Columbus interests, will also be equipped with the automatic system.

GARBER, OKLA.—The Oklahoma Rural & Municipal Telephone Company, capital stock $2,000, has been chartered. The directors are J. D. Carpenter, J. B. Morgan and W. Groneman, all of Garber.

ALTOONA, PA.—The Pennsylvania Telephone Company has completed the work of laying the conduit system, which involved the digging of 6,248 feet of trench, in which was laid 43,535 feet of terra cotta conduit and 1,162 feet of iron pipe, making a total of 44,787 feet, or 8.52 miles of pipe. This will accommodate twenty-eight cables of 200 pairs each, or a total of 11,200 wires. Twenty-two manholes were also put in.

HAMPTON, S. C.—A charter has been granted to the Hampton Telephone Company, of Hampton, which has a capital of $3,000. E. M. Peeples is secretary and treasurer.

SIOUX FALLS, S. D.—Connections have been established between Hurley and Parker on the new rural telephone line between those places. About a score of farmers will be placed in direct communication with their market points by the construction of the line.

DENTON, TEX.—The City Council has granted the Southwestern Telegraph and Telephone Company a franchise for a local telephone exchange.

FORT WORTH, TEX.—The Fort Worth Telephone Company has organized here. It is composed of Pennsylvania capitalists. R. A. Fuller is president. The capital stock is $304,000.

PARKERSBURG, W. VA.—The West Virginia Telephone Company is preparing plans for a new system here.

WELCH, W. VA.—The Welch-Williamson Telephone Company has been [illegible] stock, by J. W. [illegible], J. A. Henchey, E. P. Rucker, W. S. Dangerfield and R. E. Hainer. It will construct a line from Welch to Williamson.

TACOMA, WASH.—The Northwest Telephone & Telegraph Company is preparing to continue the building of its lines through western Washington.

DELTON, WIS.—M. L. Reynolds is building a telephone line from Dellona to Delton.

MILWAUKEE, WIS.—The Richfield, Menomonee Falls and Holy Hill Telephone Company, Richfield, Washington County, has been incorporated; capital stock, $1,000. Incorporators: Henry H. Huld and Bertha M. Zaun.

MILWAUKEE, WIS.—The Wisconsin Telephone Company is erecting a new exchange on Oakland Ave. in this city, to cost $10,000. It will have a capacity for 3,000 subscribers. The Wisconsin Company has let contracts for the erection of a new exchange at Fourth and Wright Streets. This building will also cost $10,000 and will have a capacity for 3,000 subscribers. The company will open a branch office at Wauwatosa.

ELECTRIC LIGHT AND POWER.

McRAE, GA.—Moore & McCrary, English-American Building, Atlanta, will let contracts for a water and light plant.

TIFTON, GA.—A ten years' exclusive franchise and contract has been granted to the Tifton Electric Light Co. for twenty 2000-cp arc lamps.

ALEXANDRIA, IND.—J. Thomas Roberts has asked the council for a franchise for an electric light, power and heating plant. He proposes to furnish street lights, not less than sixty-five lamps, for $75 per year. The term of franchise is thirty years and the city has the privilege of buying the plant any time after ten years.

MISHAWAKA, IND.—This city is the owner of an electric light plant and the rates for service have been 11 cents per kw-hour with 20 per cent. discount. It is now declared by the council that the plant is depreciating in value; that the demand for service is increasing and that the rates are so unreasonably low that no funds are available for supplementing the equipments or displacing old worn-out machinery with new. The taxpayers are complaining about being taxed to keep up a utility that ought to be self-sustaining. Discounts will be abolished and rates increased.

MILLBURY, MASS.—The Millbury, Grafton, Uxbridge and Northbridge electric lighting and power companies are to be combined and the power is to be furnished from Uxbridge.

CANTON, MO.—At the election on Sept. 23 the proposition to issue $10,000 electric light bonds was carried by a large majority.

LITTLE VALLEY, N. J.—Cattaraugus Cutlery Company, Little Valley, N. J., has installed two electric lighting plants. In the near future it will put in operation a large electric power building.

CAPE MAY, N. J.—The Cape May Light & Power Company has started the erection of its new power house, 66x150 feet, which will be equipped with 1600-hp engines direct-connected to Warren generators, furnished by the Rumsey Electric Mfg. Company, of Philadelphia. The E. Keeler Company, Williamsport, Pa., has the contract for the boilers, and the Russell Engine Company, Massillon, Ohio, for the engines.

COLUMBUS GROVE, OHIO.—The village council has completed a deal for the purchase of the local lighting plant and hereafter it will be operated by the municipal authorities.

CANAL DOVER, OHIO.—The Standard Motive Power Company, of New York, will remove its plant to Canal Dover. The company manufactures locomotives, street car motors and automobiles.

COLUMBUS, OHIO.—Director of Public Works Immel has notified the Columbus Electric Company that because of an injunction against the city restraining from awarding a contract for city lighting, the present contract which expires Oct. 1, will not be renewed. The company furnishes 620 arc lamps, and except for about 300 lamps furnished by the municipal plant, the city will likely be in darkness after Oct. 1.

SPRINGFIELD, OHIO.—The Springfield Light & Power Company has elected directors and officers as follows. Directors: W. A. Scott, Theodore Troupe, John H. Miller, and Paul Martin, Springfield; H. J. Crowley, Samuel DeCoursney and L. C. S. Tingley, of Philadelphia. President, W. A. Scott; vice-president, Theodore Troupe; secretary-treasurer, L. C. S. Tingley; general manager, John H. Miller. The company is owned by the American Railway Company, of Philadelphia.

CLEVELAND, OHIO.—The Interstate Foundry Company, of Cleveland, has completed its new foundry designed for heavy castings. It is equipped with one 40-ton, one 25-ton and four 5-ton electric traveling cranes. The Johnson & Jennings Company is moving into its new foundry plant. There are seven new structures. The foundry building proper is 110x300 feet; the pattern shop 37x50 feet, two stories; the power house 39x83 feet, and the office building 50x75 feet. The plant is to be driven by compressed air and electricity and equipped with electric traveling cranes.

OTTAWA, ONT.—An American company which manufactures a metal called "Adamite," a substitute for steel, desires to avail of 10,000 electrical horsepower at Ottawa. The company will eventually take 20,000 horse-power or more.

OTTAWA, ONT.—The Mexican Light & Power Company, with a capital stock of $12,000,000 has been incorporated at Halifax, N. S., to conduct an electric light, heat and power business. The incorporators are B. F. Pearson, R. E. Harris, C. E. Cahan, H. A. Lovett and G. F. Pearson.

THE ELECTRIC RAILWAY.

SANTA CRUZ, CALIF.—The Board of Supervisors has granted a franchise to W. J. Rodgers for an electric railway to extend five miles from Watsonville to Camp Goodall, where it is to connect with a line of steamers to run to San Francisco.

DOVER, DEL.—The Tonapah Traction Extension Company, of Philadelphia, has been incorporated here with a capital of $1,000,000. The incorporators are Alfred S. Ellitt, Wilmington, Del.; E. L. Brundette and A. W. Bacon, Philadelphia, Pa.

WASHINGTON, D. C.—The Washington, Berwyn & Laurel Electric Railway has been completed and the road is now in regular operation. The cars will be operated by the City and Suburban line until the new company provides its own rolling stock and power house, which will probably be a year hence.

MACON, GA.—It is announced that the merger of the three street railway lines of this city has been completed by the new company taking over the properties under the ordinance prepared by the city council. The deal involves about $1,000,000, and has been arranged by Savannah, Richmond and Macon capitalists, who have bought out Boston owners of two of the lines. T. J. Carling, president of one of the lines, will be in control of the operation of the consolidated system.

EVANSVILLE, IND.—The Evansville & Princeton Traction Company has increased its capital from $100,000 to $600,000. Rails are now being laid, and the line will be ready for service soon.

SOUTH BEND, IND.—Promoters of the Elkhart, South Bend and Chicago Electric Railway have made application for a franchise in this city and gave a guarantee bond of $5,000 that the road will be completed in a year.

INDIANAPOLIS, IND.—Of the hundred thousand people brought to the recent Indiana State Fair two-fifths were brought in over the interurban lines. Their half-hour and hourly service proved to be a strong competitor for the steam roads, and there was a perceptible falling off in the steam line traffic.

SEYMOUR, IND.—Representatives were in conference in this city recently concerning the construction of an electric railway from Columbus to French Lick. An organization was formed with W. P. Masters, of Seymour, as president and a survey ordered. Franchises have been granted for almost the entire distance.

MUNCIE, IND.—The Union Traction Company has stolen a march on the Muncie, New Castle & Alexandria Traction Company and is now grading a direct line from Muncie to Alexandria. For months there has been a fight between the traction companies for the right of way, and now both are building lines along parallel routes.

SHELBYVILLE, IND.—A controlling interest has been purchased by H. B. Smith, banker, of Hartford City, Edward Hawkins, of Indianapolis, and some Eastern capitalists, in the Indianapolis, Greenwood & Shelbyville Traction Company, which will build a line from Greenwood to Shelbyville. This company was incorporated nearly a year ago. A private right-of-way was obtained and considerable grading done when the work was discontinued because the company could not finance the project. Capitalists are now behind the project, and the line will be completed at once. The distance is nineteen miles. Fourteen miles of the Indianapolis and Greenwood line will be used. The road will become a direct competitor of the Indianapolis, Shelbyville and Southwestern road, which was opened to public service recently.

TOPEKA, KAN.—The Kansas City & Bonner Springs Railway Company, with headquarters at Kansas City, Kan., was granted a charter. It has a capital of $500,000. Stockholders are C. F. Hutchings, Samuel Maher and John W. Breidenthal, of Kansas City, Kan., H. H. Anderson, of Kansas City, Mo., and Edwin Taylor, of Edwardsville. This makes the third company that has taken out a charter to build a line from Kansas City to Bonner Springs. The first one was taken out in 1897, the second in 1899 and the third this year. Beside these three other concerns have been chartered at different times to build a line from Kansas City up the Kaw Valley to Lawrence and Topeka.

LOUISVILLE, KY.—At the recent meeting of the directors of the Louisville Street Railway Company a semi-annual dividend of 2½ per cent. on preferred stock was declared and a quarterly dividend of 1¼ per cent. on the common. No action was taken on the proposed increase of common stock.

GRAND HAVEN, MICH.—The work of building the Grand Rapids, Grand Haven & Muskegon Electric Railway into Grand Haven from Spring Lake, has begun. The transfer of the local street car line to the interurban company was formally made, $18,000 being paid for it.

MEDINA, N. Y.—The Union Traction Company has been incorporated to build and operate a 50-mile railway along the shore of Lake Ontario from Batavia to Olcott. The capital is $600,000. The directors are I. H. Gebille and F. L. Downes, of Medina, and J. W. Holmes, of Batavia.

DAYTON, OHIO.—The county commissioners have granted a 25-year franchise along the Dayton and Brandt turnpike to the Dayton & Kenton Traction Company.

ALLIANCE, OHIO.—The Alliance-Sebring division of the Stark Electric Railway is now in operation. The Alliance-Canton section of the road is being pushed to completion.

COLUMBUS, OHIO.—The Ohio Central Railway Company which proposes to build a line from Columbus to Lancaster has applied for a franchise in Columbus. H. C. Werner is at the head of the company.

CANTON, OHIO.—After a controversy lasting many months, the Stark Electric Railway Company has secured a franchise enabling its cars to reach the center of Canton without making a traffic arrangement with the Canton-Akron Company.

NEW PHILADELPHIA, OHIO.—The Canton-New Philadelphia Railway Company has secured a franchise through Beach City, completing the entire right of way. The section between Canal Dover and New Philadelphia will be placed in operation this fall.

KENTON, OHIO.—W. P. Hilands, of Chicago, is promoting an electric railway to extend from Kenton to Ada by way of McGuffey, Foraker, and Alger, a distance of about 18 miles. It is proposed to secure electric lighting franchises in the various towns.

CINCINNATI, OHIO.—Theodore Horstman has brought suit in the Superior Court to oust the Cincinnati Street Railway Company from the 50-year franchise it holds under the Rogers' law. A permanent injunction is also asked for, restraining the company from operating its cars over the John Street line, which is the only route involved in the original suit.

COLUMBUS, OHIO.—The Scioto Valley Traction Company has placed a contract with the Carnegie Company for 5,500 tons of rails and with the Mt. Vernon Bridge Company, Mt. Vernon, Ohio, for ten bridges. The contracts involve about $215,000. The controlling interest in this project was recently purchased from the Everett-Moore syndicate by Columbus people.

NEW PHILADELPHIA, OHIO.—Major C. E. Mitchner, who financed and built the Uhrichsville-New Philadelphia Railway, now a part of the Tuscarawas Traction Company, has asked the county commissioners for a franchise along the highway from New Philadelphia to Newcomerstown. The proposed line will pass through Beidler, Tuscarawas, Seventeen, Port Washington and Glasgow.

[illegible]

NEW INDUSTRIAL COMPANIES.

[illegible]

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LEGAL.

[illegible] ation of in- [illegible]

[illegible]

[illegible]

[illegible]

OBITUARY.

[illegible] 27 on [illegible]

PERSONAL.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] of Siemens & Halske Company, at [illegible] the United States. It is the purpose of [illegible] country and engage in professional work here.

[illegible] of the Jenney Electric Manufacturing Company, of Indianapolis, made the Chicago office of the ELECTRICAL [illegible] The company is doing a large business [illegible]

PROF. R. S. HUTTON, of Owens College, England, who has been in this country for a short vacation, studying chiefly electro-chemical work, sailed last week for home, after a very pleasant and helpful holiday, during which [illegible] friends.

[illegible] Company, is interested in a company which will build a large central station at Waukegan, Ill., to supply electric light and power to suburban towns along the shores of Lake Michigan from Highland Park to Waukegan.

[illegible] HOBART, manager of the Triumph Electric & Ice Machine [illegible] nati, was a visitor at the Chicago office of the ELECTRICAL [illegible] expedition with several friends.

[illegible] successful meeting of the Institute in the Berkshire Hills, has just returned [illegible] n, Mass., where he has been fitting up the beautiful [illegible] le fête champetre was given to the members.

[illegible] SBOROUGH, of the electrical exhibits department of [illegible] has been doing some good work in the East during [illegible] how, and took advantage also of the opportunity to attend the opening session of the Institute and participate in the discussion.

[illegible] PHIPPS, the American steel manufacturer has given $100,000 [illegible] on condition that it be used for bread and beef and [illegible] guns. He returned to this country during the present [illegible]

[illegible] RGE W. JACKSON recently gave an illustrated lecture on the [illegible] one tunnels at the rooms in that city of the Society of Western [illegible] A large audience listened interestedly to the details of the con- [illegible] of this unique subway, which is 12 miles long. It will afford room for a service of over 100,000 telephones Mr. Jackson stated.

MR. T. D. LOCKWOOD, the well-known expert of the American Telegraph [illegible] glishman by birth, but has been prominently associated with Bell interests in this country as long as they have existed—an eventful period in American electrical [illegible]

MR. KILLINGWORTH W. HEDGES, of the Institute of Civil Engineers, a well known writer on electrical and engineering subjects, arrived at New York last week on the Celtic. Mr. Hedges comes here as one of the Lightning Research Committee, and his purpose is to arouse interest in the work of contriving some absolute protection against lighting. Mr. Hedges hopes to establish some committees in this country.

LIEUT. COL. H. A. YORKE, of the Royal Engineers, was on board the Celtic, which arrived last week. He comes on behalf of the London Board of Trade to investigate American systems of electric railway signaling, and also to examine electric traction systems. "I shall be here about five weeks," said Col. Yorke, "and shall, after investigation, make comparisons between your systems and ours." Col. Yorke is the London Board of Trade railroad accident expert.

MR. CHARLES J. GLIDDEN, of Lowell, Mass., arrived in Paris last week, having driven a 16-hp Napier over five thousand miles. His driving days [illegible] thirty-eight. Mr. Glidden started on his tour from London, drove [illegible] haven and then shipped his machine to Dieppe. A summary of the miles driven is as follows: England, 132; France, 2,700; Germany, 608; Austria, 250; Italy, 508; Switzerland, 897; Spain, 30; total, 5,125. Throughout the total distance Mr. Glidden experienced sixteen punctures.

[illegible] nership of Weeks, Kendall & Newkirk, in that city, and needs no introduction [illegible] president of the National Electric Light Association. Mr. W. R. Kendall is a graduate of the Massachusetts Institute of Technology, and has been in active [illegible] "Tech" man, and was an instructor in engineering there. He was on the [illegible] causes, etc. The new firm will make a specialty of power generation and [illegible]

[illegible] A great many friends will note with pleasure the news [illegible] Prince Henry when he met the American "Captains of Industry." The younger [illegible] cellent work in the field of electrical invention and engineering and when at Yale was one of the editors of the "Scientific Monthly." One or two of his contributions have also appeared in the pages of this journal.

[illegible] WARD, vice-president, general manager and director of [illegible] of the Postal [illegible] the White Star liner [illegible] San Francisco and Manila will be [illegible] cable ships will be engaged in the work of

laying the cable. They are the Silvertown, the Colonia, and the Anglia, and one of them has left London to proceed to Manila via the Suez Canal. Another ship will follow her, and the third will go to San Francisco via the Straits of Magellan. Thus two ships will work from Manila and one from San Francisco, and they will meet somewhere in midocean and the cable will be spliced. The cable itself is now being made in London at the rate of fifty miles a day, and I expect that it will be finished in March." Mr. Ward is accompanied by Mr. Thomas Skinner, of London, who is a director of the Commercial Cable Company.

EDUCATIONAL.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—The department of mechanical engineering of the Massachusetts Institute of Technology is the subject of a 32-page pamphlet just issued. A schedule of the studies, detailed descriptions of the courses and much information on the general subject are given. The pamphlet also contains many half-tone illustrations of the various laboratories, apparatus, etc., used in the practical instruction of the students. The equipment and the work of the department in its various branches are fully set forth.

Y. M. C. A.—The West Side Young Men's Christian Association, 318 West 57th Street, New York, begins its sixth season's activities in October. This Association now has a membership of over 2,300. The current expenses are $50,000 annually, less half of which are met by membership fees, a small amount by rentals and the balance by donations. There are over 600 students enrolled in the 40 evening educational classes. There are also eight literary, musical and art clubs with large memberships. The library contains 48,000 volumes, about 15,000 of which are in the circulating department. Entertainments, which are free to members and their friends, are given every week. Meetings, addressed by prominent men, are held every Sunday afternoon at four o'clock either in the Association Auditorium or in Carnegie Hall. There are classes in gymnastics every afternoon and evening. The Association has a savings fund department, an employment bureau, dormitory rooms, a restaurant, a boarding house record and many other features which are helpful to young men, especially to those whose homes are not in New York. This Association, which has the best equipment of any Y. M. C. A. in the country, is open to visitors at all times. An attractive illustrated catalogue of 64 pages, which announces the privileges offered in the various departments, may be obtained free by calling on or addressing the Secretary, 318 West 57th Street, New York.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is selling large numbers of Packard "Mogul" lamps.

THE ATWATER KENT MFG. WORKS, Philadelphia, have issued a folder printed in two colors describing "The Monoplex Telephone." This folder will be sent to anyone upon request and is accompanied by an attractive card to hang on the desk.

UNITED ELECTRIC HEATING CO.—Supplement 30, issued by the United Electric Heating Co., of Detroit, Mich., illustrates the latest additions to its lines of electric heating devices, including a new glue pot and new cooking ovens.

THE OHIO BRASS COMPANY, Mansfield, Ohio, is preparing plans for the building of an addition to its machine shop. The new building will be 56x336 feet. A new warehouse is now under course of construction, and the foundations are laid for a new insulation building.

THE OSBURN FLEXIBLE CONDUIT COMPANY, 21 Park Row, New York, reports a very brisk business at present and that its product, "Flexduct," is meeting with great success wherever used. "Flexduct" has recently been put to some very severe tests and has been highly spokn of by experts.

PORCELAIN SPECIALTIES.—A new company for the manufacture of electrical porcelain specialties is being organized at East Liverpool, Ohio, by Mr. T. F. Anderson, who has been identified with the American Sewer Pipe Company. A new factory will soon be erected for the new concern.

THE EMPIRE ELECTRICAL INSTRUMENT CO., 654 Hudson St., New York, has issued a series of bulletins on its Empire instruments. As shown by these bulletins the company produces ammeters and voltmeters of every style in use, including the illuminated dial pattern, portable type, switchboard pattern, round pattern, etc.

MR. WILLIAM ROCHE, 42 Vesey St., New York, the manufacturer and inventor of the New Standard dry battery, reports the demand for his electric gas lighters and portable flash lights as very large, the simplicity of construction and length of life being special features of these articles. The New Standard dry battery is peculiarly adaptable for all of the uses above mentioned.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, New York, in a circular invites the trade to consult it before placing orders for arc lights, asserting that money will be saved thereby. Reduced reproductions of the company's various arc-lamp bulletins are given, and the principal features of these lamps are pointed out. The circular is gotten up in attractive form and pleasing color.

THE JEWELL ELECTRICAL INSTRUMENT CO., which makes a complete line of switchboard instruments has recently removed to 61 and 63 Union Park Court, corner of Carroll Ave., Chicago, Ill. In giving notice of its change of address, the company issues instructions as to how it can be reached, and the back of its business card contains specific directions for locating its quarters.

RENOLD SILENT CHAIN.—The importance of Renold silent chain in the field of motor driving is demonstrated by the new bulletin which is devoted to that subject exclusively. Renold silent chain has been on the market in this country not quite a year. Its extended application is already notable. The bulletin No. 1001 is issued by the Link Belt Engineering Co., of Philadelphia, Pa., and consists of 12 most interesting quarto pages.

GENERAL ELECTRIC MICA WORKS.—The General Electric Company is now employing over 200 hands in its new Ottawa branch in sorting and shipping mica. Machinery will be installed at the Ottawa works for additional treatment of the mica, which can be carried on to better advantage and at cheaper rates than in Schenectady. When the Ottawa works are completed 2,000 hands will be employed and all of the output of the Canadian mines owned by the company will be treated at the Ottawa works.

THE INTERNATIONAL TELEPHONE MFG. CO., Chicago, it is reported, is having a large demand for its improved telephone switchhook. It is said that this hook is one of the most scientifically designed and durably constructed telephone switches ever produced. It has a restoring spring of more than five inches in length, made of the best spring german silver and has all the parts self-contained, with no rubbing or scraping, excepting at the platinum contact points, which form a good positive connection at all times.

COALAOC.—A preparation called "Coalaoc" is being marketed by Mr. M. A. Bobrick, 315 Walnut Street, St. Louis, Mo. It is sprinkled on coal in liquid form and is said to harden the coal, thus making it burn slower and give increased heat. Among other claims made for this substance is that, besides effecting a saving in the amount of coal consumed and giving additional heat, it insures the consumption of smoke. Mr. Bobrick claims that this preparation will effect a saving in coal consumption of 15 to 25 per cent. at a cost of 10 cents per ton.

LAVITE is an anti-corrosive, unchangeable insulating material, resisting heat to a great degree. It is made in practically any required shape, can be made for washers and bushings and takes an accurate thread. This is the new name that the D. M. Steward Mfg. Co., of Chattanooga, Tenn., has given to its well known lava insulation. The name is a coined word original with the Steward Co., with the merit of being easily remembered and almost entirely descriptive of the material of which the insulation is made. The use of this insulation is increasing and with it is a corresponding gain in familiarity with the new word.

SMITH & HEMENWAY COMPANY.—We have just received from the Smith & Hemenway Company, of 296 Broadway, New York City, a copy of the fourth edition of the Green Book of Hardware Specialties. This book is considerably larger than the last one. It contains 144 pages of highly interesting matter and is illustrated throughout by a number of half-tones. This book contains illustrations of all articles manufactured by the Smith & Hemenway and Utica Drop Forge & Tool Co.'s. It is printed on green paper and each page has a very attractive border in orange around it. This book will be quite an addition to the catalogue file of any up-to-date dealer.

VALLEE BROS. ELECTRICAL CO., Philadelphia, has recently issued, in addition to its general catalogue, twelve smaller catalogues, each of which covers thoroughly and in a convenient form for ready reference a certain department of electrical supplies. The list is as follows: Electric light supplies, electrical house goods, telephone apparatus, tools for electrical purposes, switchboards and panel boards, electrical fixtures, transformers, electrical fans, dynamos and motors, electrical instruments, arc lamps, and line material. They are all attractively gotten up and are profusely illustrated. The practical value of this idea can readily be appreciated. Any of these catalogues will be promptly mailed upon request.

THE HAINES & NOYES CO., manufacturer of telephone apparatus, Chicago, Ill., announces that it has recently opened an Eastern office, under the management of Mr. J. A. Mears and Mr. F. H. Schlesinger, at 220 Broadway, New York. This office will take care of the entire Eastern business and all prices in this territory will be f. o. b. New York. A full line of stock and samples will be carried, and inasmuch as both Mr. Schlesinger and Mr. Mears are practical electrical men as well as telephone men, the Haines & Noyes Co. states that it feels sure that all prospective purchasers as well as former customers, will be well taken care of. Mr. Schlesinger was formerly associated with Stanley & Patterson, as well as with the Peru Elec. Mfg. Co. Mr. Mears is a well-known business man of New York City. The Haines & Noyes Co. requests that all correspondence coming from the East be directed to the New York office.

ELECTRICAL SUPPLIES.—Mr. C. J. Harrington, 15 Cortlandt St., New York, has had a large personal experience in the electrical supply business and fully understands the requirements of every branch of the trade, especially in the street railway and telephone fields. He has purchased the Medbury insulating plant, which has been dismantled and moved to Mr. Harrington's Newark factory, and we are informed that the same high-grade of insulated material will be manufactured under his trade mark "Empire," instead of the Medbury name. In addition to this the Harrington firm is the sole Eastern representative of several concerns well known in the railway and electrical trade, among which are the Banner Electric Company, Youngstown, Ohio; Heil Railjoint Welding Company, Milwaukee, Wis.; and the Scranton Fire Brick & Conduit Company, of Scranton, Pa. The firm has secured space No. 6 at the Detroit Convention this month, also Parlor E at the Hotel Cadillac, where it will entertain its friends.

IDENTIFICATION WANTED!—Two postal cards were received at our office Monday of this week. One of them bore the legend:

"N. Y., Sep. 27/02.

"Gentlemen:

"We would like to change our advertisement for next week. Please call for cuts. Respectfully yours."

The other read:

"Electrical World and Engineer, 9/26/02.
114 Liberty St., N. Y.

"Gentlemen:

"Please return the zinc etching used in our "Ad" of Aug. 30, Sept. 6 and 13, and oblige, Yours very truly, ———"

Neither of them was signed, neither bore the name of any firm or any address; one of them did not even state what city it hailed from. Will the writers kindly identify them and thus enable our business department to carry out their instructions, and in the meantime please don't blame the advertising man.

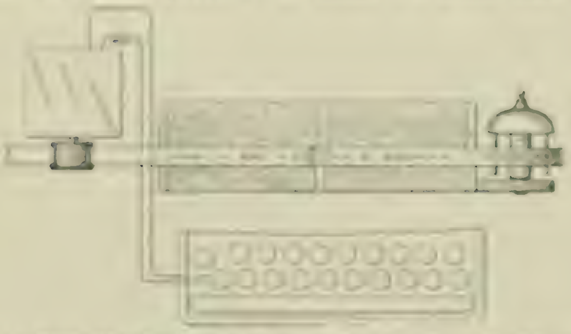
[illegible]

[illegible] of multiple than heretofore known. [illegible] Railway Convention will show the high [illegible] working, especially in such features as the [illegible] vitrification. The company's factory [illegible] will, it is said, be the largest in the world. Its enormous capacity, the superior product, and the reputation of Mr. R. W. Lyle, president, and Mr. Barnard will undoubtedly insure success of this corporation. It may be well to mention a few of the contracts awarded to [illegible] Niagara Falls Power Co., United R[illegible] [illegible] of Newcastle, Pa., Richmond Telephone Co., Mobile Light & Railway Co., Electric Lighting Co., of Mobile, Ala., [illegible] Shreveport, La., Catskill, N. Y., and also the Bell Telephone Co. for many of its installations throughout the country.

Record of Electrical Patents.

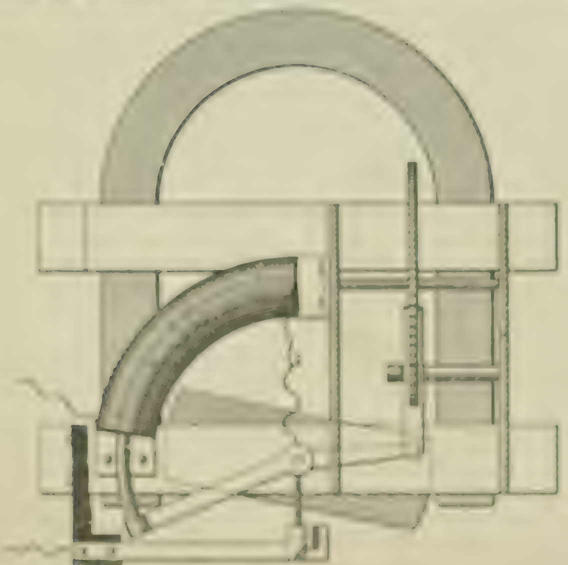
[illegible]

[illegible] MAGNETIC WHEEL; [illegible] App.



[illegible]—Means for Handling Telegraphic Receiving Tapes for Translation.

[illegible]



[illegible]—Electric Clock.

[illegible] shutters to close in case of fire.

709,611. SECONDARY BATTERY; W. L. Silvey, Dayton, Ohio. App. filed Feb. 8, 1902. A construction affording ease of assembling and dissembling [illegible]

[illegible] ELECTRICALLY OPERATED RAILWAY SWITCH; J. [illegible] App. filed June 21, 1902. The switch point is raised and lowered vertically by a cam surface on the rod connecting the cores of [illegible]

709,681. SAFETY DEVICE FOR MOTOR VEHICLES; A. L. Riker, New York, N. Y. App. filed March 2, 1900. A clutch between the motor and drive shaft is automatically opened when the weight of the driver is removed from the seat.

709,714. METHOD OF CONTROLLING THE ENERGY DELIVERED TO ELECTRICAL TRANSLATING DEVICES; H. W. Leonard, East Orange, N. J. App. filed Jan. 31, 1896 A method consisting in connecting the terminals of the translating device between two conductors which are electrically connected with a source of electromotive force, and varying by magnetic induction the relative potential of the two conductors independent of and without altering the connections with the source so that the potential of one of them is made to become higher or lower than that of the other, whereby the current through the translating device is reversed.

709,746. TRAIN SIGNALING APPARATUS; W. D. Clopton, Lewisburg, W. Va. App. filed Jan. 23, 1902. An electrical coupling making a through circuit between cars when connected, but each half adapted to close its own circuit when the coupling is disconnected.

709,752. MEANS FOR HANDLING TELEGRAPHIC RECEIVING TAPES FOR TRANSLATION; P. B. Delany, South Orange, N. J. App. filed Dec. 15, 1896. This invention consists of a device for pulling the tape with the received message recorded thereon across the translators' desk in definite lengths at a time, quickly and for convenience of translation about [illegible]

709,762. COUPLING FOR CONDUIT RODS; J. F. Greaves, St. Louis, Mo. [illegible] Details.

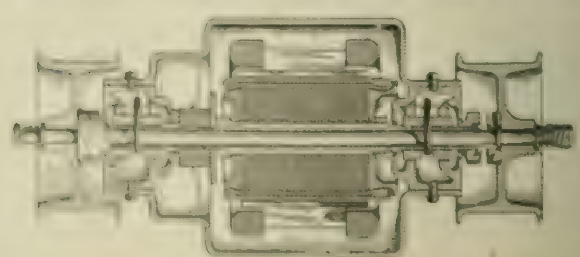
709,798. RAILWAY SIGNALING APPARATUS; E. Rowe, Indiana, Pa. App. filed June 1, 1901. Apparatus whereby the signal and other operators along the roadway can communicate by telephone with engineers on trains at any part of the road.

709,806. ELECTRICAL INDICATORS; H. S. Tittle, Los Angeles, Calif. App. filed Nov. 29, 1901. An electrically operated cash register in which the movable index can be stopped at any predetermined time or place.

709,808 CARBORUNDUM ARTICLES AND PROCESS OF MAKING SAME; F. J. Tone, Niagara Falls, N. Y. App. filed Jan. 2, 1901. (See Current News and Notes.)

709,817. ELECTROLYTICALLY TREATING ORES; C. E. Dolbear, Boston, Mass. App. filed June 3, 1901. (See Current News and Notes.)

[illegible] ELECTRIC CLOCK; Newton Harrison, New York, N. Y. App. filed



[illegible]—Combined Dynamo and Driving Gear.

[illegible] A permanent magnet is used to propel the train of gears [illegible] restores the initial [illegible] and the train.

[illegible] MEANS FOR DRIVING GENERATORS BY POWER TAKEN FROM [illegible] New York, N. Y. App. filed Sept. [illegible] and belts between the axle and the [illegible] always in the same [illegible] changes of direction of rotation of the axle.

[illegible] COMBINED DYNAMO AND DRIVING GEAR; J. L. Creveling, [illegible] Nov. 18, 1901. A modification of the preceding [illegible]

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

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NOTICE TO READERS
WHO ARE NOT SUBSCRIBERS.

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Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

SPECIAL ANNOUNCEMENT TO ADVERTISERS.

The attention of advertisers is directed to an important announcement appearing on page xviii of the advertising section of this issue, on the subject of the new schedule of advertising rates taking effect January 1, 1903.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

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Single Copies,	.10

Remittances for foreign subscriptions may be made through our European office.

In requesting your address changed give OLD as well as new address.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, OCTOBER 11, 1902.

CONTENTS.

STREET RAILWAY PROBLEMS.

The meeting which has been held this week at Detroit by the American Street Railway Association has been of wonted magnitude and well-sustained interest. As was pointed out in these pages last week, the city chosen for the annual convention this year has many attractions for street railway men, whether from the standpoint of historical associations or because of the interesting developments that have made Detroit the center of a vast network of rural and interurban trolley lines. This outreaching for new territory and exterior connections, as evidenced by the long-distance trolley system of Michigan, is indeed symptomatic of the whole attitude of the electric railway art, and of the newer conditions that were so admirably delineated and emphasized by Mr. Vreeland in his broad-visioned presidential address—one of the best that the association has ever heard.

Perhaps it was only natural that a street railway manager who began his brilliant career on steam railroads, should be keen and prompt to see the wider aspects of the industry in which he is one of the most conspicuous figures; but be that as it may, there is no denying that President Vreeland touched deftly on the topics about which we are all thinking, and showed in many luminous passages how wide is the field of the "street car" and the "trolley." Indeed, he did not overstate the case when he said: "It should be understood that the Association is not merely a street railway association, but its scope covers the entire field of electric railway transportation." This is true, even though it may not be necessary or judicious to change the name of the Association in order to conform with the facts. An analogous case is presented in the National Electric Light Association, most of whose members are to-day selling a large proportion of their current to run motors, lift elevators, feed storage batteries, perform electrometallurgical operations, supply telegraph and telephone plants and help any lady curl her hair or ply the chafing dish in domestic seclusion. In all branches of electricity, "the greater lies before," and in none more irresistibly than in that of electric traction.

It is in reality quite significant and suggestive that the president of a street railway association, himself the active, vigilant manager of the greatest urban street car system in the world, devoted the major part of a strong "inaugural message" to questions outside the narrower and more immediately pressing topics of city transportation. To those of us who dwell in city limits, it would seem that there alone are difficulties and needs enough to demand the best ability of the times; but Mr. Vreeland showed how the ubiquitous trolley and the all-prevading electric motor has opened up novel vistas that it will take many years to make familiar.

We find him talking about interurban roads, long-distance service, exchange of traffic with old steam roads, freight and express by trolley, and the deep interest shown by trunk steam railroad management in what lies ahead at no very distant future. The demands on ability and capital in these new departures is tremendous, but the engineers, such as Sprague, Arnold, Potter, Stillwell, Lamme and others, who have launched us all on these newer and greater enterprises are fully able with the financial support that is so generously given them, to win abundant success, and to make, in due time, the whole domain of transportation thoroughly electrical.

International Regulation of Wireless Telegraphy.

Those who would put under close governmental supervision "natural monopolies" are welcome to what comfort they can find in a movement now on foot to curb wireless telegraphy, owing to its claim on the ether of the universe as a medium of transmission. The thought of a French message traversing the ether over and in German soil—or of a message proceeding from any source without bureaucratic supervision—was evidently disturbing to the Kaiser, and he has taken the initiative in a movement having for its object to bring the new art under international governmental control. One can readily agree with the German government, which has taken up the matter so seriously, that wireless telegraphy most nearly approaches to what has been vaguely denominated by the term "natural monopoly," and reasonably admits of some international control; but we have a suspicion that had Slaby instead of Marconi controlled the new art, the German representations made to other States would probably have been confined to the political and maritime aspects of the question, and such great concern would not be manifested in relation to the plans of the Marconi Company, which are pronounced as threatening a commercial monopoly. Moreover, if Prof. Slaby, who appears to be very close to the German government, has really perfected a practical system of syntonic wireless telegraphy as is claimed, that part of the representations set forth which relates to interference loses in considerable part its force.

As reported by a correspondent of the London *Times*, the German government has invited England, France, Russia, Italy, Austria-Hungary and the United States to make arrangements for a meeting of delegates to provide for an international congress on the subject of wireless telegraphy. The principal work of the proposed congress will be to draw up rules settling the conditions under which the establishment of stations for wireless telegraphy shall be allowed, and the ultimate co-operation of all maritime states is contemplated. It is announced that the proposal of the German government has been met in a friendly spirit by the governments interested, and that the appointment of delegates by these powers may be anticipated in the near future. It must be admitted that in the present state of the art the matter of interference—either with or without design—is a vital one, and to this extent some agreement may be advisable among the nations of the world, particularly as concerns maritime wireless telegraphy. It may be recalled that at the time of one of the yacht races off New York, the wireless telegraph service was rendered almost entirely useless, owing, it was charged, to interference set up by one of the wireless companies. It is sincerely to be hoped, however, that any regulation that may be decided upon at the proposed conference will be confined to the narrowest possible compass consistent with the object to derive for the public the greatest possible benefit from the new art. Governmental regulation is always an evil only to be excused on the score of tending to the prevention of a greater evil. The manner in which electrical development in Great Britain has been trammeled by regulations laid down in the early days of the art is an object lesson that should not escape those who would lay down regulations affecting an art which as yet is only in an embryo state of development.

The Metric System.

Elsewhere we reprint a consular report to the State Department on the status of the metric system movement in Great Britain, which, it will be seen, is extremely encouraging. The advocacy of the reform by the colonial premiers will undoubtedly have a powerful influence, and with almost 300 members of Parliament pledged in favor of the adoption of the system, besides all the chambers of Commerce, nearly all the school boards, and the trade unions, the prospects of the passage of a bill in the near future by the British Parliament are indeed promising. This situation renders it extremely important that our Congress should at the earliest possible moment take action on the metric bill before it. It is quite probable that such action would be favorable, and if taken in time would relieve us from the alternative of later being placed in the position of merely following in the footsteps of Great Britain; for the adoption of the system by that country would, from the bearing on export trade, inevitably drive us to it regardless of all other considerations. At the recent session of Congress, the House Committee on Rules favored the bill to the extent of pledging that it would be granted a day for consideration, but owing to an adjournment of Congress earlier than was expected, it was laid over. The bill will undoubtedly be brought up at the coming session, and unless its friends are grievously mistaken in their canvass, a large majority will register approval of the desire of the enlightened to be relieved from the incubus of the present abominable system of weights and measures.

In this connection we may refer to the outcome of an incident relating to the metric movement in this country. Last spring a protest issued in the name of the American Society of Mechanical Engineers against the metric bill was widely circulated, the protest being signed by several members of the society well known as unequivocal opponents of the metric system. One of these in an article sent to this journal attacking the system, specifically stated that the protest referred to was issued by the American Society of Mechanical Engineers. In view of the warm favor accorded the measure by mechanical engineers, as expressed in resolutions of some of their representative bodies and in testimony before the committee having the bill under consideration, we expressed at the time our disbelief that the protest conveyed the opinion of the majority of the members of the national professional body. That this surmise was correct was later made evident at the Boston meeting of the society. At this meeting a member took the floor to warmly protest against the action which made it appear that the American Society of Mechanical Engineers was strongly opposed to the introduction of the metric system into the shops of this country, and subsequently a resolution was adopted administering inferentially a stinging rebuke to those who misrepresented the opinion of the society, and ordering that "the present metric opposition committee be excused from further considering the subject before it, and members be appointed thereon who are more in harmony with the customs and practices of this Society.' We refer to this incident for the reason that some may have been deceived by the action thus condemned into believing that the metric bill was viewed with disfavor by the mechanical engineering profession.

State Electric Light Associations.

We have on several occasions referred to the good work being done by the smaller central station associations, the list of which has during the past several years been considerably augmented. While the papers presented at the meetings of these bodies usually contain little of general value from the electrical engineering standpoint, they treat as a rule of matters of live interest to the membership, and together with the discussions, give an indication of the state of development of smaller central stations which otherwise it would be difficult to obtain. Of the 3,500 central stations in this country, probably 2,500 do not have on their staff a professed electrical engineer, and the management is apt to have little touch with current electrical development. The benefit is, therefore, obvious of local associations, at which superintendents and managers may meet to exchange notes, listen to the reading of papers treating of problems of the kind which they encounter, and through the enterprise of manufacturers and supply dealers have brought to their attention the latest improvements in the art. An additional value is frequently given the meet-

ings by the presence of a professor of a State college, who, as a trained expositor, performs a good office in imparting information of practical educational value. It has also become the custom for manufacturing companies to detail members of their technical staffs to prepare papers for such meeting, and while such contributions are naturally ex parte, they nevertheless serve a good end.

One of the latest of these bodies is the Indiana Electrical Association, the sessions of which were recently reported in our pages. Should the standard of the inaugural meeting be kept up, this association will take a high rank among the State bodies; for without aid from the foreign sources above referred to, an excellent programme was successfully disposed of. As at the meetings of most of the State associations, the question of relations with customers was well to the front, and, as usual, flat vs. meter rates received discussion. Flat rates were unanimously condemned, but the difficulties met in educating customers to the equity of the meter were not at all minimized—on the contrary, were shown to form a matter of vital concern. As we recently pointed out, it is one thing to demonstrate irrefragibly the equity of any charging system, but quite another to induce the public to accept the conclusions. In condemning simple methods of charging, the obstacles to better practices are usually ignored; and if these are considerable in passing from flat to meter rates, how much more must they necessarily be in the adoption of the more complicated systems now receiving attention. This is not said in discouragement of efforts to put in practice the several rational systems now being advocated, but once more to direct attention to a side of the question that has been too largely ignored. In the discussions, open arcs suffered badly in comparison with the enclosed types. This but echoes the opinion of similar gatherings of the past several years, and if the open arc still has friends, it is high time that they appeared on the forum.

Alternating-current Railways.

We are glad to note that at last the much-exploited Valtellina railway is in regular commercial operation. It has been for so considerable a period in the experimental stage that we began to fear it had come to some manner of grief not laid down in the programme. Our readers will doubtless recollect that this is the famous Ganz three-phase road, of which so much was heard during the spectacular "Inner Circle," litigation of some months since. In view of the awakened interest in alternating-current motors for traction purposes, the commercial operation of the Valtellina line is of no small importance, and we greatly regret that its location will detract from its value as an object lesson to American engineers. It is a very difficult matter to get authoritative facts about the working of Continental electric railways and transmission plants, for our excellent foreign contemporaries seldom go into such matters in great detail. It is sufficiently obvious from formal beginning of commercial operations that the road is regarded by the Italian Government as thoroughly workable, but it is not the general conditions of operation that are interesting and important to the engineer so much as the special performance of the line in certain important respects. There seems to be no doubt that several of the foreign polyphase roads are in good operative condition, but the vital question is: How far would this condition be satisfactory for suburban and interurban work, judged by American standards? This is a matter not to be determined by papers dealing in general description, nor by casual inspection by engineers who chance upon them in traveling, but by a patient and somewhat protracted study of their everyday operation. The questions that need to be answered are practical ones, touching the performance of the double trolley system, the repairs on controllers and accessories, the problem of speed variation presented in holding to the schedule under more severe traffic conditions and in getting back to it after unusual delays, the average power factor of the system, its working efficiency in watts per car-mile, and so forth.

The Valtellina road is rather the most ambitious and interesting of these polyphase systems on account of its considerable length, and particularly by reason of the concatenated arrangement of the motors, claimed by the engineers to give results comparable with the series-parallel control of direct-current motors. It is the practical substantiation or reputation of this claim that involves the key to the whole situation. Until some alternating motor system, polyphase or other, gains such a power of speed control, any alternating-current railway system must be rather limited in its application. The mere matter of making up time, so as to reorganize a disordered schedule, is of very great practical importance in railway working, and any motor system that has not a reasonably efficient reserve of speed is put at a serious disadvantage. For certain classes of work such a power is of relatively small account, in others it is fundamentally important. One of the chief claims to consideration of the new Westinghouse and Arnold systems is their flexibility in this respect, and the same may be said of the system based on the Ward Leonard method of control, now being brought out by Huber at the Oerlikon works. It is safe to say that any alternating system having really good and efficient speed control will get at least a respectful hearing. and will probably have an immediate field of usefulness. If the Ganz Company has secured what Blathy asserted in his evidence in London, then the Valtellina road should eventually score a success in spite of all the difficulties inherent in the double trolley, which, by the way, seems to be much less feared abroad than here. If we look back over the almost intolerable troubles that the early forms of trolley exhibited in this country, and then contemplate the reliability of the overhead trolley in its present form, we need have small fear of the ultimate result in using a double trolley system.

But this matter of speed control is all important. While it is perfectly true, as we have more than once remarked, that polyphase motors can be varied in speed by rheostats in the secondaries on just the same terms once obtained in the direct-current railway motors, it is notorious that in this latter case rheostatic control is a thing of the past as regards serious undertakings. A thoroughly successful alternating system must embody not only the equivalent of series-parallel control, but lend itelf readily to the multiple-unit control that is at present so important a feature in the larger work of the electric railway. How nearly will the system used on the Valtellina line meet these somewhat exacting requirements? And how, in fact, will any of the systems yet proposed meet them? These are questions which must be answered by experience in actual railway operation, which seem likely soon to be acquired. Of the very material advantages which are given by an alternating distribution we have little need to spark, and we fully realize that they are very inadequately secured by the ordinary distribution to substations with rotaries. With the situation awaiting development, we are heartily glad that American engineers like Messrs. Arnold and Lamme have tackled the problem in dead earnest. With several of Brown's roads in regular operation, the Valtellina line finally open, and Huber at work on the single-phase line of attack, it is high time that we on this side of the water should get into the game. In some form or other alternating current is going to be extensively used in the larger developments of electric railroading, and the more workers the sooner success will come. The roads to be equipped in this country we shall watch with eager interest, and we hope for full and early reports on the various foreign systems. Every bit of experience, successful or not, is valuable to the engineer.

The John Fritz Medal and Banquet.

The eightieth birthday of Mr. John Fritz, the distinguished ironmaster and inventor, of Bethlehem, Pa., will be celebrated by a dinner given in his honor at the Waldorf-Astoria, in the ballroom, on Friday, October 31st. This banquet will also signalize the successful founding of the John Fritz Gold Medal, for achievement in the industrial sciences, the medal to be awarded annually by a committee of members of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the American Institute of Electrical Engineers.

The organizing committee having the matter in charge on behalf of these various societies has already raised $6,000, representing the contributions of some 500 of the leading members of the engineering professions in this country and in Europe. The medal itself has been entrusted to the American sculptor, Mr. Victor D. Brenner, who has succeeded in designing a medal which is regarded by connoisseurs as a fine piece of work, while the friends of Mr. Fritz speak of it as an eminently vigorous and faithful portraiture. This foundation and the banquet which is to celebrate it have excited the utmost interest in engineering circles, and are an indication of the consideration being given in these flourishing times of the iron and steel industry to the higher aspects of the industrial arts to which those metals are an indispensable necessity. It is understood, moreover, that this is the first time upon which the four great engineering societies have got together for the accomplishment of any such purpose, and there can be no doubt that the award of the medal each year will be considered a distinction of the highest honor. No award of the medal is to be made unless the candidate's name has been under consideration by the Board of Award for at least one year, and it is proposed that this board shall consist of 16 members, four from each society, selected by the governing council of each, to hold office for one, two, three and four years. In case of the non-participation in any year of one of the societies, the award is to be made by the representatives of the remaining societies.

The banquet at the Waldorf will be accompanied by many interesting features and the speakers selected are to respond not only for each branch of the engineering and mechanical arts, but for the Army and the Navy and allied interests. It is worthy of mention that several contributions to the Medal Fund have been received from abroad and that a number of foreign gentlemen will participate in the banquet. The electrical profession and interests are well to the front in the subscriptions to the medal and to the dinner. The tickets for the dinner cost $12, including wine and cigars. Ladies tickets for the boxes, and including a light collation, are being issued at $3, and a large number of them have already been applied for.

Labor and Capital in the Trolley Field.

The sixth anniversary of the Metropolitan Street Railway Association, of New York City, was held on October 4 at the Metropolitan Opera House. The first meeting of the organization was held in a car barn, but at the rate its membership is increasing, Madison Square Garden will hardly be large enough to hold the members and their friends at the anniversary next year. The seating capacity of the opera house was taxed to its utmost. This organization that has grown to such proportions in six years was started by President Vreeland, of the Metropolitan Street Railway Company, solely for the benefit of the company's employees. It is in no sense a charity and is without official patronage. There are nearly 5,000 members, and they have $12,714 in bank, along with $15,000 invested in the properties the members operate. Every person employed by the company is eligible for membership, and the dues are only 50 cents a month. The organization has its own home and a sick and pension fund. Mr. Vreeland opened the proceedings last night with a most interesting speech, and said:

"This institution which you have organized and supported with your own money and by your individual efforts has attracted universal attention ,and has taught an eloquent lesson. It originated with no other thought than the benefit of its individual members, and its growth and vitality have shown what can be done by a class of men who give exclusive attention to their own affairs. Since the existence of this association questions have arisen more than once involving the relations of capital and labor, and they have been settled amicably and to the perfect satisfaction of both parties to the issue, and without any of the wasteful expense that seems to be unavoidable with others. These frictions with us have left no wounds behind them. In fact, they have done more than anything else to foster and develop a mutual confidence between management and men that is as unique in its way as this organization itself. It has been proven to the men employed on this property that 'the open door' of the management was not a mere name, but an actual fact. That we have been able, without wasteful loss, to adjust our differences becomes very significant when one considers what the history of the last 20 years shows, that contests between capital and labor have cost the men the appalling sum of $257,863,487, and that employers in the same time, as the result of strikes, lost $122,731,121.

"It staggers imagination to consider what might have been wrought by the application of this princely sum, wasted so wantonly, if it had been applied to such ends as those to which we apply our little mite. In my opinion this great waste is the result of the failure of mutual knowledge between employers and their men. As this necessary knowledge can only come from acquaintanceship, and as associations like this promote and foster intercourse, it is to be regretted that other workers do not view the situation as we do. How can men, whether they are capitalists or laborers, expect to understand each other if they are not acquainted? Without acquaintanceship there must be as much ignorant suspicion on one side as on the other. Nothing inspires more fear and distruct than half understood and wholly unseen things. I am no prophet, nor have I at hand data to prove the assertion, but it seems to me that if all these difficulties—and there were 22,793 of them—had been left to the employers and employees, without outside interference, they would have been adjusted without this horrible waste, and would have tended to a narrowing instead of a widening of the breach between the men and their employers.

"All told, there are more than 17,000 of us in this community, and as it is true that every one of us helps to support at least five persons it will be seen that in the life of this greatest metropolis on the western hemisphere, we are no insignificent factor."

This address, of which part is quoted, was followed by a remarkably good vaudeville show, which lasted till midnight.

Metric System in Great Britain.

Consul-General H. Clay Evans sends from London, August 30, 1902, a letter from the secretary of the Decimal Association, showing the progress of efforts to have the metric system of weights and measures adopted in England. The letter says:

"It has come to my knowledge that there is a considerable feeling in favor of the adoption of the metric weights and measures in the United States of America, and with this in mind, I am sure that you will be interested in information regarding the prospect of this country adopting metric weights and measures also. I therefore venture to lay before you the following information:

"There are 290 members of the present House of Commons so thoroughly in accord with our aims that they have given me authority to publish their names as supporters. If we add to this the number of members of Parliament who would be influenced by a debate in the House of Commons to vote in our favor, we are convinced that we are now strong enough to carry a bill. During the last four or five weeks, no less than 60 city, town and county councils have passed resolutions to the effect that it is desirable that the reform should be made in the interest of commerce and education.

"One of the most definite results, in fact, I think I may say, the most definite result, of the conference of the colonial premiers was the passing of a resolution in favor of the adoption of the metric weights and measures throughout the British Empire. This will have a most important result, and will render certain the early passing of a bill to give effect to these views. All the chambers of commerce in this country, nearly all the school boards, the trades unions, and a great number of societies of various kinds have for a long time been active supporters of the association.

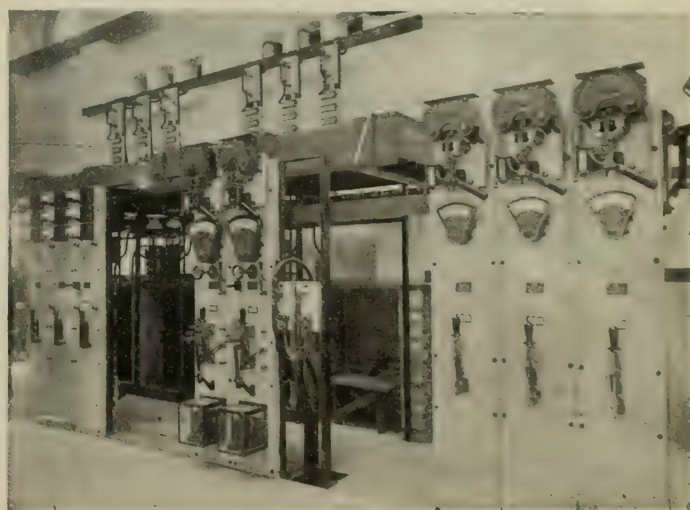
"The attitude of our Premier may be gathered from some remarks he made to the deputation which waited upon him in rgard to this question in [illegible]. He said: 'If I may express my own opinion upon the merits of the case, there can be no doubt whatever that the judgment of the whole civilized world, not excluding the countries which still adhere to the antiquated systems under which we suffer, has long decided that the metric system is the only rational system.'"

One of the Substations.

Long Transmission From a Steam Station for Electric Traction.

PORTSMOUTH, New Hampshire, is the site of a generating station that operates electric cars in Nashua and Rochester, 75.5 miles apart. Coal comes to this station by tide water, and its energy is transmitted 25.5 miles to the north, along the Maine and New Hampshire boundary line, to Dover and Rochester. To the south the line passes through the Hamptons, touches Exeter, skirts the New Hampshire beaches, reaches the Merrimac River at Amesbury, turns up the valley to the west, enters Haverhill, Lawrence and Lowell on the way, and ends at Nashua, 50 miles from the Portsmouth station.

The main purpose of this notable system is to operate electric car lines between all of the cities named, through many smaller places, to a pleasure resort at Canobie Lake, and along the short but celebrated sea coast of New Hampshire. The minor purpose of the system is the general distribution of light and power in Portsmouth, Exeter, Hampton and other points where it may be desired. This generating station, transmission system, electric railway lines, pleasure resorts and lighting equipments are owned by the New Hampshire Traction Company.



Figs. 1 and 2.—Interior of Substation.

Portsmouth, the only seaport of New Hampshire, furnished the most desirable site for the steam generating station, because the high railway charges for the transportation of coal could be then avoided. But this location of the main station implied a high voltage of transmission because the more distant end of the system is 50 miles away, half across the State. Accordingly the energy for transmission leaves the generating station at 13,200 volts. A part of this energy passes north to substations at Dover and Rochester. The other part goes south and west to substations at Stratham, Hampton, Hampton Beach, Amesbury, Plaistow, Salem and Pelham. From the Portsmouth plant to the Rochester substation, the more distant one to the north, the transmission line has a length of 23.52 miles.

Between the Pelham substation, which marks the end of the high-tension transmission on the west and the generating station, the distance by line is almost exactly 42 miles. This distance probably represents the longest electrical transmission at high voltage in New England. Feeders and trolley wire at 500 to 600 volts extend the transmission two miles beyond the substation at Rochester, and to Nashua, eight miles west of the Pelham substation. The total length of line operated at 13,200 volts between Dover and Pelham, by way of Portsmouth, is 65.5 miles, and branch lines to Stratham, Amesbury and Hampton Beach raise this total to 80.3 miles of high-tension transmission. Throughout the greater part of its course, this 13,200-volt line does not follow the tracks of the railways it is designed to feed, but takes, as a rule, the shortest course across country from one station to another. A result of this plan is that a great part of the high-tension line is run over private land. To convey the rights on such lands to set and maintain poles, string wires, transmit electric currents, and cut away all trees and branches that come within one rod on either side of the line, forever, there has been prepared and used a uniform, printed deed, suitable blank spaces being left for the necessary insertions in each case. The easements conveyed by the deed are very fully set out, and it is evidently designed to prevent future litigation. All of the 13,200-volt line, except about two miles of that entering the Amesbury substation, is in New Hampshire. Poles for this line are of Connecticut chestnut, and their most common length is 35 feet, though other lengths are used where more suitable. Over the entire 80 miles of line, the standard distance between poles is 100 feet. Every pole is numbered, and a drawing to scale shows its exact location. The line is especially well guyed, and all the poles are painted.

Two-pin and four-pin cross-arms have been used for the 13,200-volt lines. On the four-pin cross-arms the pins are spaced 15 inches apart at each end, and this is the standard distance apart throughout the system for the three conductors that go to make up each three-phase line. The greater part of the three-phase circuits are arranged in the triangular form by placing one conductor at one end of a two-

pin arm, and the other two conductors underneath at one end of a four-pin arm. Standard locust pins are generally used for the high-tension lines, but at corners and where these lines turn to enter the substations composite pins are employed. Each of these pins consists of an iron bolt 10½ inches long, ½ inch in diameter, and with a thin flat head. A piece of wood corresponding to the top of a pin, and two inches long, fits over this bolt next to the head, and is threaded to receive the insulator. Next to this wood comes a porcelain sleeve, 3 inches long, that rests on the cross-arm. The bolt passing down through the porcelain sleeve and the cross-arm is secured underneath by a nut. The cross-arms are all provided with two iron braces each.

Vitrified porcelain insulators are used to support the entire transmission line. These insulators are all provided with both top and side grooves, so that the conductors can be mounted in either position, and both methods of mounting have been employed. Insulators vary in size to adapt them for the various conductors used in the transmission. One of the large insulators is 6¾ inches in diameter at its largest point, 4 inches in diameter at the rim above the side

FIG. 3.—MAP OF THE RAILWAY SYSTEM.

groove, 4¼ inches high from the lower rim to its top, has a top groove of 1⅛ inches diameter, and a sleeve that surrounds the pin to a distance of 1½ inches down from the lower rim. The height of this insulator when set upright on this sleeve is 5¾ inches.

The 13,200-volt conductors are bare, except a short stretch in Portsmouth, from Rochester to Nashua, a small part of them are aluminum, but the greater part is copper. Nine substations are supplied by the high-tension, three-phase lines, and the general plan of their arrangement is to decrease the number or size of conductors at each substation as the distance from the generating plant increases.

From the generating plant at Portsmouth three No. 2 copper wires connect with the Dover substation, a distance of 16.78 miles. These No. 2 wires are replaced by a submarine cable of three No. 6 copper wires crossing Great Bay, an arm of the ocean between Portsmouth and Dover. The length of this cable is about one mile. From the Dover to the Rochester substation, a distance of 6.74 miles, the 13,200-volt line consists of three No. 6 copper and three No. 6 aluminum wires. Starting again from the generating plant in Portsmouth six No. 3/0 wires extend to switch houses at a steam railway-crossing, distant about three and one-half miles. From this crossing the line of six 2/0 copper conductors continues south to the Hampton substation, distant 11.11 miles from the plant at Portsmouth. At a point about six miles from the Portsmouth plant, three No. 2 copper conductors connect with either set of the 2/0 wires, and run thence to the substation at Stratham, a distance of about 7.9 miles from the junction of the circuits just named. From the Hampton substation three circuits go south. One circuit of three No. 2/0 copper wires runs to the substation at Plaistow, a distance of 16.56 miles. Two other circuits, each made up of three No. 6 aluminum wires, run side by side to the Amesbury substation, distant 8.16 miles from that at Hampton. At a junction point on this aluminum line, 5.77 miles from Hampton, three No. 4 copper wires connect to either set of three wires, and extend 8.02 miles to Hampton Beach. Between the substation at Plaistow and that at Salem, a distance of 7.78 miles, the 13,200-volt line consists of three No. 0 copper conductors. Three No. 2 copper wires extend the transmission line, 6.49 miles from the substation at Salem, to the one at Pelham, which marks the end of the high-tension system, 41.94 miles from the Portsmouth station.

Where the transmission line from Portsmouth to Dover crosses Great Bay, into which flows the Piscataqua River, the submarine cable joins the overhead wires at each end in fire-proof terminal houses. Each of these houses is brick, on a foundation of concrete, and has a roof of vitrified tile or slate laid in cement and supported by steel T's that rest on the brick walls. The concrete foundation extends 5 feet below the ground surface, and the floor is formed by one inch of Portland cement resting on 3 inches of concrete, and this in turn on 8 inches of cinders. Each house is 6 x 8 feet at the floor level inside, and 12 feet 9 inches from the floor to the lowest point of the roof. The walls are 13 inches thick, of hard brick in red cement mortar.

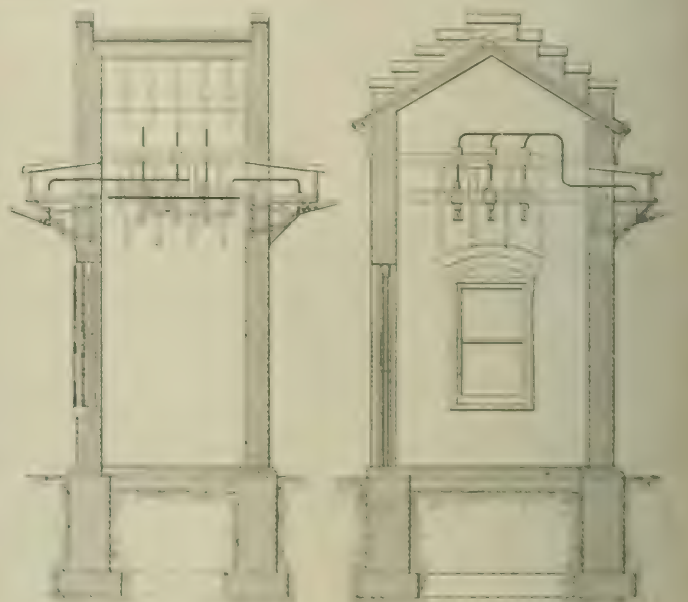


FIG. 4.—SECTIONAL ELEVATIONS, TRANSFER SWITCH HOUSE

The overhead wires carrying 13,200 volts enter each terminal house 10 feet 8 inches above the floor, and these wires are 10 feet above the ground outside. Entry of the overhead lines is made through a form of outlet designed by the General Electric Company, and to be described in detail later. The lead-covered submarine cable passes through the foundation of each house at about 4 feet 3 inches below the floor level, and extends up the side, having an outlet at a point 8 feet 9 inches above the floor, where the three conductors separate and pass to the porcelain supports at the outlet which are spaced two feet apart. Just back of each of these supports a tap passes from the line conductor to a knife switch and series of lightning arresters mounted on a frame of 4-in. x 4-in. white pine. The three series of lightning arresters are joined to a common ground plate, and between the series are placed slabs of slate, each 1 in. x 24 in. x 7 ft. 10 in.

Where the transmission line, connecting the generating plant at Portsmouth with the Hampton substation, crosses the tracks of the Boston and Maine Railroad, in Portsmouth, a switch house similar to that just described has been erected at each side of the right of

way, and the conductors pass from one house to the other underneath the tracks.

At the junction of the Stratham line with that passing from Portsmouth to Hampton, a transfer-switch house, similar to the above in general construction, has been erected, and the same is true at the junction of the line running to Hampton Beach with that which connects the substation at Hampton and Amesbury. In the case of each of these transfer-switch houses, however, there is no underground cable, but overhead lines enter on three sides of the house. At two sides enter the two circuits of three wires each, either of which can be connected to the third circuit which is to receive energy, by means of the transfer switch. The third circuit enters at the remaining side and can be operated when either of the other two is connected to the transmission system. The 13,200-volt lines enter these transfer-switch houses at about 10 feet 6 inches above the ground level.

Not only is it possible to disconnect each set of three conductors leaving the generating station from the switchboard there, but oil switches at the substations give each of them control of all the transmission line beyond it. Thus at Dover the 13,200-volt line that extends to Rochester may be disconnected from the high-tension system by throwing a single oil switch. At Hampton, one oil switch will disconnect the three No. 2/0 wires that run to Plaistow, and another oil switch will cut-out the six aluminum conductors extending to Amesbury. In a similar way the energy may be cut off from both the Salem and Pelham substations by an oil switch at Plaistow, or from Pelham only by the switch at Salem. Every high-tension conductor entering a substation passes at once to a knife switch, which may be opened after the conductor has been disconnected from the source of energy by an oil switch.

At the station side of each knife switch two connections are made, one going to a series of five lightning arresters, and the other to an oil switch mounted in a compartment of brick and stone behind the switchboard panels. The several series of lightning arresters are joined to a common ground plate in each case. The nine substations above named are all similar as to the character and connections of the equipment that receives and converts energy from the 13,200-volt line. At each station the received energy after passing through the oil switches goes to transformers that reduce the voltage from 13,200 to 380 for the rotary converters. The transformers now installed and in operation number 45, with a combined capacity of 5,010 kilowatts. Of these, six are rated at 100, twelve at 120, and twenty-seven at 110 kw each. All of these transformers are of the air-blast type, and at each substation one or more blowers, direct connected to electric motors, are provided to give the air blast of 3/8-ounce pressure which the transformers require. In connection with the double-throw switch which joins each rotary to its bank of three transformers is a reactive coil for use in starting the rotary.

FIG. 5.—HAMPTON RIVER BRIDGE—LENGTH, 4,623 FEET.

The reactive coil used with each 300-kw rotary is rated at 540 amperes and 28 volts, and for 350-volt circuit.

The nine substations contain 15 rotary converters, all three-phase at 25 cycles per second, and rated to deliver direct current at 600 volts. Three of the rotaries are rated at 250 kw each, and the other twelve at 300 kw each, giving a total capacity of 4,350 kw. Each of the 300-kw rotaries has six poles, six sets of brushes, and operates at 500 r. p. m. Three collector rings receive the alternating current at each rotary through copper leaf brushes, and distribute it to the armature coils through nine radial connections that enter the coils at equidistant points. The switchboards at substations are in each case provided with energy from the 13,200-volt line for indicating instruments through a small transformer designed for the purpose. These instruments include a volt meter, at which the indication of 110 corresponds to 13,200 volts on the line; an ampere meter, and a power factor indicator, with range from 90 to 100, for each three-phase circuit. The energy output of each rotary in the form of 600-volt, direct current, is measured by a recording wattmeter. This energy then passes to feeder panels and out of the substation. At one substation, that at Salem, a booster generator with capacity of 400 amperes at 250 volts is provided for use in one of the 600-volt feeders. This booster has six poles, and operates at 550 r. p. m. On page 572 is a list of the apparatus at each of the substations.

Each of the 16 blowers is driven by a 1-hp motor, direct connected; three of these motors operate with direct current, and 13 motors are of the induction type.

The portable substation is contained in a box-car, 30 feet in length, and of about the usual freight-car construction. During the summer this car has been at Hampton Beach, but it will shortly be taken to Rochester to provide additional capacity there during the coming fair, and can be moved to any part of the system.

These nine substations are devoted exclusively to the operation of the electric railway of the New Hampshire Traction Company. This street railway system has a total length of about 132 miles, of which more than 100 miles is now in operation and the remainder is nearing completion. The line connects the cities of Dover, Somersworth and Rochester, and from Nashua forms a continuous road through the busy Merrimac Valley to Portsmouth, the only seaport of the State of New Hampshire. Between these terminal points the main lines passes through Exeter, Hampton, Plaistow, Salem, Pelham, in New Hampshire, and Amesbury and Haverhill, in Massachusetts. Connecting with this through line are branches to Hampton Beach, a line between Haverhill and Lawrence, Lawrence to Canobie Lake and to Pelham, and from Lowell to Pelham. The Traction Company thus connects and draws its traffic from the four large cities of the Merrimac Valley, Haverhill, Lawrence, Lowell and Nashua, and gives them a direct outlet to a seaport and to several beaches

of the Atlantic coast. The private right of way is located as follows: Between Nashua and Pelham, 5.75 miles; between Pelham and Salem, 5.25 miles; between Pelham and Lowell, 1.00 miles; between Pelham Junction and Lawrence, 1.75 miles; between Lawrence and Canobie Lake, 4.50 miles; between Haverhill and Lawrence, 2.75 miles; between Haverhill and Amesbury, 4.00 miles; between Amesbury and Hampton Beach, 2.00 miles. The total length of railway on private way is thus 27 miles, and this has been graded, ballasted and provided with masonry culverts in a way similar to the practice on steam roads. Fifty feet is the standard width of this private right of way, and the company has purchased it in fee. Several bridges crossing the tracks of steam railways and a small river have been built for the electric system. Between the northern and southern portions of Hampton Beach is the Hampton River, an arm of the sea, nearly a mile wide at this point. In the past a detour of about five miles around the mouth of this river has been necessary in order to pass from lower Hampton or Salisbury Beach to the main part of Hampton Beach. A wooden, pile bridge across this river, one mile in length and with a draw, has been constructed by the electric railway company for the use of its cars and as a toll-bridge for the general public. This is, perhaps, the longest bridge ever built for an electric railway. Pile bents under the bridge are 12 feet apart, and there are 14 piles to each bent. The toll over the bridge is five cents for each person or vehicle crossing it. At Canobie Lake, which is about eight miles from Lawrence and nine from Haverhill, the electric railway system includes a park of 35 acres, with a frontage of about 1,000 feet on the Lake. Suitable buildings for recreation purposes have been erected in this park, and it has become an attractive and easily reached resort.

Station	Transformers No.	Transformers each K.W.	Rotaries No.	Rotaries each K.W.	Reactive Coils. No.	Reactive Coils. each Volts
Rochester	3	[illegible]	1	250	1	28
Dover	6	[illegible]	1 1	250 300	2	28
Stratham	[illegible]	[illegible]	[illegible]	300	[illegible]	28
Hampton	6	[illegible]	2	300	2	28
Amesbury	6	[illegible]	1 [illegible]	250 300	2	28
Plaistow	6	110	2	300	2	28
Salem	6	110	2	300	2	28
Pelham	6	120	2	300	2	28
Portable	3	100	1	300	1	28

Station	No. of blowers	Type of motor	No. of feeder panels	Amperes each
Rochester	1	D.C.	2	600
Dover	2	A.C	3	600
Stratham	2	A.C	3	600
Hampton	2	A.C	3	1200
Amesbury	2	A.C	2	1200
Plaistow	2	D.C	2	[illegible]
Salem	2	A.C	4	1200
Pelham	2	A.C	4	600
Portable	1	AC.	600 ampere circuit breaker.	

During the past five months about 85 miles of new track have been added to the system of the New Hampshire Traction Company, and the remainder of the line is made up of previously existing roads. In

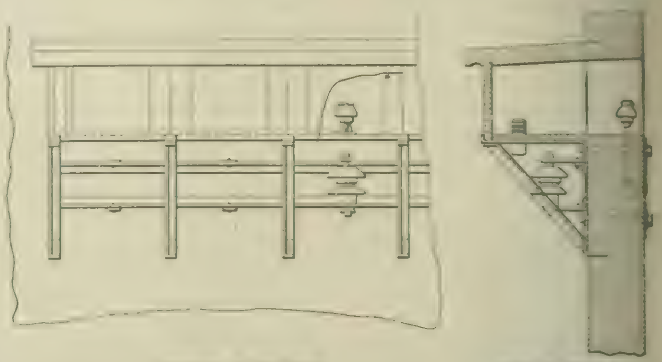


Fig. 7.—Line Anchorage.

city streets the construction has been carried out with 9-inch, 90 pound per yard girder rail. Outside of the cities a T-rail of 70 pounds per yard has been mainly used. The entire length of track is double bonded with 4/0 bonds, one bond being placed inside and one outside of the fish plate. No return conductors aside from the rails are provided. The length of rails mainly used is 60 feet.

All of the new track has been laid on chestnut ties, each 6 in. x 8 in. x 7 feet, spaced two feet apart on centers, and ballasted with one foot of gravel. On all the new line a No. 2/0 hard copper trolley wire has been erected, mostly on side brackets, though some center construction has been put up in cities and elsewhere. Chestnut poles have been used throughout, generally 35 feet each in length. These poles all carry the trolley-wire feeders and telephone lines in addition to the brackets for the trolley wire. The United States block signal and telephone system is used over the entire line.

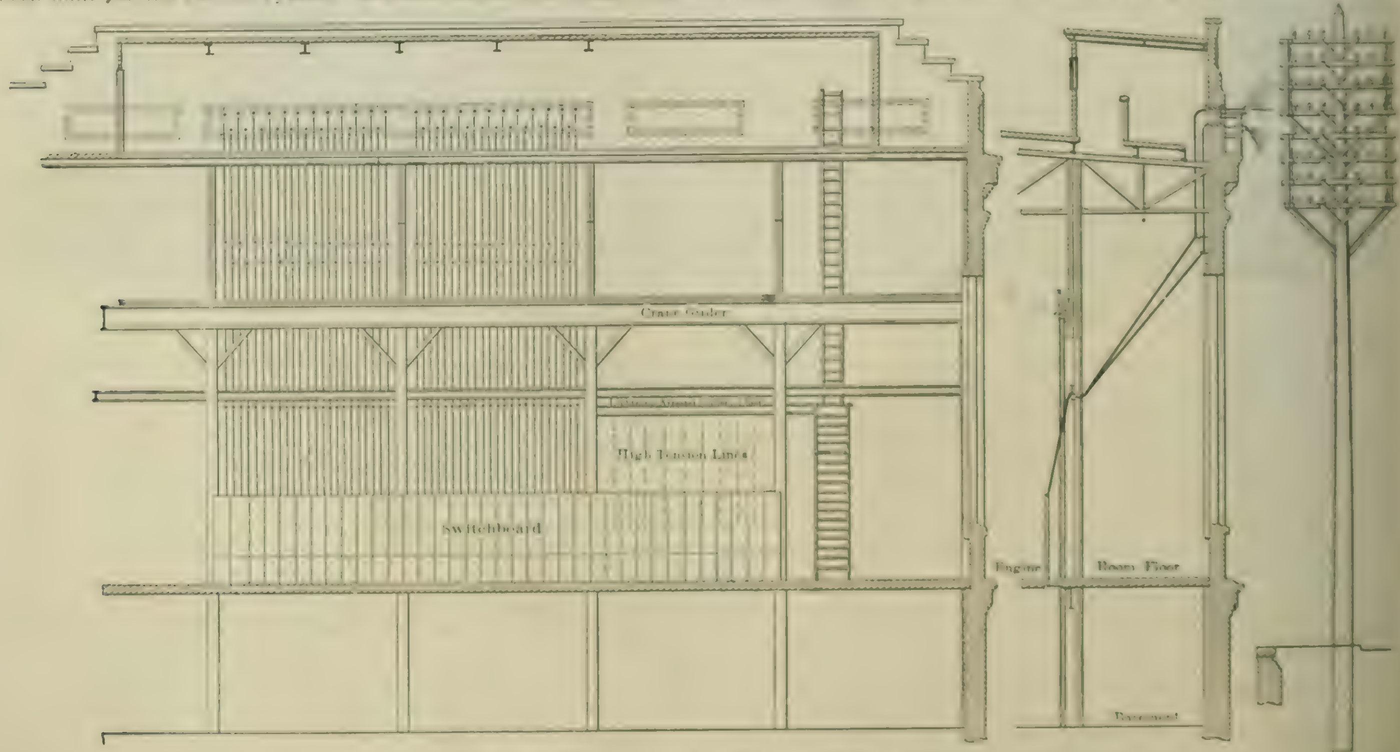


Fig. 6.—Outgoing Low-Tension Wires.

Heavy feeders of weatherproof, insulated wire connect the substations with each other and with the trolley wire. The rule with

these feeders is to follow the track, join all the feeders on a particular line, so that they form one conductor, and connect first one feeder and then another to the trolley wire at short intervals. Between the Dover and Rochester substations there are two feeders each of 500,000 cm. From the Dover substation to Dover City there are three No. 2/0 feeders, and two feeders of No. 2/0 follow the tracks from the same substation to Somersworth. Between the generating plant at Portsmouth and the substation at Stratham two No. 3/0 feeders are run, and others of the same size continue on to Exeter, where they are met by two feeders of No. 4/0 from the substation at Hampton. From this same substation three No. 4/0 feeders pass over the line to the northern portion of Hampton Beach, and two feeders, mostly of the same size, go to the Amesbury substation, one being of 500,000 cm., for 2.5 miles south of Hampton. At Smithton these two last named feeders are joined by a single 4/0 that goes to the southern portion of Hampton Beach and crosses the long bridge over the Hampton River to join the feeders from the north. Between the Amesbury and Plaistow substations there are two No. 4/0 feeders for the trolley wire, and they continue from the latter station to Haverhill. The Salem substation sends out a 500,000 cm. along the track toward Haverhill, and this changes to a No. 4/0 where it joins the direct line between Haverhill and Lawrence, which has a 4/0 feeder running its entire length. Two feeders of 375,000 cm. each extend from the Salem station to Lawrence, and a third feeder of 350,000 cm. goes from the same station to the junction in Methuen, where it changes to a 4/0 and follows up the Lawrence and Methuen line to join the 4/0 feeder that joins the Salem and Pelham substations. This latter station sends out one pair of 4/0 feeders to Nashua, and another pair of equal size to Lowell, thus completing this extended system of 600-volt feeders that reaches from Portsmouth to Nashua, and with its branches follows more than 100 miles of track.

The first substation to receive energy from the Portsmouth plant was that at Hampton, which was connected to the 13,200-volt line from Portsmouth on August 8, and began to operate with the transmitted energy on August 9, 1902. Prior to this time a part of the substation had been operated from a smaller generating plant at Hampton. On Sunday, September 14, 1902, the direct-current outputs of some of the substations in kw-hours were as follows: Stratham, 3,120; Plaistow, 2,640; Hampton, 2,160; Amesbury, 2,040.

The rolling stock of this system includes about 140 cars, of which the greater part, approximately 100, are either the 14-bench open or

FIG. 8.—INTERIOR OF SUBSTATION.

the 30-foot enclosed type, fitted with air brakes. Running time and passenger fares over the greater part of this system are as follows: Nashua to Haverhill—time, 1½ hours; fare, 25 cents. Haverhill to Canobie Lake—time, 45 minutes; fare, 10 cents. Haverhill to Amesbury—time, 1 hour; fare, 15 cents. Haverhill to Lawrence—time, 45 minutes; fare, 10 cents. Amesbury to Hampton Beach—time, 45 minutes; fare, 15 cents. Amesbury to Exeter—time, 1 hour, 15 minutes; fare, 15 cents. Exeter to Portsmouth—time, 1 hour; fare, 20 cents.

The car barns connected with this electric railway, like the substations buildings, of which they form a part in most cases, are one story in height and of brick and steel construction with concrete floors. The locations of these car barns and their capacities in cars are: Amesbury, 16; Plaistow, 12; Stratham, 14; Hampton, 34; Salem, 36; Pelham, 32; Dover, 12, and Rochester, 12. In the building that forms the car barn and substation at Salem, there is also a machine shop to handle the repair work of the system.

Lighting and the distribution of power to stationary motors forms an important though minor part of the business of the New Hampshire Traction Company. Electric lighting is at present done in three places—Portsmouth, Hampton and Exeter. The lighting in Hamp-

FIG. 9.—PORTSMOUTH GENERATING STATION.

ton and Exeter is done at present by a generating plant in the former place, but this plant will be replaced later by substation equipment operated with energy from the Portsmouth plant.

The lighting load in Hampton and Exeter includes 77 enclosed alternating arcs, taking 6.6 amperes, 45 series incandescent lamps of 32 cp each, on the arc circuit, and about 1,600, 16-cp incandescent lamps. To carry this load of lamps a three-phase alternator of 150-kw capacity, at 600 r. p. m., 2,350 volts and 60 cycles per second, is operated by a belted engine in the Hampton plant. Connected to this alternator is a constant-current transformer, rated at 58 kw and 6.6 amperes, and used for the arc circuit.

Besides this lighting equipment, the Hampton plant contains direct-current generators of 350-kw capacity, at 600 volts, also a 500-kw, three-phase, 25-cycle, 13,200-volt alternator, at 107 r. p. m., direct

FIG. 10.—PORTSMOUTH GENERATING STATION.

coupled to a horizontal, compound engine. Both the direct and alternating generators last named have been used for several years to operate portions of the electric railway system previously described. From now on these Hampton generators will be operated merely as an auxiliary to the Portsmouth plant.

At Portsmouth the local service includes gas supply as well as electric light and power. All of this service is carried out, and the Portsmouth generating station operated by the Rockingham County Light and Power Company, one of the corporations that go to make up the new Hampshire traction system.

Coal gas enriched with oil is supplied at Portsmouth, and its candle-power is about 18. During the past year the output of this gas has

been about 14,000,000 cubic feet, but this amount is being rapidly increased by the introduction of gas stoves.

About 20,000 16-cp and 230 25-cp incandescent lamps, and 120 enclosed arc lamps are now connected to the distribution system at Portsmouth. The arc lamps operate with 6.6 amperes, and with the 25-candle incandescent lamps are used for street lighting. The 25-candle lamps take 1.75 amperes at 50 volts, or 88 watts, and are used in large Edison bases, connected in series. For the series circuits of these 50-volt incandescent lamps the alternating voltage of 2,300 is steped-up to 4,000 volts, and a General Electric reactive coil is connected in each circuit to hold the current at 1.75 amperes. Enclosed arcs are operated by two constant-current tub-transformers, each rated at 6.6 amperes and 6,000 volts, and connected to a separate circuit. These tub-transformers and those for the incandescent street lamps draw their energy from two-phase generators at 2,300 volts. The local distribution lines for incandescent lighting are also connected to the 2,300-volt, two-phase generators.

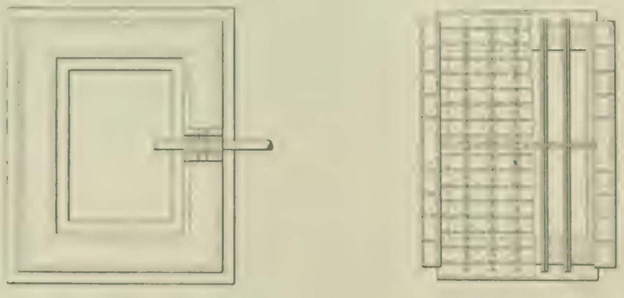
A load of direct-current motors in Portsmouth is provided for by a rotary converter of 150 kw and 550 volts at the new generating station. This rotary takes its energy from transformers that step-down the primary voltage of 13,200 to 370.

Service to large stationary motors at Portsmouth is available through transformers that step the 13,200-volt energy from the main generators down to 550 volts at 25 cycles, three-phase.

The local distribution of electric light and power from the main generating station is thus carried out through five classes of circuits.

One set of circuits for both arc and incandescent lighting is two-phase, four-wire and 60 cycle, at 2,300 volts. Arc circuits for series lamps are two-wire, 60-cycle, single-phase, 6.6-ampere and 6,000-volt. Incandescent street lamps are operated by two-wire, 60-cycle, single-phase, 1.75-amperes and 4,000-volt circuits. Two-wire, direct-current power circuits at 550 volts supply energy to direct-current motors in general use.

These various distribution circuits make up a total of 46 wires which pass from the switch panels directly to the brick wall at one side of the station, and then out through 40 porcelain tubes, each 16 in. x 1 in., and 6 tubes, each 16 in. x 1½ in., to poles carrying eight cross-arms with six pins each. The porcelain tubes are arranged in two rows, one row being 18 inches above the other, and the tubes are on 15-inch centers in each row. All wires are attached to a special bracket, fixed to the face of the brick wall, before passing to the pole.



Energy at 13,200 volts, 25 cycles, three-phase, that operates at once electric cars in Nashua 50 miles away, and the synchronous motor in the Portsmouth station is supplied by a pair of main generators.

Each of these generators is rated at 1,000 kw, 13,200 volts, three-phase and 25 cycles, at 94 r. p. m. A cross compound, horizontal engine, with cylinders 28 in. x 54 in. x 48 in., is direct connected to each of these main generators These generators are of the revolving-

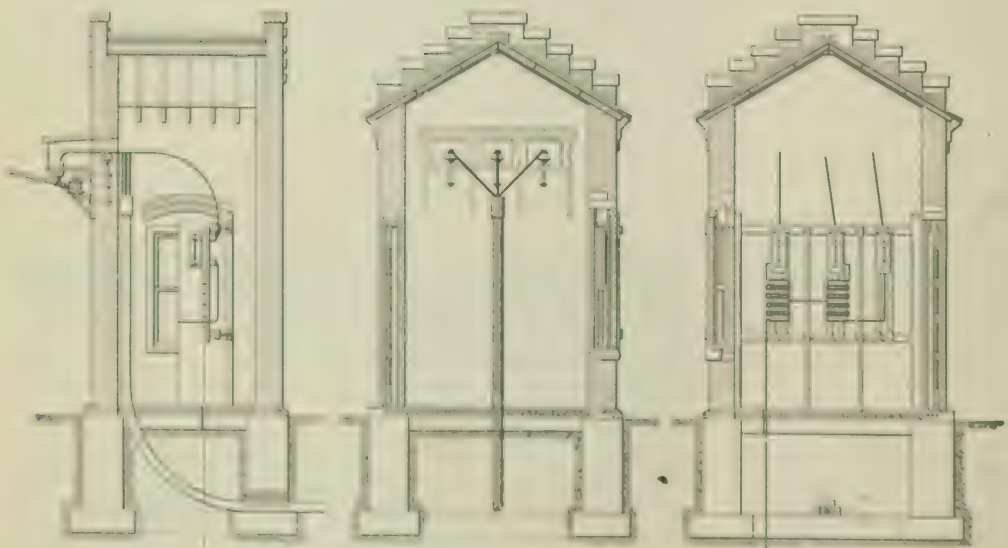


FIG. 11.—PLANS AND SECTIONS, CABLE TERMINAL AND LIGHTNING ARRESTER HOUSE, PISCATAQUA RIVER CROSSING.

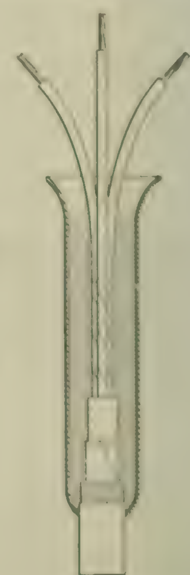


FIG. 12.—TERMINAL BELL FOR HIGH-TENSION CABLES.

Two generators have been installed at the Portsmouth station for electric lighting, and service to stationary induction motors. Each of these generators is of 200-kw capacity, 2,300-volt, two-phase and 60 cycles. One of the generators is direct connected to a compound, single-acting, vertical engine, with cylinders 18 in. x 30 in. x 16 in., and operate at 233 r. p. m. The other 200-kw generator is direct connected to a synchronous motor, and operates at 500 r. p. m. This synchronous motor is rated at 300 hp, and is driven by current from three transformers of 80-kw each that step-down the voltage from 13,200 to 2,300, 25-cycle, three-phase. An exciter for this motor-generator set is mounted on an extension of its shaft, is rated at 60 volts and 166 amperes, and has 8 poles. For the steam-driven 200-kw generator, an exciter rated at 20 kw and 125 volts is provided. This exciter is direct connected to a 30-hp, two-phase, 60-cycle induction motor, and operates at 900 r. p. m. This motor is supplied by two transformers of 15-kw each, that step-down from 2,300 to 230 volts, two-phase.

magnet type, with contact rings for their exciting currents. This current is supplied by either of two dynamos, each rated at 100 kw and 125 volts. A vertical compound, single-acting engine, with cylinders 12 in. x 20 in. x 12 in., is direct connected to and drives each of these exciting dynamos at 300 r. p. m. Besides the two generators of 1,000-kw each now in operation, a third generator is now on order, which will have a capacity of 2,000 kw at 13,200 volts, three-phase and 25 cycles. This 2,000-kw machine will be direct connected to a compound, vertical engine, with cylinders 38 in. x 76 in. x 54 in., and operated at 83.3 r. p. m.

As the main generators develop 13,200 volts, the normal pressure used on the transmission system, in their armature coils, no step-up transformers are required. From each main generator the three cables carrying current at 13,200 volts are carried in vitrified conduits down and under basement floor to the oil switches near the back of the switchboard panels. This switchboard is in itself a notable piece of work. From the basement floor

bus-bar compartments rest, to the top of the lightning arresters and knife switches in the gallery above the main floor is a distance of 33 feet. There are 36 switch panels with a width side by side of 48 feet. The three 13,200-volt bus-bars of bare copper strip are mounted on porcelain in a series of brick and stone compartments, built up from the basement floor to a height of seven feet. Each compartment is ordinarily closed, so that the bus-bars are covered on all sides. Oil switches for the 13,200-volt generators and for the feeders at this pressure are mounted in cells of brick and stone, built up from the main floor behind the switch panels. On the top of this cell structure are the motors that operate the oil switches. Connected with each motor is an automatic overload relay which starts the motor, so as to open its switch in case of an overload on the feeder circuit concerned. This arrangement adds to the usual action of an oil switch the function of an automatic circuit breaker. Each generator panel carries volt and ampere meters, a power factor indicator, Lincoln synchronizer, and indicating and recording wattmeters. Each feeder panel carries three ampere meters and two recording wattmeters. Three 13,200-volt, three-phase sets of feeders pass from the oil switches to the tower for high-tension lines at the top of the building, making a total of nine wires, of which six go to the Hampton and three to the Dover substation. At the gallery level, a connection brought down from each 13,200-volt feeder wire

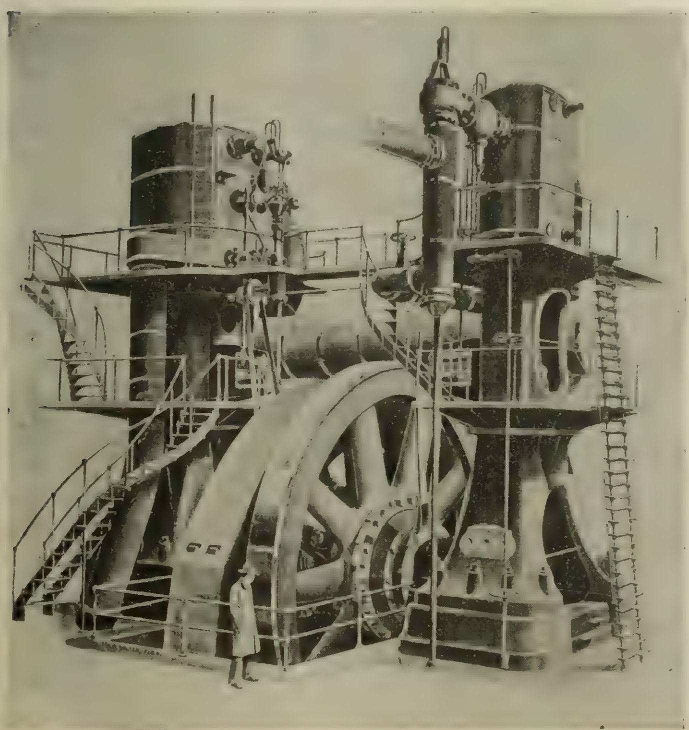


FIG. 13.—THE NEW 2,000-KW GENERATOR.

passes into a knife switch in series with a train of lightning arresters. The nine series of lightning arresters are separated from each other by slabs of slate, each about 30 x 80 inches.

All of the engines before mentioned at the Portsmouth plant exhaust into a central condensing system. The regular steam pressure is 160 pounds. The Holley drip-system is used with all the engines.

A crane with two trolleys of 30-tons capacity each for hand working sweeps the entire engine and generator room. As now installed, the boiler plant is made up of six units, rated at 520-hp each. These boilers are of the horizontal, tubular type, and are provided with superheaters. A mechanical stoker with a capacity of three tons of coal in its bunker per front foot of the boilers, feed their furnaces automatically. All coal is crushed and weighed before passing into the bunkers, and again weighed above each boiler. Coal comes by water, and is unloaded directly into bins that adjoin the station.

An economizer with 10,400 square feet of heating surface receives all the gases from the boilers when desired, being located in a by-pass on the main flue. To ensure ample draft, in spite of the resistance offered by this economizer, two fans with 15-ft. wheels have been provided near the base of the 150-ft. brick chimney, and draw the flue gases through a sheet-iron flue, 15 feet x 7 feet in section. Boiler feed-water from the city mains is forced through primary and auxiliary feed-water heaters of the straight-tube type, and 1,300 square feet of heating surface, and then through the economizer by feed pumps wth compound steam cylinders. Sea water for the central condensing system is obtained through an intake crib from the Piscataqua River.

The generating station on the water front at Portsmouth is a one-story fireproof building with basement, of brick, tile, concrete and steel construction. This building measures 148 ft. 11 in. x 125 ft. 6 in. outside, on corner being cut off along one side, to conform to the street line. Inside, the building is divided by a brick wall into engine and boiler rooms. The engine room is 144 feet 3 inches long, 54 feet wide at one end and 65 feet wide at the other. Inside the boiler room the length is 144 ft. 3 in. x 54 ft. Underneath the engine room is the basement, with its floor level 12.5 feet below that of the engine room floor. Between the floor of the engine room and the bottom cord of the steel roof trusses is 31 feet. In the boiler room the height from floor to bottom cord of roof trusses is 38 feet. The entire building is roofed with hard tile, laid in cement and supported by cross I-beams over the steel trusses. This building is of steel and masonry throughout, wood in its construction is used only at door and window casings, and a space equal to the entire length of this article might easily be devoted to its interesting features. The steel and masonry type of construction has been carried out in the combined substations and car houses of the New Hampshire Traction Company. Of these eight substation buildings, that at Salem, New Hampshire, may serve as a good example, though somewhat larger than the others. This building fronts along the street a distance of 204 ft. 8 in., and etends back from the street 182 ft. 4 in. in the main part. Brick, steel and concrete are the principal materials of construction, and the building is in the main one story, lighted from above with skylights in addition to its windows. The central and larger portion of this building, 118 feet front by 182 feet 4 inches deep, forms the car house, with nine tracks running its entire length. At one rear corner of this car house a space about 55 ft. x 40 ft. is partitioned off for a paint shop. In its central part, the car house measures 20 feet from floor to bottom cord of roof truss, and 18 feet is the corresponding distance on each side. The entire building is roofed with tar and gravel, laid on 2-inch plank that rest in turn on the steel roof trusses. The floor of the car house is 3-inch plank, laid on 8-in. x 10-in. hard pine beams, that are supported in turn by posts of the same material that rise from a sub-floor of concrete, about 4 feet below the plank floor.

A wing at one side of the main building, 48 feet front by 118 feet 4 inches deep serves as a repair shop, winding room and boiler house. Save in the boiler room the wing just named has a plank floor supported by hard pine beams and brick piers. At the other side of the car house is the substation, 38 ft. 8 in. x 81 ft. 8 in. on the ground and 21 feet 4 inches from the concrete floor to the bottom cord of roof truss. This floor rests on steel beams and is 7 feet 6 inches above the concrete floor of the basement underneath. A crane sweeps the substation at a distance of 17 feet above the main floor, and light is received through windows and a central skylight.

Each bare wire of the 13,200-volt transmission line enters the side brick wall of the substation through an opening about 16 inches square. A porcelain insulator is so mounted in this opening that the high-pressure conductor passes through nearly at the center. Outside of the row of openings in the brick wall, and built into it, a stone box is constructed with roof of blue flag-stone, 3 inches thick, and sides and bottom of 1-inch slate. Inside, this box extends 22 inches out from the face of the brick wall, and is 15 inches high at the face. Underneath this box, and with its center eight inches from the face of the brick well, is a large porcelain insulator, on which the high-tension wire is secured. From this insulator the wire passes up through the bottom of the box in a heavy glass tube, and thence to the insulator mounted in the opening of the brick wall. The extreme front of the wing containing the substation is devoted to offices and toilet rooms, covering a ground space of 18 ft. x 38 ft. 8in., and to a locker room for employees in a second story.

The power plant at Portsmouth was designed and built by Sanderson & Porters, New York, as engineers and general contractors. The same firm also acted as consulting engineers for the entire property. Plans for the substations and car houses were made by Sheaff & Jaastad, engineers, of Boston. The electric generators, motors, rotary converters, transformers, switchboards and instruments above described were made by General Electric Company. Boilers at the Portsmouth plant are the product of Aultman-Taylor

Company. The economizer is of the Greene make. Horizontal Corliss engines, used to drive the 1,000-kw, 13,200-volt generators, were manufactured by Providence Engineering Works. All the vertical engines named are of Westinghouse make. The condenser for the engines is of the Worthington elevated pattern. The crane in the main generator room was furnished by the Whiting Foundry and Equipment Company. Roney stokers fire the boiler furnaces.

The new electric cars were built by the Laconia Car Company. Air brakes are of the Standard type. Snow plows are from the Taunton Locomotive Works. Electric motor equipments are mostly of the General Electric and Westinghouse makes.

Underground Work for Telephone Exchanges—VI.

By Arthur V. Abbott, C. E.

THE more modern type of manhole roof patterns after fireproof building construction, and contains much greater evidence of design. Two or more I-beams or channels of sufficient strength are set across the top of the wall, and brick or tile arches sprung between the beams. Such a roof is shown in Fig. 32. This plan is much more scientific, and is structurally compulsory where vaults larger than 5 feet by 7 feet top are used, but necessitates a correspondingly greater expenditure. In Fig. 33 a special arch brick is shown, manufactured particularly for manhole roofs. It is reported that these bricks are safe for a load of ten tons per square foot, and are designed for 32-inch span between beams. Finally when the necessary time can be allowed for setting, even brick manholes may advantageously be supplied with a moulded concrete top. This method is simple and easy as may be seen be reference to Fig. 29 (Page 496), being merely sheet of concrete about one foot in thickness The only mould required is a staging of plank set inside the vault

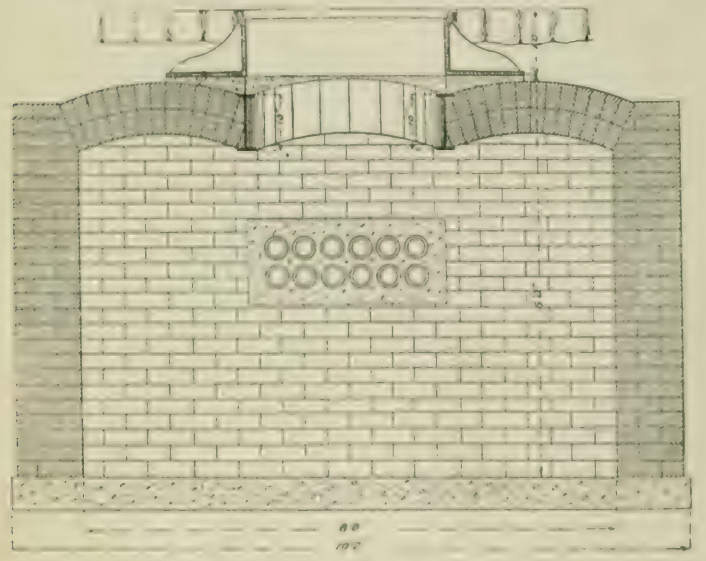


FIG. 32.—MANHOLE WITH ARCHED ROOF.

walls, flush with its top, carrying in the center a section of a cylinder or a square of the same diameter as the hole in the cover. Such a staging can be built in a couple of hours, by even an unskilled carpenter, and the vault completed by dumping concrete thereon and ramming solidly into place. By giving the staging sufficient strength to carry the street traffic, pavement may be immediately replaced, and the staging allowed to remain indefinitely until the concrete has gained any desired strength. Such roofs need no metal reinforcement, and have proved entirely satisfactory in so large a number of instances, even under the most trying circumstances, as to be worthy of the widest application.

The designing of vault covers has presented one of the most vexatious of detail problems, and multitudes of devices have arisen—flourished for a time—and disappeared. Almost every conduit builder has his own pet plan. There are two generic types—the *"Tight"* cover and the *"Open"* cover, while morphologically either may be built on the round or square plan. In early conduits the attempt was made to render ducts water and gas tight, and consequently particular stress was given to making the entrances waterproof. To this end covers, usually round, were made double, as shown in Figs. 34 and 35, having an outer lid flush with the street to carry traffic, and an inner or sealing cover pressed against a packing ring or gasket, designed to make the entrance air tight. In Fig. 34 the packing gasket rests in a circular groove in the underside of the inner cover, which is forced against it by a screw playing through a bar interlocking in the lug *A*. In Fig. 35 the sealing lid is drawn

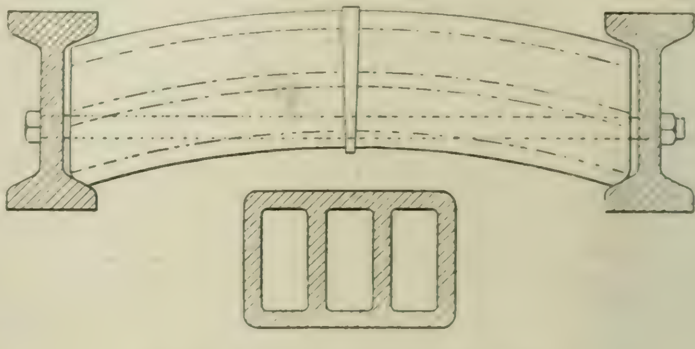


FIG. 33.—SPECIAL MANHOLE, ARCH BRICK.

up against the inside of the cover frame by four bolts. The design of Fig. 34 is the cheaper to build, easier to manipulate and generally most satisfactory, avoiding exposing the cables to the danger of the inner cover falling against their sheaths. In Fig. 34 reasonable drainage of the spaces between the covers is secured by connecting the groove in the frame around the packing ring with the sewer, but in Fig. 35 no such proviso exists, and this space must be cleaned out by hand each time the vault is opened before the inner lid is dropped.

A very short experience with conduit systems demonstrated the futility of trying to make them water tight, and designers reacted

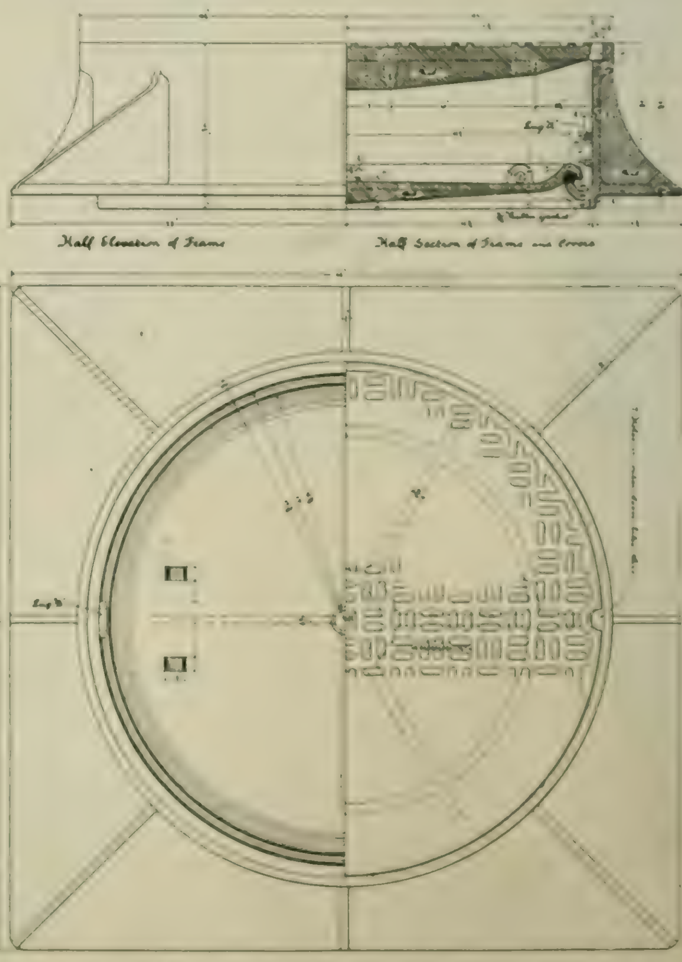


FIG. 34.—CIRCULAR TIGHT MANHOLE COVER, OVERHUNG INNER COVER.

to the other extreme in the endeavor to secure dryness by thorough ventilation. Accordingly, covers were simplified by entirely omitting the inner lid, and in its place hanging a sheet-iron pan in such a manner as to catch any street drainage, as illustrated in Fig. 36; while the traffic cover was pierced with as many holes to permit ventilation, as

strength would permit. The most recent experience indicates that even the pan is superfluous, and present tendencies are in the direction of an exceedingly plain, strong, simplified cover, as shown in Fig. 37.

The prime requisites in the manhole entrance are resistance to street traffic and accessibility to the vault. The round cover is smaller, consequently can be built lighter, cheaper and easier to handle, but access to the vault is much more restricted, the difficulty and cost of cable pulling increased, while the light round traffic cover is quite likely to be dislodged by the blows of passing wheels. In the design of Fig. 37 a lock is supplied to secure the cover in place. As a guard against accident, this is valuable, and probably worth both its original investment and its maintenance cost; but as a protection from malicious interference, it is of little moment, as there is no manhole into which a determined party of strikers, easily arming themselves with picks and shovels, could not quickly effect an entrance, while a small stick of dynamite would open the strongest lock in a moment.

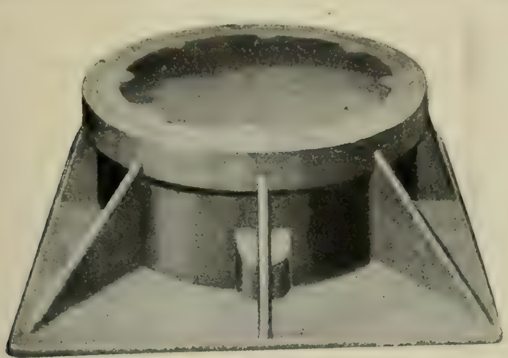


FIG. 35.—CIRCULAR TIGHT MANHOLE COVER, UNDERHUNG INNER COVER.

Occasionally circumstances compel the construction of a water-tight manhole, then the same engineering precautions must be observed as in building a cofferdam or other subaqueous work. The plan of Fig. 38 exemplifies a successful method. The excavation is completely and carefully sheeted with 3-inch by 6-inch tongue, and grooved matched piling, driven closely together, extending at least 4 feet below the manhole bottom. When the excavation is finished, a double wooden floor of matched tongued and grooved 2-inch plank, the seams in each layer laid diagonally to those in the other, fitted around the sheeting, and calked into place with tar and oakum is introduced. On this floor a course of brick masonry 8 inches thick, laid with Flemish bond, is placed about 3 inches inside the sheeting, the intervening spaces being afterwards tamped full of concrete. The chamber thus formed of the wood floor and the brickwork is now lined with at least three layers of the best roofing felt thoroughly asphalted and mopped into place. Six inches of concrete are now deposited upon the bottom, then three more layers of roofing felt applied; next 12 inches of concrete to complete the bottom, on which the interior, and vault walls proper, are built. These should be made of brick masonry 12 inches in thickness, laid up in old English bond. All the mason work must be in neat cement mortar, and all joints thoroughly pointed and calked. In such a manhole, the entrance of the ducts presents the chief difficulty, as it is next to impossible to carry in any of the clay forms and preserve water-proofness. By using iron pipe on either side, flanging the same to the sheeting with roofing felt gaskets, the entrance may be made water-tight.

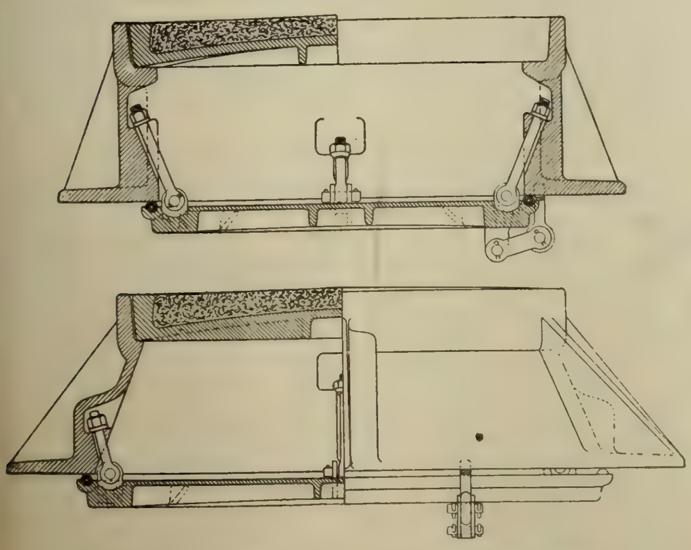


FIG. 35A.—BALTIMORE MANHOLE FRAME AND COVER.

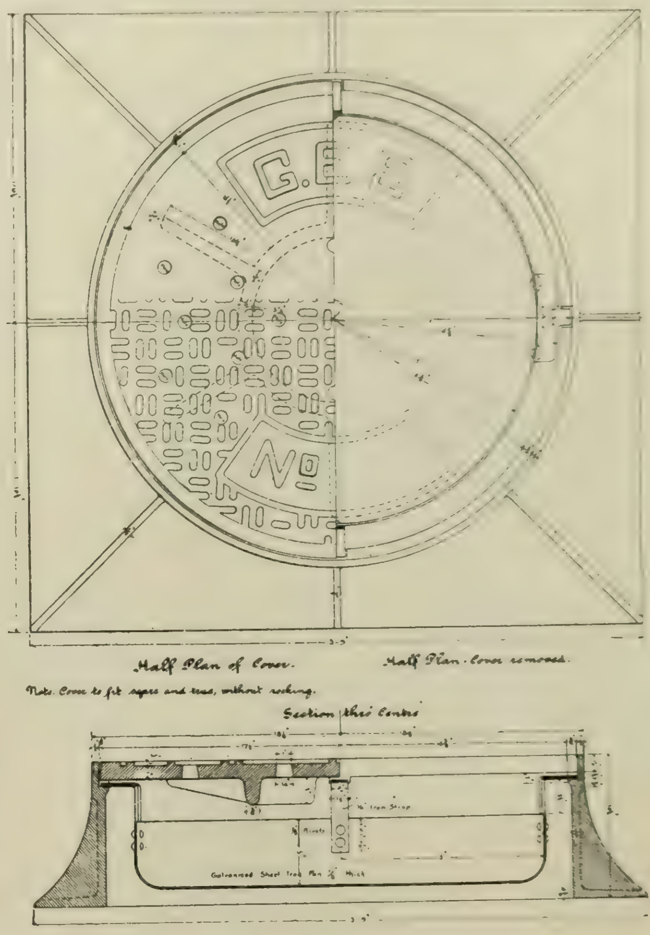


FIG. 36.—OPEN MANHOLE COVER.

SMALL MANHOLES.

The design of manholes so far considered has proceeded upon the assumption of providing space beneath the street surface to allow all of the avocations of cable splicing to be performed. In certain localities where conduit systems are not of great magnitude, where street traffic is not excessive, and where great cheapness is desired, a much smaller and cheaper style of vault may be adopted. Such manholes are provided with large rectangular covers, about 36 inches by 24 inches. The cover frame is made of angle iron joined at the corners with knee braces, and the cover itself of a rectangular angle iron frame filled with hard oak plank. This provides a cover of great lightness, cheapness, and of reasonable durability under the light

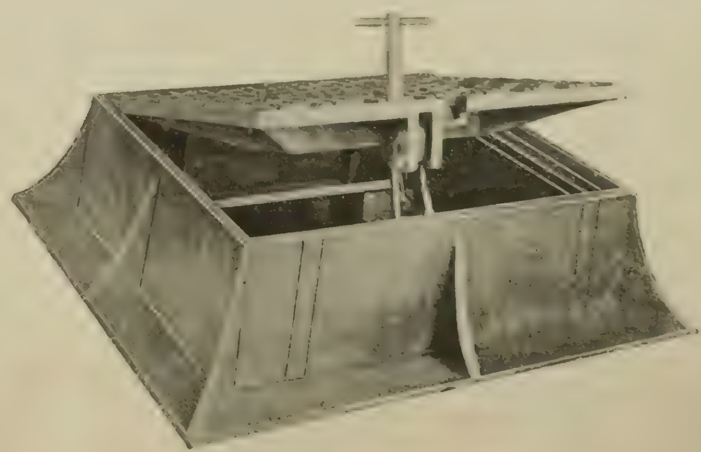


FIG. 37.—SQUARE MANHOLE COVER.

street traffic of cities of 40,000 or less population. The manhole itself may preferably be a brick structure, not over 2 feet in depth, and about 4 feet by 3 feet in plan. Vaults of this description may be constructed either of concrete or brick at pleasure, or even built of 2½-inch matched plank. These manholes are too small to permit of cable splicing inside of them, so cables are drawn into place and spliced in the street by allowing a large U-bend to extend out

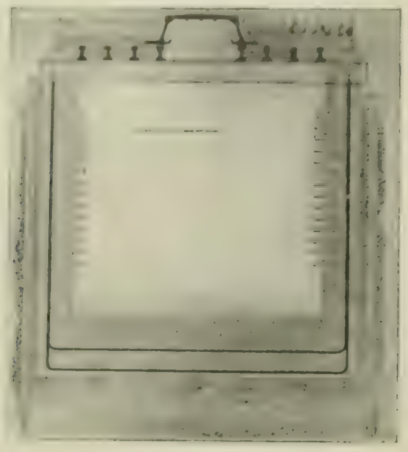


FIG. 38.—WATERPROOF MANHOLE.

of the manhole entrance. After splicing is completed the cables are dropped into place. Such construction is only permissible where a few small-sized cables are used, but becomes desirable in the smaller cities where the underground systems must be constructed with greatest economy, or in the outskirts of larger towns where the systems are rapidly changing.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

CARBORUNDUM ARTICLES.

Mr. Fitzgerald has heretofore described a method of recrystallizing carborundum into definite forms, involving the subjection of the crystals resulting from a previous furnace operation, after molding into suitable shape, to a sufficient temperature to recrystallize the mass.

As is well known, the operation of the carborundum furnaces results in the transformation of the charge, not only into the crystalline carbide of silicon known as carborundum, but in lesser degree into an amorphous carbide, technically known as "white stuff," having a similar chemical composition but quite distinct physical properties. Mr. Frank J. Tone, of Niagara Falls, now patents and assigns to the Carborundum Company, a method which substantially parallels that of Fitzgerald, above referred to, starting, however, with the amorphous instead of the crystalline carbide. As might be expected, the resulting product differs from that of the earlier method chiefly in its lesser apparent specific gravity, or in other words, its greater porosity. This difference is of importance for such uses of the product as subject it to sudden and excessive temperature changes, and fits it especially for use in furnace construction. The degree of porosity may be further increased by mixing with the amorphous carbide of silicon a proportion of the usual charge mixture of sand and carbon, or even by molding the brick or other article entirely from such charge mixture. The articles are conveniently heated by imbedding them in the charge of the usual carborundum furnace, a temporary binder of glue or water glass being added previous to the molding.

OZONIZING APPARATUS.

An ozonizer for which a patent has recently been issued to Alexander Vosmaer, of Haarlem, Netherlands, would seem to represent an approach at least toward the extreme limit of simplicity. The device is without dielectric surfaces or fixed parts, and comprises merely two insulated and self-supporting discharging conductors resting loosely in a conduit, between which and one of the terminals an electric contact may or may not exist. The conduit is conveniently constructed of a section of gas pipe, and the size of the apparatus may be increased to any desired extent by simply assembling a number of sections as in an ordinary surface condenser. The electrodes are given the form rendered familiar by Vosmaer's earlier constructions, in which a series of points constituting the so-called "discharger" oppose a parallel plane surface. As shown in the accompanying cut, a metallic bar, 2, constituting one electrode is fitted with forked insulating standards, 3, 4; a second bar, 5, fitted with the downwardly

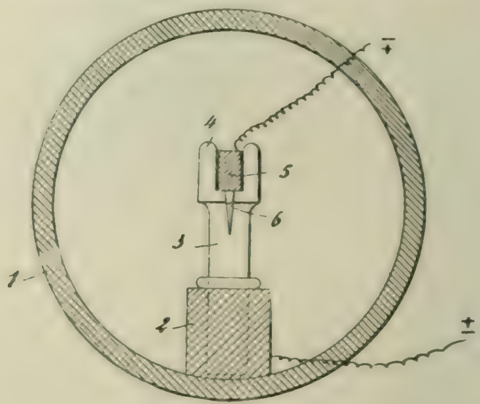


FIG. 1.—VOSMAER OZONIZING APPARATUS.

directed discharging points, 6, rests loosely in the forks of the standards. The two electrodes, so assembled, are placed in the pipe or conduit 1, through which a current of the air or other gas to be treated is caused to flow. An adjustment of distances between the active surfaces is readily effected by an interchange of standards, and either electrode may be replaced with the utmost facility.

SEPARATION OF METALS FROM ORES.

C. E. Dolbear, of Boston, describes, as a method for the direct separation of metals from their ores, the use of a mixed solution of two electrolytes, the one being a solvent for the metal or ore, and the other a suitable electrolyte for the separation of the metal in reguline form. Sulphuric and nitric acids are named, the latter being the solvent. If sulphide ores of copper, for instance, are being treated, the metal is dissolved as a nitrate, converted by the sulphuric acid to a sulphate, and therefrom deposited, the electrolyte reaching a condition of equilibrium beyond which it will suffer only such changes as arise from the foreign components of the ore. There is an especial advantage in conducting the solution as well as the deposition in the electrolytic vat, since the oxides of nitrogen resulting from the reduction of the nitric acid by the metal are continuously reoxidized to nitric acid by oxygen liberated at the insoluble anode. The patent is the property by assignment of the American and Metal Extraction Company, of Boston.

ELECTRODEPOSITION OF COPPER WITH INSOLUBLE ANODES.

An ingenious electrometallurgical method for the treatment of sulphide ores of copper is proposed by M. Constantin Jean Tossizza, of Paris. The copper in such ores is associated with iron and the sulphate solutions obtained by treating the roasted ores with sulphuric acid are unsatisfactory electrolytes: for although copper is more readily deposited than iron, no separation of the metals is practicable with insoluble anodes. Such separation would involve the maintenance of the e. m. f. between terminals at a necessary minimum, whereas the polarization of the anode quickly raises it to a point at which iron also separates. M. Tossizza introduces into the bath in the neighborhood of the anodes, the sulphur dioxide derived from the roasting, thereby reducing the potential difference to the theoretical figure of 0.2 volts, or under practical conditions to 0.6 volts. Obviously the e. m. f. necessary for the separation of iron is reduced in similar proportion, but with effective depolarization such intermediate values may be maintained as will permit the separation of the copper alone.

The relation of this process to the prior art is somewhat peculiar. The method, that is to say, the use of reducing gases, and particularly sulphur dioxide for the depolarization of insoluble anodes in the deposition of copper was described in 1878 by Cobley. The realization that thereby the purity of the separated metal might be

controlled is due to Tossizza, who is, therefore, to be considered as the inventor of the method as applied to ferruginous solutions. On the practical side the process confronts the fact that no thoroughly satisfactory anode material for sulphate solutions is known.

MERCURY CATHODE CELL.

In an electrolytic cell for the production of caustic soda by the deposition of sodium in mercury and its oxidation therefrom by water, the quantity of mercury, and therefore the cost of the cell, is largely controlled by the efficiency of the means employed for promoting the oxidation of the alkali metal. The most efficient, as well as the most economical of all means for accomplishing this end is the employment of a "combining circuit"—such arrangement of terminals that the mercury functions, in part at least, as a bipolar electrode between independent anodes and cathodes located respectively in the decomposing and oxidizing compartments: this principle of operation is known as the Castner-Kellner method.

Many efforts have been made, however, to effect the quick oxidation of mercury by means of local action. The use of metallic fragments floating upon the mercury is less effective than would be supposed, by reason of their tendency to become amalgamated, or at least coated, with the liquid metal; and floating fragments of carbon do not seem to come into effective contact with the amalgam. Messrs. Edser & Wildermann, of London, propose to use carbon and metal together, in the form of composite rods projecting from the base of the caustic compartment through the amalgam and into the superposed caustic solution. These composite rods are preferably of iron and carbon, and may be prepared by producing a partial electrodeposit of iron on carbon pencils, by wrapping carbon pencils with iron wire, or by molding them from a mixture of carbon with iron filings. They may be given the form of rods or plates, and may be applied to rocking or rotating cells of any known type.

As above stated, the function of these elements is to promote local action, and it follows that however effective they may be in promoting oxidation of the alkali metal, their use represents a considerable waste of energy as compared with the employment of a combining circuit in which the electrical energy derived from the oxidation of the sodium is turned into the electrolyzing circuit..

THE FIXATION OF ATMOSPHERIC NITROGEN.

A recent issue of the ELECTRICAL WORLD AND ENGINEER described the Niagara Falls installation of the Atmospheric Products Company for the synthetic production of oxides of nitrogen. In the construction there described the arcs are produced in a high-tension, direct-current circuit, and are most ingeniously maintained, by relatively moving terminals at that minimum amperage which corresponds with the maximum permanent synthetic effect. As stated in the paper referred to, an experimental study has resulted in favor of the direct-current arc. The current patent issue includes, however, a construction assigned to the same company, the patentees being Messrs. Bradley and Lovejoy, in which an alternating arc is applied to the same purpose. While this must be considered, upon the statements of the patentees, as a less efficient form of the device, it is nevertheless of interest as showing a means, devoid of moving parts, for maintaining the arcs at the minimum volume. This is accomplished by permitting the arc to strike across the narrow gap between two divergent terminals, and causing it to travel upward under the influence of the air current until it finally breaks at the point of widest separation of the electrodes. The current used being alternating, individual transformers replace the inductances used with the direct current.

As here figured, the individual combining chambers 1 carry diverging metallic terminals, 5, 6, connected to the secondary, 9, of the coil 9, 10. The air enters at 2, directly beneath the point 7 of closest approach of the terminals, and the product passes through conduits 3, 4, to the absorption tower 14. The coil is imbedded in insulating cement, 26, and the primary and secondary terminals, 30, 27, are so arranged that the act of placing the coil in position closes the circuit on the one hand with the line wires, 32, of the alternating circuit, 11, 12, and on the other with the terminals, 28, of the electrodes. For absorption of the oxides of nitrogen sulphuric acid is employed, and is caused to circulate over an insoluble distributing filling, 15, in the absorption tower, and thence through a cooling chamber, 23, by means of the pump 21. The residual air is withdrawn by the pump 24, while the absorbed oxides of nitrogen are expelled from the acid by heat applied to the vessel 16, to be condensed in the worm 18 and collected in the vessel 20. The use of an acid absorbent offers great economy over the employment of an alkali, since the absorping liquor is not subjected to chemical change. As will be clear from the

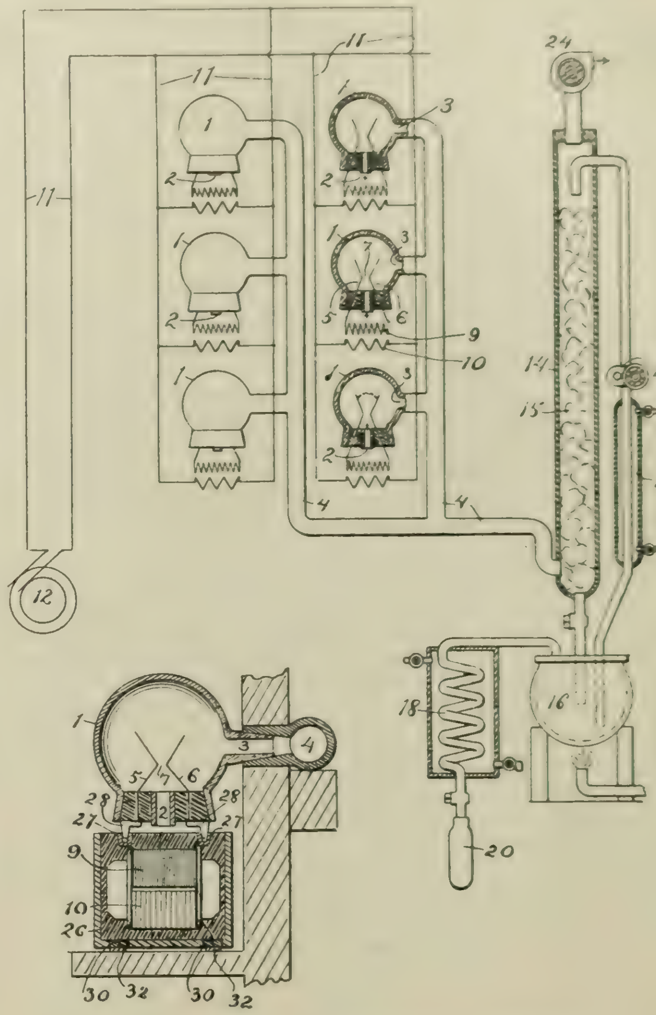


FIG. 2.—FIXATION OF ATMOSPHERIC NITROGEN.

drawings, the successive arcs struck at the point 7 will, under the influence of the upward air current, rise along the electrodes and break at their point of widest separation.

The Point of View.

That it all depends on the point of view is again illustrated by the following paragraph from the New York *Evening Post* of recent date: New Orleans has been enjoying a street-car strike for the last ten days or so. Other cities are inclined to complain and lament when their transit facilities are interfered with by labor disputes, but not so New Orleans. "What a relief it is," cries one enthusiastic newspaper, "that this dear old town of ours should have been suddenly blessed with a Sunday that must have brought back to the older inhabitants the peace of quiet and the Sabbath-keeping of 50 years ago." And further on this same paper says: "When the day was done—and the last note from the church bells had become solvent in the silence of the city, how comforting it was to step to your window and to look out upon and over the wide stretch of houses and to know that in each one of them prayers of thanksgiving were being said for the gracious day-long quiet that had blessed the whole community! How you longed then for the days when the telegraph and the telephone and the trolley were unknown, when even the car rumbled not over the stony street; when men and women made use of the vehicles of locomotion God had given them; when, in a word, man, as well as all other creatures of the Creator, was satisfied to be natural." This, by the way, described the first Sunday of the strike. It would be interesting to know whether a sentiment so sublime has survived the exclusive use since then of the God-given "vehicles of locomotion."

The Installation of Electrical Machinery in the Tropics.

By Chas. H. Hines.

WITH the rapid increase of the work of installing lighting and power plants in countries lying within the tropics, especially during the last five years, and the recent extension by the United States of its sway into such climes, the writer of this article, having been one of the pioneers in this particular line at a time when the field was new and untried, and remembering his own troubles and the lack of any previous knowledge to draw upon, feels that the relation of a few of the peculiar "bugs" that may be expected, may prove interesting and profitable to those who may be called upon to undertake this class of work.

In the early days of this work, it was the usual thing for the South American merchant when he had decided to install an electrical plant, to place the order with his agents in the States in very much the same manner as he would order a consignment of groceries or other goods; and in many cases the agent, only considering how large a commission could be exacted and the cheapness with which he could purchase, bought the plant without any regard to the class or fitness of the material. Finally, at the last moment, he would engage an engineer to go with the outfit, to erect it, and usually his selection of the man was on a par with his selection of the material.

In most cases the engineer arrived at his destination only to find that the machinery ordered was either not adapted to the requirements of the case or wofully lacking in many essential things. This meant many weeks of delay and vexation, and this coupled with his lack of knowledge of the country and customs, rendered his employers only too prone to place the blame upon his shoulders, forgetting the fact that he had not been consulted in the least regarding what had been ordered, and that he would have been entirely unfamiliar with the peculiar necessities involved, even had he been so consulted. At the present day, however, the field has broadened, and in the case of many large power and lighting enterprises the services of skilled consulting engineers are called upon to direct the preliminary work; but it will be found in most of these cases that these enterprises are backed or controlled by American capital, and that the native of the country when left to his own devices still persists in putting the cart before the horse—that is, buying his plant first, and hiring his engineer afterward.

The first and most important thing to be considered in taking up this class of work is a thorough knowledge of the foreign language; for without that the engineer, no matter how great his ability, will find himself sadly handicapped. Even though he may procure the services of an interpreter, he will soon find that he cannot depend upon him to interpret faithfully, and will be led into serious errors owing to mal-interpretation, both as to his work and to differences with his employers. In many cases this occurs through maliciousness due to jealousy or other causes, and is always a constant source of annoyance. I well remember my own first experience, when my knowledge of Spanish was nil, and I used to wander around with a piece of paper on which I had written down the Spanish and English meaning of different tools, etc., forgetting that the pronunciation of the words was most essential. On getting screw-drivers for screws, wrenches for bolts and like mistakes, I would be gravely assured by the dusky workers in my employ that my Spanish was "muy malo"—very bad—and I have no reason to doubt them, judging from the results obtained. Spanish is an easy language to acquire, and should be learned in advance, as the process of learning on the ground is slow, vexatious and costly.

Before sailing, the engineer should always go carefully over the list of materials sent, checking off all articles and being sure that he has everything required to the very nails and screws, for should anything be omitted it may mean weeks of delay, and in any case he will pay dearly for what he has to purchase on the ground, even if obtainable. I well remember on one installation which was to have iron poles made of three sizes of pipe connected together by reducers, and, through error, sufficient reducers were sent for but half the number of poles, being fortunate enough to be able to find them in the town I was under the necessity of paying $4.50 apiece for an article worth about 30 cents in the States.

Arriving at his destination, the engineer will find that his machinery is generally handled in any old way. He must personally supervise the unloading of the same if he wishes to preserve it unbroken, and his ingenuity will be called upon from the start if the plant is located at any distance from the port of disembarkation; as in most instances mules or oxen are the sole means of transportation, and the roads are invariably vile, even in the dry season, and generally impassable during the wet one. I have been three months conveying the heavy castings of generators over a distance of 40 miles. A knowledge of the conditions to be met with in advance is here of great service in regulating the weights of the packages to be handled. It is here also that the first lesson regarding himself must be learned by the engineer, and that is the care of his health. If the place where he is located is unhealthy, and most tropical towns are more or less so, too much care cannot be taken until well acclimated. He should wear a flannel band around the stomach, drink sparingly of water, and that filtered or boiled, avoid much fruit, and always sleep a story or two above the ground, the higher the better, and also keep indoors at night; and above all things, observe the strictest temperance. Right here, let me explode a fallacy that has caused the death of more than one bright man in these countries, and that is the saying that will be repeated by natives and even his own countrymen located there, that "a little liquor is absolutely required in the drinking water," or "drink to keep out the fever germs." This is not only untrue, but the surest way to bring about what he wishes to avoid. I have tried both methods; in one case succumbing to fever within two weeks, and in the other I passed six months in one of the deadliest ports of South America untouched by any disease by practicing strict abstinence.

We will now suppose the engineer on the ground where the plant is to be erected, and ready to begin operations. Now begins the test of his fitness for this class of work, as he finds that he must be in turn surveyor, mason, blacksmith, machinist, boilermaker, engineman, lineman and a few other things, besides being an electrical engineer. The first and greatest trouble to be encountered is labor, and this varies greatly in different countries. I have found the brightest and best men in Central and South America, many of them capable of being taught anything, and generally willing and sober; while the poorest class of labor I have met with has been in Cuba and the West Indies. But wherever found, save in the large cities, they are in most cases ignorant of even the appearance of electrical machinery, and must be taught from the beginning even how to handle tools; and tact and patience of the highest order is required. The motto of the Latin-American workman is, "never do anything to-day that can be possibly put off until to-morrow," and the employer must go slowly in combating this idea lest he incur the hatred of his men—this meaning in some cases his sudden decease. He will learn the word "manana" (to-morrow) until he hates the sound of it, as, no matter what he wants done or how urgent it may be, it will be done "manana." However, patience, and above all a perfect command of temper, will overcome all obstacles in time, and he will find his troubles lessening as his pupils grow more apt. Let him always direct and not try to do it all himself. The saying is in these countries, "If you see one man working and the rest sitting down, the man working is boss, and if you see one man sitting down and the rest working, the man sitting down is boss;" and it is most true in every respect.

In handling and erecting the heavy pieces, the engineer had better personally see every hitch and tie made on all work, as otherwise disaster is sure to follow. This also applies to line construction, until his men become more or less familiar with the work; they will generally spurn "climbers" and work with bare feet and a rope around the waist, but will get there just the same. The matter of insulation must be carefully looked after, owing to the heavy rains and dampness of these climates. All work in this line should be done in the best possible manner, as on this will depend to a great extent the success or failure of the plant, and the higher the voltage carried, the greater the safeguards to be taken. In the matter of poles, galvanized iron is the most reliable, as insects and dampness soon play havoc with the best of wood, and the expense and labor attached to replacing them more than balances the extra cost of the iron ones.

In the matter of stringing wires, the fact of the great expansion during the intense heat of the day and contraction in the almost always cool nights, must be taken into consideration, or trouble will ensue from the start; and above all, the matter of protection from the heavy thunder showers of the tropics must be given the most careful study. The very best arrester obtainable should be employed, and all parts of apparatus liable to injury carried in duplicate, especially armatures, unless the engineer is capable of rewinding the same. Right here let me say that nine-tenths of good engineers are unfamiliar with the practical part of armature and field winding, no

matter how well they may be grounded in the theory and design, yet such knowledge is invaluable in this class of work.

If the prime movers of the plant are wheels or turbines, as in all cases where possible they should be, owing to the high cost of fuel—coal costing in many parts as high as $20 per ton, gold—another factor of trouble must be considered in planning the hydraulic part of the station, and that is the rapid rise that takes place in the streams after a heavy rainfall. I have seen a river from which I derived my power rise 15 feet in as many minutes. Great care must be taken to provide for this, more especially if the work is installed during the dry season, as otherwise the labor of months may be destroyed in a brief hour. In all cases these streams are filled with floating vegetation and drift, causing endless trouble in clogging turbines, breaking gate valves, etc., if not most carefully provided for.

We will now suppose the station completed and everything ready for the start. Let it not be thought that the troubles of the engineer are over; for, on the contrary, they have but begun. He will now appoint his assistants from among the best of the men who have aided him in the construction, and it is now he will encounter fresh troubles. The egotism of the average native is prodigious, and he will at once, on attaining a little knowledge, assume much more, and, if not closely watched, will cause disaster by attempting to do more than he is capable of doing. He will handle the most intricate machinery with a superb disregard of consequences that will make the beholder shudder, and is only too ready to do, not what he is told, but also what he is told not to do. When he has worked a few months, he considers himself a full-fledged "electricista," and resents any further instruction. I well remember an instance which illustrates this fact, in a plant which I had erected, and in which on occasions we were obliged to run our alternators in synchronism. I had a rather bright native acting as station man, and I cautioned him particularly never to attempt to throw his machines together without first calling me, as, owing to several causes, the synchronizing of the machines was a difficult matter. My back was hardly turned, however, when he *did* throw them in without synchronizing, with the result of his leaving by the window route, leaving me with a two weeks' shut-down on my hands. In this connection there is a story which I can well believe of a Mexican who was left in charge of the boiler of his plant, and the superintendent happening in later saw to his horror that the handle of the steam gauge was crowded over against the pin at the far side, while the engineer was still feeding the roaring furnace for all he was worth. As soon as the superintendent could haul the fire and get his breath, he inquired the reason of such proceedings, and the answer was, "Well, what are the figures there for if the steam is not to go to that point?"

There is another side to this matter that has a more or less serious bearing to the seller and manufacturer of the plant, and that is that when the contract of the engineer who erects the plant expires, in nine cases out of ten his employers will either refuse to renew the same or insist on his accepting far less salary. In most instances they have a touch of the same egotism, and think that one of their own countrymen is entirely capable of taking charge at far less money, and the consequence of this idea is, in many cases, the total ruin of the plant, with the fault laid at the door of the makers of the machinery, when it is the fault of the unskilled man who was placed in charge. I have seen in a Mexican city, a fine new plant, with the most approved apparatus, engines, etc., and after a year's run under native management, I have seen the same plant again, its fine machinery rusted and covered with filth and oil, the belting saturated with resin and the whole place a wreck, while the line work had fallen into a condition that not only endangered the plant but the lives of the citizens.

After starting up and getting the plant to running in more or less smooth shape, other troubles may arise, caused by the ignorance or the superstitions of the natives. Lamps are stoned and broken, lines cut or poles uprooted, and for these troubles drastic remedies are needed. The severe punishment of any offender caught will generally have a salutary effect on others. This annoyance is not always confined to the ignorant, however, as in the case of one plant which I erected and where from the start I was bothered by the continual breakage of lamps. I found on doing a little quiet detective work that the chief offender was no other than the cashier of the bank there, who found it "great fun" on his nocturnal rambles to destroy property. A fine of $200, coupled with the threat of a long term of imprisonment for a repetition of the offense, convinced him that this class of fun was an expensive luxury.

In conclusion, I may say that these countries have but just awakened to the necessity of electrical development, and in the near future will be the chief fields of electrical enterprise as they become more developed and opened up by the energetic Anglo-Saxon. At the present time any young engineer who understands his profession and their language, and can interest capital, can find valuable franchises in these countries for almost the asking. The chief trouble that arises to-day is that the salesmen and engineers from America have not made a study of the manners and customs that prevail in these parts, insisting rather that the people should conform to *their* customs. It is through this that the English and the Germans to a large extent control this field. The Latin-American does his business in his own peculiar way, and while it is not our way, yet it will prove vastly more profitable to study this way and meet it, than try to force him to ours. Long credits and a leisurely method in following out an idea is his motto, and our German and English cousins by conforming to his ideas have succeeded, while our men with their "push" and determination to "rush" things have failed through the very thing that has brought them success in other parts. Let them cultivate patience and make a study of the people and their customs and manners, and be willing to devote a month where they are accustomed to spend a week in arranging a sale or a contract; and in the matter of credits and terms, meet the foreign manufacturer on his own ground, and then backed by the superiority of American machinery their reward will be rich and the foothold obtained lasting.

The British Pacific Cable.

A telegram from Vancouver, B. C., of September 21, says: The cableship "Colonia" has laid over 500 miles of the Pacific cable between Vancouver Island, B. C., and Fanning Island. In two weeks the "Colonia" will have paid out all her cable and be within 200 miles of Fanning Island, where she will anchor the end to a buoy. The end will be picked up and spliced by the cableship "Anglia," and the laying completed by that ship, while the "Colonia" will proceed to England to secure the cable for the line between San Francisco and Manila. The "Colonia" is laying 160 miles of cable a day, is traveling at a speed of seven and a half knots, and is in constant communication with the Banfield Creek station on Vancouver Island.

Rapid Transit at the St. Louis Fair.

It will cost $750,000 to construct and equip the rapid transit system upon the World's Fair grounds. The length of the road and its branches will be eight miles, and it will enable the visitors to see the vast exposition with as little fatigue as possible. The problem in planning the intramural road has been to place it where it would not mar the beauty of the exposition. Eminent engineers have been called into consultation and all phases of the project thoroughly studied. It is believed the plan presented by Charles V. Weston, of Chicago, comes nearest to a perfect solution of the difficulty. Owing to the varying altitudes of the exposition grounds the road will be at times an elevated line, and in other parts built at grade or below the surface. The trip on the intramural will be one of the most delightful diversions for visitors to the exposition.

Another Water Power Project in Canada.

The development of the High Falls on the Lievere River, Quebec, about 30 miles from the city of Ottawa, is being projected. There is a drop of 180 feet at the falls, and further drops between the falls and the outlet in the Ottawa River. In all, at lowest water, the Lievere River from its falls to its mouth, can probably produce 50,000 hp of electrical energy, which can be transmitted to Ottawa and other points. Electrical energy, produced by water power, costs in the Ottawa Valley, at present, about $15 per hp per year, while the same amount of power produced by steam costs upwards of $50 per annum, but with the important difference in favor of water that the steam produced power is only for the ordinary working day, while the water produced power is for the whole 24 hours. The Ottawa Valley is a veritable store-house of power. The Rideau, Lievere and Gatineau Rivers; the Chats Falls, Dechenes Rapids and the Chaudiere Falls are destined to make Ottawa the center of a vast supply of electric energy when all these water powers are fully developed.

New Telephone Patents.

In some localities telephone service has not been considered by the public all it should be, all trouble being promptly charged to the operator. This has led many inventors to try to perfect some system in which the much-maligned "central" would be superseded by machinery under the immediate control of the calling subscriber. Lately several such systems have been the subject of letters patent, and the Patent Office issue of September 23 adds two more to the list. One patent (No. 709,739) is issued to Albert W. Bullard, of Somerville, Massachusetts, and the other (No. 709,740) to the same inventor, in conjunction with Malcolm C. Rorty, both patents being assigned to the American Bell Telephone Company.

Each patent covers a separate and practically complete system, both of them being that type of automatic exchange which requires for each subscriber a machine operated electrically and controlled from the subscriber's station, involving a complete multiple of all other lines. As usual with systems of this type, a dial and pointer is provided at each telephone instrument, the pointer being movable over the dial. In addition, the machine at the central office contains an equivalent of this in one or more arms which carry contacts movable over a dial whose divisions are conducting bars, the divisions and numbers on the substation dial corresponding exactly in angular arrangement to the conducting bars and the numbers of their connected subscribers' lines. The method of operation provides that if the pointer is set opposite a given number and the electrical circuit of one or both sides of the line, as the case may be, is then closed, the pointer will return to the normal or zero point, the arms at the central office being synchronously moved forward an exactly equivalent distance so that they will register with the conducting bars of the line whose number on the dial was chosen. In addition to this, means are provided for determining whether the line whose connections is desired is busy, in which case the connection will not be established but a humming signal will be received at the calling station to indicate this fact. When a call is completed, as signified by the return of the receiver to the hook, all conditions are restored to normal by springs properly arranged. As above indicated, the general functions performed by the machines of the two systems are identical, the means by which they are performed, however, differ quite materially.

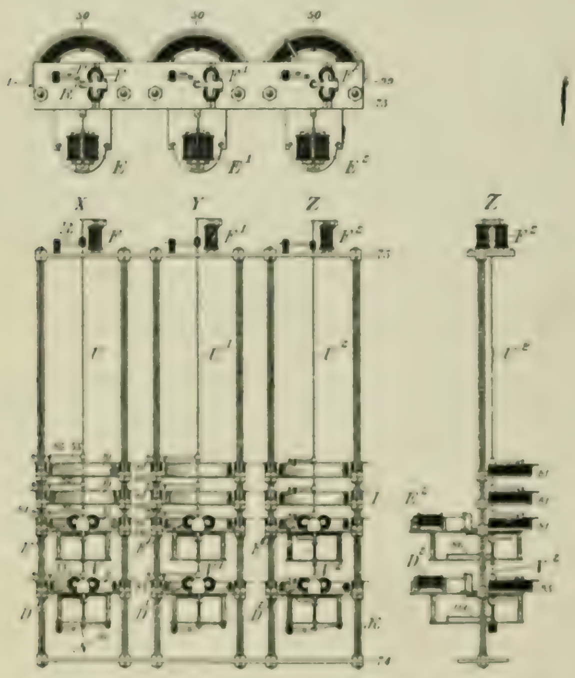


FIG. 1.—CENTRAL OFFICE APPARATUS, BULLARD AUTOMATIC TELEPHONE SYSTEM.

Considering first the system of which Mr Bullard alone is inventor, Fig. 1 shows a plan and two elevations of three central office machines. In the plan view the conductor dials are shown, giving the appearance of combs, which term will be hereinafter applied to them. Four of these combs with the allied revolving arms are shown in each machine, this being due to the fact that provision is made for a large number of subscribers; and in order to keep the parts of practical size, it is though advisable to divide the subscribers' lines into groups of 99, and arrange one group upon a comb. It may be well to mention here that there are but 99 lines per group, because, the inventor states, it is advisable to omit numbers which would involve a zero setting on the dial, on account of the likelihood of one forgetting to make such a setting. In arranging the combs, all conductors of the same number are in the same vertical plane. Similarly, the contact arms are aligned vertically, so that if the upper arm is in contact with the fifth bar of its comb, the fifth bar of every other hundred group will be in contact with its corresponding revolving arm. This contingency is provided for by the use of a hundreds-comb, the lowest in the figure. In addition to the radial bars, every comb is provided with a circular conductor, so placed that the electrical connections are always carried through it, these latter conductors being wired to and controlled by bars of the hundreds conducting comb, placed with exact reference to the hundreds number of their attached combs. This is one of the chief novelties of the invention, and may be more clearly traced out from the circuit shown in Fig. 2, where the combs and arms are shown for convenience, in plan one above the other instead of superimposed.

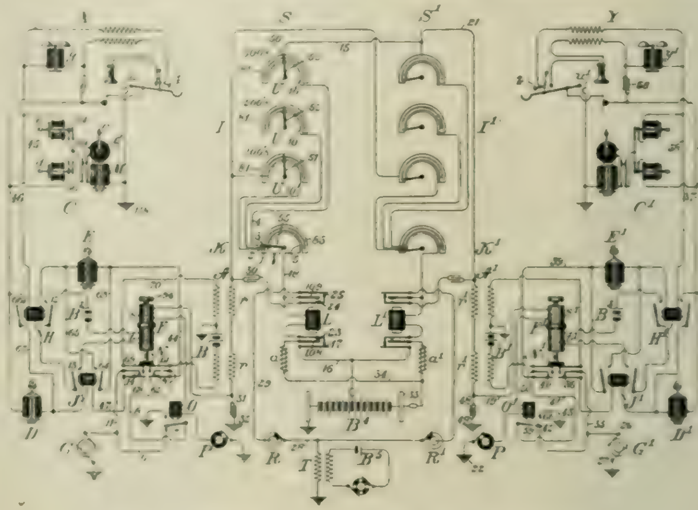


FIG. 2.—DIAGRAM OF CIRCUITS, BULLARD SYSTEM.

The subscriber's station dial, together with the internal mechanisms, are well shown in Fig. 3, the apparatus being given in diagrammatic form in the circuit drawing, Fig. 2. It will be noticed, a single dial is provided, the numbers on which are from 1 to 99; but two push buttons *d* and *e* are shown below the dial, and it is these buttons, which, after the dials have been set, start its motion and determine whether the "hundreds" or "tens and units" mechanism at the central office shall follow the movements of the pointer.

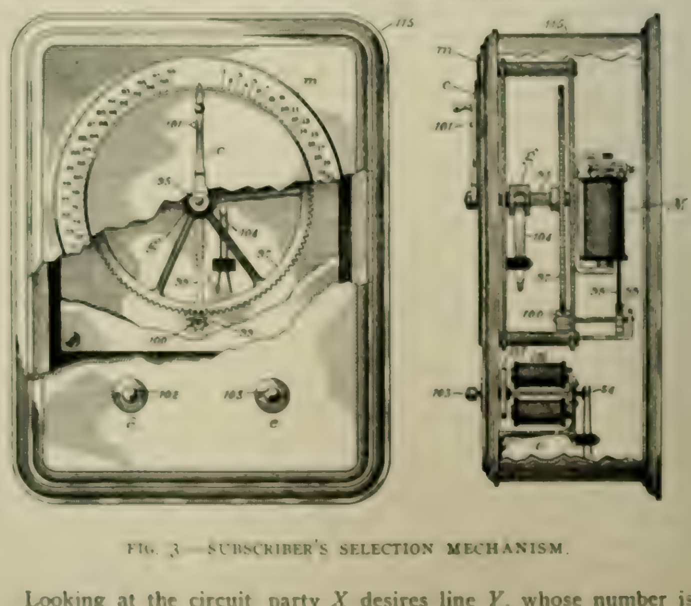


FIG. 3.—SUBSCRIBER'S SELECTION MECHANISM.

Looking at the circuit, party *X* desires line *Y*, whose number is shown as 350. *X* first divides this number into two parts, 3-50, and sets his pointer at 3, then pushing button *d*. It is seen that button *d* closes a contact in series with the coils of its own magnetic clutch and also in series with a contact 104, which is closed except when the

dial pointer is exactly in its stopped or normal position. Thus when *X* depresses *d*, a current passes from the alternating-current generator *G*, through contacts *N*, relay *S*, magnet *D*, line wire 46; through key *d*, contact 104 and magnet *M* to ground. This locks *d*. It also operates relay *J*, which, however, is not at this time significant. In addition to this it energizes magnets *D* and *M*, which are polarized and whose armatures are arranged exactly similar to a polarized bell.

The effect of the alternating current is, therefore, to vibrate in synchronism the armatures of *D* and *M*, which armatures are geared through the agency of escapements, respectively, to the arm of the hundreds comb and to the dial pointer, with the result that the pointer is returned to the stop position, when the circuit is opened, while the arm is advanced to its third conducting bar. The arms of the units and tens combs do not at this time move, as the shaft is divided between the hundreds and next higher comb, and the independent rotating magnet *E* is provided for its upper portion. *X* next proceeds to send in the number 50 through the agency of button *e*, which controls apparatus on the side of the line marked 45; and by means of polarized magnet *E* the units and tens arms are brought above the conducting bars, 50

Up to this time no actual contacts at the combs have been made, for the rotating arms clear the conducting bars until depressed by the next operation, which is the removal of the telephone from the hook switch at station *X*. As the hook switch ascends, it makes a transient contact at *u* to ground just after closing contact *z*, with a result that current from *G* passes out both sides of the line, at the same instant operating relays *J* and *H* simultaneously. This not only operates the magnet *F*, and its associated switch *N*, but depresses the revolving arms so that their contacts engage the conducting bars and circular contact strips. Relays *H* and *J* also short-circuit the polarized magnets *D* and *E*, but even then there is likelihood that the armatures of these latter have made one or two vibrations moving the arms out of register with the comb bars. This, however, is rendered of no effect, as the escapements are so geared to the pointer and contact arm shafts that a considerable number of vibrations of the armatures is necessary for appreciable displacement of them; and as a further precaution, the contact springs of the arms are flared at the tips, so as to be in a measure self-centering.

Now is the time for the machine to discriminate between a busy and free line, and this is accomplished by relay *L*, which is wired through its contacts to the middle of the battery *B* (*B*, *B1*, *B2*, etc., all being one and the same battery), and to the hundreds comb, which has just been connected to bar 350 or *Y's* line. If *Y* is busy, he may have called some one or may have been called. In either case, the relay *L* will be between equi-potential points, and will fail to operate, but will send out to *X* from its back contacts a hum, repeated from the interrupter near *B5*. In case *Y* is not busy, relay *L* operates through a circuit involving *Y's* repeating coil, *N1* and relay *O1* thereby removing one side of *Y's* line from generator *G*, and so grounding it that the bell at station *Y* will be rung by the currents from generator *G*. *Y's* answering operates exactly as for *X*, the magnet *F1* stops the ringing and completes the connection.

To the system of Messrs. Rorty and Bullard, in conjunction, much of the foregoing description of apparatus applies, except that but one comb is used for all subscribers, the total number contemplated in one exchange being small. In this case the motor mechanism of the machine operates by direct battery in synchronism with a make-and-break device, operated by the dial pointer. This system is adapted for use wtih party lines rung on the code system, and thus the electrical circuit from end to end of a completed connection must be continuous without the intervention of repeating coils. Furthermore, as with party lines it is essential to have a subscriber listen to ascertain that the line is free before starting a call, all circuits are arranged so that the removal of the receiver from the hook is the first requisite of calling. The action of selection hinges upon the action of the peculiar relay *R*, which is shown diagrammatically in Fig. 4. This relay has two armatures controlling independent contacts, and two windings, the whole so arranged that while the armature *h*, will operate quickly, and, therefore, follow the impulses of the circuit breaker at the station, the armature *g* will only respond after the current is steady, the dial pointer having come to rest.

In this system, as in the foregoing, the busy signal is a hum or buzz in the receiver, the busy test and non-interference features being controlled by the differential relay with windings *z* and *r*. Normally, the comb-conducting bars, *v*, *v*, are free from battery, but when a connection is established these are so involved as to be supplied with current from the battery. Thus from the circuit (Fig. 4), in case the line *Y* is free, but one coil, *z*, receives current, and the relay operates; but if *Y* is busy both relay coils receive current and the relay fails, the busy tone being supplied to *X* through the back contacts.

Among the most novel features is the ability to call from one station on a line to a second and be secure from interruption from an outside call for the line which is well provided for. The existence of parties on one's own line having the same code ring as the desired party on another line has been taken care of by the combined effects of grounded ringing current thrown on either side of the

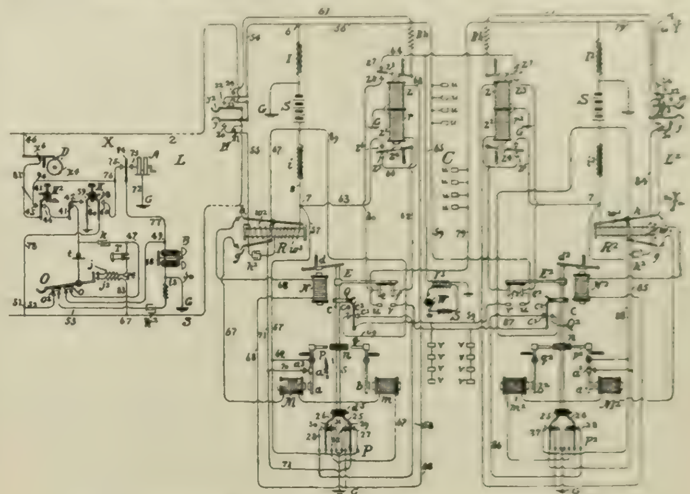


FIG. 4.—DIAGRAM OF CONNECTIONS, BULLARD AND RORTY AUTOMATIC TELEPHONE SYSTEM.

line by suitable keys, and the complete reversal of the line at the central office before connection is completed.

From the detail patent drawings it would seem that the machines and station apparatus are well worked out for both these inventions, so that wiring and adjustments can be made easily accessible, the latter and, in fact, the whole machine being of fairly simple construction. Moreover, the keys, relays and magnets have the appearance of conforming closely to standard telephone practice, a quality often wanting in inventions of this kind. From the standpoint of maintenance, both systems also appeal to one in eliminating the continual wear of the contacts of the lower numbers, which is a property of so many previous systems of this type.

Electrical Method of Framing Glass.

We recently printed an account of a patent granted to H. W. Scattergood on a process for an electro deposited framing for stained glass windows as a substitute for the usual lead frame. In a patent granted September 30 to the same inventor, further details connected with the application of the process are given. The design of the object is first produced on thin paper, on which are then stuck the pieces of glass by means of a suitable adhesive, spaces being left between the various pieces of glass and between the design as a whole and strips of wax or other non-conducting material laid around the same. A curve of considerably greater height than that of the highest piece in the design is then placed around the whole, and the various spaces filled with some substance, such as starch in the form of paste, which is capable of being dissolved or washed out of the spaces. The object is then covered with sand to the top of the curb, a board placed thereon and clamped to the lower board upon which the design is laid. The whole is then reversed, the former bottom board removed, the paper stripped or washed off, and the substance in the spaces metallized by the application of a suitable metallic powder, which is then painted over with fluid wax, which in turn is backed with molten wax. This forms the backing during the remainder of the operation. The curbs and supporting boards are then removed together with the sand and temporary filling in the spaces, and the whole object exposed to the action of an electrolytic bath. The electro deposition proceeds until a frame is formed of sufficient thickness and rigidity to support the constituent pieces of the object when removed from the backing. It is claimed that the pouring of the wax on the constituent pieces makes a perfect contact with these pieces and prevents the spreading of the deposition under these pieces and leaves only the spaces to receive the deposition.

CURRENT NEWS AND NOTES.

CHICAGO ELECTRICAL ASSOCIATION.—Mr. Edward W. Jewell, president of the Jewell Electrical Instrument Company, gave an illustrated lecture on "the History of Electrical Measuring Instruments and Some Novel Uses of Them," on the evening of October 3. His discourse was devoted mainly to the Duprez-D'Arsonval type of direct-current instrument now used in commercial portable work.

STREET SIGNS.—A patent granted September 16 to J. W. Lieb, Jr., and J. H. Tyler relates to the illumination of street signs by means of incandescent lamps, replacing the steadying resistance in street arc lamps. At present such resistance serves no useful purpose, but according to the patent will be employed in lighting incandescent lamps, which latter may be arranged in a sign lantern supported on the post which carries the arc lamp.

AMERICANIZED STRIKE IN EUROPE.—Even in the methods of conducting strikes European countries are becoming Americanized. In a recent dispatch to the London *Daily Express* from Geneva, Switzerland, riotous scenes are described in connection with a tramway strike in that city, which was brought about, it is stated, by economies effected by the manager of the line, who is an American. A mob filled the streets and prevented the cars from running. They attempted to overturn cars that were manned by non-strikers, and a number of shots were fired. Motors were damaged and the overhead lines were cut. The police are inclined to side with the strikers, whose cry is "Down with the Americans."

STARTING ROTARY CONVERTERS.—Two patents were issued September 30 to B. G. Lamme on a method of starting rotary converters by means of direct current, the voltage of which is less than the normal voltage of the system to be supplied by the machine, but which is more than one-half such voltage. In the case of converters in a distant substation, the e. m. f. there may be materially below the normal voltage, and in starting up the insertion of a resistance to prevent a rush of current from the alternating to the direct-current circuit will prevent the conventer from attaining the desired voltage and speed unless some special disposition is employed, and the patent relates to such a disposition. In the case of a three-phase converter, three star-connected balance coils are employed, which by means of switches may have their outer terminals connected to the collector rings, and the common terminal of the balance coil by means of a switch may be connected to the direct-current line. With full resistance in, the motor is first started in the usual way, and when it has reached the speed due to this condition, the balancing coils are thrown into the circuit, the resistance remaining. The conditions with the balancing coils are then those of half the normal voltage of the converter; the speed is, therefore, increased, and at synchronism the coils are cut out and the normal connection made to the alternating-current circuit.

ELECTRICAL APPARATUS FOR COALING AT SEA.—Two patents, granted September 30 to H. W. Leonard, relate to a method of coaling at sea, which employs the well-known Ward Leonard method of control. Rigged on one of the vessels is a sheave looped, in which is a carrying line, whose two ends are secured to two drums on the other vessel. These drums are connected to two dynamo-electric machines, one of which operates as a motor when the other operates as a generator. The armatures of these machines are in parallel with the source of current supply, and the fields are separately excited. In operation, the machine connected to the taking-up drum acts as a motor, and the machine connected to the drum paying out acts as a generator. When the tension on the cables varies, the loads on the drums will vary accordingly, resulting in a corresponding variation of the counter e. m. f. of the machines, with the result that the machine operating as a motor will automatically take a greater or less amount of energy, producing a corresponding variation of torque and speed; while the machine driven as a generator by the moving cable will produce a greater or less amount of energy, according to the speed of the cable; the result being that the drums pay out the cable faster or slower, according to the variation in tension produced by the rolling or pitching of the vessels. By this arrangement a given tension may always be automatically maintained on the hauling line.

ELECTRICAL STEERING GEAR.—An interesting form of electrical steering gear forms the subject of a patent granted, September 30, to M. W. Day, the principle of which is closely allied to that of the steam steering gear. The arrangement consists of a motor geared to the rudder and supplied with current from a generator having two field-windings wound in opposite directions and two rheostats controlling the supply of current to these windings, one rheostat being controllable by the steering-wheel and the other being mechanically connected to the motor. When both rheostat-arms stand in the same position, the two field-windings are energized by equal currents, and as they oppose each other no current will be generated and the motor will remain at rest; but if the steering-wheel is moved, thereby shifting one rheostat-arm and causing a different current to flow through one field-winding from that in the other, the resulting differential field will generate a current which will start the motor and cause it to shift the rudder and at the same time swing its rheostat-arm until the field-winding connected therewith receives the same current as the other, when the generator-current will cease and the motor will stop. It is evident that this system can be applied to other objects, such as working signals, turrets, train control apparatus and the like.

LETTERS TO THE EDITORS.

Motors in Steel Works.

To the Editors of Electrical World and Engineer:

Sirs.—Your reference in the issue of your paper of September 27 to a paper by Mr. R. M. Darlen, on "Motors in Steel Works," is interesting. His remarks against motors are amusing to one intimately associated with such work.

The writer knows of one steel plant where the motors in service aggregate 8,000 to 9,000 horse-power, and where their use is only limited by the slow rate of extending the station capacity. The work done by these motors covers every step of the process from unloading the ore from boats to the final loading of the finished product on cars; with the single exception of the large roll trains. Even the operation of roll trains by motor power is contemplated in some of the lighter sections.

Usually, power may be obtained very cheaply in the vicinity of blast furnaces, as only a fraction of the waste gases are required to furnish steam for the large blowing engines.

SOUTH CHICAGO, ILL. WM. T. DEAN.

The Effect of Electric Waves on the Human Brain.

To the Editors of Electrical World and Engineer:

Sirs.—The nature of Messrs. McIntosh and Willmore's letter relating to the above subject in your paper of August 23, appears so inconsistent with their first attack on my experiments and so extraordinary from a psychological viewpoint that I feel called upon to affirm and reiterate some of my former statements as well as to deny several of theirs.

First, I reaffirm a "full description of the apparatus they employed would form a unique chapter in wireless." I reaffirm that electric waves acting on cellular matter of the brain cause particles of it to carbonize. I reaffirm that the apparatus I employed was a hundred times more sensitive than theirs, and I reaffirm that the apparatus I described, including a telephone receiver, renders the effect of electric waves on the human brain audible.

Again, I affirm with them, that I am "doubtless aware that brain matter is a complex substance, et cetera." I affirm that Messrs McIntosh and Willmore are unjustified in trying to determine by mind-reading or guessing, a clue to anything I did *not* say, and in this, as in trying to repeat my experiments, they failed utterly. The clue to my reasoning will be found in what I have written.

Further, I affirm, in the citation "of a case where a man was *beheaded* with a wet towel," their theory is far-fetched, their reasoning erratic and their belief in suggestion marvelous. Admitting that the man died when struck, I reiterate vigorously that unless the blow broke his neck, death was a mere coincidence, and that at the same instant several other men in different parts of the world died and several children were born, and that if a thousand men were operated upon similarly not one would forfeit his life through fear; and I

affirm, too, that many more persons have died from the effects of anæsthetics through the lack of operative skill of practicing surgeons than Messrs. McIntosh and Willmore can show by the record to have died, supposedly from fear.

In conclusion, I deny that these gentlemen disclaim any wish to enter into a controversy, their letters proving the contrary. I deny that the brain substance conducts electrolytically although the cerebral-spinal fluid that surrounds it does; but in these experiments we are dealing with the brain proper and not the solution forming the environs. I must again deny that my method for detecting electric waves was as defective as theirs, for I produced results where they failed. I deny that with apparatus the size they confess to having employed, successful tests could possibly have been made in an ordinary room, and I deny that any instrument too crude to show the deflection of a needle during the tests is "more decisive" than an instrument of the acknowledged sensitivity of the telephone or any other which will give calculations—regardless of whether these are obtained visually or audibly. Their statements are inconsistent when they say they "failed to detect any change of resistance of the brain," and in a few lines below add that "the coherer effect did not amount to one-tenth of one per cent.," and again when they say, "we are inclined to doubt that this (the coherer effect) can be satisfactorily explained by electrostatic stresses in the intervening dielectric." Their explanation of how a storm a hundred miles away may develop or accentuate pathological conditions by the external sensations of light and sound is not plausible.

Until Messrs. McIntosh and Willmore have elucidated their ideas more consistently and described their apparatus fully, I shall deny that they have a case or have proven or disproven anything.

New York City. A. Frederick Collins.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Heyland Machine.—Heyland.—A very long and well illustrated paper read before the International Society of Electricians, in Paris, on self-exciting alternators of the induction type. The paper does not seem to contain anything that has not been noticed before in the Digest. A very long discussion followed the paper. Boucherot expressed the opinion that the Heyland and Latour machines are of the same type; the resistance, placed by Heyland between the commutator segments, do not make an essential difference, although they may be effective in suppressing sparks at the commutator and change the current flowing through the brushes. Concerning the practical prospects he is somewhat skeptical; for motors he thinks that the gain does not warrant the sacrifice in the simplicity of construction of the ordinary induction motor; for generators the prospects may be better, but experience only can settle this question. Latour explained with the aid of diagrams the action of his machine and made some remarks on the relation between his and Heyland's machine. Janet, Korda and Rey discussed briefly some details. Heyland emphasized that the tests of his motor had clearly shown that his motor is essentially an inductive motor, which is not the case with the Latour motor; he believes, however, that Latour will be able to build good machines without sparks at the brushes, if he follows strictly the modern principles of direct-current dynamo design.—*Bull. Soc. Int. des Elec.*, July.

Transformers for Electrochemical Work.—Peck.—A long, illustrated article in which he discusses the special features of the design of transformers for electrochemical purposes which generally must be capable of delivering extremely heavy secondary currents at widely varying voltages, and which shall have a construction sufficiently rugged to stand excessive overloads for short periods and to operate 24 hours per day without deterioration. He discusses especially the various methods of changing the secondary voltage, the primary voltage being constant. These methods may be divided into two classes: either the ratio between the primary and secondary turns is changed, or an auxiliary transformer is placed in the primary or secondary circuit of the transformer, the auxiliary transformer having a variable voltage ratio, the voltage of which may be added to or subtracted from that of the main transformer. The various possible arrangements are described and illustrated by diagrams.—*Electrochem. Ind.*, September.

Transformers.—An illustrated description of transformers made by the Burnand Transformer Company. A special feature is that the coils are of triangular cross-section, and are on four sides of an iron square built up on stampings. It is claimed that the advantage of this lies in the large surface exposed, the small radial depth of coil, and the shortness of the electrical circuit, without increase in the length of the magnetic circuit. The insulation consists of micanite simply placed round the core and winding, like a postal wrapper, the edges of the insulation projecting well beyond the windings. Movement of the windings sideways on the insulation is prevented by the mutual support between the triangular coils inside the iron square. Every layer is visible after the coil is completed. In case of injury, while in use, any section of the transformer can be replaced, apparently by hand winding, without disturbing any other section.—Lond. *Elec.*, September 19.

Three-Phase Generator.—Some data and diagrams of 500-kw, three-phase generators, ten of which will be installed in a new station near Naples. They are the largest dynamos that have been built in Italy; the number of revolutions per minute is 92.5, and the frequency 40 periods per second. The diameter of the armature is 6.018 m., and the length is 20 cm. The star e. m. f. is 5,000 volts. At normal load the current in each phase is 33 amperes. The magnet system, which serves also as a flywheel, has 52 poles.—*Elek. Zeit.*, September 4.

Lights and Lighting.

Direct-Current Arc with Large Currents.—Rey.—A long illustrated paper read before the International Society of Electricians, in Paris. It is an account of experiments made by Blondel and Rey with direct-current arcs, using more than 25 amperes, such are used in practice for searchlights and similar purposes; the results are given in tables and diagrams, and the two main results are as follows: The intrinsic photometric brightness of the crater of an arc, operated in free air, increases with the current density in the positive carbon. In a series of carbons with different diameters, held at the same temperature by the passage of the current, the current density in the positive carbon varies in inverse ratio with the square root of its diameter.—*Bull. Soc. Int. des Elec.*, July.

Power.

Electric Power in a Paper Mill.—An illustrated description of the electric power installation of the Linwood paper mills in Renfrewshire, N. B. There are two 300-kw, 200-volt, direct-current dynamos. The motor equipment consists of eight 80-hp motors, two of 50-hp and three of 25-hp each. Six of the 80-hp motors drive the beating machine; owing to the sudden and sometimes excessive variation of the load of these machines, it was thought advisable to adopt a belt-drive, and this has proved quite successful. The large calenders are driven by 80-hp motors. The rolls of the calender have to be adapted to suit the various thicknesses of the paper, and the speed has also to be regulated in accordance with the nature of the paper and the degree of finish or surface necessary. To meet these requirements, the calender motors are of the variable speed type, being designed to run at from 100 to 600 r. p. m. A speed of 100 r. p. m. is necessary only for starting the machine, and from 300 to 600 r. p. m. is the average range. The variation can be regulated by the shunts, the loss being negligible, particularly when compared with the wasteful working of the steam engines formerly used. A number of the motors in the mills are geared up to the various machines. After a series of experiments it was decided to use pinions made of paper; these pinions are composed of specially manufactured paper, discs being cut from the web and built up like an armature core; the paper discs forming the pinion are bound together by iron hoods or caps. One of these wheels, about 12 inches diameter, which has been work-

ing into an ordinary spur wheel for the last three years, has given no trouble whatever, and is still in good order. Besides the well-known other advantages of electric driving, the saving in coal alone on this plant will pay off the first costs in about five years.—Lond. *Elec. Rev.*, September 12.

Electric Driving of Machinery.—BROADBENT.—An article in which he recommends studying all the conditions carefully before deciding any question of motor driving. Electricity generated by steam power must necessarily be dearer, at the generator, than the steam power itself. It is only in the method of transmission and application that electricity scores; only by getting it directly to the tool or machine, avoiding all unnecessary losses in transit. The ease with which subdivision of electric power can be accomplished, and the ability to connect a motor directly to the machine, not only permits great economies to be effected, but gives such a complete control over individual machines that the output or turnover can be also greatly augmented with little or no addition to standing charges. Subdivision is carried to its highest point in printing plants and in general in plants with machines whch are frequently and suddenly stopped. Concerning regulation, he recommends winding the motor for the maximum power at the middle speed, and speed up by shunt regulation and down by "series regulation." To avoid sparking, it is necessary in order to obtain the best results, to use compound-wound motors for this class of work; the series winding should produce from 20 to 30 per cent. of the total field, the precise amount depending with a varying load, but for most purposes this is unimportant.—Lond. *Elec. Rev.*, September 12.

Small Single-Phase Motors for Factory Driving.—Brief illustrated descriptions of installations of small single-phase motors for power purposes in a tobacco factory and in bakeries. In a tobacco factory there are six motors installed varying from 1 to 3 hp, and running at 1,400 revolutions at 110 volts, the frequency being 50. In a bakery, five motors of [illegible] to 3 hp are installed, running at 2,800 revolutions, the voltage being 110, the frequency 50. The running cost appears from the data of another bakery as follows: Working week, 44½ hours; price of energy, 4 cents per kw-hour; one 16-hp motor driving biscuit plant and one 10-hp motor driving mixing machines, consumed 106 units per week, costing $4.40; one 4-hp, one 6-hp and one 1-hp motor, driving hoists and spice machines, consumed 70 units per week, costing $2.90; two 4-hp motors, driving dough and cake machines, and one 1-hp motor, driving a biscuit brake, consumed 70 units per week, costing $3.30.—Lond. *Elec. Rev.*, September 12.

Swiss Water Power Installation.—BIGNAMI.—An illustrated description of the hydro-electric station at Hagneck, which contains five 8,000-volt, three-phase generators. The voltage of the alternators is regulated separately for each machine by interposing variable resistances in the field circuit of the corresponding exciters. A special device allows simultaneous mánipulation of the rheostats of all the machines. The voltage can also be changed by manipulating a rheostat in the field of the shunt exciter which feeds the principal exciters. The various localities served by the system take from it about 1,500 kw for motor service, and about 950 kw for lighting. In order to improve the load curve, a carbide factory has been erected which is able to use energy to the extent of 2,400-hp.—*Elec. Rev.*, September 13.

REFERENCE.

Water Power and Electrochemical Industries.—JOHNSON.—A communication in which he points out that the prospects of electrochemical industries are very bright on account of the large amounts of power being now available at several conveniently located hydraulic installations at very low prices for electrochemical industries. There is also an editorial on the subject in which some statistical data are given.—*Electrochem. Ind.*, September.

Electric Power Plants.—Nearly the whole issue is filled with illustrated descriptions of electric plants for power purposes. Besides the articles which are abstracted elsewhere in the Digest, there are descriptions of electric power installations in a Clyde shipyard, in a coal mine near Manchester, in an engineering and boiler-making plant in Paisley, in a lard refinery in Manchester, in a Bedford manufacturing plant; also articles on the Kalgoorlie electric power and lighting system in Australia, the electric power, light and welding installation at the New Pimlico wheel works, on high pressure oil-break switches, on electric power from blast furnace gas, new power switchboards at the City Road Works in London, the hydro-electric power plant at St. Maurice in Switzerland.—Lond. *Elec. Rev.*, September 12.

Three-Phase Plant in a Welsh Lead Mine.—An illustrated description of the 2,500-volt, three-phase power installation of the Frongoch mine. During the summer months a steam engine drives the generator, while from September to May sufficient water power is available. There are used two 50-hp, two 85-hp and one 35-hp induction motor. About 10-kw is used for lighting.—Lond. *Elec. Rev.*, September 12.

TRACTION.

Tramcar Brakes.—A long editorial referring to a recent accident in Glasgow, and discussing the problem of brakes for tramcars. In England the hand wheel brake is generally supplemented with slipper brakes. The advantage of the latter over the former is due to the fact that the coefficient of friction between wood and iron is greater than between iron and iron. The slipper brake is recommended for four-wheel cars. But when the profile of the line is such as to make the working of hand brakes, both wheel and slipper, exhausting to the motorman, power brakes should be used; on bogie truck cars, power brakes should always be fitted. The electric brake gives excellent service; it has the great advantage that the wheels automatically release when the braking power is sufficient to skid them. It also responds in a measure to another requirement of a good brake, namely that the power applied should diminish with the speed. The objection to the electric brake is that it requires careful inspection and considerable keep-up, and the further objection that the motors become generators during the braking period, and so do not get the chance to cool that they would otherwise have. In practice, this means that the motor capacity, where electric brakes are used, must be at least 20 per cent. in excess of what it otherwise would be. The air brake for tramway service is coming into quite general use in the United States and in continental Europe; it is recommended to work an air pump placed on the car by means of an electric motor which is automatic in its action, so that when the pressure in the tanks falls below a given amount, the motor is started and continues running until it is automatically cut off when the pressure reaches the desired amount; the principal objection to this method appears to be the first cost. It is best practice to use power brakes regularly and the hand brakes only as a reserve. Motormen should be fully trained in handling the brakes.—Lond. *Elec.*, September 12.

An "All-Station Express."—BROWN.—An abstract of a British association paper, in which he proposes the following system of electric express railways. He contemplates an express train running without a single stop from end to end of the line. In order to serve intermediate stations, it is proposed that, on the approach of an express to any one of these stations, passengers desirous of joining the express should enter a railway carriage standing still at the platform, on the same track as that on which the train is approaching. The system of traction being electrical, the guard on this stationary carriage, on the near approach of the express, will start the carriage in motion in the same direction as the express is moving, gradually getting up speed. In time the express will catch up to the single carriage, and coming into contact without a jolt, will be automatically coupled to it. This operation is to be operated at every station. Means are, moreover, provided by which a passenger on the trains may alight at any desired station, for the rear coach on the train is detached and brought to a standstill as each station is passed. A working model of this railway was exhibited. Prof. Perry described his own invention in this form of railroading, in one modification of which the station platforms are made to spin round until they have the same velocity as the passing train; passengers merely step from platform to train.—Lond. *Elec.*, September 19.

REFERENCE.

Automobiles.—An illustrated description of several electrically-propelled motor cars of English make.—Lond. *Elec.*, September 19.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Maintenance of Direct-Current Motors.—MAYES.—An article on the up-keep of the direct-current motor and its accessories. The most serious and frequent causes of trouble are overheating of the armature winding with consequent destruction of the insulation, and failure in the field coils. To avoid overheating of the armature winding, proper fuses should be used; and he points out that there are five principal factors governing the carrying capacity of a fuse:

its cross-section, the nature of the metal used, length between the terminals, mass of metal contained in the terminals, and to a small degree the temperature of the surrounding atmosphere. If all these factors are properly taken into account, the fuse can be made a reliable apparatus, and the actual time and current limit can become definite known quantities. Concerning the failure of the field coils, he considers that dampness is mostly responsible; hence motors should be placed in a dry situation, and if this is not possible, the whole of the field coils should be treated with hot paraffin, applied preferably in the process of manufacture. He also gives some brief notes on the maintenance of brushes and commutators and on the main starting switch.—Lond. *Elec. Rev.*, September 12.

Electro-Chemistry and Batteries.

Electric Resistivity of Steel and Pure Iron.—Benedicks.—An account of tests of steel made in the electric furnace in Gyringe. This steel is very homogeneous and free from gases. He found that chemically equivalent quantities of different materials, dissolved in iron, increase the electric resistivity by the same amount; this is correct, for *C, Si,* and *Mn*; according to Wedding also for *P*; according to Le Chatelier also for *Wo,* and according to Barrett, Brown and Hadfield also for *Al*. One dissolved (gram) atom per 100 (gram) atoms of solution, increases the resistivity by 5.9 microhms for a cubic centimeter, which is in agreement with the measurements of Le Chatelier. Carbide in iron has no appreciable influence. The resistivity of absolutely pure iron at ordinary temperature is 7.6 microhms for a cubic centimeter.—*Zeit. f. Phys. Chem.*, v. 40, 5; abstracted in *Elek. Zeit.*, September 11.

Gaseous Discharge in a Rotating Magnetic Field.—Chabot.—An account of an experiment which is an extension of Leher's experiment with a conductor in a rotating magnetic field, a vacuum discharge being in this case substituted for the wire. The magnet used was a bell electromagnet, and against its central piece was mounted a vacuum tube so that the magnetic field between the center and the circumference of the bell magnet traversed the tube radially. The current thread in the vacuum tube revolved about the magnet pole in the usual manner, as discovered by Ampere, making about one revolution per second. The magnet and tube were then set in rotation about a vertical axis, the connections being kept up by means of sliding contacts, and it was noticed that the rotation had a well-marked influence upon the magnetic rotation of the current thread, contrary to what was the case with the wire. The rate of rotation was sensibly accelerated by mechanical rotation in the same sense, and retarded or even reversed by a mechanical rotation in the opposite sense. On suddenly reversing the direction of rotation, it was noticed that the portions of the discharge nearest the electrodes changed first, and that the middle portion was dragged round apparently with reluctance. No induced currents produced by the alteration of the rotation were noticed.—*Phys. Zeit.*, September 1; abstracted in Lond. *Elec.*, September 12.

Absorption of Projected Electrons.—Seitz.—An account of an investigation of the fact that the absorption of cathode rays by thin metallic plates decreases when the discharge potential, *i. e.*, the velocity of the projected electrons, is increased. The coefficient of absorption is inversely proportional to the fifth power of the velocity, or to the 2.5th power of the difference of potential.—*Phys. Zeit.*, September 1; abstracted in Lond. *Elec.*, September 12.

Cathode Fall.—Baker.—An account of an investigation of the cathode fall and ultra-violet light. The cathode fall of potential or negative drop, is the difference of potential between the cathode and the outer limit of the dark cathode space. According to Stark's theory, the normal cathode fall represents the ionizing energy of the positive ions, and varies with the gas and the metal, as well as with other circumstances. It is small in the case of the chemically active metals, as these have a great "catalytic" power upon the formation of free positive ions. The present author has endeavored to produce some effect upon the cathode drop by using a polished zinc plate, as in photo-electric experiments, and illuminating it with ultra-violet light. He found that the ultra-violet light produced no effect upon the negative drop, nor did the change of current amount to one-half of a per cent. But a marked effect was produced in the potential required to start the discharge; in a case quoted, the reduction was from 558 to 510 volts; the effect was due to an action upon the cathode, and not to a volume ionization of the gas.—*Proc. Cambridge Phil. Soc.*, Easter, 1902; abstracted in Lond. *Elec.*, September 12.

Ionization of Solutions.—Cunningham.—An [illegible] of experiments in which he attempted to ionize solutions by ultra-violet light and Röntgen rays, but with a negative result. Such an ionization would shed some light on the disposal of the energy [illegible] by a substance with an absorption spectrum. He experimented with Carey Lea's solution of collodial silver and various other solutions. No distinct increase of conductivity, apart from the temperature effect, was obtained with ultra-violet light. With Röntgen rays, however, he obtained a distinct though small effect in a solution of Hoffmann's violet, in a dilute solution of collodial silver, and in an ammoniacal solution of silver chloride. No effect was found in uranyl or silver nitrate.—*Proc. Cambridge Phil. Soc.*, Easter, 1902; abstracted in Lond. *Elec.*, September 12.

Electro-Physics and Magnetism.

Concentration Cells.—Carhart.—An abstract of an A. A. A. S. paper, in which he gives a thermoelectric theory of concentration cells. A concentration cell may be considered as a device for converting the heat of the surroundings into electrical energy. He has also found the law that the thermo-electromotive force increases with the concentration of the solution; hence the thermoelectric forces on the two sides of a concentration cell do not balance each other, and the difference is the electromotive force of the concentration cell. This law is also applied to the theory of the Daniell cell, and is shown to explain some facts concerning it. There is also an editorial, giving a review of the development of the theory of the galvanic cell in general and of the concentration cell in particular.—*Electrochem. Ind.*, September.

Ionic Velocities in Liquid Ammonia Solutions.—Franklin and Cary.—An account of measurements of the electric conductivity of salts dissolved in liquid ammonia, which show that such solutions carry the current with remarkable facility, surpassing in this respect even aqueous solutions. There is a rapid increase in the molecular conductivity with dilutions up to a final high value, which is interpreted as meaning that in the more concentrated solutions the salts are dissociated to a much smaller degree in ammonia than in water, and that to complete the dissociation in ammonia solutions the dilution must be carried much higher than in the case of aqueous solutions. If liquid ammonia solutions are to meet the requirements of the theory of electrolytic dissociation, it is necessary to assume that the ions in this solvent travel at a much greater speed than they do in aqueous solutions. He has measured directly the ionic speeds in liquid ammonia at 33° C., the results showing that these speeds are indeed about three times the speeds in aqueous solutions at 18 degrees.—*Electrochem. Ind.*, September.

Aluminum Alloys.—Wilson.—A British association paper on the electrical conductivity of certain aluminum alloys as affected by exposure to the London atmosphere. The specimens are in the form of wire, 0.126 in (3.2 mm.) diameter, supported on a wooden frame; they were exposed on the roof of a building for 13 months. It is assumed that the observed effects are principally due to pitting at the surface, but exposure might also affect the structure. The position of aluminum in the electrochemical series with respect to the other substances used is as follows: *Al Mn, Zn, Fe, Ni, Cu, Si.* It should be expected that copper, widely separated as it is, would be effective in the production of corrosion. This is found to be the case, the effect increasing with the percentage of copper. Nickel is well separated from aluminum in the series, and alone has considerable effect, but if alloyed with copper the conductivity increased slightly during exposures. This specimen is specially promising, as it has a breaking load of 45,900 lbs. and limit of elasticity 36,600 lbs. per square inch. It has a comparatively low percentage extension, a high coefficient of expansion, and a low temperature coefficient for electric resistance. Again, iron in the presence of nickel has slightly increased conductivity. The results of the analysis of the different experiments before and after exposure are given in a table. For exposed light, aluminum alloys it appears that copper alone should not be used in the alloy; the presence of equal amounts (about one per cent.) of nickel and copper certainly reduces conductivity by a small extent, but the increase in mechanical and the decrease in corrosive properties is great.—Lond. *Elec.*, September 19.

Graphite Electrodes in Electrolytic Work.—Collins.—An article in which he first gives a summary of the results obtained by tests of the relative value of graphite and other forms of electrode material in various lines of electrolytic work, concerning the chemical properties and the corrosion of the electrodes; as well known, graph-

ite is generally much superior to other forms of carbon. He points out that graphite shows also a decided superiority in its adaptability to machinery, its purity, high electric conductivity and other physical characteristics. Graphite electrodes can be machined with the greatest ease; several practical forms of electrodes are described and illustrated.—*Electrochem. Ind.*, September.

Resistance Furnace with Platinum Foil.—Haagn.—A German Bunsen Society paper on electric furnaces for laboratory purposes, made by Heraeus with platinum foil of 0.007 mm. thickness. The furnace is said to be very easily adjustable, by insertion and variation of a series resistance. The tubes on which the platinum foil is mounted are best made of china or glass; magnesia is not suitable for high temperatures, as it begins to become a good electrolytic conductor. He has obtained a temperature of 1,700 degrees for a short time; the china then gets soft; the furnace can be made for any voltage up to 220; lower voltages are better for very high temperatures. In the discussion Heraeus said that he has succeeded in making a non-electric furnace in which temperatures up to 2,200 degrees can be produced; he uses for this purpose an iridium tube, which is placed in a suitable way in a line furnace; it is heated by means of an oxyhydrogen flame. The temperature was measured by means of a thermocell, consisting of wire of absolutely pure iridium against an alloy of 90 per cent. of iridium with 10 per cent. of ruthenium; this cell was compared up to 1,650 degrees with a thermocell calibrated by the Reichsanstalt, and the higher values were "calculated."—*Zeit. f. Elektrochemie*, July 31.

A Principle of the Design of Galvanic Cells.—The first of a series of articles on electrochemical theories, illustrated by examples from practice. The following experiment of Oswald is discussed. Well amalgamated zinc does not dissolve in a solution of sulphuric acid, but it does if in contact with platinum. If a vessel with two compartments is used, separated from each other by a porous condition, a zinc rod and a platinum wire being placed in the two compartments, respectively, and being connected together outside, then the question arises to which compartment acid is to be added in order to start the dissolution of zinc. The experiment shows that the acid must be added to the platinum compartment, which is somewhat unexpected. The explanation of this fact is shown to give a general principle of the design of galvanic cells, as the above arrangement represents an electrochemical system. The question is first discussed which chemical reactions can represent an electrochemical system, and the answer is: only those in which there is a change of valency, *i. e.*, in which there is oxidation and reduction, but not, for instance, equations which represent double decomposition. In order that by a chemical reaction of the former class, chemical energy is really changed into useful electrical energy, it is further necessary that the material to be reduced is at the cathode and that to be oxidized at the anode: if they are brought together directly, heat is developed instead of electrical energy. In Oswald's experiment the zinc is to be oxidized and the hydrogen is to be reduced from the sulphuric acid, hence the sulphuric acid is to be added to the platinum compartment. This principle is applied to the explanation of several commercial galvanic cells.—*Electrochem. Ind.*, September.

REFERENCES.

Niagara as an Electrochemical Center.—Richards.—The first part of a very long and well-illustrated article on the electrochemical industries of Niagara Falls. The installations of the plants are described, and the process used are explained in detail. The present part deals with the power houses and the following electrochemical plants: Castner Electrolytic Alkali Company, Niagara Electrochemical Company, Norton Emery Wheel Company, United Barium Company, Oldburg Chemical Company, Ampere Electrochemical Company, Electrical Lead Reduction Company, Roberts Chemical Company, A. J. Rossi, National Electrolytic Company, Atmospheric Products Company, and Union Carbide Company. The article is to be concluded.—*Electrochem. Ind.*, September.

Electrolysis of Sodium Chloride.—Townsend.—An article in which he discusses the influence of diffusion in the electrolysis of sodium chloride. For the production of caustic and of chlorine the essential point is to keep these products apart, and to permit the accumulation of the caustic to a reasonable concentration, yet to prevent so far as may be its movement by diffusion into the anode solution. He gives an outline of and discusses critically, the different methods used for this purpose which may be divided into the following classes: diaphragm cells, gravity cells, and the use of a liquid metal cathode to absorb the sodium as separated.—*Electrochem. Ind.*, September.

Electrochemical Oxidation.—Elbs.—A brief German Bunsen Society paper on the electrochemical preparation of $(NH_4)_2 Pb Cl_6$ using a carbon and a lead anode simultaneously. The general principle of thus using two different anodes, one being non-polarizable and soluble, while the other is inert—can be applied for many purposes.—*Zeit. f. Electrochemie*, July 31.

Atomic Theory.—Divers.—A note on his presidential address to the chemical section of the British Association, on "the atomic theory without hypothesis." His aim is to show how "the exposition of even advanced chemistry, in its symbolic, equally as in its ordinary language and nomenclature, is independent of any hypothesis as to the mechanically and chemically differentiated structure of substances, and that chemistry can be studied and still further developed without reference to such a structure."—Lond. *Elec.*, September 19.

Cuprous Ions.—Bodlaender.—A brief German Bunsen Society paper on the chemistry of cuprous compounds. Among other things he found that the cuprous ions are monatomic, not diatomic.—*Zeit. f. Elektrochemie*, July 31.

Education of Electrochemists.—Burgess.—An abstract of a paper on electrochemistry as an engineering course. A knowledge of the properties of materials of construction and of the transformations, distributions and utilization of various forms of energy is essential for an electrochemical engineer, and such knowledge can best be obtained in an engineering course, conducted along much the same lines that are followed in electrical mechanical or other engineering courses.—*Electrochem. Ind.*, September.

A New Electrochemical Journal.—The publication of a new journal, entitled "Electrochemical Industry," has been begun; it is published monthly in Philadelphia; it is the first journal on this subject in the United States, and the second published in the English language. It is to be devoted to both the industrial and the scientific interest. The articles in the present issue, which contains 42 pages of reading matter, are all original, and of a high order of merit; they are or will be abstracted under their respective headings in the Digest. The regular departments, besides correspondences, book reviews, trade and personal notes, include the following: An analysis of the U. S. electrochemical patents of the month, a synopsis of articles in other journals by Carl Hering, being similar to the Digest but containing longer abstracts; reports of meetings of societies; and a digest of U. S. electrochemical patents prior to July, 1902, by E. A. Byrnes and C. P. Townsend. The editor is E. F. Roeber.

Units, Measurements and Instruments.

REFERENCES.

Measurements of Power in Alternating-Current Circuits.—Rhodes.—An illustrated article in which he describes the following three methods: the three voltmeter method, the three ammeter method, and the split dynamometer method.—Lond. *Elec. Rev.*, September 5.

Oscillograph.—Durand.—An illustrated description of a recent type of the Blondel oscillograph. One of the main improvements is the use of a vibrating band in place of an iron strip mounted on pivots, which was not entirely satisfactory, especially for high rates of vibration.—*Elec. Rev.*, September 13.

Telegraphy, Telephony and Signals.

REFERENCES.

Wireless Telegraphy.—Turpain.—A long illustrated article describing recent experiments made by Ferrie and Tissot.—*L'Eclairage Elec.*, August 23, September 6.

Wireless Telegraphy.—An illustrated description of the principles and instruments of the Slaby-Arco system.—*Elec. Rev.*, September 27.

Berlin.—Arendt.—An illustrated description of the Telephone Exchange III in Berlin, which is designed to ultimately connect 14,000 subscribers.—*Elek. Zeit.*, August 10, 14.

Miscellaneous.

Engineering Education.—Perry.—The conclusion of his address, the first part of which was recently abstracted in the Digest. All boys of fifteen ought to possess three powers: To use books and to enjoy reading; to use mathematics and to enjoy its use; to study nature sympathetically. The main study in the college should be in the laboratory, where every student should make quantitative experi-

ments; he does not recommend large and elaborate machines for students' laboratories. The difficulty about all laboratory exercise work is that of finding demonstrators and assistants who are wise and energetic. In an electrical engineering laboratory the elementary principles are made part of a pupil's mental machinery by many quantitative experiments. The cry for technical education is simply a protest against the existence of unskilled labor of all kinds. "There is far too much unskilled labor among workmen and foremen and managers, and especially in owners. There may be some kinds of manufacture so standardized that everything goes like a wound-up clock, and no thought is needed anywhere; but certainly it is not in any branch of engineering. Many engineering things may be standardized, but not the engineer himself. Millions of money may build up trusts, but they will be wasted if the unskilled labor of mere clerks is expected to take the place of the thoughtful skilled labor of owners and managers." He strongly urges a reform of engineering education in England.—Lond. *Elec.*, September 19.

Electric Currents in Plants.—Ries.—An account of experiments relating to Waller's observation that if a leaf is placed on a glass plate between zinc electrodes, and one-half of it is illuminated, while the other half is wound with black paper; then an electric current passes from the illuminated portion of the dark portion, especially under the red rays which are absorbed by chlorophyll. Waller believes this current to be due to a direct photo-electric action of the light upon the leaf. The present author gives a number of reasons for believing that it is a photochemical current of a non-physiological nature. In the first place, it is not necessary that the leaves be green to show the effect. Furthermore, no current is indicated when the electrodes themselves are covered. The effect also depends upon the material of the electrodes. When copper or silver electrodes are substituted for the zinc electrodes the current is reversed, and it is greatly reduced by carefully cleaning the electrodes. The effect is practically the same when the electrodes are dipped into the juice of the leaves instead of being in contact with them. He believes the phenomenon to be identical with the photochemical currents observed by Hankel, Schmidt and others, and to be mainly due to the sodium, potassium and calcium compounds contained in the plants. The effect is enhanced by chlorophyll, just as it is by a variety of other dies and pigments.—*Phys. Zeit.*, August 15; abstracted in Lond. *Elec.*, September 19.

REFERENCES.

Volcanoes and Electricity.—Boehm-Raffay.—An article on the electric phenomena during the eruption of Mount Pelee on Martinique.—*Zeit. f. Elek.*, September 7.

Biographical.—The beginning of a series of biographical sketches of pioneers in electrochemistry. The present one gives an account of the life and work of C. M. Hall, with portrait, the inventor of the Hall aluminum process.—*Electrochem. Ind.*, September.

New Book.

Self-Propelled Vehicles. A Practical Treatise on the Theory, Construction, Operation, Care and Management of all Forms of Automobiles. By James E. Homans, A .M. New York: Theo. Audel & Company. 632 pages, 466 illustrations. Price. $5.00.

This volume is advertised as being intended for owners, operators, repair men and intending purchasers of automobiles, and certainly forms the best treatise of this nature that has so far been issued. It might have been added with perfect justice that it would be found of interest to manufacturers of self-propelled vehicles as well, as there are probably but few of them who could read it through without finding some hints of practical value. It is gratifying to be able to record that the book shows no evidence of being the compilation of trade catalogues that has been so glaringly noticeable in other volumes on the subject. It is true that when a purchaser is making his final decision it is convenient to have assembled at one point a complete description of any given machine, but this is the function of a trade catalogue.

The chapters on the theory of steering and turning automobiles are exceedingly good, and sure to clear up many points that perplex amateurs. That on speed changing and reverse gears for gasoline cars is also commendable as explaining a subject of which the average person has but little idea.

While the chapters on electrical vehicles are hardly up to the standard of the rest of the book, the author must nevertheless be complimented on his success in setting forth in simple language the fundamental principles. His illustration of torque of a motor is particularly happy.

Of course the book is by no means perfect. In one portion, for instance, the author advocates blowing out the gauge glass on a steam machine by opening a drain cock at its lower end, something that is impossible with almost all steam vehicles, as they are provided with self-closing valves, which would shut under these conditions, and it is very easy to forget to reopen them afterward. A certain type of boiler is very favorably mentioned without a warning being inserted, calling attention to the fact that it cannot be drained, and is hence very liable to burst in winter. The diagrammatic symbol used for an electric condenser is also anything but conventional.

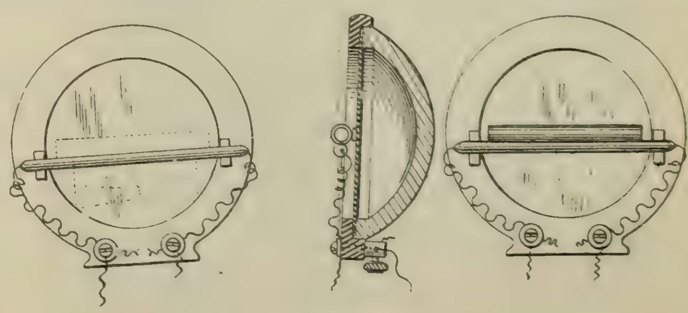
Some of the "freaks" included might well have been left out, so far as their intrinsic merit goes; but, after all, in future years a book like this will serve a further purpose for consultation from the historical standpoint. The automobile art is advancing so rapidly, it seems probable that few of the best types herein described can long survive as exemplars. We note that all the types of vehicles shown are for pleasure or passenger traffic. Our own idea is that some of the very best electrical work has been done on industrial vehicles, and that when electricity comes to its own, it will be found very prominent in doing much of the heavy work still left to that anachronism of modern city life, the horse.

While the press work is good, the illustrations as a rule are very poor indeed, and detract from the otherwise handsome appearance of the volume.

Gally Telephone Transmitter.

In our issue of December 7, 1901, we noticed briefly two telephone patents, granted November 26, 1901, to Merritt Gally, well known as an inventor, particularly in telegraphy. The subject of the patents is a form of telephone transmitter differing widely from the usual types. This transmitter is now being shown in operation at offices in the Fulton Building, corner Fulton and Nassau Streets, New York, and we give below a description in fuller detail.

There is nothing in the transmitter corresponding to the electrodes in the ordinary type. Instead of electrodes and loose particles of carbon, the circuit is completed through a solid piece of high-resistance conductor, such as carbon, which is attached to the back of the diaphragm mounting, without touching the diaphragm. Loosely resting upon this high-resistance conductor, and having no electrical connection therewith other than the contact due to its own weight, is a short piece of a better conductor, such as metal, which shunts more or less current around the higher resistance of the poor conductor, according to the nature of the contact. The vibrations of



GALLY TELEPHONE.

the diaphragm, due to the sound waves, are communicated to the loose conductor by means of two projections extending from the back of the diaphragm. The motion of the loose conductor upon the fixed one causes variations in the contact, and consequently in the current, which flows as usual through the primary of an induction coil.

The sensitiveness of this transmitter is very great. With one cell of dry battery it transmits the faintest whisper in a very perfect manner, and a faint watch tick quite distinctly. On the other hand, it is impossible to scream into the transmitter loudly enough to break or mar the transmission. Conversation in a low tone of voice in any part of the room where the transmitter is situated can be distinctly heard in the receiver in an adjoining room.

From one point of view this transmitter is a return to first principles; that is, there is only one loose piece, as in the Hughes micro-

phones and localizing arrangements. The [illegible] is however [illegible] considerably lower than with the usual transmitters, and there is a fundamental difference between Mr. Gally's invention and other transmitters, namely that it works by more or less completely short-circuiting a fixed resistance placed in the main circuit, other transmitters varying the main circuit resistance directly. The accompanying cuts show the construction so clearly that further description is unnecessary.

"Ceco" Electrical Machinery.

The Christensen Engineering Company, Milwaukee, has just placed upon the market complete new lines of "Ceco" electrical machinery, including direct-current motors and generators, alternators and transformers.

For several years this company has been manufacturing electric motors for driving air compressors used in connection with the well-known Christensen air-brake equipments on electric cars. More than 6,000 of these motors are in highly satisfactory service throughout the world. The company has also built a large number of motors of various capacities for driving air compressors used in general commercial service, and all the motors for driving machine tools and shafting in their own works.

In order to manufacture these motors the company has maintained an extensive equipment particularly suited to the purpose. Some time ago it was decided to greatly increase the company's manufacturing facilities and to develop a complete line of electrical machinery of the highest grade.

The policy of the Christensen Engineering Company has always been not to place any apparatus upon the market until the entire work of development has been satisfactorily completed. The high reputation and remarkable success of the air-brake apparatus are largely due to this policy. Therefore, the company has made no announcement regarding its electrical apparatus until the various lines were completely developed and severely tested and the company considers that the results have proved that these machines are in design, construction and performance worthy of the high reputation now accorded to the Christensen air-brake equipments. The company is now prepared to build machines up to 1,200 kw in capacity suitable for general power, railway or lighting service.

FIG. 1.—MOTOR YOKE.

The line of "Ceco" motors known as "Type C. E." ranging in capacity from 1 to 50 hp. is illustrated herewith. These motors are made in three styles, open, semi-enclosed and enclosed. The standard styles are suited for any motor can be geared or direct connected to the driven machine or shaft. The C. E. motors are for general service in industrial establishments of every kind where a high-grade, durable and reliable machine is required.

The frame or magnet yoke to which the poles are secured is cylindrical in shape. It is composed of a single steel casting. The bearing brackets are secured to the frame by bolts. The terminals are mounted on top of the frame, where they are not liable to be accidently touched, but where they are readily accessible in case it is desired to change the connections in order to reverse the direction of the motor. The two bearings are supported by two end brackets which are identical and interchangeable so that the motor is symmetrical and pleasing in appearance. The semi-enclosed style is the same as the open, but with the addition of four perforated malleable iron cover plates. The plates fit into the four open spaces between the arms of the end brackets, and can be quickly and easily removed or replaced. The enclosed style is the same as the semi-enclosed except that the cover plates are solid instead of perforated. Either style of cover plates will fit into the open-style motor, consequently the same motor may be used as open, semi-enclosed or enclosed.

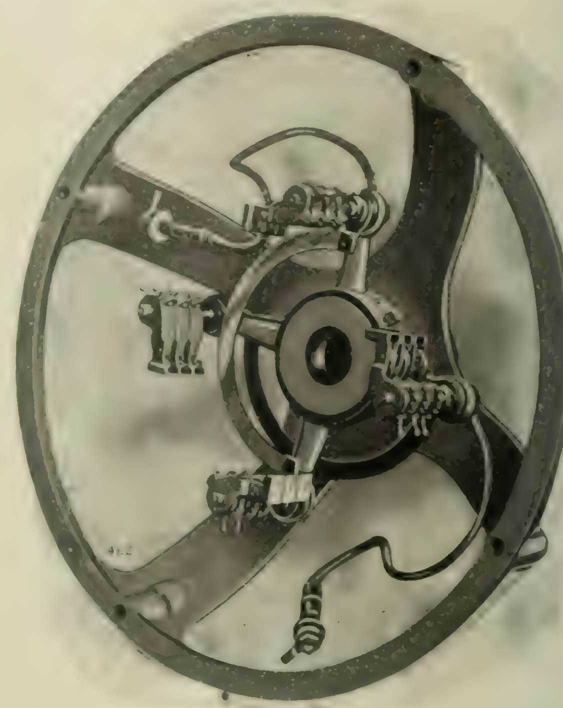


FIG. 2.—MOTOR BEARING BRACKET AND BRUSH HOLDER.

FIG. 3.—MOTOR ARMATURE.

The field poles are built of laminated sheet steel, thereby avoiding eddy current losses. The larger machines have four poles, and the smaller sizes are built with two only, thus permitting the use of a commutator that can be insulated far more satisfactorily than is possible in small machines of the usual four-pole construction. The poles are bolted to the yoke so that a rigid construction is obtained, and the pole is easily removable without disturbing the armature.

The field winding is composed of machine-formed coils, accurately wound by automatic machinery. Any field coil can be readily and

quickly removed without disturbing the armature by simply withdrawing the pole as explained above. The armature core is built up of punched discs of soft sheet steel, slotted around the periphery to receive the armature winding. These discs are reannealed and insulated after being punched, before assembling. The shape of the punching is such, that when assembled on the steel shaft openings are

FIG. 4.—MOTOR POLE PIECE.

FIG. 5.—MOTOR FIELD COIL.

provided for ventilation parallel to the shaft. Additional ventilation is secured by the use of radial air ducts.

The armature coils are all machine wound. Those for the smaller motors are of wire, while those for the larger sizes are composed of copper bars. The coils are all carefuly insulated, then dipped into a bath of special insulating compound, and finally placed in a drying oven until they are thoroughly baked. Surface bands are used to retain the coils in the slots on the smaller sizes, while the same result is secured in larger sizes by the use of retaining wedges placed in specially provided notches near the top of each slot.

As the core and poles are constructed of soft laminated steel, it is evident that the magnetic circuit which consists of these three elements, is of the highest permeability and the efficiency of the motor is, therefore, correspondingly increased.

The commutator is built up of copper segments insulated from each other by sheets of the highest grade of mica, of hardness corresponding to that of the copper, so that a smooth and even wearing surface is presented to the brushes. Pure hard-drawn lake copper is used. The segments are of generous length and depth, insuring cool running, and allowing ample margin for wear. The commutator is easily removable from the armature shaft, tapped holes being pro-

FIG. 6.—"CECO" MOTOR.

vided in the face of the commutator sleeve for that purpose. As the commutator is usually the cause of more trouble than all other parts of a motor combined, unusual care has been given to the design and construction of this important element of "Ceco" motors.

Carbon brushes are used, and the brush holders are of the Christensen Company's coil spring, reaction type. They are very simple in design, and absolutely reliable in operation. The brush holder studs to which the holders are secured are mounted upon a yoke, which is fastened to the inner side of the bearing bracket. Each brush can be readily adjusted, and any brush can be quickly and easily removed while the motor is running. The brush contact area is in all cases ample for the current to be commutated, the current density being very low and at the same time consistent with economical design. Wear of the commutator is provided for by radial adjustment of the brush-holder studs. After the brushes are properly set no shifting is required, and the motor operates without noise and without sparking.

The bearing surfaces are generous in area. Self-aligning, babbited bearings with the well-known self-oiling ring arrangements are provided. The motors are mounted on a cast-iron sub-base, which is composed of a single casting, thus insuring perfect alignment. Belt tension is accomplished by moving the motor upon the sub-base in the usual manner.

The ventilation of the armature and commutator is remarkably good, thus insuring a low temperature while running continuously. The "Ceco" motors will operate at their rated loads without the temperature of the armatures rising more than 30° C. The rise in temperature of the field coils under these conditions will not exceed 40° C. and of the commutator 45° C. These machines will operate from no load to full load with the brushes in a fixed position without sparking. They will also operate for two hours with 25 per cent. overload, and for two or three minutes with 50 per cent. overload without injurious heating or sparking.

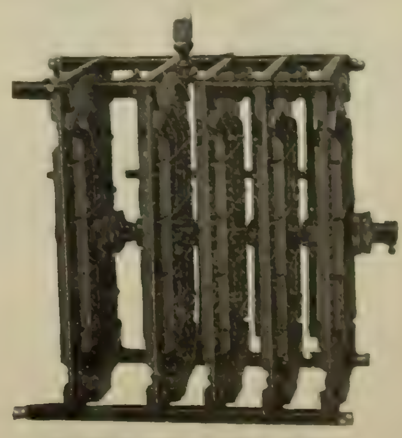
These motors will operate in any position in which the shaft is horizontal. This is accomplished by shifting the bearing brackets on the frame so that the oil chambers remain in the proper position, whether the motor is secured to the floor, the ceiling or the side wall.

FIG. 7.—ENCLOSED "CECO" MOTOR.

A rigid system has been established for the inspection of the parts of each machine while under construction, and there is no poor material or workmanship to hide under canvas, rope or other "protecting" material. When completed, each machine is given a severe running and high-insulation test. Then the frame is rubbed with a good filler and painted. All bright parts are polished, so that in addition to being compact in design, substantial in construction and superior in performance, each machine presents a graceful and pleasing appearance.

Printing Press Motor Control.

A controller for printing press motors has recently been made by the Ward Leonard Electric Company, of Bronxville, N. Y. It is illustrated herewith. The principal point aimed at in this controller



PRINTING PRESS MOTOR CONTROL.

is the elimination of the objectionable arcing and burning of the ordinary types of controllers for this purpose. This is accomplished by the use of a very high resistance divided up into a large number of steps. The difference in voltage between the consecutive contacts

prevented by the resistance, a feature in which no sparking can possibly occur. The current is stopped by the gradual insertion of this high resistance, and the circuit is never opened upon the controller. The cut shows a controller for 12½ hp. These controllers are made upon the multiple unit system by combining any desired number of unit 2½-hp controllers. Each one of the plates shown is complete with its own switch, contacts and resistance.

In many new installations, it is extremely difficult to predetermine exactly the current the work will require, and the controller when installed may be found to have too small or too large current capacity with correspondingly improper ohms. With the multiple unit construction for the controller, it is a very simple matter to add additional plates or disconnect those not needed, while with the controllers in general use an entirely new controller would be required if it is sought to make the ohms and ampere capacity exactly suited to the power actually taken by the motor in practical operation.

A New Deflecting Fan Motor.

The growing popularity of fan motors which deliver their breeze over a large area instead of constantly in one direction and over one circumscribed space, has greatly stimulated invention in this field; and the result is seen in some very ingenious devices. We illustrate and describe herewith the "Palm" fan motor, which is being put upon the market by the Coleman Manufacturing Company, of 111 Fifth Avenue, New York City. This ingenious mechanism has been devised and very fully patented by Mr. Walter E. Coleman, an inventor of repute in other lines of industrial development. The general idea hitherto worked upon in deflecting fans has been that of rotating or swiveling the motor itself, involving, of course, the construction of a motor and apparatus to perform such movement. In the Coleman device, any motor will answer the purpose, and the ordinary fan guard itself becomes an integral part of the deflecting

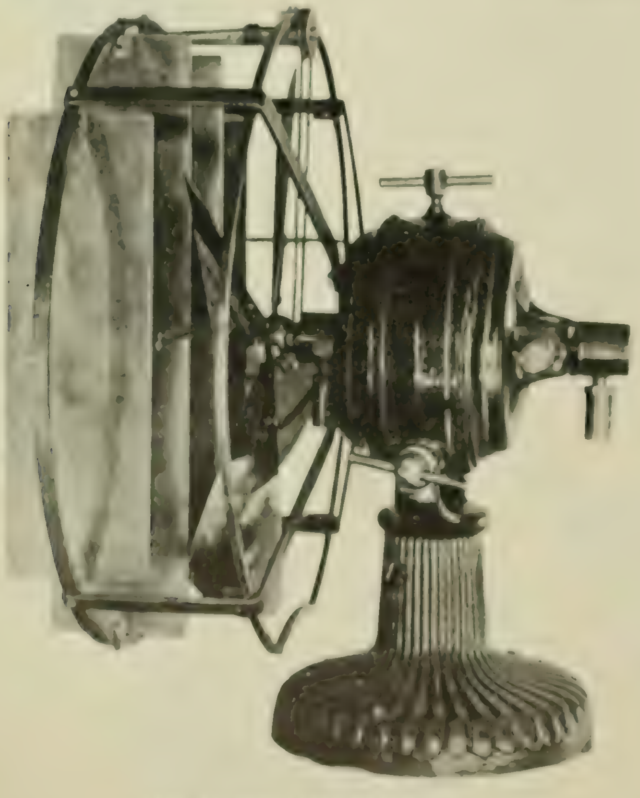


FIG. 1.—DEFLECTING FAN MOTOR.

mechanism. Mr. Coleman accomplishes his purpose in a variety of ways, all ingenious and practicable. In the form shown in Figs. 1 and 2, and now being introduced, an extra pulley of small size is fixed on the extension of the armature shaft, on the fan side, and belted up to another pulley driving a compact worm gear, by whose movement the deflector blades are swung from side to side within the guard rims, slowly or swiftly as may be desired. The amount of power consumed to deflect the blades is so slight that a thin rubber band suffices as a driving belt between the two pulleys. Usually a coiled wire belt is employed. As will be observed, the worm communicates motion to a small toothed wheel that carries a reciprocating rod in engagement with the deflectors in front of the fan.

Another interesting form of mechanism devised by Mr. Coleman for controlling and distributing currents of air from a fan motor comprises arrangements by means of which a single worm gear and its connections turn the motor on its axis and change simultaneously the inclination of the deflectors with relation to the motor.

It is interesting to note that the Coleman fan herewith illustrated

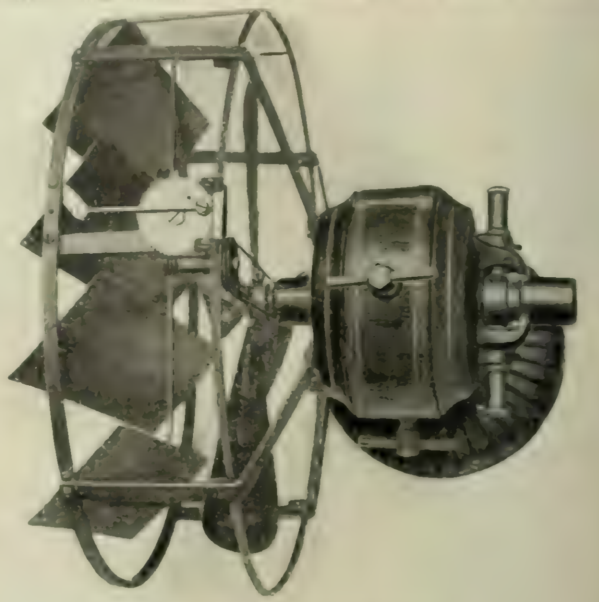
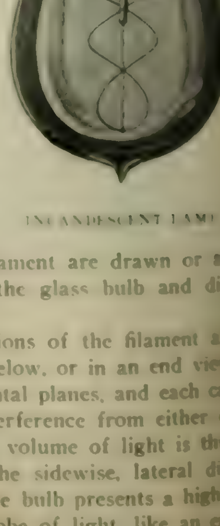


FIG. 2.—DEFLECTING FAN MOTOR.

can be run at any angle, the worm being positive in its drive on the gearing, so that the motor can be tipped up and hung around to deliver its breeze straight ahead, or towards the ceiling or downward to the floor. The device is not only inexpensive but a mere tyro can attach it in a few minutes to any fan motor as easily as he could an ordinary guard.

New Form of Incandescent Lamp.

An interesting new form of incandescent lamp has recently been invented by Glenn C. Webster, of Warren, Ohio, and put on the market by the Sterling Electrical Manufacturing Company, of that place. It is illustrated herewith, and as will be noted there is a double spiral filament, or actually, on account of the central member two spirals. The aim of the inventor has been to produce a lamp with a maximum symmetrical distribution of rays, yielding the same candle-power virtually at every point in the vertical and horizontal planes. The glass bulb used is of usual character. From the top is sealed a pendent glass member, at the lower end of which is an anchor, thus constituting part of the glass mount, the anchor being of wire, the lowest loop of the filament being attached to it. To this anchor, it is stated, the carbon particles shed by the filament are drawn or attracted statically, instead of bombarding the glass bulb and discoloring it in the familiar way.



INCANDESCENT LAMP.

As will be observed, the three convolutions of the filament are of different shapes and sizes. Seen from below, or in an end view, the convolutions appear in different horizontal planes, and each can throw its light downward without any interference from either or both of the two other ones. A maximum volume of light is thus secured in a downward direction, while the sidewise, lateral distribution of light rays is also uniform. The bulb presents a highly luminous aspect, suggestive rather of a globe of light, like an enclosed arc, than of the ordinary incandescent filament in its distinctly seen shell of glass. The cut shown illustrates the new lamp so clearly that few words are needed to point out the manner in which the inventor has sought to achieve his object.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was in better supply, 6 per cent with commission being demanded. In the stock market more strength developed as a result of the relief of the financial stringency through the action of the Treasury Department. The strength of the market, however, is not accepted as indicating any settled feeling on the part of Wall Street interests; a bull campaign is looked upon as possible at any time. The favorable condition of business and the large earnings of the railroads seem to furnish a basis for expectations that no very serious decline can occur, and that with a return to easier conditions in the money market, renewed appreciation may be seen in the stock list. In the industrial list, the chief feature of prominence was the tendency of United States Steel shares to rally on small transactions. The traction stocks gained ground with the rest of the market, Manhattan being particularly strong, owing to the belief in the increase of the company's earning power following the completion of the electrical installation. This stock reached 138¾, closing at 135¾, the lowest price being 132. Metropolitan Street Railway reached 142½, but dropped and closed at 139, the lowest figure of the week, being a net loss of 3 points. Brooklyn Rapid Transit recorded a net loss of 2¼ points on the week's business closing at 64, which was 2 points below the highest quotation. General Electric closed at 185, which is a net decline of 5 points, the lowest and highest quotations being 182 and 188½, respectively. Westinghouse lost 6 points, closing at 217. Western Union's range of the week was between 90 and 93⅞, the closing price being 92½, a net loss of 1½ points. Commercial Cable was dealt in at 170½, which is 2¼ points below the last previous quotation. American District Telegraph stands alone in the electric list, with a net increase to its credit, the amount being 2 points, the closing price being 39. In Boston, Western Telephone was added to the regular list of stocks dealt in. Following are the closing quotations at New York of October 7:

NEW YORK.

	Sept. 30.	Oct. 7.		Sept. 30.	Oct. 7.
American Tel. & Cable.	—	92	General Electric	187	180
American Tel. & Tel..	—	165	Hudson River Tel.....	—	108
American Dist. Tel....	—	36	Metropolitan St. Ry...	142¼	136½
Brooklyn Rapid Transit	66	61½	N. E. Elec. Veh. Trns..	¼	—
Commercial Cable	—	—	N. Y. & N. J. Tel....	157	160
Electric Boat	25	23	N. Y. E. V. T. Co....	13	12½
Electric Boat pfd......	40	35	Tel. & Tel. Co. Am..		—
Electric Lead Reduc'n..	3¼	2¾	Western Union Tel....	93⅞	90¾
Electric Vehicle	5¼		West. E. & M. Co.....	218	200
Electric Vehicle pfd....	14	10	West. E. & M. Co. pfd..		210

BOSTON.

	Sept. 30.	Oct. 7.		Sept. 30.	Oct. 7.
American Tel. & Tel..	167	163½	Western Tel. & Tel. pfd.	100	98½
Cumberland Telephone .		—	Mexican Telephone	2⅛	2⅛
Edison Elec. Illum....	277	275*	New Eng. Telephone....	139	139
Erie Telephone		—	Westinghouse Elec.	108	102
Western Tel. & Tel....	28	—	Westinghouse Elec. pfd.	108	—

PHILADELPHIA.

	Sept. 30.	Oct. 7.		Sept. 30.	Oct. 7.
American Railways	52½	52½	Phila. Traction	98	98
Elec. Storage Battery..		—	Phila. Electric	8⅞	8⅝
Elec. Storage Bat'y pfd.		—	Pa. Elec. Vehicle......		-
Elec. Co. of America..	10	9½	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	Sept. 30.	Oct. 7.		Sept. 30.	Oct. 7.
Central Union Tel.....	—	—	National Carbon pfd....	101	100¾
Chicago Edison		—	Northwest Elev. com...	36½	36
Chicago City Ry.......	215	212	Union Traction	17½	17
Chicago Tel. Co........	—	—	Union Traction pfd....	48⅝	50
National Carbon	32	30			

* Asked.

GENERAL CARRIAGE SCANDAL.—In a suit brought by Joseph Leiter, against the members of the former brokerage firm of Thomas & Post and others, to recover for the stockholders of the General Carriage Company the sum of $1,110,000, he charges the defendants with having wrecked that corporation, which went into the hands of a receiver in May, 1901. Mr. Leiter makes sweeping charges of fraud, and papers in the case have been served upon General Samuel Thomas, Edward R. Thomas, Orlando F. Thomas, Edwin M. Post, Camille Weidenfeld, Cyrus Field Judson, Joseph S. Tracy and Winfield S. Jewell. All of these defendants, according to the plaintiff, except E. R. Thomas, were directors of the Chicago company in January, 1901, while the three Thomases and Mr. Post composed the firm of Thomas & Post. Mr. Leiter declares in his complaint that the valuable piece of property on Sixth Avenue, from Forty-third Street to Forty-fourth Street, owned by the company and mortgaged for $800,000, was fraudulently and illegally transferred to the firm of Thomas & Post [illegible] $50,000, although the equity was worth much more. In the same month, Leiter charges, the directors—composed largely of the members of the firm of Thomas & Post—sold to that firm 50,000 shares of treasury stock for 80 cents a share. At that time, he says, shares were worth $4 each, and before the fraud had been discovered by Leiter and other stockholders had risen to $23, making a value of $1,150,000 for the block, which was sold for $40,000. By this transaction, Leiter declares, Thomas & Post made great profits, and the other directors, too, he claims, participated in and received benefit of the fraud and losses to the company.

MANHATTAN ELECTRIC TRACTION.—Ten electric trains are now being run on the Sixth Avenue Manhattan line, terminating at Fifty-eight Street, and it is understood that for three or four weeks no attempt will be made to place an electric service on the section of the line running to 155th Street. Earnings continue to increase gratifyingly, and it will probably be found that the quarter ended September 30, shows a larger gain in gross than has been shown in any other quarter. The increase in traffic on the East side lines, due to the introduction of electric equipment, is estimated at not less than 10 per cent. This is said to be a very conservative estimate, but should equally good results follow the change of power on the West side the effect on Manhattan earnings would be very important. According to the quarterly statements the system earned last year $7,808,661 gross, $5,518,584 net, leaving a surplus after charges of $3,073,405, which is equal to 6½ per cent. on the stock. Should electric operation of the entire system result in increasing the gross earnings 10 per cent., the increase would be $1,066,591. It has been estimated that the saving in operating expense will be in the neighborhood of $1,100,000 per annum, but assuming that some slight effect of this was felt in the later part of the year, and allowing for a loss in other income derived from money loaned in the street, the saving might still be in excess of $500,000. An increase in gross of $1,066,591 coupled with a decrease of $500,000 in expenses would indicate a surplus of $4,639,996, or 9.6 per cent., as the earning capacity of Manhattan under electric operation.

THE AUGUSTA TROLLEY DEAL.—A special dispatch from Baltimore, Md., says: Interests identified with the Railways and Light Company of America, who are also the controlling owners in the North Augusta Electric and Improvement Company, of Augusta, Ga., and the Augusta-Aiken Electric Railway have consummated the purchase in this city of a majority of the stock of the Augusta Railway and Electric Company, of Augusta, Ga. The purchasers are as follows: J. W. Middendorf & Co., of Baltimore; John L. Williams & Sons, of Richmond, Va.; John Blair MacAfee, of Philadelphia; Alfred S. Elliot, of Wilmington, Del., and James W. Jackson, of Augusta, Ga. The Augusta Railway and Electric Company owns the entire street railway and electric light properties of the city of Augusta, Ga. The control of the company was bought from Messrs. Jarvis & Conklin, of New York, and Colonel D. B. Dyer, of New York. Its capital stock is $1,000,000, and it has $1,000,000 of bonds outstanding.

BELL TELEPHONE OUTPUT.—The American Telephone and Telegraph Company instrument statement for the month ended September 20 and since December 20 shows:

	1902.	1901.	1900
Gross output................	75,011	75,578	44,190
Returned	43,334	33,482	30,948
Net output.................	31,677	42,096	13,242
Since December 20:			
Gross output...............	808,334	683,171	501,354
Returned	340,080	301,280	220,003
Net output	401,045	381,882	280,457
Total outstanding	2,987,251	2,334,698	1,860,956

DIVIDENDS.—The directors of the Philadelphia Company have declared a dividend of 1½ per cent on the common stock, payable November 1. A quarterly dividend of 1¼ per cent. has been declared on the preferred stock of the Georgia Railway and Electric Company, payable October 15.

TELEPHONE EXTENSIONS.—Dispatches from Tacoma state that the Northwest Telephone and Telegraph Company has placed $400,000 bonds in New York and will proceed to build lines through Western Washington.

TROLLEY MILLION MORTGAGE.—It is stated that the Philadephia, Bristol and Trenton Street Railway system has mortgaged its property for $1,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports of trade all indicate an exceptionally good business for Fall, orders already booked being in most cases in excess of preceding years, and crop reports, except in some sections, guaranteeing the full volume of business in the remaining months of this year and the early part of 1903. In the Northwest, merchandise sales generally exceed those of last year, and collections are good; a large Fall business is indicated on the Pacific Coast, where collections are better, and except for a few scattered pessimistic reports from the South, advices from that section are generally of a fair to good trade with improved productions. New Orleans is an exception, owing to numerous strikes already declared or threatened, and retail business is reported paralyzed thereby. Less strength is noted in some lines of the iron and steel business than heretofore, but the quieting-down in the cruder form is due to scarcity of fuel and of pig iron, necessitating shut-downs of steel mills, as much as to the flood of foreign iron, which appears to be steadily increasing. The receipts of foreign iron and steel in August exceeded 140,000 tons, though it may be pointed out in this connection that exports of iron and steel and their products, mostly machinery, are still more than double the imports for that month. Copper ruled quiet but steady throughout the week, the range of prices being confined to narrow limits. The closing quotations are Lake 11⅝ @ 11¾c., electrolytic in cakes, wire bars and ingots 11⅜ @ 11½c., cathodes 11¼ @ 11⅜c., and casting stock 11⅛ @ 11¼c. *Bradstreet's* reports 164 business failures during the week ending October 2, as against 172 the week previous, and 175 the same week last year.

HARRISBURG ENGINE ORDERS.—The Harrisburg Foundry and Machine Works, of Harrisburg, Pa., have just received a contract through their New York offices, 203 Broadway, for a 190-hp standard engine, to be direct connected to a 125-kw Westinghouse alternating-current generator, for installation in the Danville, Va., plant of the American Tobacco Company. The equipment will be used for lighting and motor work. A 150-hp standard engine for direct connection to a 100-kw Bullock generator has been ordered for lighting purposes by the Harlem Amusement Company. Two 60-hp standard engines, each to be direct connected to 40-kw generators, built by the Western Electric Company, are to be installed for lighting use in the new Webster Hotel, West Forty-fifth Street, New York. The Y. M. C. A. Building, at Newark, N. J., is to be equipped with two 75-hp standard engines for direct connection to Western generators of 50-kw capacity each. These outfits are intended to be utilized for electric light. A 50-hp Ideal engine, to be direct connected to a 30-kw Crocker-Wheeler generator, has been requisitioned for installation in the Cushman Building, Broadway and Maiden Lane, New York, for lighting use. The United States Government has ordered a 25-hp Ideal engine, to be direct connected to a 17½-kw Westinghouse generator, for the Quartermaster's Department, at Manila, Philippine Islands.

MORE SUBSTATIONS FOR NEW YORK.—Plans have been filed with the Building Bureau, of New York City, for two of the power stations of the Rapid Transit underground road, respectively at 29, 31 and 33 City Hall Place and 108 and 110 East Nineteenth Street. They are to be three-story structures with cellars. They will have two large entrance doors and façades of granite and limestone with terra-cotta trimmings. The two upper floors will contain the electric operating machinery. The City Hall Place station will be 58.2 feet front and 199.10 feet deep, with an extension 57 x 81.43 feet. The Nineteenth Street station will be 50 feet front and 92 feet deep, with an extension 49.10 x 79 feet. Each building is to cost $600,000. Plans have also been filed by the subway architects for an inspection shed, to cost $95,000, to be built for the use of the underground road, fronting on 148th Street, east of Seventh Avenue. It is to be of brick and steel, with a glass roof, and will be 338 feet front and 199.10 feet deep.

BALL ENGINE CONTRACTS.—C. O. Lamson, Waterloo, Ia., has recently put in operation a direct-connected unit. The Ball Engine Company, Erie, Pa., furnished the engine, and the Westinghouse Electric and Manufacturing Company, Pittsburg, the generator. The Pennsylvania Railroad Company, G. R. & I. division, Fort Wayne, Ind., has recently purchased a Ball engine for electric service. The Pueblo Electric Company, Pueblo, Colo., has recently purchased an additional unit from the Ball Engine Company. The Detroit Iron and Steel Company, Detroit, Mich., has placed an order with the Ball Engine Company for three 350-hp engines, each arranged for direct connection to a generator. These units will be used in its electric power plant.

LIGHTING PROPERTIES IN WASHINGTON, D. C.—A deed has been placed on file by the United States Electric Lighting Company, conveying all its property, assets and franchises to the Potomac Electric Power Company. The consideration named in the deed is but $10, but it is understood that it was a $3,250,000 deal. It is also explained that the prime cause for the transfer being made is that the charter of the United States Electric Lighting Company expires at once. It is also explained that the Potomac Electric Power Company is to pay all the debts of the other corporation. It is stated that the property transferred to the Potomac Electric Power Company is subject to a trust of $650,000 due the Guaranty Trust Company of New York.

IMPORTANT EXPORT TELEPHONE SHIPMENT.—One of the most important export shipments recently was a large invoice of telephone equipment for two complete public service telephone exchanges for the cities of Port Arthur and Fort Williams, Ont. The shipment consisted of two 1,000-line multiple-capacity International lamp signal central energy switchboards, with all necessary central office apparatus and subscribers' telephones, including two Roth charging machines and ringing generators, with General Electric motors, and two sets of chloride accumulator storage batteries, by the International Telephone Manufacturing Company, of Chicago.

LIGHTING PLANT FOR JAPANESE HOTEL.—The Japanese house of Takata & Co., whose New York address is 10 Wall Street, has just secured another contract for a complete plant for lighting use in Japan. The outfit is intended to be installed in the Oriental Palace Hotel, at Yokohama. It will consist of a 25-kw Westinghouse generator, to be direct connected to an Ideal engine built by A. L. Ide & Son, of Springfield, Ill. The pumps will be furnished by the Knowles branch of the International Pump Company. The exhauster is to be supplied by the Burt Manufacturing Company, of Akron, Ohio. A Cross oil filter has also been ordered.

WESTINGHOUSE SCOTCH CONTRACT.—A cable dispatch from Glasgow, of October 3, says: A £500,000 contract has been placed with the Westinghouse Company by the Clyde Valley Electrical Company, of Glasgow, for the equipment of two generating stations to supply power for industrial purposes over an area of 755 square miles. The initial installations are to be of 6,000 hp each, and are to be completed within eighteen months. These will be the first of a series of great power stations to be built in the United Kingdom.

SWITCHBOARD WORK.—C. L. Sherman, 1026 Filbert Street, Philadelphia, is completing a switchboard for the new Commonwealth office building in that city. This board consists of six panels of blue Vermont marble, with a slate base, and is about 13 ft. x 8 ft. in size. Weston instruments and I-T-E circuit breakers are being used. Among other work recently completed by Mr. Sherman is the switchboard and 24 tablet boards, enclosed in cabinets, for the five new Carnegie Library buildings, Washington, D. C.

THE CINCINNATI PLANER COMPANY, Cincinnati, Ohio, continues to make extensive improvements to its plant and equipment. It is now installing a 150-hp boiler, a 50-kw generator and a 25-hp motor; 14-inch and 18-inch Lodge & Shipley lathes, 36-inch Schumacher & Boye lathe, 48-inch G. & E. automatic gear cutter, 16-foot Bridgeport automatic screw lathe, Owen Miller, 3-foot and 5-foot Fosdick radials, Higley cold saw and several of its own planers. It reports a steady run of orders.

INTERCOMMUNICATING TELEPHONES.—A contract for an intercommunicating telephone system for the Boston Athletic Association has been placed with Sargent, Conant & Co., Boston. The same firm has also finished recently the complete electrical equipment of Mr. T. W. Lawson's "Dreamwold," at Egypt, Mass., including telephones, arc and incandescent lights, wiring, etc. All the distributing circuits are carried in underground ducts throughout the estate.

INQUIRIES FOR MOTOR CARS FOR N. S. W.—The United States Export Association, Gerken Building, West Broadway, New York, has secured inquiries for motor cars, which are intended to be utilized on an extensive scale for the purpose of transporting the mails in New South Wales. The same concern has also received inquiries for naphtha launches for Russia.

ELECTRICAL EQUIPMENT FOR B. & O. SHOPS.—Considerable purchases are about to be made for electrical equipment to be installed in various shops of the Baltimore and Ohio Railroad. Thayer & Co., Incorporated, of 39-41 Cortlandt Street, New York, the local sales agents for Cahall boilers, have just been allotted orders aggregating 2,500 hp.

LARGE ELECTRIC HOISTING EQUIPMENT FOR BUENOS AYRES.—The Export Club, 82-88 Wall Street, New York, has received an inquiry from Buenos Ayres for a large electric hoisting equipment, which is intended to be used on the docks of that Argentine port.

LARGE INDIAN WATER-POWER SCHEMES.—Mr. J. N. Tata, of Bombay, who is now in this country, is primarily interested in two large Indian water-power projects, the carrying out of which may result in the placing of very considerable contracts for equipment on this side. The larger scheme is to utilize the waters of the Doodh Sagar, located about 300 miles north of Bombay, at a point where there is a water-fall no less than 2,600 feet in height. It is proposed to construct reservoirs so as to take advantage of the heavy rains which fall seven months of the year in that region. It is estimated that fully 50,000 hp would be thus available all the year round. It is intended to furnish energy to operate some 60 miles of railroad. The other project Mr. Tata and his friends have in hand is one to furnish electric power to Bombay, for the purpose of working the electric traction system under contemplation, and supplying energy for manufacturing and general purposes in and around that city. It is proposed to construct an hydraulic plant at Neral, located some 40 miles from Bombay. The General Electric Company and the Swiss firm of Escher, Wyss & Company are reported to be after the contract. Mr. Tata, who will be in the United States for some five weeks, has been at the Holland House, New York, and at the offices, 82-88 Wall Street, of Tata & Company, of which firm he is head.

THE ELECTRIC LAUNCH COMPANY, of Bayonne, N. J., has had an exceptionally busy season the past summer, more electric and gasoline powered launches having been shipped by it than ever before. At present it has under construction two 45-foot steam launches for the War Department, and ten men-of-war boats for the Brazilian navy, besides a number of electric launches for delivery in the late fall and early spring months. The electric-powered boat is becoming very popular in yacht tender service, the many advantages of safety, seaworthiness and availability for immediate use making it particularly adapted for such work. The company's electric passenger launches have proved to be paying investments in connection with street railway pleasure resorts and summer hotels. Two 42-foot launches have been supplied to the Omaha & Council Bluffs Railway and Bridge Company, with a seating capacity of 70 adults or 92 children each, which at ten cents a head shows good returns on the investment when the low cost of operation is considered; one man, usually a motorman, operating the boat. The current for recharging is obtained from the trolley road.

WATER POWER IN OREGON.—The Condor Water and Power Company, Tolo, Oregon, has recently been incorporated with a capital stock of $100,000. Officers: Dr. C. R. Ray, president and general manager; W. F. Hunter, secretary. The water power plant is a dam and ditch construction, which will develop 6,000 hp. An order has been placed with the General Electric Company for some of the electrical machinery, and some McCormick water turbines have been ordered through Col. Frank H. Ray, second vice-president of the Continental Tobacco Company, New York, who is the principal stockholder. The purpose of the company is to supply power and light for the adjoining towns and villages and to the mines, both quartz and placer, in the vicinity, and to supply water for towns, villages and for mining and irrigation. To carry out these plans, quite a good deal of machinery, supplies and materials will be needed; most of which as yet has not been ordered. Dealers and manufacturers are requested to send catalogues and prices to Dr. Ray.

CAR BODIES FOR SOUTH AFRICA.—The Durban Municipal Council, South Africa, is reported to have made objection to the acceptance of the tender of the British electrical engineering and contracting firm of Macartney, McElroy & Company for additional trolley cars at £10,000, on the ground that a British firm actually manufacturing cars should be given the preference. The mayor explained that the motors would be British make, but the car bodies would have to be procured from America as they were urgently wanted. Hitherto, the major portion of the cars have been built in England, 22 having been turned out at the George F. Milnes shops. The equipments were of General Electric build, and the trucks were manufactured by the J. G. Brill Company. Last spring, as noted in these columns at the time, eight cars were ordered through Macartney, McElroy & Company, which were completely built in this country, the J. G. Brill Company making the bodies and trucks and the General Electric Company furnishing the motor equipments.

BRITISH GET SHANGHAI TRACTION CONTRACT.—The Shanghai Municipal Council has at last come to a decision regarding the electric traction system which is to be built in the foreign settlement of that Chinese city. The contract has been awarded jointly to the British Brush Electrical Engineering Company, Limited, and the British Electric Traction Company, Limited. Construction work will be begun almost immediately on some nine miles of double track and 8½ miles of single track. The overhead trolley system is to be used. The voltage will be 500-550. There will be from 50 to 60 cars. Single deck ones are proposed, each seating six first class and 40 second class passengers. The rails will be 90-pound girder. The gauge is to be 4 feet 8½ inches. The franchise is for 21 years, after which the Council may purchase on certain conditions. It is expected that by the end of 1904 the system will be ready for traffic. The cost of construction, etc., is put at $1,500,000.

EQUIPMENT FOR BRAZILIAN ELECTRIC ROAD.—The City of Santos, Brazil, is to have an electric traction system. The electrical engineering and contracting firm of James Mitchell & Co., of Rio Janeiro, have secured the contract. The initial length of the road will be about 10 miles. The power house equipment is to consist of two 200-kw General Electric generators, direct connected to 300-hp engines manufactured by A. L. Ide & Son, of Springfield, Ill. The boilers will be Babcock & Wilcox. The pumps are to be furnished by the Worthington branch of the International Pump Company. The car bodies are to be built in Brazil, owing to the cheapness of wood in that part of the world. The trucks will be furnished by the Peckham Manufacturing Company, whose New York offices have lately been removed to the Engineering Building, Liberty Street. The motor equipment will be built by the General Electric Company.

ELECTRICALLY EQUIPPED PRINTING PLANT FOR LONDON.—Edward Lloyds, Limited, of London, proprietor of *Lloyds' Weekly* and the *London Daily Chronicle*, is to erect a mammoth printing plant on the site of its existing works, in Salisbury Square, London, W. C. The plant will be equipped with American machinery. The motive power will be electric exclusively. George W. Mascord, the chief mechanical engineer of the British concern, is now here for the purpose of placing contracts. The equipment will entail an expenditure of more than half a million dollars. The plant when completed will be by far the largest newspaper printing establishment in Great Britain. Mr. Mascord is making his headquarters at the New York offices of Edward Lloyd's, Limited, in the Broad Exchange Building, 25 Broad Street.

POWER FOR A SHOE FACTORY.—It has been decided by the United Shoe Machinery Company to accept the offer made by the city of Beverly, Mass., to build a huge plant, to cost $750,000, and to occupy ten acres and employ at least 2,000 operatives. The company has organized a committee to carry on this work. The plant will include an administration building, 60 x 80 feet, three stories high, two parallel main manufacturing buildings, 600 x 60 feet, three stories high; a storage building, 400 x 60 feet, three stories high; a drop forge, blacksmith, die sinking and hardening plant, 60 x 220 feet; a 20-ton daily foundry plant, and a central power plant of 1,800 hp. Industrial and underground railways will connect the various buildings, and the whole plant will be electrically driven. All the factories will be consolidated in this big plant.

FOR A 6,000-HP MEXICAN HYDRAULIC PLANT.—The Yaqui Copper Company, 377-379 Broadway, is about to let contracts for the equipment of a 6,000-hp hydraulic plant at its mines, in the State of Sonora, Mexico. The company is to build a 5,000-ton smelting plant there, to be operated by electricity, as will all other machinery in the property. The head will be 112 feet. About three miles of pipe line, varying from 2½-inch to 5½-inch steel pipe, will be constructed. W. P. Harlow, of Nogales, Arizona, is president of the company. He is now a guest at the Waldorf-Astoria. M. E. Harby, lawyer, of 25 Broad Street, New York, is vice-president. The secretary is Geo. E. Green, of Binghamton, N. Y. The capital of the company is $5,000,000.

EQUIPMENT FOR ANOTHER JAPANESE ROAD.—The Tokio Street Railway Company—a Japanese capitalized concern—which is about to construct an electric traction system some 20 miles in length in the city of Tokio, is at present letting contracts for various equipments. Frazar & Company, of Japan, whose New York offices are at 63-65 Wall Street, has been awarded the contract for 100 car trucks and motor equipments. The power to operate the road will be furnished by the Tokio Electric Light Company.

ELECTRICAL EQUIPMENT, ETC., FOR CHINESE DOCKS.—The Hong Kong & Whampoa Dock Company, Limited, of China, will shortly let contracts for the supply of electrical equipment, machine tools, etc., for an extension of its docks. The contracts will probably be awarded through the firm of Shewan Tornes & Company, of China, 16 Beaver Street, New York.

AMERICANS AFTER JAPANESE ROAD.—The Hanqin Electric Railway Company, of Japan, which was recently organized for the purpose of constructing an electric traction system between Osaka and Kobe, is entering into negotiations for the introduction of American capital. Japanese advices state that a Mr. Tison is acting for A. N. Brady in the matter.

POLICE TELEPHONES WANTED.—Police Commissioner Partridge, of New York, has asked for $170,000 for extra telephones and telephone supplies.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—The Commercial Pacific Cable Company is constructing its underground land line to connect its cable landing near the Cliff House with the Postal Telegraph Commercial Cable offices in San Francisco. The distance to be covered is 6¾ miles. The conduits consist of 3-inch wrought iron pipe into which the lead-covered cable will be drawn. The cable testing-house near the beach is almost completed.

BOISE, IDAHO.—The employees of the Rocky Mountain Bell Telephone Company in the States of Montana, Idaho and Utah are on strike for an increase of wages.

CHICAGO, ILL.—It is stated that the International Union of Commercial Telegraphers has been formed here by a convention of 40 delegates representing as many cities.

LA FOUNTAINE, IND.—The La Fountaine Telephone Company has increased its capital $15,000 and will make extensive improvements.

WABASH, IND.—The Home Telephone Company, of this city, whose exchange was destroyed by fire two weeks ago, has restored the plant and resumed business.

PERU, IND.—The entire system of the Home Telephone Company, of this city, was rendered useless on Sept. 26 by a fire, which started from a candle, burning the main switchboard.

COLUMBIA CITY, IND.—A scheme is on foot for the consolidation of the independent telephone exchanges of South Whitley, Cherubusco and this city. The consolidated interests will make extensions and improvements.

RUSSIAVILLE, IND.—A community system is being organized by the farmers of this section. A switchboard will be installed at Russiaville and free connection will be made with Forest, Frankfort, Middlefork, New London, Kokomo, and other towns.

BROWNSTOWN, IND.—The Brownstown Telephone Company has been purchased by Henry Rust, William Robinson, and Elmer Brown. The purchasers will make improvements and extend the system throughout the surrounding territory.

ELWOOD, IND.—The new telephone exchange was put in operation in this city Sept. 18. At the same time the toll lines connecting Elwood with Alexandria and Anderson were thrown open to the public and the Muncie line will be opened as soon as the new exchange there is completed.

EVANSVILLE, IND.—The Cumberland Telephone Company is advertising for new patrons and making preparation to connect with other lines and otherwise to continue its service to the public, regardless of the action of the council in declaring its franchise expired and ordering it to cease business and remove its poles and wires within ninety days. The city will attempt to remove the poles at the expiration of the ninety days.

INDIANAPOLIS, IND.—The Monroeville Home Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $10,000; directors: S. E. Mentzer, G. E. Speke, S. B. Walters, G. W. Muma and S. L. Ashton. The company will construct telephone lines and telephone exchanges in Allen and contiguous counties. The franchise includes the right to use telegraphy should it decide to do so in the future.

RICHMOND, IND.—The New Long Distance Telephone Company, of Indiana, and the Richmond Home Telephone Company have brought suit against the Richmond Interurban Railway Company to enjoin it from constructing a system of high-tension feed wires between Richmond and Dublin. The three wires are to connect the power house in Richmond with apparatus at Dublin to reduce the voltage. The court has granted a temporary restraining order and the work which was nearing completion has been stopped. The case will be heard October 8.

DES MOINES, IA.—The Whittmore Telephone and Electric Light Company has been organized with a capital of $10,000.

EDDYVILLE, IA.—The Eddyville Telephone Company has incorporated with $15,000 capital.

PADUCAH, KY.—The People's Telephone Company, which will soon commence operations here, has secured an option on the Alexander line and will give connection with Smithland and other towns in that vicinity. It will be necessary to string a large cable across the Tennessee River. An exchange will probably be established at Smithland.

FOWLERVILLE, MICH.—Business men of this place propose to organize a co-operative telephone company.

LANSING, MICH.—The Michigan Telephone Construction Company, of Alma, with a capital of $75,000, has filed articles of incorporation.

KALAMAZOO, MICH.—The Kibbie Telephone Company is about to enter this city. The company is capitalized at [illegible] and stock is owned by farmers and business men of neighboring towns. Six years ago the system was started on a small scale by J. H. Tripp and it now covers a large district in this section of the State.

DETROIT, MICH.—A citizen's committee, composed of J. E. Scripps, Joseph Harris, T. G. Craig, J. B. McKay, Ralph Phelps, W. H. Ellis and others, has petitioned the city council to repeal the franchise granted to the People's Telephone Company, and ask that another franchise be granted to the citizens committee to be transferred by it to another company to be formed by the consolidation of the properties of the People's Telephone Company and the Co-operative Telephone Company.

HANNIBAL, MO.—The Bluff City Telephone Company, of Hannibal, has filed articles of incorporation. The capital stock is $100,000. The incorporators are J. C. McCoid and H. C. Conger, Mount Pleasant, Ia.; Claire W. Manatt and C. H. Brown, Grinnell, Ia.; B. F. Hixon, R. L. Hixon and V. T. Strong

JEFFERSON CITY, MO.—City Counselor R. J. Ingram has procured an alternative writ of mandamus, returnable Oct. 14, to test the right of Kansas City to regulate the rate the Missouri-Kansas Telephone Company shall charge in the city. The company refused to put in telephones unless the rates of $96 for business and $72 for residence telephones are paid. The council recently passed an ordinance reducing the rates and fixing them at $60 for business telephones and $36 for residence telephones. The legality of the council's action is to be tested.

OMAHA, NEB.—A popular vote will probably be taken on the question of granting a franchise to the Interstate Independent Telephone Company. This company, which has a capital stock of $100,000, proposes to establish an independent telephone system in the tri-cities, Omaha, South Omaha, and Council Bluffs.

COHOES, N. Y.—The Waterford Home Telephone Company is constructing a line between this place and Waterford.

HAMBURG, N. Y.—The Haines Telephone Company is forming a system of the local telephone companies in this vicinity which will connect with the Frontier Company.

LANCASTER, N. Y.—The Lancaster Telephone Company has been incorporated, capital stock $10,000. Directors: W. I. Sockett, of Buffalo, and G. P. Zurbrick and W. DeC. Moore, of Lancaster.

ALBANY, N. Y.—The Interlake Telephone Company has been incorporated to operate in counties in western New York, capital $100,000. Directors: George S. Fuller, Albrecht Vogt and Jacob Gerling, Rochester.

WILLISTON, N. D.—The Williston Telephone Exchange, which was recently incorporated, will build lines to White Earth, N. D., and Culbertson, Mont.

FARGO, N. D.—The Twin City Telephone Company has applied for a franchise in this city to connect Fargo with the Twin Cities by long distance toll lines.

GROVE HILL, OHIO.—The village council has granted a franchise to R. E Kingery for a telephone system in the village.

ASHTABULA, OHIO.—The new exchange of the Ashtabula Telephone Company, it is expected, will be in operation by November 15. A 1000-drop board is being installed.

ZANESVILLE, OHIO.—The Zanesville council is considering a measure requiring all telephone, telegraph and electric light wires to be placed in underground conduits, within certain limits in this city.

WOODSFIELD, OHIO.—The Woodsfield Telephone Company has elected L. E. Steyne, of Lewisville, secretary and general manager. Z. B. Rhodes, of Zanesville, has been chosen president and treasurer. The company will make a number of improvements to its system.

ZANESVILLE, OHIO.—The Central Union Telephone Company has adopted a new method of fighting the independent company at this point. Bell telephones are to be installed free of charge for a limited time in residences and places of business where the independent telephones are in use

WARREN, OHIO.—The Madison Telephone Company, at its annual meeting in Warren, elected the following officers: President, C. W. DeVoe, Orwell; vice-president, Dr. H. M. Fenton, Cleveland; secretary, N. R. Williams, Orangeville; treasurer, E. U. Hyde, Orangeville; general manager, E. E. Howe, Mesopotamia. The other director is Dr. C. S. Fenton, Orangeville.

MARION, OHIO.—The Marion County Telephone Company has increased its capital stock to $250,000 to provide for numerous extensions. Exchanges will be established in Prospect, La Rue, Caledonia, Green Camp and other towns. Farmers' lines will be built throughout a large district. The company will give long distance service over the lines of the United States Telephone Company and the connecting line is now being built.

HAMILTON, OHIO.—At the recent annual meeting of the stockholders of the Hamilton Telephone Company, the following officers and directors were elected: F. M. Hughes, president; C. E. Greismer, vice-president; J. W. Slonecker, secretary; F. W. Whitaker, treasurer. Directors: O. M. Blake, S. W. Fitton, J. C. Slayback, E. E. Newman, W. W. Morrison, J. L. Greismer, Ben Strauss and J. Gardner. Rapid progress is now being made in the construction of the system. A switchboard of [illegible] lines capacity is being installed.

CLEVELAND, OHIO.—The annual meeting of stockholders of the Federal Telephone Company, which was set for Oct. 2, was postponed to Nov. [illegible], owing to the fact that there was no important business to transact at this time. It is announced that E. L. Barber and associates have not yet closed for the purchase of the controlling interest in the United States Telephone Company, although developments are expected in the near future. Owing to the fact that its other properties are doing an excellent business, it is stated that the Everett-Moore syndicate is not particularly anxious that the sale of the U. S. Telephone stock be closed up.

WAVERLY, TENN.—A telephone line from this place to Danville will be built in the near future. Dr. M. R. Horner and C. M. Cooly, of Clydeton, and others have the matter in hand.

WEST NEWBURY, VT.— A telephone line is being constructed between West Newbury and the Center.

MILWAUKEE, WIS.—The Richfield, Menomonee Falls and Holy Hill Telephone Company, with the principal office in Richfield, Washington County, has been incorporated to build a telephone line from the village of Richfield by way of Goldenthal to Menomonee Falls, and from Richfield to Holy Hill by way of St. Hubertus, with a branch line to the town of Richfield; capital stock, $1,000. Incorporators: Henry H. Zaun, Hulda Zaun and Bertha M. Zaun.

MILWAUKEE, WIS.—The lines of the American Telephone and Telegraph Company from Milwaukee, for which a franchise was granted some time ago, will soon be completed into Janesville.

ELECTRIC LIGHT AND POWER.

SANTA BARBARA, CALIF.—A franchise for the operation of an electric lighting and power system has been granted to W. W. Barnes, J. T. Coffman and other capitalists who reside in Sonoma County. The corporation will establish generating plants in Santa Maria and Lompoc, from which electric energy for power and light will be transmitted to the ranches intervening.

CARROLLTON, ILL.—The Carrollton Electric Light and Power Company has announced an increase of rates. An explanatory letter states that on account of greatly increased cost of operating, the company finds it necessary to equalize the rates by raising the charge to those who had heretofore been favored by a specially low rate.

BLUFFTON, IND.—A petition for an electric light franchise by a company of local citizens is being held up by the council on the ground that a majority of the councilmen favor municipal ownership of such a plant. The city is $15,000 above the debt limit and it is not likely that it can purchase a plant for the next ten years. The business men urge the granting of the franchise, but the councilmen think some way can be devised to secure the plant for the city.

SAULT STE. MARIE, MICH.—The Hatch Electric Smelting and Refining Company proposes to erect an experimental station here, and power will be furnished by the power company.

ST. LOUIS, MO.—The two bills providing for the construction of electric lighting plants at the City Hall and Insane Asylum, which were introduced a month and a half ago at the request of the Board of Public Improvements, were passed September 30 by the House of Delegates by a solid vote. It is estimated that the establishment of plants in these two institutions will result in a saving to the city of about $15,000 annually. The plant at the City Hall is to cost $33,000 and the one at the Insane Asylum $12,000.

CAPE MAY, N. J.—The new owners of the Cape May Electric Company's plant and light privileges here have re-organized the company under the name of the Cape May Electric Light Company, and have capitalized their corporation at $100,000. The officers are: President, Frank K. Bull, of Racine, Wis.; vice-president, Edward C. Brainard, of Chicago; secretary and treasurer, Edward E. Mandeville, of Chicago, and local superintendent, James W. Hildreth, a lawyer of this city. A new plant will be built. Henry D. Dagitt, the architect and engineer of Philadelphia, completed the plans for the improvement, and the contracts have been let. The power house is to be 68 by 150 feet. The boiler house will be 66 feet by 58 feet, and will contain eight 200-hp watertube boilers. The engine room will contain six 250-hp engines, to be connected direct to 225-kw Western Electric generators. The capacity of the plant will be 10,000 16-cp incandescent lamps, and 200 arc lights of 2,500-cp each. All the poles and lights in the city are to be renewed.

MT. GILEAD, OHIO.—A new electric light and power plant is being built in this town by local parties.

GRAND RAPIDS, OHIO.—The village has placed a contract with A. Pilliod to furnish lights for the town.

BELLAIRE, OHIO.—Prominent citizens of this town are agitating the matter of building a municipal lighting plant.

FOREST, OHIO.—C. C. Hale has been given assurance of a local franchise for an electric lighting plant and hot water heating system.

DELAWARE, OHIO.—The Delaware Electric Light Company is extending its system to cover practically the entire residence section of the city.

WARREN, OHIO.—The county infirmary directors have placed a contract with the Warren Electric Light & Power Company for lighting the infirmary buildings.

THE ELECTRIC RAILWAY.

WASHINGTON, D. C.—The Washington Electric Railway Company will build an addition, 30x250 feet, to its power house. New equipment will be installed.

DETROIT, MICH.—It is reported that the Pullman Car Company has sold its old plant in this city to the Detroit United Railway for $70,000, and that the latter company will construct its own rolling sock.

SPRINGFIELD, OHIO.—Directors of the Dayton, Springfield & Urbana Railway will meet Oct. 15 to consider the advisability of increasing the capital stock of the company to $1,500,000.

ALLIANCE, OHIO.—The Akron-Alliance Connecting Railway has been granted a franchise enabling it to reach the center of Alliance. The company will give a three cent fare inside the city limits.

COLUMBUS, OHIO.—The Greenville & Union City Traction Company, of Greenville, capital stock $75,000, has been incorporated by J. E. Lowes, J. E. Feight, T. J. Weakley, W. B. Gebhart and Ralph E. Deweese, of Dayton. The same parties are interested in the Dayton & Northern Traction Company and the new line will be an extension of the latter road.

SPRINGFIELD, OHIO.—At the recent annual meeting of the Springfield Railway Company, officers and directors were elected as follows. Directors: O. T. Martin, J. H. Miller, W. F. Foose, Charles L. Bauer and Theodore Troupe, of Springfield; Samuel DeCoursney, H. J. Crowley, J. J. Sullivan and W. H. Shelmerdine, of Philadelphia. O. T. Martin is president; H. J. Crowley, vice-president; L. C. S. Tingley, secretary-treasurer, and J. H. Miller, general manager. The property is controlled by the American Railways Company, of Philadelphia.

COLUMBUS, OHIO.—The roads centering in Columbus controlled by the allied interests of Tucker, Anthony & Co., and A. E. Appleyard, of Boston, have placed on sale at their various offices, 500 and 1,000-mile mileage-books, good on any of the roads of the system. The books are sold at the rate of 1¼ cents per mile and can be used on the following roads: Columbus, Buckeye Lake & Newark Traction Co., [illegible], Springfield & Urbana, [illegible] Western, and Cincinnati, [illegible] & Dayton.

LEGAL.

U. S. INCANDESCENT LAMP CO.—[illegible] September 30 by H. G. Ferguson, in which he asks for the appointment of a receiver for the United States Incandescent Lamp Company, St. Louis. Ferguson charges that on May 1, [illegible], he and J. M. Davey [illegible], it being agreed that he would furnish the money and Davey attend to the business and share one-half the profits. On August [illegible] Davey [illegible] Ferguson, asking for an accounting of the business. Ferguson now claims the firm owes him $34,628.50. He fixes the assets of the firm at $23,000, and its liabilities $35,000. He claims he is under contract to furnish lamps to the city and asks for the appointment of a receiver to take charge and conduct the business of the firm.

CHICAGO TELEPHONE RATES.—At Chicago, on October [illegible], Judge Tuley gave the complainants in the suit of the Illinois Manufacturers' Association permission to amend their petition for injunction so as to enable them to secure the return of the funds alleged to have been collected in excess of the franchise rate. The construction placed on his decision by attorneys for the complainants is that 5,000 or 6,000 telephone lessees may come into the suit and become parties to it, whether they are members of the Manufacturers' Association or not. The decision of the court, it is estimated, will cost the Chicago Telephone Company more than $1,000,000, unless the Supreme Court reverses the judgment of Judge Tuley. All that remains for the complainants to do now is to prove up their claims. There were 337 lessees involved in the original suit, their claims being in the aggregate about $75,000, but all the druggists, liverymen, and private citizens who paid $175 a year for their telephones may come in and become parties to the suit, Judge Tuley holding that all may be considered together. The question as to whether they can go back of five years, the time provided in the statute of limitation, remains to be argued.

NEW INDUSTRIAL COMPANIES.

THE IDAHO SPRINGS ELECTRIC CHLORINATION COMPANY, of Saco, Me., has been incorporated with a capital of $500,000. P. C. Tapley is president and J. R. Powers, treasurer.

THE M. B. FOSTER ELECTRIC COMPANY, of New York, has been incorporated; capital, $1,000. Directors: M. B. Foster, New York; T. F. Freund, Bayonne, N. J.; F. H. Corduan, Brooklyn.

THE LOCKE INSULATOR MANUFACTURING COMPANY, of Victor, N. Y., has been incorporated, capital $150,000. Directors: F. M. Locke, Victor; C. P. Brown, Shortsville; H. M. Parmele, East Bloomfield.

THE CHICAGO TELEPHONE SUPPLY COMPANY, with a capital stock of $500,000, of which $50,000 is represented in Indiana, has complied with the law by filing articles of incorporation with the Secretary of State. Henry L. Briggs, of Elkhart, is named as the company's State agent.

THE CLEVELAND AUTOMATIC MACHINE COMPANY, of Cleveland, Ohio, has been incorporated under the laws of New Jersey, with $1,500,000 capital stock, by George H. Kelly, G. G. Whitcomb, J. C. Russell and A. L. Garford, of Cleveland. The company succeeds the Cleveland Machine Screw Company.

THE CHAPMAN FUEL ECONOMIZING SYSTEM, of Albany, N. Y., was incorporated recently, with a capital of $35,000, to manufacture a certain invention of John S. Chapman, to be used for economizing in the use of fuel, arresting smoke and increasing steam boiler capacity. The directors are John S. Chapman, Isaac La Grange, James W. Bentley and B. A. Chapman, of Albany, John Pressley, M. Pressley and M. [illegible] of Rochester.

THE COLONIAL SIGN COMPANY, capitalized at [illegible], has been organized at Akron, Ohio, with H. B. Camp, president; George P. Good, vice-president; C. R. Quine, secretary; J. E. Good, treasurer, and G. D. Chapman, general manager. The company will erect a factory at [illegible] for the manufacture of porcelain letter electric signs [illegible] Messrs. Quine and Chapman are inventors and patentees. The office of the company will be located in Akron.

PERSONAL.

MR. W. E. HASELTINE, of the [illegible] Company, [illegible], Mass., was a recent visitor to New York City.

MR. MAURICE A. OUDIN, of the General Electric Company, has returned to Schenectady from a recent visit to Europe.

MR. G. D. PITMAN, of Sibley & Pitman, electrical manufacturers and contractors of New York City, has just returned home from a European trip.

MR. J. A. McELROY, of the British Electrical engineering and contracting firm of Macartney, McElroy & Company, is now on a short visit to the United States.

MR. GUISEPPE MUSSO, an official under the Italian government, is in the United States with regard to the development of a wireless telegraph application he has devised.

MR. G. MARTIN BRILL, of the Brill Car Company, is reported among prominent Philadelphians interested in the consolidation of the railroads of Yucatan, Central America.

[illegible] a trip to the other side of the Atlantic.

MR. J. J. HENRY, of Denver, Col., owner of ten or more gas and electric light properties in the Far West, spent a week in Chicago recently accompanied [illegible]

MR. H. BEVIS, of the General Electric Company, 1900 Ltd., of London, England, [illegible] his headquarters at the Hotel Imperial, New York City, as usual.

MR. H. F. PARSHALL, the American consulting engineer, who has so long made London his headquarters, has been in this country, but sailed during the week for England, where some important electrical problems await his attention.

MAJOR S. FLOOD PAGE, M. I. E. E., managing director of the Marconi Wireless Telegraph Company, Ltd., and of the Marconi International Marine Communication Company, Ltd., was among the arrivals on the Cunarder "Campania" last Saturday.

MR. HERBERT LAWS WEBB, of the New York Telephone Company, sailed for England last week, on a combined business and pleasure trip that may last some months. Mr. Webb is well acquainted all over Europe and is a nephew of Sir W. H. Preece, K. C. B.

MR. ELGIN E. STODDARD, head salesman with Charles C Moore & Company, representing the Babcock & Wilcox Water Tube Boiler Company and the McIntosh & Seymour Engine Company in San Francisco, has been visiting to New York and the Eastern States on business.

MR. JOHN L. PUTNAM, manager of the Clark Automatic Telephone Switchboard Company, Providence, R. I., was a visitor at the New York office of ELECTRICAL WORLD AND ENGINEER last week, on his way West, where he is making an extended tour in the interests of his company.

MR. W. N. CUMMINGS, who was formerly connected with the American Vitrified Conduit Company, and was latterly manager of the British Electrical engineering and contracting firm of Maguire & Baucus, of London, is at present on a visit to this side. He is a guest at the Hotel Imperial.

DR. M. I. PUPIN returned recently from a trip to England and the Continent and resumes his duties at Columbia University, New York. He was called abroad in relation to his various important inventions in the field of telegraphy and telephony. Among the countries visited were Germany and Austria.

MR. A. B. SANDERS, who has for several years been connected with the engineering department of the American Telephone & Telegraph Company at New York, has resigned to take a position as sales engineer with the Electric Storage Battery Company, of Philadelphia. Mr. Sanders assumed his new duties on Oct. 6.

MR. CHARLES S. DRUMMOND, the president of the Manhattan Transit Company and one of the principal directors of the British Electric Traction Company, Limited, who has been on this side for some weeks past regarding the business of the former concern, sailed Tuesday for Europe by the North German Lloyd liner Kaiser Wilhelm der Grosse.

MR. G. MARCONI.—A cable dispatch from Rome, Italy, of October 4, says: Mr. Marconi announces that he has perfected an electric motor-car having a speed of thirty-eight miles an hour, the accumulators weighing 250 pounds, being sufficient for a journey of 560 miles. There are four batteries arranged in a circle divided into four sections. Tests will be made soon in Paris.

MR. C. H. NORWOOD, formerly representative of the Cutler-Hammer Mfg. Co. in Chicago, has been appointed to the care of the Chicago office of the Commercial Electric Company, of Indianapolis. He will be located at 1503 Fisher Building, and will devote his attention to the application of direct current electrical machinery for the economical distribution of light and power.

MR. RALPH W. POPE, secretary of the American Institute of Electrical Engineers, was married to Mrs. Katherine A. Durant, of Great Barrington, Mass., on Wednesday afternoon, October 1, at the bride's summer cottage, Ocean Grove, N. J. The ceremony was performed by the Rev. Mr. Longley, rector of Trinity Church, Asbury Park. Mr. Pope is well known as a veteran electrician, and has been secretary of the Institute for some sixteen years.

MR. A. C. SHAW, [illegible] pany's interests, arrived in this country last week per "Campania," to attend the street railway convention at Detroit. Mr. Shaw has a host of friends and acquaintances in America, where he spent a great many years. He is very [illegible]

MR. ADOLF ASCHOFF, [illegible] Brazilian interests of the General Electric Company, McIntosh, Seymour & [illegible] Europe on the North German Lloyd liner Kaiser Wilhelm der Grosse with his wife and daughter. [illegible] will take a direct steamer to Brazil.

MR. J. H. SWINNARTON, [illegible]

[illegible] The chair of physics will be occupied next year by Henry A. Perkins, of [illegible] degrees of E. E. and M. A. from that institution. He was at one time connected with the Hartford Electric Light Company. He has been the past year at Yale, where he holds a scholarship.

MR. THOMAS B. WHITTED has opened an office as consulting engineer at 221-224 Equitable Building, Denver, Col. Mr. Whitted has for several years been district engineer of the General Electric Company at the Denver office and is consequently exceptionally well versed in electrical engineering practice in the mountain regions. He has been retained regularly to look after the J. J. Henry properties which include the Tucson (Ariz) Gas, Electric Light and Power Company; Albuquerque, (N. Mex.,) Gas, Electric Light and Power Company; Rawlins (Wyo.) Electric Light and Fuel Company; Sheridan (Wyo.) Electric Company; Baker Gas and Electric Company, and a number of others.

NEW INSTITUTE MEMBERS.—At the last meeting of the Board of [illegible] Armstrong, James Roberts Charlton, 140 E. 34th St., New York City. Bay[illegible] James Adams, electrical engineer, The Bell Telephone Co., Montreal, P [illegible] Beldon, David W., electrical engineer and general superintendent, The Ph[illegible] Light and Fuel Co., Phœnix, Ariz. Benecke, Adelbert O., Weston Electr[illegible] Instrument Co., Waverly Park, Newark, N. J. Burson, Herbert Art[illegible] demonstrator in electrical engineering, McGill University, Montreal, P. Q. Cogan, Henry Manning, electrical engineer, The American Sugar Refining Co. [illegible] Paul, assistant superintendent, Colorado Department, Telluride Power C[illegible] Telluride, Col. Finney, John H., assistant manager, New York office, Sta[illegible] Electric Mfg. Co., 29 Broadway, New York City. Freund, Henry Paul, testing department, General Electric Co., Schenectady, N. Y. Gibbs, Harry Par[illegible] constructing engineer, Gen Elec. Co., Champion Reef, Kolan Gold Field, S[illegible] India. Hartmann, Francis M., instructor of experimental physics and ele[illegible] trical measurements, Cooper Union, New York City. Hatch, Austin Sm[illegible] assistant general superintendent, Public Lighting Commission, 40 East Atwa[illegible] St., Detroit, Mich. Hill, Joseph Mansfield, Edison Storage Battery Co., Orange, N. J. Hodgson, Cecil, electrical engineer with Stephens & Tyler, 7[illegible] Monadnock Block, Chicago. Holley, Carl Hiram, chief engineer, The M[illegible] [illegible] Engineer's Office, 5 Masonic St., New London, Conn. Hunter, M[illegible] electrical engineer, Kilbourne and Jacobs Co., Columbus, Ohio. Joyner, A[illegible] Henry Winter, electrical engineer, Edison Electric Illuminating Co., of B[illegible] Mass. King, R. O., 503 Markham St., Toronto, Ont. Leslie, Hugh [illegible] The Electric Storage Battery Co., 19th St. and Allegheny Ave., Ph[illegible] Pa. Lusk, William Clardy, agent, General Electric Co., residence, 234 [illegible] St., Schenectady, N. Y. McIntyre, Henry Knox, assistant engineering de[illegible] ment, New York Telephone Co., 15 Dey St., New York City. Myers, [illegible] eric William, superintendent of construction, Standard Underground C[illegible] Co., Pittsburg, Pa. Packard, Granville Frederick, chief engineer, Stow M[illegible] ufacturing Co., 195 Court St., Binghamton, N. Y. Parodi, Hippolyte, [illegible] trical engineer Francaise Thomson-Houston Cie, 10 Rue de Londres, P[illegible] France. Pearson, John, superintendent St. Croix Power Co., Somerset, W[illegible] Potter, Carroll, superintendent, Electric Storage Battery Co., 19th St. [illegible] Allegheny Ave, Philadelphia, Pa. Potts, Louis Maxwell, chief c[illegible] engineer, Rowland Telegraphic Co., 710 No. Howard St., Baltimore, [illegible] trical draughtsman, Pennsylvania Steel Co., 17 N. 4th St., Steelton, [illegible] gel, Hermann Georg, general manager, Rand Central Electric Works, Ltd., [illegible] 3498, Johannesburg, S. A. Steinmetz, Edward George, assistant superinten[illegible] The Electric Storage Battery Co., 19th St. and Allegheny Ave., P[illegible] Pa. Tuttle, Horace Burt, engineering chemist, Cleveland Electrical [illegible] electrical engineer, American Union Electric Co., 18 West 130th St., New Y[illegible] [illegible] tric Storage Battery Co., 19th St. and Allegheny Ave., Philadelphia, Pa. Y[illegible] John Mason, student in electrical engineering, Cornell University; [illegible] New York Edison Co., New York City. W. S. Franklin, profess[illegible] and electrical engineering, Lehigh University, South Bethlehem, Pa. [illegible]

Trade Notes.

THE W. D. GRAVES ELECTRIC & MACHINE WORKS [illegible] the Mutual Electric & Machine Company.

[illegible]

DAVENPORT MACHINE WORKS.—[illegible]

WIRELESS CLUSTERS.—[illegible] clusters.

BELT CONVEYORS.—[illegible]

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, is removing its factory and general offices into a large five story building on St. Clair Street, in that city. The building has been entirely remodeled for manufacturing purposes and the North Company will occupy practically the whole of it, giving it several times the floor space of the old factory.

GREGORY INSTALLATIONS.—It requires most of 70 octavo pages of type to record the installations up to date of the Gregory Electric Company, of Chicago. This record is bound in pamphlet form with an attractive cover. Some illustrations show the offices and various departments of the company's large factory. The record is one of which the company may well be proud.

DIRECT-CURRENT DYNAMOS AND MOTORS.—The Star Dynamo Works, Jefferson City, Mo., manufactures a line of dynamos and motors ranging from ¾ to 3 kw and 1 to 4 hp. These are illustrated and described in a pamphlet recently issued by the company. This concern makes a specialty of complete outfits for incandescent and arc lighting of 15, 25 and 50-light capacity.

THE SAN FRANCISCO ELECTRIC PROTECTIVE COMPANY, which has filed articles of incorporation with a capital stock of $100,000, will install a second burglar alarm system in San Francisco. The stockholders of the company are Ex-Captain of Detectives John Seymour, Ex-Lieutenant of Police Fred Esola, J. L. Eppinger, Henry Rosenfeldt and Harry Goodall. The company will open for business as soon as the necessary plant can be purchased and installed.

ROBIN'S BELT CONVEYORS.—The adaptability of the Robin's belt conveyor for the handling of material which attacks iron, such as salt, etc., is well illustrated in a large illustrated circular just issued by the company. One illustration shows a conveyor handling salt, another shows a Robin's conveyor in the works of the Acker Process Company at Niagara Falls. This conveyor is particularly well adapted for use in chemical works. The working parts are protected against contact with corrosive substances, the conveyor being a rubber belt with its edges turned up dish fashion.

POWER PUMPS.—The Gould's Manufacturing Company, of Seneca Falls, N. Y., as is well known is one of the largest manufacturers of power pumping machinery. Its products in this line are very clearly shown in illustration and briefly described in a handsome pamphlet of 160 pages just issued by the company under the title "Efficient Triplex Power Pumps." The catalogue covers the company's entire line of triplex power pumps for every service, pumps suited for each service being grouped in sections. Any one interested may obtain a copy of this complete catalogue by applying to the company.

VENTILATORS.—The Buffalo Forge Company, Buffalo, N. Y., in a pamphlet calls attention to the merits of its "Buffalo Improved Ventilators" which are specially recommended for the rapid and constant [illegible] of [illegible] air, hot air, smoke, steam or gases. The removal is effected by accelerated upward currents of air induced in the ventilator. The exhaust currents, it is stated, are unfailingly set up by wind action, also by the difference of temperature between the inside and outside air. These ventilators are recommended for use in the ventilation of factories, mills, hotels, schools and buildings of all classes.

JAEGER LAMPS.—Dr. C. A. Meeker, the well known [illegible] of [illegible], N. J., writes to the Jaeger Miniature Lamp Co.: "I bought one of your [illegible] at the N. J. Exhibit Annual Meeting of 1902. Permit me to say it is the best I have ever be n the possessor of. I have purchased many, the earliest in 1883, exhibited at the A. D. A. meeting in Newark. The care of the batteries and the vexatious delays of giving out just when you most desired them, always made them a necessary evil. This one seems to go as long as the street current continues. You should bring it before the profession by advertising it."

THE WESTERN ELECTRICAL SUPPLY CO., of St. Louis, general selling agent for the new Peerless incandescent lamps, states that owing to the popularity and exceedingly large demand for this lamp, the factory has largely increased its capacity recently, and while it is making even better lamps than ever, on account of the very greatly increased facilities, it is offering this lamp at a slightly lower figure. It states that this lamp is thoroughly high grade, and that it has met with unusual success with it. It is sold subject to the strongest of guarantees. Any one on the market for lamps is requested to communicate with the company.

JOHNSON & MORTON, Utica, N. Y., have just issued a new catalogue on "Panel Boards and Accessories," which is the most convenient and complete literature published on this subject. The catalogue includes all forms of panel and distribution boards and all fittings that are ordinarily used in connection with them. The lists are arranged so as to be very convenient for reference. Each style of panel is listed on a separate page, and all of the items for use in connection with the panels are given on the same page as the panel boards list. This feature will be a great convenience to all of the contractors in estimating, as they can get the complete prices without referring to a number of catalogues. The company has just completed a large addition to its plant, increasing the floor space about four times, and is now equipped to fill promptly all orders for panel boards, distribution boxes, switches and switchboards. The company has decided to discontinue the New York office, and will handle this business directly from the factory in the future.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 30, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

709,865. RAILWAY SWITCH OPERATING DEVICE; J. C. Booth, Monessen, Pa. App. filed May 14, 1902. By operating a push button on the car, a magnet is energized to throw downward a plow that engages with mechanism in the roadway to move the switch.

709,867. PROCESS OF MANUFACTURING NITROGEN COMPOUNDS FROM ATMOSPHERIC NITROGEN; C. S. Bradley, New York, N. Y., and D. R. Lovejoy, Niagara Falls, N. Y. App. filed March 9, 1900. (See page 579.)

709,868. APPARATUS FOR SUBJECTING CASES TO HIGH TENSION DISCHARGES; C. S. Bradley, New York, N. Y., and D. R. Lovejoy, Niagara Falls, N. Y. App. filed Aug. 29, 1901. (See page 578.)

709,878. MANUFACTURE OF RAIL BONDS; F. H. Daniels and H. W. Wyman, Worcester, Mass. App. filed Feb. 7, 1902. The end of the bond has a socket to receive a plug which spreads the end in the orifice in the rail.

709,915. CONTROL OF ELECTRIC MOTORS; H. W. Leonard, Bronxville, N. Y. App. filed Aug. 26, 1901. (See Current News and Notes.)

709,916. METHOD OF CONTROLLING ELECTRIC MOTORS; H. W. Leonard, Bronxville, N. Y. App. filed Dec. 10, 1901. (See Current News and Notes.)

709,971.—ELECTROLYTIC DECOMPOSITION OF ALKALINE SALTS; E. Edser and M. Wildermann, London, Eng. App. filed March 28, 1902. (See page 578.)

709,982. APPARATUS FOR SEPARATING MAGNETIC AND NON-MAGNETIC MATERIALS FROM ONE ANOTHER; J. W. R. T. Heberlé, Sala, Sweden. App. filed Dec. 28, 1897. A vertically moving belt having magnets behind it is arranged in a water tank, the magnetic particles being conveyed thereby to a compartment on one side of a partition, while the other particles fall to the other side.

709,996. SIGNAL LAMP FOR TELEPHONE SWITCHBOARDS; Frank R. McBerty and Frederick H. Loveridge, Evanston, Ill. App. filed May 14, 1900. (Notice will appear in next week's issue.)

710,045. ELECTRICAL STEERING GEAR; M. W. Day, Schenectady, N. Y. App. filed Aug. 23, 1901. (See Current News and Notes.)

710,050. CONSTANT CURRENT TRANSFORMER; A. R. Everest, Lynn, Mass. App. filed March 4, 1899. In order to compensate for the variations of the load curve, a variable counter weight is provided of such nature as to decrease the force urging the coils together the more they are separated.

710,052. APPARATUS FOR MAINTAINING UNIFORM RESISTANCE IN ELECTRIC CIRCUITS; F. A. Gilbert, Brookline, and E. O. Lundin, Beachmont, Mass. App. filed Dec. 17, 1897. An electric arc lamp provided with series and shunt regulating coils, and a controlling magnet in shunt to the arc for cutting out part of one of said coils after a determinate rise of temperature due to starting the lamp, to compensate for change of arc length due to such rise of temperature.

710,055. ELECTRIC ARC LAMP; C. E. Harthan, Lynn, Mass. App. filed July 24, 1900. Means for adjusting the carbon carrying tube within the surrounding spool and coil.

710,056. AUTOMATIC CIRCUIT BREAKER; C. D. Haskins, Schenectady, N. Y. App. filed Dec. 14, 1900. A transformer having its primary coil in circuit with the apparatus to be protected, a fragile conductor in the main circuit and devices controlled by the secondary coil for rupturing the fragile conductor.

710,065. SELF RESTORING TELEPHONE; Louis J. Loeffler, New York, N. Y. App. filed October 23, 1901. (Notice will appear in next week's issue.)

710,067. SYSTEM OF ELECTRICAL DISTRIBUTION; A. D. Lunt, Schenectady, N. Y. App. filed Jan. 31, 1901. Certain means for connecting a neutral conductor through a point of neutral potential to an armature winding of a dynamo electric machine.

710,068. METHOD OF MAINTAINING UNIFORM RESISTANCE IN ARC LAMP CIRCUITS; E. O. Lundin and F. A. Gilbert, Boston, Mass. App. filed Dec. 17, 1897. A method of regulating lamps having series and shunt coils consisting in automatically cutting out part of one coil, when it heats after starting the lamp, to compensate for the change of voltage at the arc accompanying such heating.

710,070. APPARATUS FOR MULTIRATE METERING; E. Oxley, Lynn, Mass. App. filed March 8, 1899. A number of meters located at the various points of consumption, each being arranged to register at more than one rate and an automatic control device operated by current received from the system for changing the rate at which the meters register.

710,072. ELECTRIC RAILWAY SYSTEM; W. B. Potter, Schenectady, N. Y. App. filed Feb. 28, 1901. The conveyor of a sand box is run by an electric motor when desired.

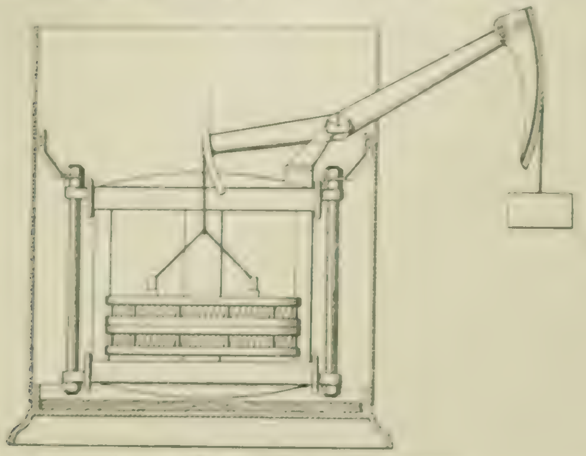
710,081-82. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles P. Steinmetz and William L. R. Emmet, Schenectady, N. Y. App. filed Dec. 21, 1899. By means of a phasing transformer, two phase e.m.fs. are derived from a three-phase circuit and combined to produce six-phase e.m.fs., the latter being supplied to a rotary converter. Means are also provided for leading out from the phasing transformers a neutral to form part of the direct-current circuit.

710,083. ELECTRIC METER; G. Stern, Charlottenburg, Germany. App. filed Dec. 11, 1900. In this meter a shunt circuit is so organized that the current therein is displaced by 90° behind its electro-motive force, so as to reduce the consumption of energy in the shunt circuit.

710,084. CLOCK CHIME; G. M. Stevens, Cambridge, Mass. App. filed July 22, 1901. Details.

[illegible] ELECTRIC CONTROLLER [illegible] App. filed [illegible] [illegible] circuit at all times and a circuit changer provided with a magnetic blow-out.

[illegible] METHOD OF [illegible] INCANDESCENT ELECTRIC LAMPS OF RELATIVELY LOW VOLTAGE; S. E. Doane, Marlboro, Mass. App. filed Feb. 7, 1902. In order to properly heat the joints of the



[illegible] Constant Current Transformer.

[illegible] used, one of low potential through the filament, and the other of high potential through the [illegible]

[illegible] WIRELESS TELEGRAPH SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed Dec. 11, 1901. A transmitter for wireless telegraphy, which comprises means for generating high-frequency oscillations, and connections from said generator to the terminals of a winding, a portion of said winding operating as the inductance element of a resonant radiating circuit.

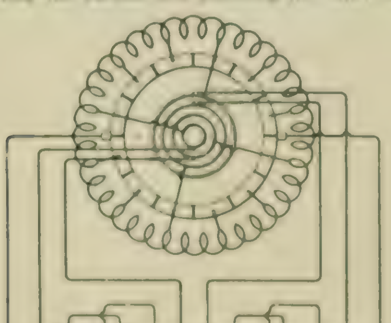
710,122. WIRELESS TELEGRAPH SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed Jan. 11, 1902. Improvements in various features of the system, including an adjustment for the tapper and a shield for the wave-[illegible]

[illegible] RESISTANCE COIL AND SUPPORT THEREFOR; H. P. Davis, [illegible] smaller ring and a number of insulating blocks mounted in the frame at one side of the coil.

[illegible] AUTOMATIC ELECTRIC TIME SWITCH; [illegible] Details.

[illegible] SYSTEM OF ELECTRICAL DISTRIBUTION; [illegible] Pittsburg, Pa. App. filed Oct. 14, 1901. (See Current News and Notes.)

710,186. METHOD OF EXHAUSTING INCANDESCENT ELECTRIC LAMPS; S. E. Doane, Marlboro, Mass. App. filed Dec. 10, 1900. A [illegible]



[illegible] System of Electrical Distribution.

[illegible]

[illegible] ELECTRIC SWITCH; [illegible] Details.

[illegible] MEANS FOR PREVENTING INJURY IN USING X-RAYS; [illegible]

[illegible] APPARATUS FOR TRANSPOSING ELECTRIC CIRCUIT WIRES SO AS TO EQUALIZE INDUCTION; [illegible] Staten Island, N. Y. [illegible] intervals to the parallel [illegible] crossed.

[illegible] INSULATING HANGER; J. M. Schmidt, Elkhorn, W. Va. App. filed June 12, 1902. Details.

[illegible] ELECTRIC SWITCH; F. H. Headley, St. Austell, England. App. filed Jan. 21, 1901. Details.

710,278. ELECTRIC BATTERY; T. H. Klinker, Jr., and R. Gareillsky, Jersey [illegible] The two elements of a sealed [illegible] are provided with tubular passages through which liquid can be introduced to the cell when it becomes exhausted.

[illegible] INSULATOR; E. Lefever, Climax, Ohio. App. filed March [illegible] 1902. The insulating block is covered with sheet metal having upwardly [illegible] attachment.

710,297. INSULATOR; R. S. Peirce, Chicago, Ill. App. filed Feb. 10, 1902. The threaded pin is in two loose parts, placed on opposite sides of a flat plate, which projects beyond the upper end of the pin. When the knob screws on, it strikes the end of the plate and draws the two parts of the pin into intimate contact with itself.

710,309. TELEPHONE TRANSMITTER; Mathias Weisser, of Milwaukee, Wis. App. filed January [illegible] (Notice will appear in next week's issue.)

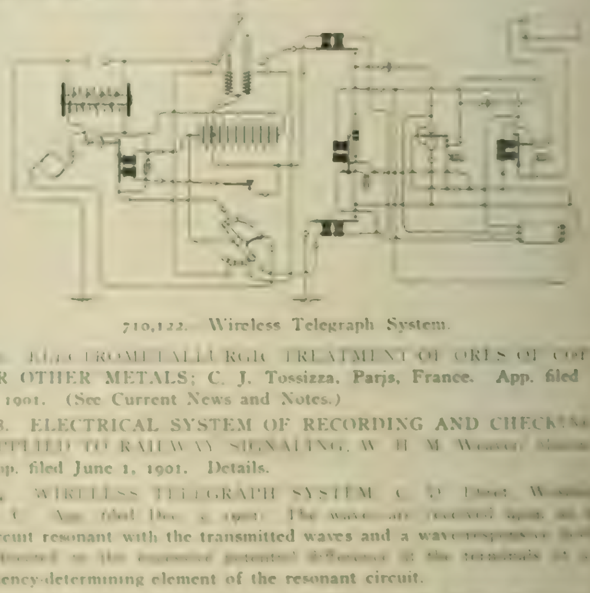
[illegible] ELECTROMAGNETIC DEVICE FOR CONTROLLING THE ROTATION OF SHAFTS; P. V. Avril, Paris, France. App. filed April 20, 1901. Details.

710,318. TOLL APPARATUS FOR TELEPHONE EXCHANGES; William W. Dean, Chicago, Ill. App. filed January 14, [illegible] (Notice will appear in next week's issue.)

[illegible] SIGNALING APPARATUS; H. A. Fessenden, Detroit, Mich. App. filed Sept. 6, 1901. The arm of the sending apparatus is followed in its movements by an index and the failure of the index to move, shows that the signal was not received.

710,333. SELECTIVE CALLING APPLIANCE FOR TELEPHONE LINES; Frank R. McBerty, Evanston, Ill. App. filed May 21, 1898. (Notice will appear in next week's issue.)

710,335. SELECTIVE CALL FOR TELEGRAPH OR TELEPHONE LINES; William Palmer, Jr., Rincon, N. M. App. filed December 11, 1901. (Notice will appear in next week's issue.)



710,122. Wireless Telegraph System.

[illegible] ELECTROMETALLURGIC TREATMENT OF ORES OF COPPER OR OTHER METALS; C. J. Tossizza, Parjs, France. App. filed Aug 6, 1901. (See Current News and Notes.)

710,348. ELECTRICAL SYSTEM OF RECORDING AND CHECKING [illegible] APPLIED TO RAILWAY SIGNALING; [illegible] App. filed June 1, 1901. Details.

[illegible] WIRELESS TELEGRAPH SYSTEM; [illegible] circuit resonant with the transmitted waves and a wave-responsive [illegible] quency-determining element of the resonant circuit.

[illegible] WIRELESS TELEGRAPH SYSTEM; [illegible] App. filed Dec. 3, 1901. Apparatus for carrying out the preceding [illegible]

710,356. CIRCUIT BREAKER FOR ELECTRIC LAMP GLOWERS; [illegible]

[illegible] METHOD OF STARTING ROTARY CONVERTERS; [illegible] (See Current News and Notes.)

[illegible] CIRCUIT BREAKER; [illegible] force to that of the dynamo.

[illegible] ELECTRIC LAMP GLOWER AND METHOD OF ATTACHING TERMINAL WIRES THERETO; [illegible] by applying a globule of cement.

[illegible] [illegible] H. Shoemaker, Philadelphia, Pa. App. filed Jan. [illegible] tube may be carefully regulated and nicely adjusted during the operation [illegible]

[illegible] INTERRUPTER FOR ELECTRIC APPARATUS; H. Shoemaker, Philadelphia, Pa. App. filed Jan. [illegible] 1902. A motor driven, reciprocating contact into the path of travel of which is brought a second contact under [illegible] a telegraph key.

[illegible] ELECTRIC ARC LAMP; A. F. Shore, New York, N. Y. App. filed Nov. 9, 1899. Improvements in a lamp using ring-shaped carbons.

Electrical World and Engineer

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NOTICE TO READERS

WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

SPECIAL ANNOUNCEMENT TO ADVERTISERS.

The attention of advertisers is directed to an important announcement appearing on page xviii of the advertising section of this issue, on the subject of the new schedule of advertising rates taking effect January 1, 1903.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico,	per year, $3.00
Foreign Countries, within the Postal Union,	6.00
Great Britain and Ireland,	25 shillings
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France,	31 francs
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Remittances for foreign subscriptions may be made through our European office.

In requesting your address changed give OLD as well as new address.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, OCTOBER 18, 1902.

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THE STREET RAILWAY CONVENTION.

It will have been noted from the report which we gave in our issue last week of the Detroit Street Railway Convention, and by the supplementary details presented in this week's issue, that the association did not take up this year with as much fullness and specific attention the engineering questions relative to the great art of urban traction. This, of course, must have been more by way of deliberate plan than accidental, as there are many engineers of the highest standing who would welcome the opportunity to appear before such an influential body and to discuss standard features or to ventilate their own ideas as to the manner in which new conditions should be met. The availability of such matter and the general interest in it were well evidenced by the Great Barrington meeting of the American Institute of Electrical Engineers last June, and we think that many members of the Street Railway Association will have regretted this absence of discussion on technical subjects. It is, however, a moot question how far such a body as the Street Railway Association should go in technical discussions, and whether it is not better to take up the broad issues of genêral policy relating to the care of traffic, the handling of employees and other matters which have nothing to do with the construction and care of apparatus. The meeting, last May, of the National Electric Light Association went pretty far in technical controversies, and brought up a multitude of engineering topics, but after all, many of these might have been better left to the Institute, freeing the association to consider—as it never yet has properly considered—the great questions of dealing with the public. The deep interest shown in the vital and ever present question of rates was an indication of the manner in which the practical, managerial members desire to thresh out matters which deal with the dividend earning capacity of the properties entrusted to them.

The Street Railway Association had already undergone a process of subdivision in the creation of the Accountants Association, to take care of the more specific technical questions belonging to the financial end of the business; and a further excellent step was taken last week in the proposal to organize an association of master mechanics of the different street railway companies. This, again, tends to deprive the programme of many interesting papers, and leaves the discussion of them to men more particularly concerned, so that the great central body will have more time than ever to take up the large problems of administration, which belong in the hands of the executive heads rather than in those of the technical staff. Presumably this division of work was in mind in drawing up the programme of the meeting last week, and we are rather curious to see how it works out in later conventions. In view of the fact, however, that the body of master mechanics was not yet in existence, we think the programme might well have been enriched by one or two papers such as they would deal with. For it must be evident to any one who studies the situation that at this stage as much as at any other, the engineering aspects of the art are fresh and new, and invite to that friendly discussion which can best be indulged in at such gatherings.

Elsewhere, we discuss the treatment of the steam turbine at the convention, and, having done that, exhaust the large technical questions brought before the body. One other paper which was of wide general interest was that of Mr. G. W. Parker, of the Detroit United Railway, on "Electric Express and Package Delivery." As noted

in our columns last week, this paper was extremely interesting, but it is agreed by all who attended the convention, that only by visiting the territory in which the company operates can a full scope of the magnitude of this work be realized. So far as the farmer is concerned, the trolley has deprived the word "isolation" of any meaning. It has been said that farmers' wives have been more apt to become weak-minded because of the loneliness of their lives than any other class in the community. But any one who thinks that a farmer's life need be lonely has only to visit the rural regions lying around Detroit. There, every farmer who chooses has his telephone. There, it is hard to find a farm house which is out of sight or out of sound of the ubiquitous trolley. There, the main trolley lines follow stragetic routes for the collection of farm produce, while switches and sidings ramify ell nigh to every farmer's barn door. The city storekeeper can make swift and easy delivery to his bucolic customers, while from every hill and valley a constant stream of farm freight converges towards the freight depots of the trolley system, either for city supply or for transfer to the steam railroads. It is impossible not to be profoundly impressed with the possible range of such work; it is impossible not to be convinced of its great benefit and utility to the farming population.

The Steam Turbine.

The paper which, judging from the animated discussion which followed its reading, elicited the greatest interest at the Detroit Street Railway Convention, was one on the steam turbine, an abstract of which is printed elsewhere in this issue. While the paper is frankly a commercial one and refers to but one type of turbine, it is of much general interest through setting forth in detail the advantages claimed for this prime mover as applied to the generation of electric current. While perhaps not of so much practical moment at the present day as some others of its features, the high speed of the turbine is an ideal qualification if the fundamental principles of electric generation are alone considered. Indeed, had the steam turbine been perfected in the early days of electrical engineering, no thought would probably have been given to any other type of engine, and dynamo development would have proceeded along quite different lines. As it was, engineering ability was concentrated on bringing up the speed and regulation of the reciprocating engine, lowering the speed of the electrical generator, and otherwise co-ordinating the two. The result merits one of the finest pages in the story of engineering triumphs, for the combination has been adapted to meet with commercial success every application in current generation thus far developed. Though for parallel operation the steam turbine appears to be better adapte than the reciprocating engine, the latter is far from being disqualified on this score in practical operation; and the slow-speed generator has been brought to a point of efficiency that leaves little or no margin for improvement—and superior electrical efficiency could not reasonably be expected at the higher speeds of the turbine generator.

The matter thus practically resolves itself into one of steam economy and first cost, if we leave aside the question of practical operation of turbine units, concerning which there is at present little data. While the paper does not touch on the cost of the prime mover itself, it dwells upon the installation factors entering into the total cost of a plant; it is shown that these in every particular are lower than in the case of a plant using reciprocating engines, either vertical or horizontal, while the cost of the turbine dynamo is also much smaller than a low-speed machine of same capacity. Accepting the figures given, it thus appears that whether the turbine unit as installed will be cheaper than a corresponding reciprocating engine unit depends upon the cost of the turbine itself, and no direct information was given on this point. In the discussion, however, it was stated that the turbine to which the paper particularly referred would not be sold separately from the electrical machine, but that the total cost installed of the complete unit is such as to compare favorably with the cost of a corresponding unit of the present type. Should the policy thus implied of considering the steam and electrical parts of generating apparatus, as one unit in manufacture, be fruitful of good results, we may look forward to a general and wide departure from present manufacturing methods, one of the first consequences of which will probably be the entry of engine builders into the dynamo field. As to economy, a number of authoritative tests show a remarkably low steam consumption for the turbine—in some cases below 11 pounds per indicated horse-power under conditions not at all ideal. Even the best friends of the steam turbine do not claim that it has reached a final state of development, and there is strong probability that considerably higher efficiencies will be attained, particularly owing to the adaptability of the steam turbine to the use of superheated steam at temperatures entirely beyond the range of the reciprocating engine. The case made out for the steam turbine unit by its advocates is one of strength, and all interested in electrical generation will look forward with the keenest expectancy for the verdict which practical experience over a sufficient length of time will bring forth.

The Calculation of Dynamo Armatures.

A rescript of a paper recently presented by Prof. Pasqualini to the Italian Electrotechnic Association, appears on page 614. It discusses the question of the design of dynamos by a series of formulæ. If the plan were feasible, and were carried out, dynamos would be built by the book, and for any particular type of winding, the detailed electric and magnetic properties of a dynamo would be capable of tabulation in advance, like the sun's daily position in the nautical almanac of the coming year. At the present time, as is well known, there is no fixed basis of calculation for dynamo design. Even if the speed of rotation of a given size of machine is fixed, there may be an indefinitely large number of variations in dimensions, which will fill the remaining specifications. For example, the iron in the machine may be plentiful, and the number of armature conductors few, or *vice versa*. There is no rule for blindly predetermining the armature and field-magnet dimensions accompanying a given speed of rotation and kilowatt-output. Various co-ordinate iron structures of field and armature might be found leading to a possible solution.

There is a corresponding divergence of opinion and habit among different designers and manufacturers of dynamos. Some affect one type and set of dimensions, while others lean to a different type and set. In the main, however, dynamo designers usually make their machines about the same size and weight for a given output and given speed; but this consensus of action is governed by a variety of circumstances, among which economy of construction, based on the ruling prices of iron, of copper and of labor, play the dominant rôle. If the relative prices of iron, copper and labor were to change materially and suddenly, within a year we might look for a modification in the type and dimensions of dynamos for a given output and speed, tending to restore the minimum cost of construction consistent with filling commercial requirements.

Prof. Pasqualini has, however, attacked the problem on the basis of an initial criterion. He designs for a minimum volume of iron in the armature, with a view to reducing the loss by hysteresis to a minimum during the operation of the machine, and thus aiming at

a maximum efficiency. We doubt, however, whether the proposition is true that the minimum volume of iron in an armature involves minimum hysteretic loss, other things being equal. On the contrary, it would seem that this proposition is invalid; since reducing the dimensions at fixed flux density might reduce hysteresis, but reducing dimensions at varied flux density might be yet better. At all events, demonstration seems to be needed to show that the fundamental proposition is true, and that a machine with minimum armature iron is the most efficient machine, other things being equal.

Even if the proposition were true, we believe that it could not be trusted to produce a commercially satisfactory machine. There are so many considerations involved in the design of a dynamo, that the final design is a mere compromise, like the vote of a much divided caucus. It is probable that an experienced dynamo designer could work out, in nearly every instance, a better dynamo than the one turned out by the Pasqualini formulas. But it would be arrived at by dint of much empirical variation of design and the survival of the fittest. The only thing that can be said for the Pasqualini method is that it strikes at a single definite solution of the problem for a definite purpose. If the formulæ are correct, the dynamo they determine will have about the minimum revolving iron in it that the conditions assigned will permit. There is at least comfort in this; but whether any hard and fast rule for determining in advance the dimensions of this dynamo of minimum armature core would be as good as some other type of machine is quite another proposition. In spite of the precision of electrical measurements and the accuracy of machine predetermination, it seems safe to predict that there never will be a dynamo built by formula without compromise.

Problems of Inter-Atomic Physics.

The investigations of the last three or four years have raised a great many curious questions touching the constitution of matter and the nature of electrical phenomena. The group of occult radiations, of which the Röntgen ray was the pioneer, have gradually been linked to a species of sub-atomic theory which seems to be assuming far reaching importance. The hypothesis of charged corpuscles certainly enables one to clear up a good many difficulties and raises at the same time a host of curious questions. Of course, the whole matter is yet in a tentative state; a vast deal of pioneering along the line has been done, but the results have not been by any means fully co-ordinated. Once granted that the atom is by no means worthy of its name and we acquire a flexibility in the constitution of things that is well nigh certain to lead to important results. Whatever the facts of the corpuscular case may ultimately prove to be, it must be remembered that the atom has been under grave suspicion for a quarter of a century. No one who is familiar with the recent progress of spectroscopy relating to the correlation between the spectra of cognate elements has been able to retain the corfortable point of view assumed by the chemist. There has long been reason to believe that atoms of similar elements are possessed of certain dynamically similar constituents, and all this recent work points to giving the atom a microcosmic character entirely in keeping with these older facts. Once this is granted, there is no logical reason why the atom should not evaporate corpuscles from its surface, possess properties homologous with vapor tension in masses, and much more to the same effect. Certainly the sacred inviolability of the atom has long since lost its grip, and recent developments can hardly be called inconoclastic.

But with all this, the phenomena charged up to corpuscular action need very careful investigation, and while they may in terms explain a great many things, they are themselves woefully in need of explanation. They are very far as yet from throwing much light on electrical phenomena as such. There is very little comfort to be derived from postulating electric charges on corpuscles unless one is prepared to state what he means by electrical charge. There is great need of turning the searchlight of investigation on the dynamics of electrification in order to make clear the meaning of its presence on either atoms or corpuscles. Otherwise one commits the same logical error of which the old astronomers were guilty in invoking a new epicycle every time they found a new irregularity in a planetary orbit. To put the matter even more plainly, note that an electrical wave propagated with a known velocity sets up a species of strain which has long been associated with the term electrification. Now it may concurrently set up enormous corpuscular activity in the body affected, but we must take care not to confuse the effect with the cause, and the final question remains the same—corpuscles or no corpuscles—what is the nature of the energy transference? We do not in the least get away from the difficulty by shuffling it off on the already heavily burdened corpuscles. And as to these latter, we are in a bad way unless some means can be found of attacking the very puzzling problems they raise along other than electrical lines. There would seem to be danger of arguing in a circle unless some independent means of investigation can be found. The whole subject is befogged for lack of such means. For example, we have now had the Röntgen ray in view and in use for some years, and wonderfully little is known about it that was not in the beginning set forth in Röntgen's great original paper.

If one stops to think of it, the available means of investigation in the study of occult radiations and their allied phenomena are singularly meagre. Aside from the electrometer, which is somewhat indirect and limited in its powers, although wonderfully sensitive in certain cases, we have little but photography upon which to rely. And, if one stops to think of it, photography as we now know it practically depends wholly upon the sensitiveness of the haloid salts of a single element—silver—to certain kinds of radiation. And in the presence of the beautiful variety of radiations that are now showing up, the wonder is that photography is of any use at all. On general principles, there should be chemical compounds sensitive to radiations, in the presence of which the silver salts are stable; and if such could be found our grasp on the Röntgen rays and their kindred should be wonderfully strengthened. A systematic search ought to be undertaken for radiation-sensitive compounds. Not only would a find in this line be of great value to the investigator, but it might also prove to be a priceless addition to scientific photography. The chemical resources of the art, even to-day, are not greatly beyond what was known half a century ago. A[illegible] to be sure, [illegible] an allotropic form of silver bromide somewhat sensitive to infra-red radiations, but that is about the end of the story. Among the compounds of elements of high atomic weight there is good reason to expect new resources for the study of the general range of radient energy and the emanations which have recently been annexed to it. Here is a task worthy the most persistent efforts of the chemist and physicist. At present investigators are blundering around with facilities entirely inadequate to the work they are undertaking, and progress is almost of necessity slow and difficult. The chemical side of the problem has thus far been somewhat neglected; in fact, the whole subject of inorganic chemistry has in recent times fallen into neglect. There is sad need of some genius to do for general chemistry what Kekulé and his followers did for the chemistry of carbon compounds. Mendelief's work marks the way, but thus far there have been few to follow it. The resources of the electrician have thrown a little light into the darkness, but more methods of attack are needed before the present problems can be solved.

The Annual Report of Western Union.

The annual report of the Western Union Telegraph Company for the year ended June 30, 1902, was issued last week. The income account compares as follows:

	1902.	1901.	Changes.
Revenue	$28,073,095	$26,354,151	Inc. $1,718,944
Expenses and taxes	20,780,766	19,668,903	Inc. 1,111,863
Net revenue	$7,292,329	$6,685,248	Inc. $607,081
Interest	992,580	956,160	Inc. 36,420
Balance	$6,299,749	$5,729,088	Inc. $570,661
Dividends	4,868,031	4,868,007	Inc. 24
Surplus	$1,431,718	$861,081	Inc. $570,637
Previous surplus	9,319,285	8,458,204	Inc. 861,081
Total surplus	$10,751,003	$9,319,285	Inc. $1,431,718

Expenses in detail follow:

General expenses	$14,727,407
Rentals	1,568,534
Maintenance and reconstruction	3,591,065
Taxes	575,332
Equipment	318,428
Total	$20,780,766

The capital stock remains at $97,370,000, of which $29,496 belongs to and is in the treasury of the company.

The funded debt at the close of the fiscal year was as follows:

Funded and real estate mortgage, bonds due May 1, 1950 (4½ per cent.)	$13,000,000
Collateral Trust bonds, due January 1, 1938, against which bonds and stock bearing guarantee of interest or dividends, at 6 per cent. per annum, deposited with the trustees (5 per cent.)	8,504,000
Total	$21,504,000

During the year the $1,158,000 7 per cent. building bonds were paid off and retired. To provide the money necessary for that purpose, $1,000,000 4½ per cent. funding and real estate mortgage bonds were issued; $2,000,000 of the same class of bonds were also issued, the proceeds thereof to be used solely for improvements, betterments and extensions; $2,000,000 collateral trust 5 per cent. bonds were exchanged for the same amount of the capital stock of the New York Mutual Telegraph Company, upon which dividends of 6 per cent per annum were paid. The bonded debt of the company has, therefore, been increased from $19,660,000 to $21,504,000. The increase of the interest charges is, however, only $54,040 per annum.

The following table shows the progress of the company at different periods from 1866 to 1902:

	1866.	1890.	1902.
Miles of wire	75,686	678,997	1,029,984
Offices	2,250	19,382	23,567
Messages	5,879,282	55,878,762	69,374,883
Receipts	$6,568,925	$22,387,028	$28,073,095
Profits	$2,624,919	$7,312,725	$7,292,329

There were added to the company's system during the year 2,526 miles of poles and 57,218 miles of wire and 329 offices. The total now is 196,115 miles of poles and cables.

The number of messages increased 3,717,834 over last year. This does not include messages sent over wires leased by brokers, press associations, etc., or by railroads between their local stations. The receipts of regular commercial messages increased $1,348,531, and from leased wires $451,749. The average tolls for the messages transmitted were 31 cents, and the average cost 25.7 cents. There was expended for construction during the year $2,188,101.

Since April 1 contracts have been negotiated and closed with 14 railroad companies, covering over 16,800 miles of railroad.

The report is the best that has been made since 1893. The feature observed with especial interest was the average message receipt, which was 31 cents, and the average message cost, which was 25.7 cents. There has been hope that the management would find a way to reduce the message cost. In 1878, Western Union had average receipts per message of 38.0 cents, and the message cost was 25 cents, a drop of 10 cents per message in about three years. In 1880, the average receipt per message was 31.2 cents or about the same as at present, while the average cost per message was 22.4 cents, the lowest in any year of record. For the last seven years, the average receipts have been very stable while the message cost has been advancing a little. It has been strongly felt that the way to add materially to Western Union profits was to cut down the message cost, but it seems to have been impracticable to do this with the old-fashioned method of manual operation still adhered to. The profits of Western Union were about as large in 1882, when the gross receipts were $17,114,165, as they were last year, when gross receipts were $28,073,095. The profit on handling over 69,000,000 messages was only a trifle larger than the profit on handling 39,000,000 messages.

Wagner Motor Litigation.

Judge Townsend handed down a decision October 10 in a suit brought by the General Electric Company against the Wagner Electric Manufacturing Company, claiming an infringement of patent No. 430,328, granted June 17, 1890, to Elihu Thomson for an alternating-current motor. The invention covered by the patent in the specification is stated by the patentee to consist, broadly, "in arranging the motor so that as a structure its armature will have a different circuit arrangement at the start than those which will exist when it is up to speed, or well started in rotation. To accomplish this, the motor is started with the armature circuits commutated or changed, so that the armature will receive an initial impulse of rotation, after which, when the desired speed has been obtained, the connections are so modified either automatically or at the will of the operator, that the circuit of the armature will be locally closed on itself and commutated. Briefly, the invention consists in commencing to run the motor with a different circuit arrangement for its armature from that which it will have under its condition of steady normal working or running, such primary condition being only adapted to give torque, that being continued for a sufficient time will bring the motor up to the speed where it may run with the armature on continually closed circuit."

The defendants claimed that the clause "will receive an initial impulse" taken in connection with the locally-closed circuit after the desired speed is obtained, shows that the initial impulse is to be received by induction.

The Court held that the respective contentions are primarily directed to the interpretation of the term "locally-closed circuits" as used in the patent. It proceeds to say that Thomson originally proposed to patent broadly any method of starting motors "under a different set of conditions, or with a different structure, or with a different circuit arrangement from that which it will have under its conditions of stated normal working or running"; or by providing commutators only "in carrying out any method of starting." But upon citation of references, these statements of invention were erased, and the invention claimed was limited to only where *after* the initial impulse was received and on the attainment of a predetermined speed, the circuit of the motor armature will be locally closed of itself and uncommutated, or will be put on a "locally-closed circuit."

The Court held that the defendants have satisfactorily proved that the term "locally closed circuit" as used by Thomson in prior patents and generally, means a circuit disconnected from the main line, adding that the defendants claimed that the patent in suit is limited to a motor having its coils on a locally-closed circuit, after, but not before, the initial impulse of rotation is received. The defendant's motor starts by induction, and the motor coils are on locally-closed circuits on starting, in the sense that the circuit pertains to the armature alone, while on former trials the experts admitted that in the Thomson patent the coils are not on a locally-closed circuit on starting, but only on the attainment of the required speed.

In discussing the question at issue, the Court said that the defendants have developed the class of motors in suit, and are now met by the contention that this patent in suit—"a mere paper patent"—by a broad interpretation of its terms may be so extended as to embrace the defendant's construction, the effect of which interpretation would be to give the complainant the benefit of the broader claims rejected by the patent office. The Court said that it does not appear that any motor was ever made under the patent in suit, and that whether such a simple step as that taken by Thomson involved invention, or whether its confessed impracticability deprives it of all claims to utility, it is not necessary to determine. The conclusion of the Court is that defendants are entitled to the rule requiring a narrow construction of such a patent, and upon such a construction there is no infringement.

Electric Pumping Station for Sewage Disposal.

A FINE piece of municipal engineering has been completed at Pittsfield, Mass., and is illustrated in the accompanying views. The necessity for more advantageous disposal of sewage of this city has been appreciated by the authorities for some years, and about two years ago active measures were taken to install a more hygienic system than had previously been employed. Formerly, the entire sewage had been allowed to flow directly into the Housatonic River. Under the new method, however, it is pumped a distance of some two and a half miles from the outskirts of the city to large filter beds, where it trickles through the filtering material consisting of sand, to underdrains, and thus is discharged into the river clarified and harmless. The pumping station, by means of which this operation is performed, is the subject of the illustrations accompanying this article, and is, perhaps, the first electrically-driven pumping station for sewage disposal in this country.

The pump is a three-cylinder, clapper-valve sewage pump, manufactured by the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, and is driven by a 85-hp synchronous motor, built by the Stanley Electric Manufacturing Company, of Pittsfield. The synchronous motor is of the well-known S. K. C. induction type, running at a speed of 900 r. p. m., and is belted by means of a jack shaft to the pump. It was at first intended to operate the driving gear of the pump directly from a pinion on the shaft, but the high speed at which this pinion was run was found to prohibit this construction, and the jack shaft was introduced, as shown in the illustrations. A friction clutch in the jack shaft between the motor and pump pulleys, respectively, allows the starting up of the motor without load. The frame work of the jack shaft is constructed on ways with screws and gear for sliding, so that it acts as a belt tightener.

The starting motor, seen at the right of the synchronous motor in one of the views is an S. K. C. self-starting polyphase motor of 7-hp capacity, and is belted by means of tight and loose pulleys to the shaft of the synchronous motor. This starting motor is connected to two

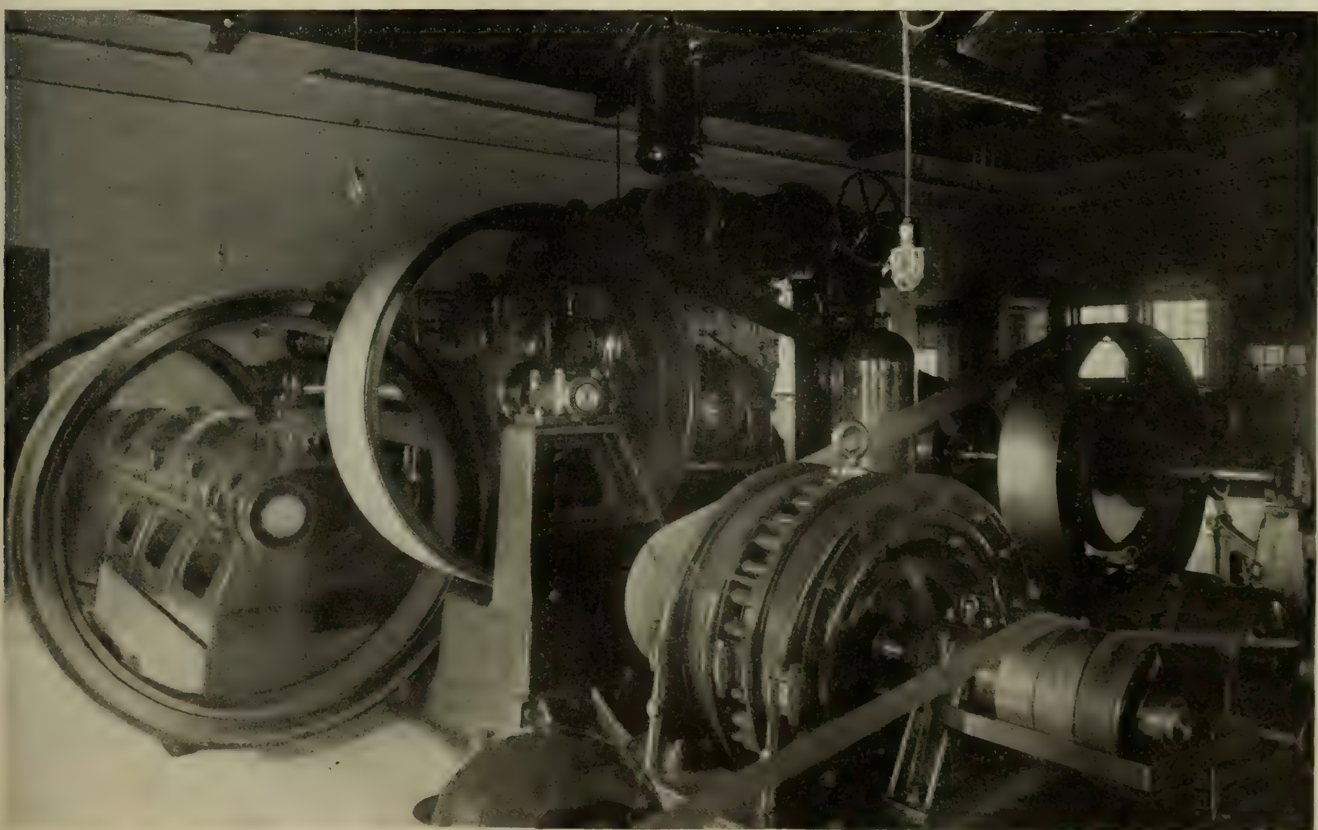


Fig. 1.—Motors and Pump.

S. K. C. transformers which reduce the line voltage to about 500 volts. The starting rheostat is of the water type, and is placed at the right-hand side of the switchboard. It consists of three blades cut in the shape of a quadrant, with a handle at the upper edge, and hinged at the apex. Upon lowering the blades, they are immersed in water contained in a rectangular tank, and the resistance in the secondary or rotor circuit of the induction motor is very easily regulated. In this way it is a very simple matter to get the larger motor up to synchronous speed and to throw it into circuit. The line circuit has a pressure of about 2,300 volts, at 7,200 alternations. Power is ordinarily taken from an auxiliary water-power plant in one of the Pittsfield mills, but the pumping station can be thrown at any time upon the regular city lighting circuits. The exciter is a direct-current dynamo, manufactured by the Northern Electric Company, of

Fig. 2.—Pumping Station.

Madison, Wis. It is belted directly to the synchronous motor. The field current of the motor is 5 amperes.

The pump is a Smith-Vaile pump, especially designed for this class of work. The valves are of the clapper type, leather seated, and are free from any possibility of becoming clogged. The pump is triple acting, and has a capacity of 2,000,000 gallons in 10 hours, delivering at a pressure of 17 lbs. per square inch, the lift to the filter beds being about 54 feet. The cranks of the pump revolve at 29 r. p. m.

The pumping plant is operated only during the day time, and to provide for the disposal of sewage during the time when it is not in operation, large storage reservoirs of some 1,500,000 gallons capacity have been built underground between the pumping station and the screen house, seen in the rear of the general view. These reservoirs

are three in number, and are roofed with brick arches. To prevent any offensive odor from escaping from the reservoir, ducts are provided for carrying all gases, etc., to the base of the chimney, seen on the power station. Should the draft of this chimney be insufficient to carry off such vapors as may arise, a rotary fan, manufactured by the B. F. Sturtevant Company, of Boston, has been placed at the base of the chimney to assist in the ventilation. This fan is not yet in

FIG. 3.—PUMP AND SWITCHBOARD.

operation, but as it is to work both day and night, and as the circuit to the pumping station is cut off at the central lighting station when the pumps are not in operation, it is probable that a water motor will be used for running the fan. A complete system of hot water heating, with radiators, has been installed. The boiler for this hot water system was built by the William Page Boiler Company. As will be seen from the illustrations, the pumping station is built for

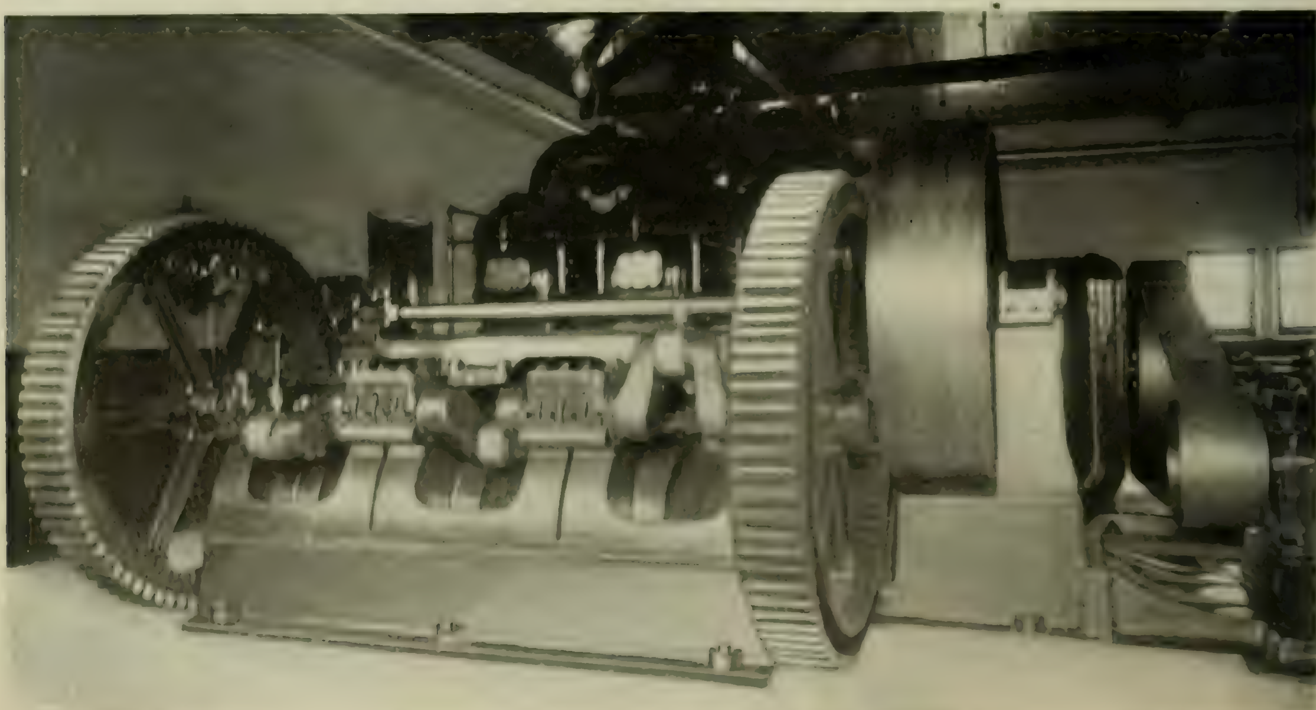


Fig. 4.—Front of Triple Pump.

twice the capacity of pumps and motors now installed. The general dimensions are about 75 feet x 50 feet, the station being a regular cross. It, as well as the screen house, is built of brick, faced with repressed brick and trimmed with rock-faced Monson granite, and both station and grounds have a very pleasing appearance. The construction was under the direct charge of James C. Harding, assistant city engineer of Pittsfield, and it is through his courtesy that the above description is published.

The Calculation of Armatures.

At the July meeting of the Italian Association of Electrical Engineers, Prof. Luigi Pasqualini read a paper in which he considered some of the factors involved in the calculation of armatures. His paper begins with the statement that there is no unanimity of opinion among even the authoritative writers concerning the methods of calculating armature dimensions. Some writers would deduce the diameter in terms of the space occupied by the copper, the number of wires on the periphery of the armature and their section. Others assume the ratio between the diameter and the length of the armature, based on the data of successful machines. Others again assume conditions based upon secondary phenomena, for example, non-sparking at the commutator, a certain definite cooling surface, etc. Professor Pasqualini does not think that these secondary conditions are sufficiently important to be taken as an absolute base on which to calculate the more important dimensions of a machine. While it is logical to verify whether a machine as calculated by a different method, has sufficient cooling surface or can work without sparking at the commutator, it seems rational that only conditions based upon the essential phenomena of a machine ought to be used for determining the dimensions of an armature in a preliminary calculation.

There is a single condition from which it is logical to start, namely, that of a minimum amount of iron in the armature, for it is this condition which assures that the machine will operate with a minimum loss from hysteresis, and consequently, with the highest efficiency. If one assumes this condition he can arrive at extremely simple formulæ for establishing the dimensions of the armature in a first approximation. It will be assumed that the following data are given, which is generally the case:

E=electromotive force.

I=strength of current.

N=number of revolutions per second.

w=watts expended in an armature in joule effect.

p=number of pairs of poles.

p_1=number of pairs of brushes.

δ=density of current.

$\mathfrak{B}$=magnetic induction in the iron embraced by a coil at maximum flux.

$\mathfrak{B}'$=maximum induction in the armature core.

The quantities to be determined are d, the diameter of the armature at the bottom of the teeth; l, the length of the armature core, and n, the total number of coils. Since we have w, I and δ, the length, L, of an armature coil is evidently also known, for we have

$$L = \frac{2\, p_1\, w}{I \rho \delta}$$

in which ρ is the resistivity of the conductor. Calling h the thick-

ness of the core of a drum armature, we have for the volume

(1) $$V = \frac{\pi}{4}\,(2\,d\,h - h^2)\,l$$

but we also have (Fig. 1)

$$\frac{h}{c} = \frac{\mathfrak{B}}{2\,\mathfrak{B}_1},\ \text{and}\ c = d\,sin\,\frac{\pi}{2p}.$$

That is to say, $h = \frac{\mathfrak{B}}{2\,\mathfrak{B}_1}\,d\,sin\,\frac{\pi}{2p}$, and from (1) we can write

(2) $$V = \pi\left(\frac{\mathfrak{B}}{2\,\mathfrak{B}_1}\,sin\,\frac{\pi}{2p} - \frac{\mathfrak{B}^2}{4\,\mathfrak{B}_1^2}\,sin^2\,\frac{\pi}{2p}\right)d^2\,l = k_1\,d^2\,l$$

where k_1 is a constant.

But we can express V as a function of s only or of d only. We thus have the flux expressed by

$$\Phi = \mathfrak{B}\,l\,c = \mathfrak{B}\,l\,d\,sin\,\frac{\pi}{2p};$$

substituting in this expression from the relation

$$E = 2.10^{-8}\,n\,N\,\Phi\,\frac{p}{p^1}$$

from which it is seen that we can place

$$k = \frac{E}{2.10^{-8}\,\mathfrak{B}\,N\,\frac{p}{p^1}\,sin\,\frac{\pi}{2p}}$$

we have

(3) $$k = n\,l\,d$$

We have still another relation between l and d, since the length of a coil is given by

$$2\,a\left(l + d\,sin\,\frac{\pi}{2p}\right)$$

where a is a numerical coefficient greater than unity. We thus have

(4) $$L = 2\,n\,a\left(l + d\,sin\,\frac{\pi}{2p}\right)$$

From (3) and (4) we have

(5) $$l = 2\,k\,a\,\frac{d}{dL - 2\,a\,k}\,sin\,\frac{\pi}{2p}$$

(6) $$d = 2\,k\,a\,\frac{l}{l\,L - 2\,k\,a\,sin\,\frac{\pi}{2p}}$$

substituting (5) or (6) in (2) we have

(7) $$V = 2\,k\,k_1\,a\,sin\,\frac{\pi}{2p}\,\frac{d^3}{L\,d - 2\,k\,a}$$

(8) $$V = 2\,k^2\,k_1\,a^2\,\frac{l^3}{\left(l\,L - 2\,k\,a\,sin\,\frac{\pi}{2p}\right)^2}$$

V is a minimum when its differential is a zero; that is to say when

(9) $$d = \frac{3\,k\,a}{L}$$

(10) $$l = \frac{6\,k\,a}{L}\,sin\,\frac{\pi}{2p}$$

We thus directly obtain very simple formulas which give us the best dimensions for the armature, the number of coils to be obtained by substituting (9) and (10) in (3.) The only empirical coefficient in this method is a, which depends upon the kind of winding chosen, and which for this very reason can be exactly determined.

The formulas (5) and (6) are not only very simple but they contain some interesting features. We see, in fact, that d, l, and n are not functions of k^1—that is to say, of the thickness of the armature core—which at first glance appears parodoxical; but it follows from the fact that a greater or less thickness will only vary the reluctance of the magnetic circuit. It is still more curious that the relation

$$\frac{l}{d} = 2\,sin\,\frac{\pi}{2p}$$

is constant and depends only on the number of poles and not on the dimensions of the machine, nor on the type of winding chosen.

The above method is applicable to the design of alternators with stationary armatures as well as to direct-current machines, for the fundamental equations are the same, there being only a different value of k.

In the case of ring armatures another condition must be taken into account, namely, the ratio between the diameter and the thickness of the armature core, a relation which may be fixed in advance with reference to mechanical considerations. If we suppose

$$h = 3\,d$$

we have

(II.) $$V = \pi\left(x\,\frac{h^2}{3} - h^2\right)l = k_1\,h^2\,l$$

(3) and (4) become

(III.) $$n\,l\,h = k$$

(IV.) $$2\,n\,a\,(l + h) = L.$$

whence $$h = \frac{2\,a\,l\,k}{l\,L - 2\,a\,k};\quad l = \frac{2\,a\,h\,k}{h\,L - 2\,a\,k}$$

substituting in (II.)

$$V = 2\,k_1\,k\,\frac{h^3}{h\,L - 2\,a\,k}$$

$$V = 4\,k_1\,k^2\,a^2\,\frac{l^3}{(l\,L - 2\,a\,k)^2}$$

Equating the differential to zero we have $h = \frac{3\,a\,k}{L}$, $l = \frac{6\,a\,k}{L}$.

We thus see that the length of a ring armature ought to double its thickness whatever the capacity of the machine or the number of poles. From the two final equations we obtain the expression for the diameter

$$d = \frac{3\,a\,k}{3\,L}$$

and from (III.) or (IV.) we can calculate the number of coils.

Women as Farmers.

One of the principal speakers at the Farmers National Congress, which was recently held at Macon, Ga., was John M. Sahl, of Chicago, who discussed "The Labor Problem from the Farmers' Standpoint," and advanced the novel proposition that the future will see many women farmers. He said in part: "One of the most annoying, difficult and vital problems of farming is to get a sufficient supply of good labor. Farmers could hardly pay higher wages. But to a very small degree is it a question of more wages. The loneliness of farm life that has been so powerful in taking farmer boys from the farm and in keeping city laborers from it is fast passing away before rural free mail delivery, the farm telephone and the country trolley line. If, by education, a proper appreciation of our calling, and the introduction of business methods, we put farming on the same plane as other business enterprises, we can command for it our rightful share of the faithful, intelligent labor that now goes to railroading, manufacturing and merchandising. This will come to pass all the sooner because the future will see many women farmers. It is already fashionable for girls to be strong and muscular and athletic and sunburned. In farmwork so much machinery is used nowadays that the greater part of farmwork on the up-to-date farm requires intelligence and dexterity and application rather than muscular strength. Very much of farmwork is no more tiring on the muscles than operating a typewriter; it is much less wearing on the nervous system, and it is certainly much more healthful."

Sault Ste Marie Power.

Next week will witness the celebration of one of the greatest events in the annals of the town of Sault Ste Marie. The Consolidated Lake Superior Company has made official announcement of the opening of the great plant of the Michigan Lake Superior Power Company October 25. Many notables will be present from various sections of the country including officers and stockholders of allied companies. More than 3,000 invitations have been sent out by the company. October 25 will be designated a civic holiday. Business will be suspended and the city lavishly garbed in holiday attire in honor of the occasion, which will mark a new era for the Soo and her people. The plant was elaborately described a few weeks ago in ELECTRICAL WORLD AND ENGINEER.

The Rowland Rapid Telegraph System—I.

An examination of a diagram graphically representing an alternating current will show how it may be altered or modified in a number of different ways, any one of which modifications may, by proper methods, be used for sending signals over a line.

Fig. 1 shows an alternating current which has had certain of its waves modified in six different ways. The minus half-wave, 2, at *E* has been reversed, the minus half-wave, 4, at *A* has been cut-out—namely, the circuit was broken during the time the half-wave would have naturally continued had the circuit not been broken. At *B* a positive half-wave is cut out. At *C* and *D* two half-waves of opposite signs have been increased in height, and at *F* a positive half-wave has been turned into a negative half-wave. If the alternating current were, for instance, made to trace itself on chemical paper the above different modifications of its half-waves could readily be interpreted as six different signals.

In the Rowland system cut-out positive and negative half-waves are employed for sending the signals over the line. A single signal is, however, made to consist of a pair of cut-out half-waves, which are not adjacent. This method leads to the so-called system of "Wave-Groups." This is a very important feature of the invention, which may be described as follows:

Figs. 1 and 2.—Grouping of Waves.

GROUPING OF THE WAVES.

Consider an alternating current, consisting of a series of positive and negative half-waves, as shown in Fig. 2. We may divide these half-waves into groups, as *A*, *B*, *C* *D*, and *X*, leaving an extra half-wave between each group. If we now cut out of each group two or more of its half-waves, a signal may be made to consist not of one cut-out half-wave, but of a *combination* of half-waves cut out from a group. For instance, if the half-waves 1 and 3 are cut out from group *A*, this could be interpreted to mean one thing, while if the half-waves 1 and 4 were cut out this combination would mean another thing, and so on through all the possible combinations of the different half-waves in the group. In practice, in the Rowland system, the signals are made up by cutting out any two half-waves not adjacent. We then have the following possible number of different signals which may be obtained in this way from a group of 11 half-waves:

1—3, 1—4, 1—5, 1—6, 1—7, 1—8, 1—9, 1—10, 1—11.
2—4, 2—5, 2—6, 2—7, 2—8, 2—9, 2—10, 2—11
3—5, 3—6, 3—7, 3—8, 3—9, 3—10, 3—11.
4—6, 4—7, 4—8, 4—9, 4—10, 4—11
5—7, 5—8, 5—9, 5—10, 5—11
6—8, 6—9, 6—10, 6—11
7—9, 7—10, 7—11
8—10, 8—11
9—11

This gives a total of 45 possible different signals, any one of which may be sent over the line during a time in which the current makes 11 alternations.

The Rowland system, in practice, makes use of five groups of waves, with one extra half-wave between each group. In Fig. 2 the groups marked *A*, *B*, *C*, *D* have 11 half waves each. The signals sent over the line, which are afterwards translated in a manner to be shown into printed characters, are made by cutting out some of the different combinations given above, of two half-waves from each of these groups. The fifth group, marked *X*, contains three half-waves, two of which are at certain times cut out automatically for purposes to be described later on.

SPEED OF TRANSMISSION OF SIGNALS.

Professor Rowland found that he could employ with advantage about 208 alternations of the current per second, and, hence, the 52 half-waves illustrated in Fig. 2 will pass over the line in one-fourth of a second, that is, any group of waves, as the group *A*, will repeat itself four times each second.

Suppose there are four sending operators, and each operator is assigned a special group of waves. Each time his group of waves recurs he can cut out from this group two half-waves, that is, send one signal over the line. Thus, four operators utilizing the groups *A*, *B*, *C* and *D* can send four different signals each quarter of a second. Thus, 960 different signals may be transmitted over the line in one direction in one minute. It should be noted that the signals are, in reality, sent over the line in succession, although the process occurs so rapidly that the four different operators appear to be sending their four different signals simultaneously.

Multiplexing of the messages is the term applied to the above process of sending several different signals transmitted by different operators over the line in one direction, though in such rapid succession that they may appear to be sent simultaneously.

The system, moreover, is also duplex. As will be more fully explained, the term duplexing means the sending of two different signals from opposite ends of the line in opposite directions. It will be shown later that the two signals sent in opposite directions may be transmitted at identically the same instant.

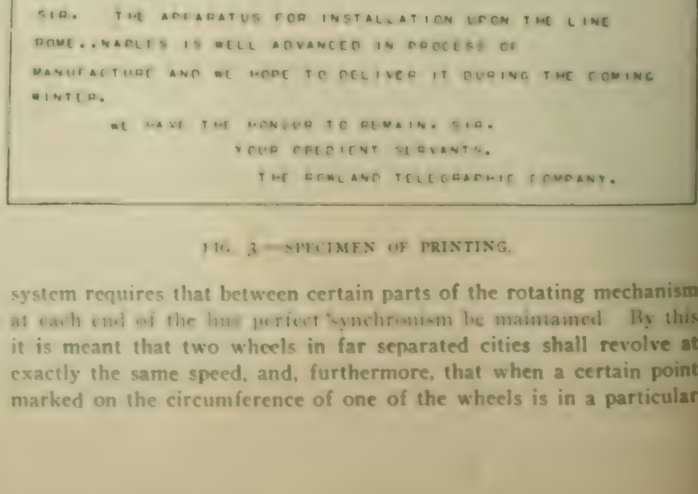
Since this system, then, is a multiplex duplex system, its total capacity for one wire is four different signals each way in one-quarter second, making a total of 1,920 signals that can pass over the line per minute.

Professor Rowland, moreover, developed his system so that the figures, the letters of the alphabet, and some extra signs are automatically printed in such a manner that each operator by writing on an ordinary Remington keyboard prints at the end of the line opposite to himself on a page eight inches wide. These pages of printed matter have the general appearance of an ordinary sheet of typewritten matter, with letters and figures printed in block type. (See Fig. 3 for specimen of the printing.)

Forty words per minute is an ordinary speed for a practised operator, so that altogether the eight operators may be printing over an ordinary telegraph line 320 words per minute.

SYNCHRONISM.

For converting the signals sent over the line in the form of combinations of cut-out half-waves into printed characters, the present


INDICAZIONI DI URGENZA

UFFICIO TELEGRAFICO

ROMA

ILLMO SIGNORE

FEDELE CARDARELLI. ROMA.

DIRETTORE. MINISTERO DELLA

POSTE E DEI TELEGRAFI.

SIR. THE APPARATUS FOR INSTALLATION UPON THE LINE ROME..NAPLES IS WELL ADVANCED IN PROCESS OF MANUFACTURE AND WE HOPE TO DELIVER IT DURING THE COMING WINTER.

WE HAVE THE HONOUR TO REMAIN, SIR,

YOUR OBEDIENT SERVANTS,

THE ROWLAND TELEGRAPHIC COMPANY.

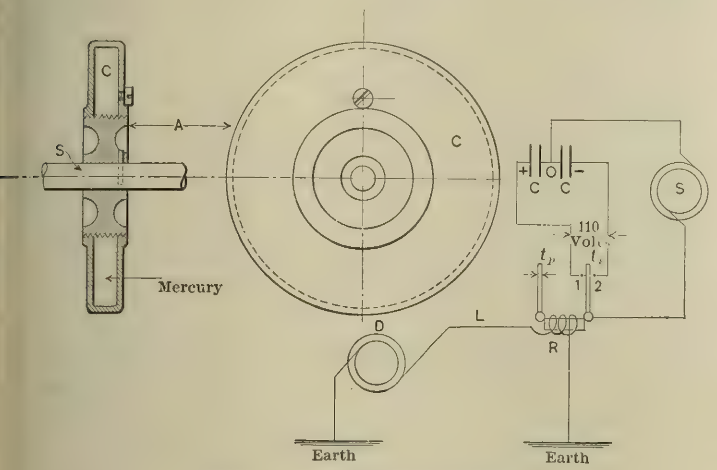
Fig. 3—Specimen of Printing.

system requires that between certain parts of the rotating mechanism at each end of the line perfect synchronism be maintained. By this it is meant that two wheels in far separated cities shall revolve at exactly the same speed, and, furthermore, that when a certain point marked on the circumference of one of the wheels is in a particular

angular position a corresponding point on the other wheel shall be in exactly the same relative angular position.

The practical attainment of such synchronism constitutes one of the chief features of the system. This feature has been so perfectly realized in practice that the synchronism has never failed or given any practical difficulty whatever. The certainty of its action is independent of the length of line between any two stations. This accomplishment opens the door to a host of other important electrical and mechanical inventions, for, if, as will appear later on, cut-out wave signals can be converted into printed letters they may also be readily converted into a variety of mechanical operations, be it the steering and operation of a torpedo boat, the loading and handling of large guns at a distance or the operating of a distant typesetting machine, etc.

Having considered the chief principles of the invention, an outlined description may be given of the practical means by which the chief operations are performed.



FIGS. 4 AND 5.—SYNCHRONIZER.

METHOD OF OBTAINING SYNCHRONISM.

The endeavor to obtain perfect synchronism for telegraphic purposes has often been made. The failure to accomplish it has prevented several otherwise ingenious and carefully worked out systems of printing telegraphy from becoming a practical success.

It might at first sight appear that, since an alternating current is employed in the present system, synchronism could be easily obtained by merely passing the alternating current through a small single-phase motor. But experience has shown that this is not sufficient, on account of a phenomenon which engineers call "the pumping" of two machines, which otherwise run synchronously. This phenomenon may be easily and beautifully illustrated as follows: Connect up electrically an alternating single-phase motor with an alternating single-phase dynamo, and fasten to the shaft of one a disc on which are painted white stripes radially. The number of these stripes should preferably be the same or an even multiple of the poles of the dynamo. On the shaft of the other machine place a disc of tin with narrow radial slots cut in it to correspond in position with the stripes painted on the disc. The two machines with the discs attached to their revolving shafts should be so placed that the face of the painted disc may be observed by looking through the slots cut in the tin disc. When now the two machines come to rotate at the same velocity, the painted stripes observed through the slits of the other disc are plainly visible and appear nearly stationary. It will, however, generally be observed that the white stripes appear to oscillate backwards and forwards through an angle of several degrees, like the balance wheel of a watch. This observation proves that the speed of the motor is first gaining and then falling behind that of the generator, with an oscillatory motion. This is the so-called "pumping" of synchronous machines, and it often becomes so great that the two machines are thrown completely out of step.

For telegraphic purposes, the pumping must be entirely eliminated. This has been accomplished by employing a device called a "mechanical damper," which has been constructed in a number of different ways, but all the various forms involve the same principle, which will appear from the description which follows:

In Fig. 4 *S* is the shaft of a single-phase alternating-current motor of small size. *A* is a wheel of aluminum, in which is cut a circular channel, *C*. This channel is completely filled with mercury, and the wheel *A* is rigidly fastened to the shaft *S*.

Conceive the shaft and wheel with its contained mercury to be revolving at a high speed. If the speed of the shaft is subject to an oscillating decrease and increase, the mercury, on the other hand, will tend, by its inertia, to revolve at a uniform velocity, and a friction is, therefore, produced between the mercury and the walls of the aluminum channel when their speeds are alike. This causes the oscillations or "pumping" to dampen and the shaft to have a smooth, uniform rotation. The device is simple but effective, and without it a perfect synchronism would be impossible.

The synchronizer itself consists of a small alternating single-phase four-pole motor of special design. The armature is made of four flat coils, without iron, and has a diameter of about three inches. The synchronism is maintained by local currents. The line current, of from 30 to 70 milliamperes, has only one function to perform in keeping two tongues of a polarized relay of a special design in constant vibration. One of these tongues is employed, by the manner in which it makes certain contacts, to complete the local circuits which print the characters, and the other tongue serves to send positive and negative local currents through the coils of the synchronizer in a manner to preserve the synchronism. Fig. 5 shows the way in which this is accomplished.

The current from the alternator *D* on the line *L* keeps the two tongues, *tp* and *ts*, of the polarized relay, *R*, in constant vibration. *S* is the small synchronous motor, the shaft of which also carries the damper described above. One terminal of the synchronizer is attached to a wire which joins two one microfarad condensers, *C*, *C*, in series, and the other terminal is attached to the insulated tongue, *ts*, of the relay. The contact points, 1 and 2, of the relay are attached to the two terminals of the two condensers, which are in turn attached to the terminals of a 110-volt direct-current circuit, which keeps the condensers charged. An inspection of the diagram will show that, as the tongue *ts* vibrates between its contacts positive and negative currents are alternately sent through the synchronizer coils. In this way the synchronizer is made to run in synchronism with the dynamo *D* without the main line current being passed through it.

The synchronism obtained in this manner is so precise that, in the experiment described above, the stripes appear absolutely stationary, and if the motor is forcibly thrown out of synchronism it will regain it in from three to six seconds.

To further perfect the synchronism and to make the synchronizer self-starting, there are used, revolving between the same field poles as the synchronizer coils, some coils through which a direct current is passed. The coils, together with their commutator, form a small direct-current motor, which starts the synchronizer and also relieves it from doing any work beyond that of maintaining the synchronism.

DUPLEXING.

In order to duplex, namely to send signals over the line in opposite directions, at exactly the same instant, a dynamo and a differentially wound relay must be used at each end of the line. The current coming from each dynamo divides, part passing around one coil of the differentially wound relay at the same end, and then into the main line, and part around the other coil magnetizing the core oppositely to the first current, and into an artificial line. The method will be made clear from the following description and a reference to Fig. 6.

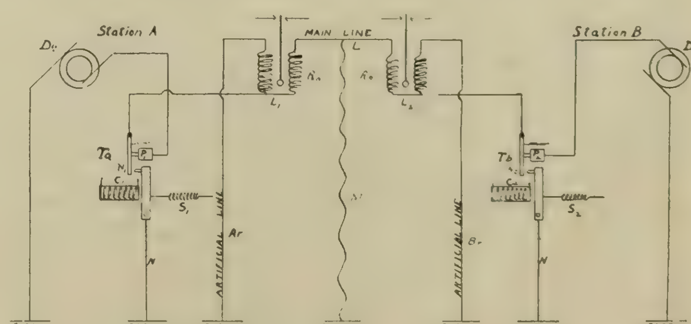


FIG. 6.—DUPLEXING ARRANGEMENT.

In Fig. 6, *A* and *B* are two stations at opposite ends of the main

line L. Ra and Rb are two differentially wound main line polarized relays. Da and Db are two alternating-current dynamos, which may or may not be running in synchronism. Ta and Tb are two transmitters.

If the coil C_1 of Ta be energized, its armatures will break the circuit to the relay Ra at P_1 and immediately complete another circuit at N_1, which connects the middle of the relay coils to earth. The transmitter, Tb, operates in the same manner. When the coils of Ta and Tb cease to be energized, the springs S_1 and S_2 return the armatures to their original position. Now suppose that the circuit from the relay Rb be broken at P_2 and made at N_2 by energizing the coil C_2 of Tb at station B. The current from dynamo Da at station A will enter the coils of relay Ra at L_1 and there divide. Part of the current will pass through the right-hand coil of Ra over the main line, thence to earth, by way of the contact N_2. A portion of this same current will have leaked off the line to earth, as at M, and a small portion will go through both coils of the relay Rb and to earth, by the artificial line at station B. The other portion of the current of the dynamo Da, entering the relay Ra at L_1, will pass through its left hand coil, magnetizing the core in the *opposite* direction to that portion which passed through the right-hand coil, and then to earth by the artificial line at station A.

The resistance, the capacity and the self-induction of the artificial line A may now be varied until it imitates the real line L with its leakage, capacity and self-induction. When this is accomplished, the current which enters at L_1 will divide into two equal portions, half passing through the right-hand coil and half through the left-hand coil of relay Ra. Since these two equal currents flow in opposite directions through the two equal coils of Ra, the core is unmagnetized and the tongue of the relay will not vibrate, but stick against its left, or its right hand, contact, to whichever one it was last carried. If, when this condition is maintained, the circuit be broken at N_2 and again completed at P_2, the current from dynamo Db at station B will pass over the line L and through the right-hand coil of relay Ra at station A, magnetizing its core and causing its tongue to vibrate. Thus, when the artificial line Ar is properly balanced against the main line, an operator at B can send signals over the main line by merely breaking and making the circuit at P_2. In like manner, with the circuit broken at P_1 and made at N_1, the artificial line Br is balanced until the relay tongue Rb remains at rest, when the current from dynamo Db passes through its coils, but again vibrates when it receives current from dynamo Da at the opposite end of the line.

Thus, if a signal consists in bringing the tongue of either relay Ra or Rb to rest, that is, in making its tongue stick against one of its contacts, it is seen that the tongues of both these relays may be brought to rest either simultaneously or separately, or, in other words, if at the same instant the operator at A and the operator at B simultaneously energize the coils of their respective transmitters, both relay tongues come simultaneously to rest, and two signals have been sent in two opposite directions at precisely the same instant. It is curious to note here that when two simultaneous duplex signals are sent over the line there is zero current on the line.

METHOD OF CUTTING OUT THE WAVES.

The operation of cutting out the waves, for transmitting the cut out wave signals over the line, is performed on an ordinary Remington keyboard. These keyboards are so constructed that the keys can only be depressed at intervals, corresponding to the passage of 52 waves over the line, that is, at intervals of about one-quarter second. The locking device which times the depression of the keys is called the "clapper" and unlocks the keys four times per second: that is, each operator can cut out four different wave combinations, and so send four different signals over the line, in one second. Each of the four keyboards can only cut waves out of the group which is assigned to it. The manner in which this is done, and how the waves can be cut out near the point of zero current over the line, may be understood by a reference to the following diagram: In Fig 7 K_1, K_2, K_3, K_4 represent the four keyboards. Each keyboard is supplied with eleven insulated contact springs, 1, 2, 3, etc. To the frame of each keyboard is attached the negative terminal of a direct current 110-volt circuit. When any one of the 41 keys, belonging to a keyboard, is depressed, contact is made with some *two* of the 11 contact springs. The contacts made will be the combination which corresponds to the letter marked on the key C is a so-called commutator or "sun-flower." It is similar in construction to the commutator of a small dynamo, and has 52 segments insulated from each other. There are four sets of segments, which are connected respectively to the eleven contact springs of the keyboards K_1, K_2, K_3, K_4. The remaining eight segments are some of them entirely insulated, while others are connected to devices for cutting out waves used for automatic signals, but which are not shown in the diagram. In other words, the segments are divided up so as to correspond with the groups of half-waves shown in Fig. 2. The group A is connected to the contact springs of keyboard K_1, the group B to the contact springs of keyboard K_2, etc. Corresponding to the half-waves between the groups, A, B, C, etc., there are insulated segments which are shown in cross-section in the diagram. A brush or trailer, t, travels around the commutator C in synchronism with the dynamo Da being geared to its shaft. This trailer passes from the centre of one segment to the centre of the next, while the current from the dynamo, Da, makes half a wave. When the brush is at the middle point of a segment, the current from the dynamo is supposed to be passing through zero value.

If a key be now depressed on keyboard K_1, contact with the frame of this keyboard will be made with two of the contact springs, as say, 7 and 11. When the trailer, sweeping around the commutator reaches segment No. 11, which is connected to contact spring No 11, the current from the 110 volt circuit flows momentarily from the positive pole through the coil C of transmitter Ta to the trailer t, from there to the segment No. 11, thence to the contact spring No. 11, to the frame of the keyboard and back to the negative terminal. This current causes the transmitter Ta to draw back its armature A

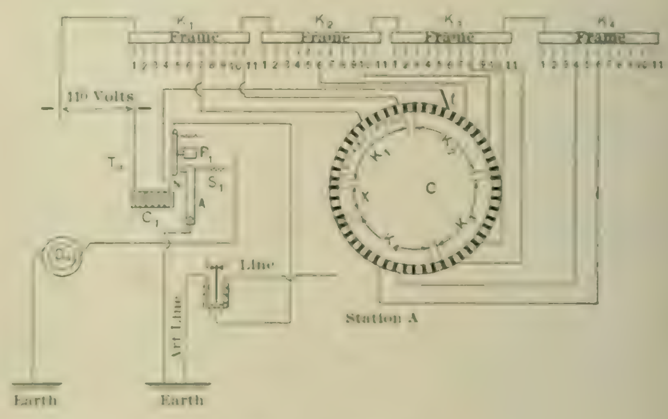


FIG. 7.—KEYBOARD.

and thus break the dynamo circuit at P, which goes to the relay and line, and at the same time the line is connected at N_1 to earth. Immediately, when the trailer passes off from segment No. 11 the spring S_1 pulls the armature A back, completing the line circuit with the dynamo D. Thus, a half-wave of group A (see Fig. 2) has been cut out of the line circuit. When the trailer arrives at segment No. 7, the same operation is repeated, because the contacts which are made at the keyboard continue for a period equal at least to the time that the trailer takes to pass over the 11 segments which are connected to that keyboard. In like manner the operators on keyboards K_2, K_3, K_4 can cut out, by depressing some *one* key, and *two* waves from the groups of eleven which belong to them. An insulated segment is placed between each two groups of eleven waves, so that, in case the last half-wave of one group and the first half-wave of another group is cut out, there will be an interval of a half-wave between these occurrences. This is found to be necessary for the proper operation of the main line relay at the receiving station.

It is now perfectly evident, from the manner in which these half-waves are cut out and the signals sent over the line, that each operator works independently of the others, and that no conflict between the signals which are sent by each can possibly occur; and it is also seen that four entirely different and independent signals can be sent in one direction in the one-fourth second that the trailer takes to pass around the commutator. Moreover, from the explanations given above regarding the method of duplexing, the cut-out waves sent over the line are seen in no way to affect the action of the home main line relay. This relay can only be affected by the cut-out waves which are sent to it from the distant station. Thus, the process is made clear how eight different and totally independent

signals may be sent over the line in one-fourth of a second, or, 1,920 in a minute.

The operation of cutting out the waves at the other end of the line is precisely the same. So far, however, we have seen that the signals which are sent over the line appear at the distant end merely as two momentary pauses in the otherwise constant vibration of the tongues of the main-line relay. We will next show how these transient signals are translated into a readable record and then, afterwards, into printed characters.

Computation of Regulation of Alternating Current Generators.

By Virginius D. Moody.

"The regulation of an apparatus intended for the generation of a potential, current, speed, etc., varying in a definite manner between full load and no load, is to be measured by the maximum variation of potential, current, speed, etc., from the satisfied condition, under such constant conditions of operation as give the required full load values."

"In apparatus which transforms, generates or transmits alternating currents, regulation refers to non-inductive load, *i. e.*, load in which the current is in phase with the e. m. f. at the outside of the apparatus, and is expressed in percentage of the full load value."—Report of the Committee on Standardization of the A. I. E. E.

In alternating-current generators, regulation is the ratio of the rise in voltage from full load to no load, at constant speed, to the full load voltage. The commercial tests that are necessary for this computation consist of "saturation" and "synchronous impedance" curves.

"The dependence of the induced e. m. f. or terminal voltage at open circuit upon the field excitation is the "saturation curve" of the synchronous machine, and consists of a straight part below saturation, a bend or knee and a saturated part beyond the knee, having the same general shape as the curve of magnetic induction."—Steinmetz, *Electrical Engineering*, p. 147.

In commercial testing, the data requisite for the no-load saturation curve is obtained as follows: The alternator is operated on open circuit at normal speed, and the residual magnetism of the field is removed by some convenient method, *e. g.*, reversal of the field current. The field current is then increased by small values, its value

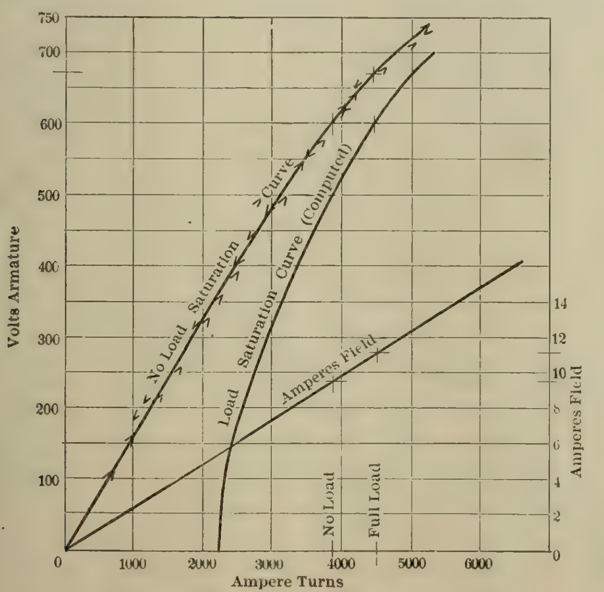


FIG. 1.—NO-LOAD SATURATION CURVE.

at each step being noted, as is also readings of armature voltage and field voltage. When the field is saturated, the field current is gradually diminished, the same observations being made.

In a log of a test for no-load saturation, machine on open circuit, the entries are as follows. Armature voltage, read for each value of field current. Field voltage, read for each value of field current. Field current, increase by small values going up on the curve; when the field is saturated decrease by small values coming down on the curve. Speed, held constant.

The curve is plotted between field ampere turns per spool, as abscissæ and armature voltage as ordinates. The field ampere turns per spool being found by multiplying the number of turns per spool by the field current.

The synchronous impedance of an alternator for a given excitation is the ratio of the induced armature voltage to the armature current at short-circuit for the same value of field excitation $Z = \frac{E_1}{I}$ where $Z = \sqrt{r^2 + x^2}$ is the impedance. This ratio will remain sensibly constant for all values of field excitation. Synchron-

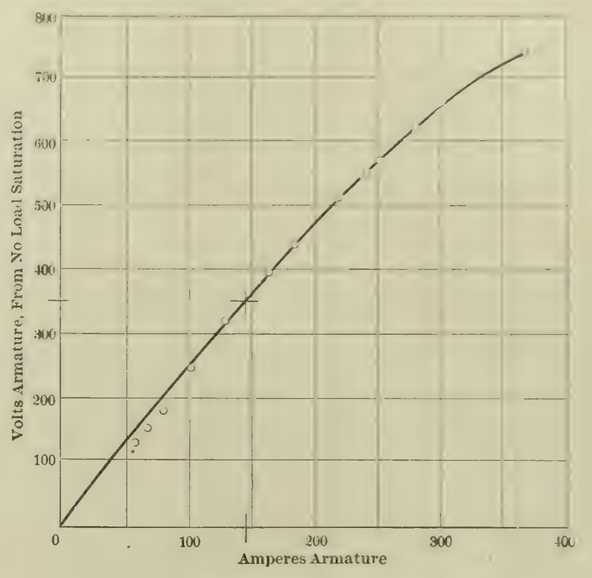


FIG. 2.—SYNCHRONOUS IMPEDANCE CURVE.

ous impedance (armature at short-circuit) involves not only the true resistance and reactance of the armature, but also the electromagnetic reaction of the armature current on the field flux.

In commercial testing the curve of synchronous impedance is determined as follows: The alternator is first heated up to satisfy the specification of "constant conditions of operation as give the required full load-values." This is done by short-circuiting the armature and operating the machine at normal speed and such an excitation as will give 1¼ times normal full-load current in the armature. The machine is run under these conditions until it becomes well heated up (1½ hours is sufficient for an alternator from 1,500-kw to 2,000-kw capacity, less time is required for smaller types). The excitation is then reduced to a value that will give normal full-load current in the armature, and the alternator is operated in this manner until it satisfies the "constant conditions of operation." This requires about half an hour for large generators.

As the field, even in the revolving field type, usually requires the longest time to attain its constant condition of temperature, and, therefore, of resistance at full load, the commercial test for constant conditions of operation, is to observe occasionally the field voltage for a given value of the field current. When the field voltage is constant for a given value of field current, the temperature and resistance of the field is constant, and the machine is in the specified constant condition of operation. With the generator in this condition, the test for the "synchronous impedance" curve is made. The armature is short-circuited, and the machine is operated at normal speed (slight variations of speed, however, will not sensibly effect the ratio, since the induced voltage and reactance are each direct functons of the frequency, and the IR drop is very small compared with the reactance drop). The field excitation is gradually increased by small steps, up to about 2½ times normal full load armature current, and the armature current and field voltage are observed for each step.

As the synchronous impedance of an alternator is the ratio of the induced voltage to the armature current for a given excitation $\left(Z = \frac{E_1}{I}\right)$, it is necessary to find the value of the induced voltage for the given excitation. The voltage induced in the armature for any given value of field current is the voltage corresponding to the given field current, as found in the no-load saturation curve, consequently the induced voltage for the successive values of field current may be taken from the no-load saturation curve, by noting the

armature voltage corresponding to the values of the field current.

The curve of synchronous impedance is plotted with armature current as abscissæ and armature voltage from the no-load saturation curve as ordinates. The resistance of the armature of the generator is measured after the test for the "synchronous impedance" curve.

In a log of a test for synchronous impedance curve, armature short-circuited, the entries are as follows: Armature voltage, taken from no-load saturation curve for each value of field current noted. Armature amperes, read for each step increase of field current. Field voltage, read for each step increase of field current. Field current, increased in successive steps up to about 2½ times normal full-load armature current. Speed, field constant.

The method of procedure for the computation of the regulation of an alternator, after having made the above tests, is illustrated by the following example: Alternating-current generator, three-phase, revolving field type, 8 poles, 150 kw, 600 r. p. m., 600 volts, 145 amperes at full load, 40 cycles, 400 turns per field spool, hot resistance of the armature between terminals, .0452. The no-load saturation curve and synchronous impedance curve, as taken in actual test on this generator, are shown on Figs. 1 and 2.

"The dependence of the terminal voltage upon the field excitation at constant full-load current flowing through the armature into a non-inductive circuit is called the 'load saturation curve' of the synchronous machine. It is a curve, approximately parallel to the no-load saturation curve, but starting at a definite value of field excitation for zero terminal voltage, the field excitation required to send full-load current through the armature against its synchronous impedance.

"The effect of saturation on the characteristic curves of the synchronous machine is as follows: The compounding curve is impaired by saturation. That is, a greater change of field excitation is required with changes of load. Under load the magnetic density in the armature corresponds to the true induced e. m. f., $E_1 = E + Ir$, where E is the terminal voltage, I the armature current, and r the effective resistance; the magnetic density of the field, to the virtual induced e. m. f., $E_2 = E_1 + Ix$, where x is the self-inductive armature reactance. Both, especially the latter, are higher than the no-load e. m. f. or terminal voltage, E, in the generator, and thus a greater increase of field excitation is required in the presence of saturation than in the absence. Due to the counter m. m. f. of the armature current, the magnetic flux which leaks from field pole to field pole through the air, increases under load, especially with inductive load where the armature m. m. f. directly opposes the field, and thus a still further increase of density is required in the field magnetic circuit under load. Therefore, at high saturation the load saturation differs more from the no-load saturation curve than corresponds to the synchronous impedance of the machine.

"The regulation becomes better by saturation; that is, the increase of voltage from full load to no load at constant field excitation is reduced, the voltage being limited by saturation."—Steinmetz, *Electrical Engineering*, pp. 138-140.

The load saturation curve is computed from the "synchronous impedance" and no-load saturation" curves, the computations being made of load, field, ampere-turns for armature voltage, varying in steps from zero to a few hundred volts above full-load normal voltage of the machine. In the case under consideration computations

LOG OF FULL LOAD SATURATION CURVE (COMPUTED).

1 Armature volts	2 Armature volts + IR drop armature	3 Full-load armature current	4 Ampere turns for armature volts + IR drop	5 Reactive ampere turns (A)	6 Load ampere turns $C = \sqrt{A^2 + B^2}$
0	6	145	[illegible]	[illegible]	[illegible]
50	56	"	[illegible]	"	[illegible]
100	106	"	[illegible]	"	[illegible]
200	206	"	[illegible]	"	[illegible]
300	306	"	[illegible]	"	[illegible]
400	406	"	[illegible]	"	[illegible]
500	506	"	[illegible]	"	3860
600	606	"	[illegible]	"	[illegible]
700	706	"	48[illegible]	"	[illegible]

of load field ampere turns are made for armature voltage varying between zero and 700 volts, the alternator being designed for 600 volts at full load.

The foregoing values are computed as follows: The IR drop in the armature $= I \times \frac{\sqrt{3}}{2} \times R$; I (full-load armature current) $=$

$$\frac{Kw}{E \times \sqrt{3}} = \frac{150}{600 \times 1.73} = 145 \text{ amperes};$$ R (hot resistance of armature between terminals) $= .0452$. Therefore the IR drop $=$

$$145 \times \frac{1.73}{2} \times .0452 = 6 \text{ volts.}$$

This IR drop of 6 volts is added to the armature voltage in column 1, and the sum of the two gives the 2nd column in the above log Field ampere turns for armature volts + IR drop armature, are read from the no-load saturation curve (Fig. 1). For example, taking 206 volts in column 2, on the ordinate of this curve, volts armature run from 206 volts horizontally to the no-load saturation curve, then vertically down and read the field ampere turns 1,275

Reactive ampere turns, column 5, are found as follows: On the synchronous impedance curve (Fig. 2), note that the armature voltage corresponding to the full-load current of the machine, 145 amperes, is 350 volts; then referring to the no-load saturation curve, the ampere turns corresponding to 350 volts, the reactive ampere turns is 2.170.

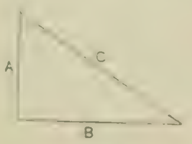


FIG. 3.

As the load saturation curve is the dependence of the terminal voltage upon the field excitation at constant full-load current flowing through the armature into a non-inductive circuit, it is plotted with load ampere turns as abscissæ and armature volts as ordinates.

In Fig. 3, let B represent the ampere turns for armature volts + IR drop armature, and A the reactive ampere turns. Then the load ampere turns $C = \sqrt{A^2 + B^2}$.

The load ampere turns as computed are shown in column 6 of the log. The load saturation curve is plotted in Fig. 1.

The regulation of an alternating-current generator being the ratio of the rise in voltage from full load to no load at constant speed, to the full-load voltage, may now be readily calculated from the no-load saturation curve and load saturation curve.

The full-load normal voltage of the generator is 600. In Fig. 1, on the load saturation curve, note that the field ampere turns corresponding to 600 volts armature is 4,475; on the no-load saturation curve the armature voltage corresponding to 4,475 field ampere turns is 668; then the regulation of the generator expressed in percentage of full-load voltage $= \frac{668 - 600}{600} = 11.33$ per cent. The amperes field of the machine at full load $= \frac{4475}{\text{number of turns per spool}} = \frac{4475}{400} = 11.19$ amperes.

The John Fritz Medal Banquet.

The arrangements for the banquet at the Waldorf-Astoria to celebrate the eightieth birthday of Mr. John Fritz and the successful founding of the gold medal bearing his name are being actively pushed, and a most successful and memorable evening is promised. The dinner takes place on Friday, October 31, at 7:30 P. M., and will be attended by some interesting ceremonies in connection with the formal presentation of the medal, which is to be awarded annually hereafter by a joint committee of the Civil, Mechanical, Mining and Electrical Engineers. There will also be some notable addresses, among the speakers being the venerable Abram S. Hewitt, Admiral Melville and Prof. Elihu Thomson. The full programme will shortly be announced. In the meantime, the work of the dinner committee will be greatly helped by the prompt forwarding of requests for seats. The tickets for the dinner cost $12 each, including wines and cigars, and $3 for ladies, who will occupy the boxes, and who will be served there with light refreshments. Application for as many tickets as may be needed, accompanied by check, should be sent at once to Mr. John C. Kafer, treasurer of the dinner committee, at the Engineer's Club, 374 Fifth Avenue, New York City. The large list of acceptances already includes the most distinguished names in the industrial arts and sciences in America.

Electrical Equipment of Antwerp Iron and Steel Works

From an electrical point of view one of the most interesting iron and steel works in the world to-day is that in course of erection on the banks of the Scheldt, on the Hoboken plains, near Antwerp, Belgium. When completed, these works will comprise a blast furnace plant, a steel works with a complete roll train outfit, iron and steel foundry, workshops, boiler and power houses, blacksmith shop, etc. The work is being rushed and the entire plant will be finished and in operation in a short time. Part of it is in operation now.

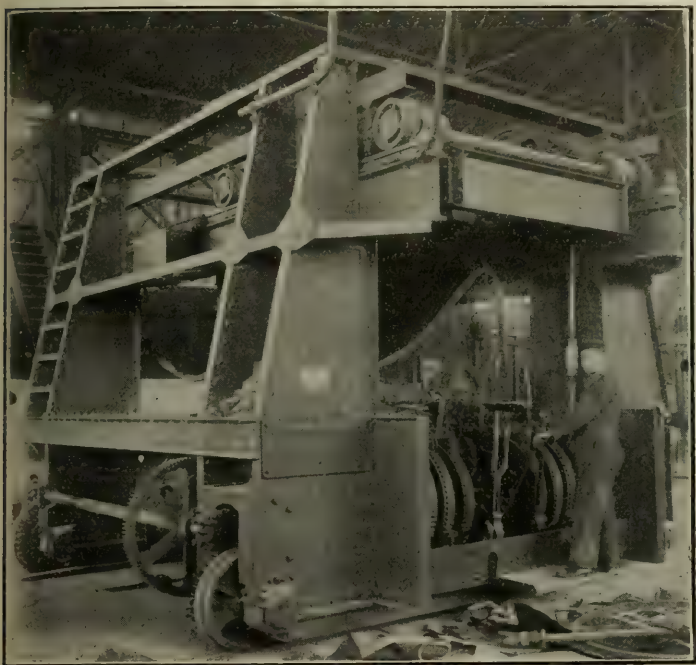


FIG. 1.—MACHINE FOR CHARGING FURNACES OPERATED BY FOUR POLYPHASE INDUCTION MOTORS.

When the plant is in full swing it will require 4,200 tons of iron ore, 1050 tons of limestone, 2,100 tons of coke and 3,000 tons of coal every 24 hours, the manipulation of which will be done almost entirely by electrical means. The coke works with recovery of bi-products is supplied with a washery and coal mixing plant. In addition, there will be a plant for transforming the refuse from the washers into briquettes. A cement factory, with a daily output of 100 tons, will convert the blast furnace slag into building or paving stones.

A tube works with an output of from 40,000 to 60,000 tons of tubes annually, varying from 1½ inches to 40 inches in diameter, is also included in the plant. The steel works proper will produce 1,200 tons of basic open hearth steel per day, which will be smelted in tilting furnaces especially adapted for receiving the pig iron direct from the blast furnaces. The scrap will be melted down in four furnaces with a capacity of 20 tons. The rolling mills will consist of two divisions; in the one, girders, rails, angles, rounds, bars, etc., will be produced; in the other, plates and sheets of the customary lengths, widths and thicknesses will be rolled. Electric drive is used throughout all the various shops, the energy being obtained from a well-equipped power house centrally located.

This power house is essentially Westinghouse in all its appointments, and it will eventually have a capacity of 30,000-hp. The present plant consists of steam driven generators. There are two main sets consisting of triple expansion marine engine direct connected units. The engines are of 1,500-hp capacity each, with cylinders of 22, 32 and 46 inches in diameter. They were originally installed on an English torpedo boat, but have been reconstructed and provided with Sisson speed regulators. Each engine is provided with surface condensation, having a centrifugal pump for the water circulation. The condensation water returns to the boilers. The two main generators are three-phase machines of 900-kw capacity each, operating at 50 cycles, 2,200 volts and 187 r. p. m. They are of the rotating field type. A third main generating set is also in use, but this has only been put down temporarily pending the completion of a part of the proposed gas-driven installation. This set consists of a belt-driven 400-kw three-phase alternator of the rotating armature type, generating an e. m. f. of 2,200 volts at 50 cycles. This machine will eventually be driven by an 800-hp compound tandem engine. The exciting plant consists of two 25-kw direct coupled sets, each being a 58-hp Westinghouse compound engine with a 220-volt direct current multipolar generator built on an extension of the engine shaft. The engines run at 350 r. p. m.

The central station switchboard connections are arranged for running the alternators in parallel, but two sets of high tension bus bars are provided, the object being to isolate the generator supplying the rolling mills from the other generators, which would be engaged in furnishing energy for general distribution. This switchboard (Fig. 4) at present contains six panels—one for controlling the two 25-kw exciters, two for controlling the two 900-kw alternators, one for the rolling mill circuit, one for the boiler works, foundry and repair shop circuit, and one for controlling the lighting circuit.

There are four transformer sub-stations located in the works, each designed with reference to the circuits they are intended to operate. Station No. 1 is located at the entrance of the central station and furnishes current for the complete illumination of the steel works, and at the present time also furnishes current for all the motors in the central station. The steel works are illuminated by 200 Körting arc lamps and 500 incandescent lamps.

The extent of the electric drive and the variety of uses to which it is put make this plant an interesting study to those that are interested in the shop equipment of a modern manufactory. In the central station the following operations are carried on by means of electric drive. A 40-hp motor operates the air compressor; a 13-hp motor operates the Benny automatic stokers; two 20-hp motors operate the air pumps of the condensers; three motors operate the 30-ton crane in the engine room—one 40-hp for lifting, one 20-hp for shifting the car and one 30-hp for moving the crane. In addition to these motors there are two 21-hp motors for driving the feeder pumps of the water works and one 65-hp motor for the railway which will transport coal from the barges on the Escaut river.

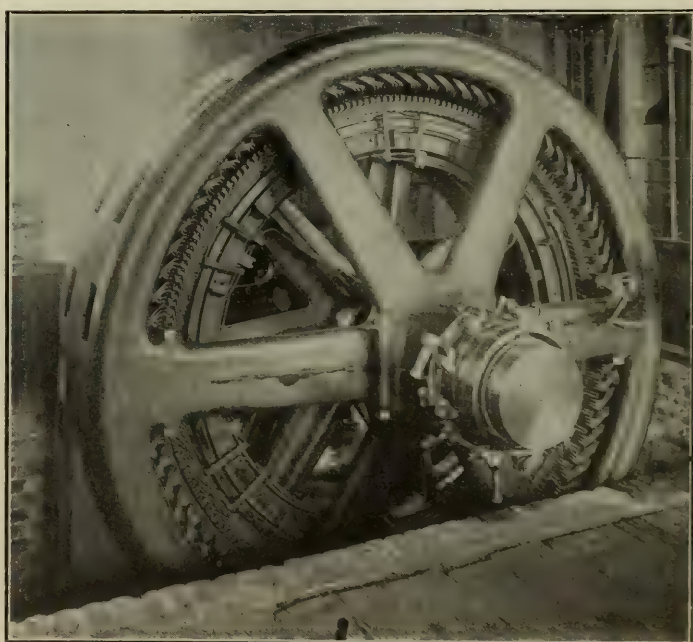


FIG. 2.—450-HP MOTOR DIRECT CONNECTED TO SHEET MILL TRAIN.

Station No. 2 furnishes current for the low tension motors in the steel mills, including pattern and carpenter shops. The following are the uses to which the electric drive is applied in this station: One 20-hp and one 13-hp motor for cold-finishing shearing machines; one 20-hp motor operates a saw; one 5-hp motor operates a centrifugal pump for pumping water from the holes and furnaces; one 3-hp and one 5-hp motor for driving the machinery in the pattern and carpenter shop.

Station No. 3 furnishes current to the motors in the boiler works, foundry and repair shops. In the boiler works there are nine travelling cranes arranged as follows:

Room 1 is 42 feet wide and contains two 6-ton travelling cranes. Room 2 is 42 feet wide and contains a six and a twelve-ton crane. Room 3 is 82 feet wide and contains a 30-ton crane similar to the one used in the central station. Room 4 is 42 feet wide and contains a six-ton and a twelve-ton travelling crane. Room 5 is 42 feet wide and has the service of a 12-ton crane which goes out of the shop as far as the Escaut river, and also another 30-ton crane which is situated higher up and is utilized for the construction of the boilers.

One 60-hp motor drives all the machine tools of the workshop. The repair shops are operated by the following motors: one 50-hp, three 20-hp, and one 3-hp. There are also two travelling cranes of 5 and 20 tons capacity respectively.

The foundry contains two travelling cranes, one of 5 tons and the other 20 tons capacity. The following motors are used for the various purposes enumerated below: a 1-hp motor for driving a fan to dry castings; a 60-hp motor for driving the furnace ventilator and sand crushers; a 20-hp motor operating a sliding platform, and a Wellman charger for the Martin furnace, operated by four three-phase induction motors. These motors are of 3½, 15, 20 and 25 hp respectively.

Station No. 4 furnishes power to the following apparatus: A 65-hp motor operating the pump of the central condensing station; two 40-hp motors operating the tables at the rolls; a 20-hp motor in the repair shop; a 6½-ton and one 5-ton travelling crane; a 30-ton travelling crane; two 60-hp motors operating the shearers.

The most interesting feature connected with the electrical equipment of this plant, and one that bids fair to revolutionize the motive power for operating the rolls in iron and steel mills, is the installation of three large variable speed polyphase induction motors for operating the blooming and finishing mills. Necessarily the fly wheel capacity is large enough to overcome the inertia effects due to the sudden changes of load from minimum to maximum and vice versa.

The motors are controlled by railway-type controllers, having a primary 2,150-volt main and reversing switch, and three

FIG. 3.—GENERAL VIEW OF MILLS OPERATED BY POLYPHASE INDUCTION MOTORS.

drums for varying the resistances of the secondary circuit. The resistances are of iron and give fifteen steps in each phase. The speed variation gained by this means allows of a reduction of from 22 per cent to 25 per cent below normal speed, the normal full load torque being maintained over this range.

One of these motors is a 325-hp induction motor operating at 2,150 volts at a rated speed of 300 r. p. m. This motor is belt-connected to a 24-inch two-stand blooming mill, which runs at a speed of 70 r. p. m. and has a fly wheel of about 30 tons weight. In one stand 880 pound billets are reduced from 10 inches square to 3¼ inches square, in the other stand 450 pound billets are reduced from 7¼ inches square to 2¾ inches square section.

Behind the blooming mill are two finishing mills. Each finishing mill is supplied from one stand of the blooming mill. These mills are direct-driven by induction motors, the motors being coupled by rigid flange couplings to the short fly wheel shafts of the mills, each mill having a fly wheel of about 12 tons in weight. The larger finishing mill is a 14-inch five stand mill and is driven by a 450-hp motor operating at 2,150 volts; the other, a 10½ five-stand mill, is driven by a 325-hp motor operating at 2,150 volts and 6,000 alternations. It will be noted that

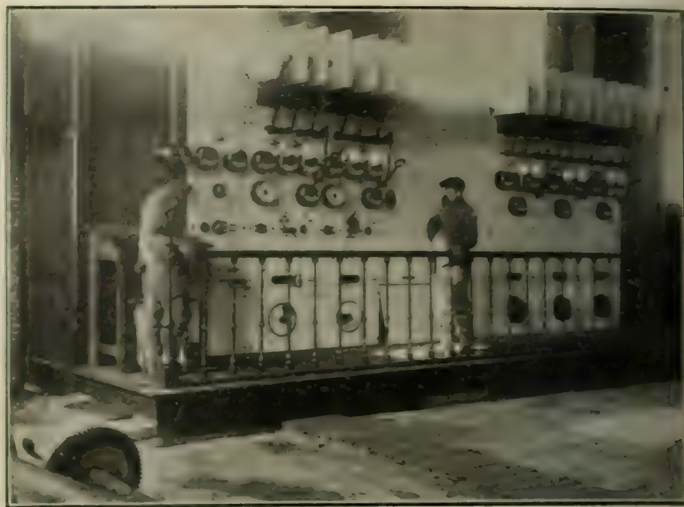


FIG. 4.—CENTRAL STATION SWITCHBOARD, ANTWERP STEEL WORKS.

the three large motors are operated at full line pressure, no transformers being used. Very high speeds have been chosen for all the cranes. At times the travelling speed is 330 feet per minute and the lifting speed 50 feet per minute. All lifting, turning and travelling drives are equipped with automatic, electromagnetic safety brakes.

Thus far it has not been possible to determine the exact amount of power required to roll the different sections of iron, as simply tightening the rolling train doubles or even trebles the power necessary to roll similar sections of iron. It has been ascertained, however, that the 325-hp motor belted to the blooming mill runs continuously at 35 to 45 amperes, and the 325-hp motor directly coupled to the finishing mill consumes on an average from 60 to 80 amperes. The 450-hp motor directly coupled to the finishing mills consumes on an average from 90 to 100 amperes. These motors have been running the roll trains for some time, and the results are highly satisfactory to the installing and operating engineers, as well as to the proprietors.

The contract for this apparatus was taken under very severe competition from European builders of electric apparatus, and it was only awarded to the Westinghouse Company after the merits of the various makes of apparatus had been fully investigated by the Antwerp people.

Officers of the American Street Railway Association.

Following are the new officers of the American Street Railway Association, elected at Detroit: President, Jere C. Hutchins, president Detroit United Railways, Detroit; 1st vice-president, W. Caryl Ely, president International Railway Company, Buffalo; 2d vice-president, W. Kelsey Schoeff, president Cincinnati Traction Company, Cincinnati; 3rd vice-president, P. S. Arkwright, president Georgia Railway and Light Company, Atlanta; executive committee, H. H. Vreeland, president Metropolitan Street Railway Company, New York; R. T. Laffin, general manager, Worcester Consolidated Street Railway Company, Worcester; Andrew Radel, vice-president Middlesex and Summerset Traction Company, Bridgeport; Walter P. Read, vice-president Consolidated Railway and Power Company, Salt Lake City; Willard J. Hield, general manager Twin City Rapid Transit Company, Minneapolis; secretary and treasurer, T. C. Penington, treasurer Chicago City Railway, Chicago.

Commercial Aspect of the Steam Turbine.

At the Detroit Convention of the American Street Railway Association, Mr. Edward H. Sniffin presented a paper, entitled "The Steam Turbine; Its Commercial Aspect," which gave information in detail of turbine plants now in operation, and discussed the cost of turbine plants and operation as contrasted with ordinary steam plants. In units as small as 400-kw, a result may be obtained of 14.47 lbs. of steam per brake horse-power per hour, corresponding to less than 13¾ lbs. per indicated hp. It is thus evident that moderate sized plants may with the turbine be sufficiently subdivided to give the maximum flexibility of service, with insurance of relay, and yet possess an efficiency heretofore identified only with very large units. Further than this, a fluctuating load is not incompatible with high economical performance. As the units become larger, the turbine is then brought into comparison with the best steam-engine practice, where it still preserves its uniform efficiency, and where its practical advantages are no less evident. In a recent instance, a result of 11.7 lbs. of steam per electrical horse-power per hour was guaranteed on a turbine of 750-kw capacity, corresponding to about 10.17 lbs. per indicated hp, which, though the size is moderate, is, perhaps, within the ability of but few engines of any size or type that have even been built.

Curves were given showing that the turbine requires about 80 per cent. of the space needed for the vertical engine, and not over 40 per cent. of that wanted for the horizontal. The vertical engine compares less unfavorably with the turbine than might generally be supposed, while the horizontal engine curve is about where one would expect to find it. The latter is not carried beyond 2,000 hp, this type of engine being practically limited in size to that required for the 1,500-kw generator.

Another set of curves showed the cubic yards of foundation material required, which was stated to be a more exact and striking comparison. The turbine would appear more advantageously still, if the actual foundations needed for stability had been computed. Instead, the foundations in all three cases were figured at 15 feet depth to give space underneath the engine-room floor for condensers, etc., though for large engines this depth is usually inadequate. The only foundation needed for the turbine is that necessary to hold its weight, as if it were a tank or some other stationary affair. It does not even require foundation bolts, there being no vertical or horizontal thrusts to be resisted. Comparing again the 1,000-kw units, it is found that in actual foundation volume required the ratio of the turbine to the vertical and horizontal engine is that of 1 to 9 and 15, respectively.

Other comparisons were given on the basis of cost. In the case of foundations, the basis assumed was $7 per cubic yard for concrete, laid. While the turbine seems to average a foundation cost of about 50 cents per hp, the vertical engine in the more frequent sizes is approximately $1.50, while the horizontal is not far from $2.50, not forgetting that all three foundations are figured of equal depth—15 feet—to provide space below, as before stated. In the instances where special foundation work is required, such as piling or otherwise preparing suitable bottom, or shoring up building walls to enable sufficient depth of excavation, the expense avoided by the use of turbines is obvious.

In a showing of the comparative engine-room building cost, the basis assumed was 15 cents per cubic foot of space inside of walls. The building cost for the turbine is about one-half of what is required for the horizontal or vertical engine, the latter two, apparently, not being far apart. Exigencies favor the turbine, because of its smaller size and rectangular proportions, and it not infrequently happens that increased power may be supplied by locating the turbine in existing space, whereas an engine would necessitate building extension, and, perhaps, the purchase of additional land. An instance of this kind arose at Akron, Ohio, where in the existing space no arrangement could be devised to accommodate additional engine power. It was found possible, however, by rearranging auxiliary apparatus, to provide space for one 750-kw and one 400-kw turbo-generator outfit, which will shortly be in operation.

Several actual cases were given to show the saving in cost. A plant was recently laid out to contain three 1,000-kw units, with vertical cross-compound Corliss engines. Subsequently three more 1,000-kw units were contracted for, steam turbines being ordered. It was found that the turbine saved 900 square feet of engine-room floor space and about 38,000 cubic feet. Had the whole plant been originally designed for turbines the saving of space would have been double these amounts, and the cost of land, building and foundations been reduced about $50,000.

An electric railroad plant in Ohio was some time ago installed, in which there are 500-kw generators direct-connected to cross-compound Corliss engines. Space was provided for two more units of the same size. For the increased power two 1,000-kw turbine outfits were purchased, which will go in the space left, and leave room for another turbine of 2,000 kw. Thus, the engine-room space planned for 2,000 kw is found sufficient for 5,000 kw. It is estimated that the boiler-plant extension will be reduced about one-third, because of improved efficiency. It is figured, too, that a saving of $2,900 was effected on each 1,000-kw foundation.

One other case, of perhaps greater interest, recently came to notice, that of a plant of 8,100-kw capacity, laid out on modern lines, employing vertical cross-compound condensing engines. There is no space for additional engine power, and any increase would require building extension and encroachment upon valuable land. It was shown that without going beyond the present building walls, and without disturbing the existing machinery, the plant might be doubled in capacity by installing turbines in the space available below the present engine-room level, and adding another deck of boilers. And it has been figured that this arrangement would effect a reduction of over $3 per kilowatt per annum in the present interest charge.

As to the cost of the turbo-generator outfit itself, it is stated that its price is reasonable; that, indeed, where the comparison is fair, the turbine will require the lesser first investment. The larger field for the turbine begins about where the high-speed engine leaves off. Its steam economy at once identifies it with the most efficient engine practice, and it therefore applies more appropriately to the classes of service where medium and large-size units are used. The comparison, then, lies generally between the turbine and the slow-speed engine. It remains merely to take an engine and generator of good construction, bring the engine efficiency as nearly as possible into parity with that of the turbine, also having it possess the same overload capacity, to find that the turbine is reasonable in price. And when we add the possible saving in foundations, buildings, etc., the first cost of installation is usually much in its favor.

The advantages of the turbine in parallel operation were brought out, and also in the use of superheated steam. The turbine may be used unreservedly with superheat of any feasible temperature. It has no internal rubbing surfaces, and there are no glands to become injured. Also, as no cylinder oil is required, there is no opportunity for lubricating trouble. Furthermore, there seems to be with the turbine rather more proportionate benefit from superheat than with the piston engine, because of diminished skin friction.

In closing the discussion on his paper, Mr. Sniffin said that the Hartford turbine plant has been running since the early days of its installation for some months whenever it was wanted. He added that the turbine was sold as a 1,500-kw machine, and that it is in operation only some two or three days a week, being a relay to the water power. It carries, however, a load from 1,800 to 2,000 kw, and, as a matter of fact, has carried, without any apparent difficulty 2,800 kw. There is a turbine at Wilmerding, of 400 kw, which has run since the first of February, ten hours a day, carrying its full load, generating current for factory power and for light. The Westinghouse Air Brake Company has four 400-kw machines that have been running for about three years, doing all the work of the factory. The economy is very high, and the repairs have been practically nothing. The company is now building four 4,000-kw turbines, three of which are for the Rapid Transit Subway in New York, to be used for lighting the subway. Four 5,000-kw turbines are to be built for the Metropolitan District Road in London, and will operate the entire system, and three 3,500-kw machines are being built for the Metropolitan Railroad of London. The De Beers Company, of Kimberly, South Africa, has ordered two 1,000-kw turbines, which will both be shipped within the next 30 or 60 days. Prof. Thurston, acting as engineer for the De Beers Company, will conduct a series of tests of these machines before they go. The Cleveland and Western Railway will put in two 1,000-kw machines for driving its new system, the turbines being now under construction.

Underground Work for Telephone Exchanges—VII.

By Arthur V. Abbott, C. E.

DISTRIBUTION.

No complete, far-reaching and universal scheme of distribution has been worked out and put into practice. There are now two general methods in use that may be termed "*Aerial*" distribution and "*Block*" distribution. Aerial distribution can further be subdivided into "Alley lines," "Back lot lines" and "House-top lines" Aerial distribution, whenever it can be used, is the most satisfactory and cheapest method, but in none of its forms could it be tolerated for a moment in the crowded portions of large cities. In most of the newer Western towns, the blocks are of greater size than those in the East. A narrow passageway or lane is built in the center of each block, on which the rear of the various lots abuts. This is not a thoroughfare in the ordinary sense of the word, although under the control of the city government, as it is rarely wide enough to permit vehicles to pass abreast, but is used for the delivery of goods, removal of garbage, ashes, etc. and an additional source of light and air. It is easy, even in the more thickly settled portions of the largest towns to obtain permits to erect light aerial lines in such alleys, for the purpose of distribution, particularly if work is so planned that lines do not cross the larger thoroughfares. The main distributing pole for each run is located inside the alley as near the street line as may be; a manhole is built in the conduit at the street and alley intersection, and from this manhole a lateral duct—preferably of iron pipe—is extended to the distributing pole and carried up alongside of it 10 or 15 feet, so that the cable may be secure from the attacks of street urchins. The general features of this method of construction are shown in Fig. 39. The cable to be distributed

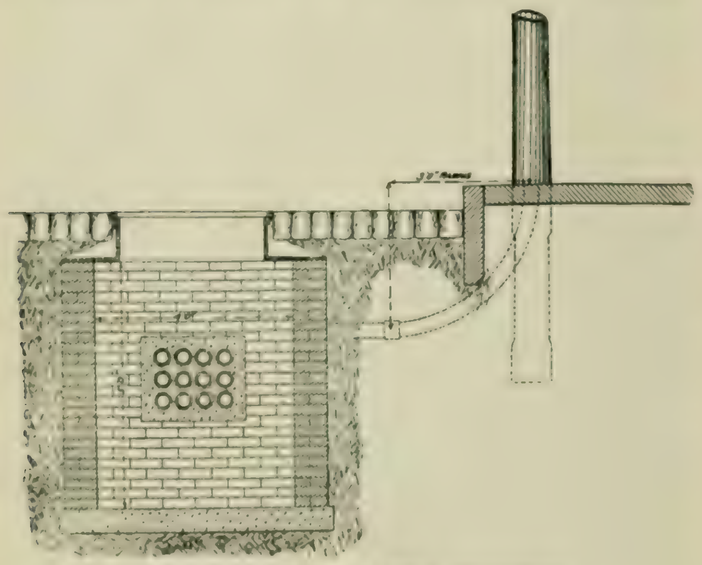


FIG. 39.—MANHOLE WITH LATERAL CONNECTION.

reaches the alley manhole in one of the main conduit ducts, and is then taken off through the lateral up the pole to a distributing box, and here the cable is fanned out and spliced to bridle wires that connect it to the open wire lines. The distributing box and general features of this plan are shown in Fig. 40.

Where alleys do not exist, it is often feasible to buy or hire the privilege of erecting a distributing line along the rear and between adjacent lots. Such lines are known as "Back-lot lines," but in constructive features differ in nowise from the regular alley line.

In cases where neither alleys exist nor back-lot rights can be obtained, a crow's-nest distributing pole may be used. Ordinarily speaking, two poles will suffice for the entire distributing system of a single block, and it must be a very obstreperous set of property owners who cannot be coaxed, cajoled or hired into granting the necessary rights. The crow's-nest pole is shown in Fig. 41. A substantial but tall pole is provided, to which, through the proper lateral duct, a cable is conducted from the nearest manhole, and terminated in a distributing box near the pole top. The pole itself is capped by a wooden ring about 5 feet in diameter, carrying insulators spaced about 4-inch centers. From the terminal box bridle wires are carried from the insulators, and from each one a clear span of bare copper—or preferably a twisted pair—is strung to the roof of the subscriber. This is an exceedingly valuable, flexible and cheap method of distribution, particularly where telephonic density is not excessive.

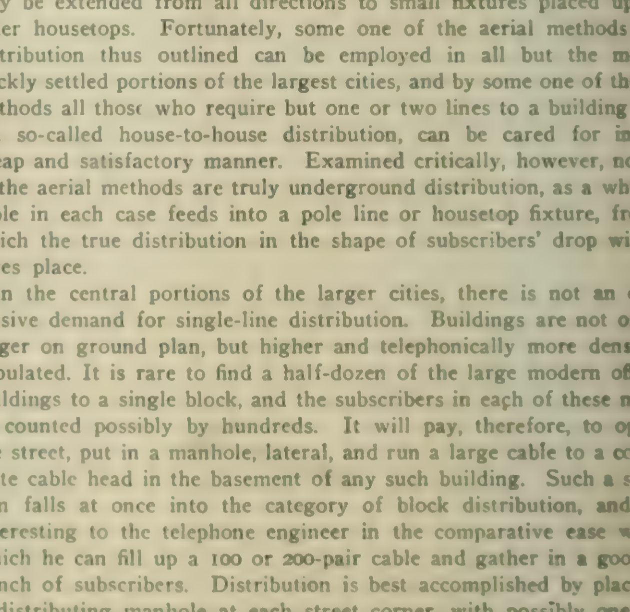
House-top distribution is accomplished by obtaining permission to extend a cable through the usual iron pipe lateral up alongside the wall of a building, usually on the outside, though sometimes through an elevator well or light shaft, to the roof and terminating

FIG. 40.—ALLEY LINE FOR DISTRIBUTION.

FIG. 41.—CROW'S NEST DISTRIBUTING POLE.

the cable upon a rack, either of iron or wood. From this rack, lines may be extended from all directions to small fixtures placed upon other housetops. Fortunately, some one of the aerial methods of distribution thus outlined can be employed in all but the most thickly settled portions of the largest cities, and by some one of these methods all those who require but one or two lines to a building or the so-called house-to-house distribution, can be cared for in a cheap and satisfactory manner. Examined critically, however, none of the aerial methods are truly underground distribution, as a whole cable in each case feeds into a pole line or housetop fixture, from which the true distribution in the shape of subscribers' drop wires takes place.

In the central portions of the larger cities, there is not an extensive demand for single-line distribution. Buildings are not only larger on ground plan, but higher and telephonically more densely populated. It is rare to find a half-dozen of the large modern office buildings to a single block, and the subscribers in each of these may be counted possibly by hundreds. It will pay, therefore, to open the street, put in a manhole, lateral, and run a large cable to a complete cable head in the basement of any such building. Such a system falls at once into the category of block distribution, and is interesting to the telephone engineer in the comparative ease with which he can fill up a 100 or 200-pair cable and gather in a goodly bunch of subscribers. Distribution is best accomplished by placing a distributing manhole at each street corner, with possibly one or two additional ones intervening. For this purpose no better plan is presented than shown in Fig. 42. The main conduit extends from



FIGS. 42 AND 42A.—TILE SERVICE DISTRIBUTION BOX WITH IRON SURFACE COVER.

street to street, as shown at *B*. Superimposed thereon the distributing ducts are placed as indicated at *A*. As often as may be, a service box, in reality a miniature manhole, is introduced, from which a lateral *C* runs to the building to be reached. The illustration by giving both a vertical and perspective view makes this method perfectly

plain. Where a small number of sub-stations is to be cared for and a less flexible and cheaper plan will suffice, the method of extending the lateral, shown in Figs. 43 and 44, will apply. In Fig. 43 the distributing conduits provide three ducts, and the service box two branches. On the multiple terminal system, two or three such boxes could be placed in each block, and a pair of 200 pair cables, one for each side of the street, looped successively through each

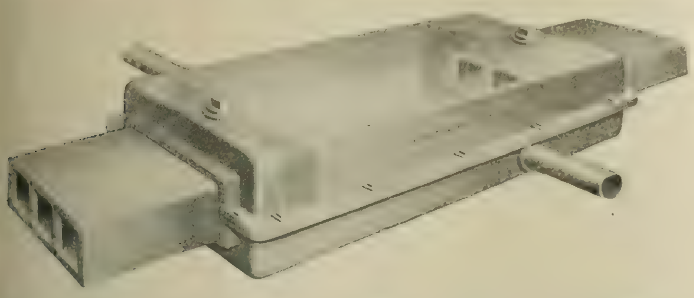


FIG. 43.—IRON SERVICE BOX FOR THREE-WAY CONDUIT, TWO SERVICES.

building passed, giving a system of almost perfect flexibility. The only drawback to this plan is the necessity of opening the street whenever access to the distributing box is required. In Fig. 44 the same general idea, but still further simplified to apply to a single cable, is shown.

The only really scientific and complete plan of underground distribution ever carefully worked out and thoroughly put into practice

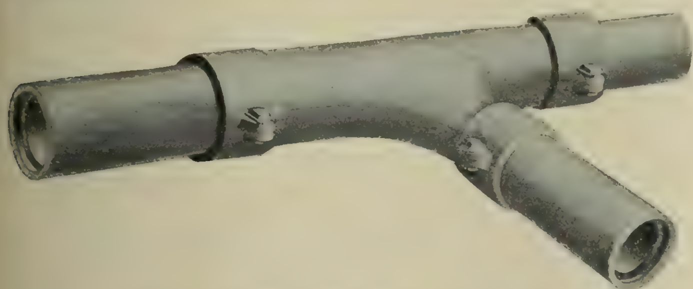


FIG. 44.—LATERAL CONNECTION TO MAIN DUCT.

is that devised by Mr. W. J. Johnston and introduced in the underground system of St. Louis. On the top of the main conduit a peculiarly shaped tile containing four compartments, as indicated in Fig. 45, is placed. This tile has side outlets on ether side placed opposite every property-owner along the conduit line. From these outlets, either at the time the conduit is constructed or subsequently as may be desired, lateral ducts are extended to and through the curb

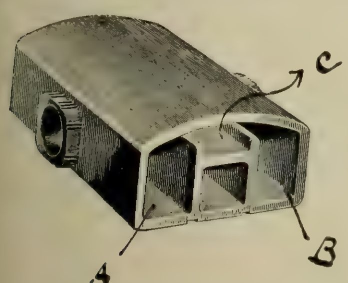


FIG. 45.—JOHNSTON DISTRIBUTING DUCT.

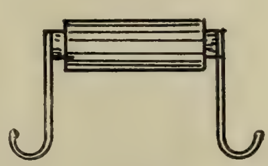


FIG. 46.—CARRIER FOR JOHNSTON DUCT.

wall of every building. In the main manhole at every street intersection, the cable to be distributed is potheaded, and "Okonite" ends are spliced on, which are drawn through the distributing ducts *A* and *B*.. The duct *C* is always reserved for the carrier—a contrivance consisting of two iron hooks attached to a roller, shown in Fig. 46, or wooden shoe of such size as to easily travel through the carrier duct *C*. When introduced into this duct, the iron hooks extend over and reach into the distributing ducts *A* and *B* on either side, and are of such a height as to pass directly opposite the center of the outlet holes. Normally, the okonite wires lie at the bottom of the ducts *A* and *B*. If a house connection is to be made the carrier is hauled through the carrier duct *C*, but prior to starting on its journey an okonite pair is lifted and placed in one of the hooks. As the carrier is drawn along the hook lifts this okonite pair away from the bottom of the distributing duct and out of proximity to the remainder of the wires. Before the carrier starts workmen have been placed in the cellar of the building to be connected, have found the end of the lateral duct, the location of which has been carefully recorded, and have passed through this lateral a long wire grapple into the distributing duct. When the carrier arrives opposite the desired outlet the grapple can engage with the okonite pair that is thus separated from the other wires, which is easily drawn into the cellar of the building. For elegance in design, complete independence of one subscriber from all others and the avoidance of frequent street openings, Mr. Johnston's method leaves little to be desired, and is a marked contrast to the makeshift plans so often adopted of running a cable from a corner manhole to the nearest cellar, and then begging, buying, borrowing or stealing right of way through the premises of the various adjacent owners to reach all other subscribers in the block.

It cannot, however, be denied that the distributing duct plan is considerably more expensive—at least, so long as in the cellar-to-cellar plan circuits remain unmolested, yet rapidly increasing maintenance due to injury inflicted by predatory rats, mice, and the malicious small boy, coupled with the fact that property owners are awakening to the idea that for long, telephone companies have been obtaining a valuable concession for nothing, and are beginning to charge rental for such rights—causes the extra expense of the distributing duct to become significant.

Municipal Electrical Control.

At the recent Richmond meeting of the International Association of Municipal Electricians, Captain William Brophy gave a history of the municipal electrical department of Boston, which brings out in a striking manner the evils incident to municipal electrical control, even when it relates to what may be considered to some extent a legitimate function of city government. With such a condition existing in the city of Boston, one can imagine what the situation in other cities and towns would generally be were the municipal ownership of electrical plants the rule. Such plants as are at present in operation are, so to speak, on their good behavior owing to the weakness of the municipal ownership movement and the watchfulness of critics, yet instances of incompetency and fraud are by no means rare. To any who may believe in the theory of municipal ownership we particularly commend the narrative of Captain Brophy, for from it he may gain an idea of the manner in which the theory is apt to work out in practice. He said:

Boston's first experience in the supervision and control of electrical construction began in 1890 under an act of the Massachusetts Legislature, permitting all cities in the State to appoint an Inspector of Wires, whose duty was to inspect all overhead wires, their insulating supports, regulate their height over buildings, and cause to be removed all "dead" or unused wires, cause also to be placed in all low potential circuits, at the point where they enter buildings, a safety device to prevent the flow of excessive or dangerous currents therein, and to inspect all wires within buildings designed to carry electric currents for electric light and power. From motives of economy the superintendent of Fire Alarm Telegraph was made Inspector of Wires. In the first named position he was responsible and subordinate to the fire commission, composed of three members, while in the latter he acted independently of them, and was directly responsible to the Mayor to whose efforts the passage of the law creating the inspection of wires department was largely due. The police signal system was not in charge of the superintendent of fire alarm telegraph, for the reason that the police department is in charge of a commission appointed by the Governor of the State, the city being obliged to furnish such sums for its support as this commission may demand, so that we had two elecrical departments where one would suffice.

The efficiency of the new department created and placed in charge of the inspector of wires can best be determined by the qualifications of the men employed therein. The head of the department had no previous experience with applied electricity outside the fire alarm system, and his most intimate friends have never accused him of a desire to explore other fields of applied electricity during his term of office.

This department was not subject to the very excellent civil service law of Massachusetts, and as a result a grand scramble

began among the little statesmen past and present, members of the city government and their followers for positions therein, and the result will show how successful their efforts proved. The working force, aside from the clerical, was divided into two divisions, the exterior and the interior, and at the head of each was placed a chief inspector, the first having to do with overhead construction, the second having to do with by far the most important branch—electrical construction within buildings. Chief Inspectors were appointed and given charge of the men in each of these divisions. The Chief of the overhead division had had large experience in overhead construction, for the fire alarm system, having been employed in that department. It is needless to say that he was not the choice of politicians, and his lack of experience on high tension work was made the most of by them, but as their followers were only adept at wire pulling of a nature that would not qualify them as electrical experts, they could not prevent this man's appointment. Of those given him as assistants, but few would be employed by any private corporation or firm.

The most important task of this department was that of interior division, as the men therein were to pass upon the work of the most vital importance to the community—interior wiring performed by the most intelligent workmen employed in the electrical business. The Chief Inspector had previously been employed in a very humble position in a lamp factory, and for a short time in a very subordinate position by one of the electric lighting companies, but at the time of his appointment he was employed in the fire alarm department. This man who was honest and sincere had no previous training that would qualify him to do electrical construction or pass upon that done by others. Three more men were selected as inspectors, all of whom were engaged in humble but honest callings which could not be said to be suitable training schools in which they could receive a proper instruction for the important work they were authorized to do, and see that others did; one was engaged in tending the gates at a railway crossing, his duties being to close the same on the approach of trains and open them when they passed; another was engaged in trimming and cleaning arc lamps for street lighting, while the third was engaged as a helper in an establishment where dynamos were manufactured; mechanical or electrical knowledge he did not possess in the silghtest degree. Those most deeply interested in the success of this new department, viz., the electrical and insurance interests; those who believed it would add greater security to the community, give security to the honest contractor by forcing the unscrupulous or ignorant to bring the standard of work and material up to the highest point, reduce the losses by fire due to electricity and the cost of insurance, were not only disappointed but disgusted to see the aim and purpose for which it was created perverted by its organization as a nursery for the political heelers. No confidence was or could be placed in the organization by those most directly interested or the public in general. The newly fledged inspectors were looked upon with amusement bordering on contempt by all who were engaged in all branches of the electrical business, from the highest officials in the public utilities companies to the workmen and helpers.

One of the tasks specifically assigned to this department was the removal of "dead" or unused wires. Notice was to be served on the owners thereof to remove them, and in the event of failure to do so they were to be removed at the expense of the owner. Hundreds of poles and thousands of pounds of such have been removed by this department and its successor, but no effort has been made to find the owners thereof or to collect the cost of such removal, the failure to do so being a direct violation of the law creating this department. The reason for this failure to comply with the law was obvious. It gave employment, or rather places, to a greater number of the political workers than would be the case were the owners of wires no longer compelled to remove the same. The city of Boston has spent thousands of dollars in the performance of this work unlawfully as a gift to private individuals and corporations owing to the betrayal of its interests by its trusted [illegible] agents.

This electrical department was tolerated or permitted to exist until 1894. It accomplished little or nothing up to that time other than help deplete the funds in the city treasury; and it failed to inspire the confidence of any who had direct dealings with it. The fire underwriters kept up their excellent inspection service just the same as they had done before, which they would not have done had this electrical bureau deserved their confidence.

Previous to 1894 a public demand for the removal of overhead wires, poles, and fixtures from the streets of Boston was made that could not be ignored, and which resulted in the passage of Chapter 454, Acts of 1894, which authorized the mayor of the city of Boston to appoint a commissioner of wires, who should have charge of a department of said city to be known as the wire department. He was to receive an annual salary of five thousand dollars and to hold office for three years from the date of his appointment. It was made his duty and he was given exclusive authority to cause to be removed from the streets within a prescribed section which included the business portion of the city, all wires, cables and conductors and the poles and fixtures for the support of the same, with the exception of long distance telephone and the trolley wires of the street railways. This work was to be completed prior to the first day of January, 1900, when the wire department would cease to exist. The commissioner was given power to designate the manner in which all wires and cables should be run on or from poles and from fixtures, and all the powers and duties exercised by the inspector of wires were transferred to him, that office being abolished. He also designated the streets in which underground conduits were to be laid and the manner in which it should be done, but granting of permits to set poles was done by the board of aldermen. It will be seen then that this department was given the supervision of practically everything electrical in the city of Boston.

It was earnestly hoped by those who labored for the passage of the law creating this department, that profiting by early experience the head of this department would be selected from among those whose education, training and electrical experience would eminently fit them to fill such an important position, but they were again doomed to disappointment.

At that time the fire department was, as before stated, under the charge of a commission consisting of three members, and justly or unjustly, it had been the subject of the severest kind of criticism for a long time. It was charged by the fire underwriters and many large and influential property holders that it was inefficient as a whole and its members incompetent, and a demand for the removal from office and the appointment of a single commissioner in their stead was so persistently urged that the mayor appointed a commission of three eminent citizens to make an investigation of the condition of the fire department.

The report of this commission was adverse to the fire commission. And notwithstanding the favorable report of a joint committee of the board of aldermen and city council, who undertook to make an investigation on their own account, it was a foregone conclusion that this three-headed fire commission would be abolished by the Massachusetts Legislature, and a single commission substituted therefor. You can imagine the feelings of bitter disappointment and surprise with which the fire underwriters, large property holders and those engaged in the electrical business received the announcement by the mayor that he intended to appoint as wire commissioner a member of this board that had been so long the subject of adverse criticism. The reason given by him for making the selection was, that as fire commissioner this gentleman had under his immediate charge the fire alarm telegraph, and for that reason he must be thoroughly equipped with all the technical knowledge that the head of this new department should possess. As a matter of fact, however, he had never acquired even a speaking acquaintance with applied electricity in any form whatever. He had served his party well however in elective and appointive offices and was ambitious to secure future political preferment in the attainment of which he would have been seriously handicapped had he been ignominiously legislated out of his position as fire commissioner. This is the real reason given by those who were supposed to know, for this appointment.

The entire force in charge of the inspector of wires was turned over to the commissioner of wires who proceeded to add enough men to make the force large enough to add dignity and responsibility to a position with the comfortable salary of five thousand dollars per annum; provide places for his personal fol-

owers, and those of a few of the other shining political lights.

The organization of the wire department was what might be expected under the circumstances. To the overhead and interior divisions of the old department was added the underground, the force in which consisted of seven men, as follows: A chief inspector; one civil engineer; two electrical engineers; one draftsman and two ordinary plain every day inspectors. The latter could have performed all the useful work required of this division, and as those who constructed conduits made their own plans and drawings, submitting copies of the same for the approval of the wire commissioner, the draftsman was not overworked, nor was he a crying necessity; and as they employed their own civil engineer such an official in the wire department proved to be superfluous. They also determined the merits of their underground cables and conduits and saw to it that they came up to the standard called for by the specifications as to conductivity, insulation and material, so that the two young gentlemen (both very worthy) who were employed as electrical engineers were not an actual necessity to the department in that capacity.

Of this entire force not one had any previous knowledge or experience in the construction or maintenance of underground conduits, cables or conductors. To nearly all, the proper mixture of mortar or concrete, the method of laying conduits, the construction of manholes, the drawing in of cables and splicing the same was a sealed book. It will readily be seen that the direction and supervision of this important work could not be undertaken by this class of men and to attempt to do so would be little less than a roaring farce. They were sent out to roam over the trenches, ostensibly to inspect and supervise the works while the only work actually performed was to obtain from those in charge the number of ducts, length in feet, kind, length of cable, and kind, to be incorporated in the annual report of the department.

The excellence of the underground electric system owned and operated by the electrical companies is due to their determination to construct them in the most thorough and substantial manner possible, and to render the disturbance of the surface of the streets unnecessary, and is not due to the knowledge, experience and forethought of the commissioner of wires and the class of men under him whom I have described. The telephone company had years of experience in the construction of underground conduits before the organization of the wire department, and a force of experienced engineers and workmen in its employ, while those who for the first time began the construction of conduits, secured experienced engineers and men from other portions of the country who needed no instructions from the commissioner of wires or his underground division. While the private companies could secure men of large experience, Boston would not, as it would be considered little short of an act of treason for the mayor or the head of a department to employ any but residents of Boston, and above all voters therein.

The overhead division was originally in charge of a chief inspector, but in this more pretentious department it was subdivided into the overhead and dead wire divisions, and an assistant to the chief inspector placed over each, three men being employed to perform the duties that could be easily performed by one. The methods pursued in this division, under this new arrangement, I will not give here in detail other than to say that a more ingenious method to accomplish as little as possible with the greatest possible number of employees could not be devised.

The interior division remained as it originally was, no change being made therein. There were two reasons for this. Owing to the open and severe criticism of its original makeup it was not deemed best to inject into it any of those who were being placed in the department mainly for political reasons; again, the public eye was not fixed on the wires, fixtures, etc., in the interior of buildings, but on the then unsightly poles in the street and fixtures on the house tops, together with the wires they were designed to support. They had made a demand for their removal and they watched the progress made in bringing about this much-desired result. There were those in the community (shrewd observers) who were uncharitable enough to say that the commissioner of wires would use his position to make people forget the fact of his long connection with the fire commission, the abolition of which seemed necessary for the public good; and for his political advancement towards the first goal of his ambition—the mayoralty of the city of Boston, by causing the removal of the overhead wires well within the time limit set by law; consequently, he had no time to devote to the interior division. This did not prove to be a misfortune. The men employed therein were honest, industrious and possessed of a desire to become proficient in their calling, and under proper instruction and direction, they made rapid strides forward. Additions to their number were very few and were made with care as to their qualifications. Owing to a wholesome fear of public opinion, this branch of the wire department was not made a resting place for political camp followers.

Owing to the inexperience of the commissioner of wires and his ardent desire to cause the streets to be clear of overhead wires well within the time limit, the amount of conduit construction which he decreed should be done was far in excess of what should have been attempted during the late season of 1894.

Owing to this mistake, when the season arrived when the excavation of streets should be discontinued, a large amount of work still remained to be done. This led to serious misunderstanding between him and those engaged in the construction of underground conduits, he contending that they were trying to embarrass him by not prosecuting the work diligently, while they with truth contended that such was not the case. This disagreement was intensified by the reports made by the underground force who, knowing well the feelings of their chief were quick to note any delays due to lack of material or unavoidable causes and magnify them. As the season drew near when work of this nature should end, the commissioner of wires became possessed of an intense desire to emulate the example of former Mayor Grant, of New York, and lead a brigade armed with axes to cut down the poles found standing in the street after a given date. There were two serious objections to the carrying out of this programme. Owing to the narrowness of the streets, tall poles in falling would crash into the walls of buildings standing thereon, and cause the suspension of traffic for an indefinite period, and the streets of the city and business houses would be plunged into darkness. This led him to cause an investigation of the subject by one in whom he had great confidence, the result of which was that the amount of work decreed to be done was greatly in excess of what could be accomplished within the time allotted therefor; and for this mistake those prosecuting the work could not be blamed, as with the utmost diligence the work could not be completed until well into February, and the connections could not be made to the underground system and the poles and overhead wires removed until much later in the spring months; that the cost of construction was very much greater during the winter than it would be during the summer season, and nothing was to be gained by delays in the prosecution of the work. In the face of these plain facts, the picturesque and realistic campaign planned against the poles and overhead wires had to be abandoned, thereby avoiding serious inconveniences, if not positive danger to the public and costly litigation to the city. There were many who regretted that this official did not carry out his threat to the fullest extent, thereby bringing forcibly to the attention of the authorities the evils that are sure to follow the vicious practice of the appointment to this important position as a reward for political services.

Soon after the organization of the wire department, the political complexion of the municipal government underwent a change, but to the credit of the mayor then elected he made no attempt to reward his friends and their followers for political work in his behalf through the medium of the pay roll of this department. At the expiration of his term the party opposed to him again came into power, and although the commissioner of wires was of the same political faith, it was decreed that he must be transferred to the head of another department to make room for another who was a powerful political factor, in fulfillment of a promise made before election that he should be appointed as the head of a department with a salary of not less than five thousand dollars per annum. The commissioner of wires strongly opposed this transfer from the wire department, as he very much desired to remain therein until the work entrusted to it was completed, the credit for which he could then take to himself and receive the plaudits of his political friends, and possibly the public, or at least a portion of it. But knowing

well that his appointment was purely a political one, and being a loyal party man, he yielded and vacated the office of wire commissioner to assume the duties of another equally remunerative one.

The new commissioner was as reluctant to accept the position as his predecessor was to resign it, as he desired to be appointed to the head of a department with the duties of which he claimed he was familiar. He frankly proclaimed that he did not possess the qualifications most essential to a successful administration of the affairs of this department, but the powers that were consigned him to this position against his will. He did not obtain the position through false pretenses, by having it proclaimed from the house tops that he was the very and only man for the position; he frankly admitted his appointment was for purely political reasons, and as his tenure of office was very uncertain, he would not attempt to acquire the technical knowledge that he felt the head of the department should possess. He trusted to his subordinates in whom he had faith to bring the work of the department to a successful issue, and never failed to give to each the credit to which they were entitled. It can be said that during his term of office the department reached its highest state of efficiency, although having dumped upon it men who could not be provided for in other departments, and whose political friends insisted on being placed on some one of the city's pay rolls. Although a believer in the doctrine that "To the victor belongs the spoils," he quickly saw the evil of applying the spoils system to a department designed as a protection for the public, and in his heart condemned it. To most of you it is not necessary to mention the name of this gentleman. He is a past member of this Association; most of you have met him at one of your conventions, while some of you have partaken of his generous hospitality in the "Hub of the Universe," and I am sure all who have known him have none but the pleasantest recollections of this glorious good fellow so full of generous impulses.

Shortly before the expiration of the term of office of this commissioner, another change in the political complexion of the city government took place, and it was well understood that the mayor-elect would not reappoint him; it was also given out that he would appoint some one thoroughly equipped for the position; but those who hoped to see such an appointment made were again disappointed as the selection made brought the office to the lowest level it could possibly reach, and one it is sincerely hoped it will never reach again.

The mayor announced himself as a business mayor before election, opposed to the practice of borrowing money to meet current expenses, and favored an increase of the tax rate so that this could be avoided, and pledged himself to conduct the affairs of the city on business principles, and to the surprise of most people, he was elected. He immediately set about securing the passage of an act by the Legislature to increase the tax rate, but he found himself bitterly opposed in this by the members of his own party, many of them thinking it would injure the party to touch the pockets of the people in this way. But there was that contingent in the Legislature who are always open to conviction—for a consideration in the form of official patronage. Among these he cast about to secure enough votes to pass his pet measure, but in order to do so he was obliged to promise to make appointments, all of which did not appeal to his best judgment. One member demanded as the price of his support of this measure the position of commissioner of wires. This was considered a pretty stiff price to pay for the service to be rendered, and was not readily agreed to, but as votes in sufficient number were difficult to secure, the terms named were reluctantly accepted so that the third appointment to the office of commissioner of wires during its short existence was secured through what looked very much like a corrupt political bargain, a vote and influence (if there was any) being secured, the price therefore being the sum of five thousand dollars per annum for a term of two years to be paid in monthly or weekly installments from the city treasury. So eager was this person to secure this princely salary to himself, that he took possession of the office immediately after his appointment, although serving as a legislator for a long time after, but his presence was not missed and the department benefitted by his absence, and would have derived far greater benefit had he remained away during his whole term of office.

In 1898 the Legislature extended the life of the wire department for a term of ten years, dating from the first day of January, 1900, but limiting its operations to clearing but two miles of streets each year, whereas it had caused an average of over seven miles per year to be cleared up to that time. Before the close of the retiring commissioner's term in May, 1900, he recommended a substantial reduction in the working force of the department owing to the reduced amount of work to be performed, which was done; later the mayor demanded that a further reduction be made, which was also done without impairing the efficiency of the department, thus reducing the amount paid for salaries from $54,773 to $36,000, a reduction of about 34 per cent. The mayor at this time declared that he would not approve the appointment of a single man whose services were not needed, no matter who desired it. He held to this resolution until a few appointments had to be made, as he claimed, in payment for votes secured at the state house, but some months later the bauble of a renomination was dangled before him and held beyond his reach until he finally turned the various departments over to what is said to be the worst gang of political spoilsmen that ever infested the City Hall. Every department except the fire and police was filled to overflowing, and the wire department came in for its share, every device possible was resorted to to find an excuse for the employment of the friends of the "gang." The expenses of the wire department were the largest in its history, 94 per cent. of which was for fixed salaries; the barrier so long erected between the interior division and the spoilsmen was finally broken down, and it was invaded; work was undertaken with which the department had, by the terms of the law creating it, nothing to do, some of which was as profitable to the community as bailing water from one side of the harbor and pouring it into the other, or taking the census of a graveyard—for the purpose of securing votes.

This "business" mayor made some of the worst appointments ever witnessed during the history of the city, for instance, a milk dealer as superintendent of public buildings, and the keeper of a small cigar stand, in which calling he was not a shining success, as commissioner of wires.

With nearly every department packed with their followers, this "business" mayor and the spoilsmen who had him so completely under their control, felt that his re-election was assured, but he went out of office the most discredited official, and with the largest vote cast against him of any man that ever occupied his position. His successor is a man of national reputation and is expected to give the city a clean and honest administration. One of his earliest and most commendable acts was to notify the person who masqueraded as, and drew the salary of, the commissioner of wires, that his valuable services could be dispensed with. I am not personally acquainted with the gentleman who has been appointed to this position. It is said that he has been a successful business man and is connected with one or two financial institutions and is an active politician. At the time of his appointment he was a member of the board of election commissioners, an institution peculiar in Boston, I believe. What special qualifications are claimed for him that would call for his appointment I have not heard. If it is on account of his financial ability, surely in a department whose annual expenditures amount to $60,000, 94 per cent. of which is for fixed salaries, the payment of $5,000 for the proper disbursement of $3,600 is rather high priced financiering. But little has been heard of him in his new position up to August 3, when the following item appeared in the Boston papers:

"Wire Commissioner Kennedy, who has been pestered for months by the Democratic leaders to make changes in his department, has at last yielded, and to-morrow three new men will report to take the places of the three removed. The new appointments are Patrick J. Heffernin, Patrick F. Hopkins and William Hogarty. The first named was for several years an official in the water department, and he was one of the many who had to retire when Mayor Hart took the reins more than two years ago. Mr. Hopkins is a well-known ward 17 Democrat, and Mr. Hogarty has been prominent among sporting men and is a close personal friend of John L. Sullivan. Other changes are looked forward to in the city collector's office and the wire department during the coming week."

It will be noticed that these men are to take the places of others removed, and that no attempt is being made to reduce the force that is costing at least 50 per cent. more than it should; and that the changes have been made to please the Democratic leaders rather than for the benefit of the public. The fact that one was formerly connected with another city department and was removed by a Republican mayor, and that the other is a well-known Democrat of Ward 17, will be sufficient evidence to satisfy the Democratic leaders as to their qualifications for any position in the wire department; but to find the true reason for the appointment of the person who has been "so prominent among sporting men and is a close friend of John L. Sullivan," ex-champion pugilist of the world, is a difficult problem for you and me. Perhaps the better way would be to write direct to Commissioner Kennedy who would no doubt give such convincing reasons that you would not rest until you had secured the services of some intimate friend of some one of the many eminent exponents of the manly art to assist you in the performance of your duties. In the absence of the Commissioner's lucid explanation, it may seem strange that appointments of this kind can be made with the sanction of a mayor who, in a public speech which he journeyed to New York to make, declared that "there was one corner of the earth where the civil service law would be respected." To be sure, he has said many other nice things, but "actions are far more eloquent than words."

Mr. Marconi on the Wireless Telegraph Conference.

On his recent arrival in London, Mr. Marconi was interviewed as to the proposed wireless telegraph conference, when he said: "To my mind the promoters of the international convention have not a sufficiently accurate knowledge of the subject with which they propose to deal to put forward any propositions of value. To be candid, I regard the proposed convention as neither more nor less than another attack by Germany upon British industry. It is probably thought in Germany that as matters stand wireless telegraphy is at present too much in favor of England. The general interests of navigation are not so much considered there as the local interests of Germany. The British and Italian navies have adopted my system, and there is none other in use in the mercantile marine of the world. I do not wish to place myself in antagonism to Germany or any other country. I wish to serve all alike, but as to Germany, the facts are these: Prof. Slaby came to England and was introduced to me by the British Post Office authorities. He came at the instance of the German Government to study my system of wireless telegraphy. He received every facility from me to do this. He went back to Germany. He lectured there, declaring that he himself had attempted experiments in wireless telegraphy which had proved unsuccessful. He had seen what Marconi was doing, which represented a real invention, and he admitted that whatever he did in the future would be due to Marconi, his master. He adopted the essential features of my system—vertical wire for transmitting and receiving, for instance. These are the main features of his system. He introduced some other variations which I consider detrimental—indeed, experiment proves them to be so. He has established a so-called system of his own, by which he has telegraphed one-twentieth of the distance I have covered. The German manufacturers who have no inventor's royalties to pay are prepared to sell their inferior apparatus for a small manufacturing profit. It is the desire of the German Emperor, I presume, to support them in this undertaking, and this it is which has inspired the demand for the convention. I think that a convention might at the proper time be a good thing, but the time is not ripe for international consideration. It is better to let fair competition work out its natural results. You cannot well yoke my system to an inferior and unsuccessful imitation. The attempt is to place inferior imitations on terms of equality with the original system."

Washington, Baltimore and Annapolis Single-phase Railway.

We are requested to say that the engineers of the Washington, Baltimore and Annapolis Railway are the Cleveland Construction Company and not the Cleveland Engineering Company, as printed in the paper on this railway recently read before the A. I. E. E.

CURRENT NEWS AND NOTES.

A FUNNY SWISS STRIKE.—A curious street railway strike occurred recently at Geneva, Switzerland, owing to some difference between the employees and the American manager. The road was built by Mr. Stephen D. Field, the well-known American engineer, with the aid of English capital. Sympathetically, all the union labor in Switzerland was called out, but it did not go. The government has intervened firmly, and the fuss seems to be over.

THE OHIO ELECTRIC LIGHT ASSOCIATION, which meets this week at Columbus, Ohio, is to discuss, among other things, the questions connected with meters; the present development of steam turbines; methods for improving load curve and net earnings; hot-water and steam heating as adjunct services, and the reliability, regulation, efficiency, power factor, etc., of alternating-current series arc-lighting apparatus. A number of well-known names are attached to these topics.

WEST INDIAN CABLE.—Repairs to the St. Lucia-Grenada cable were completed on October 10. The cable was lifted from about 2,000 fathoms of water, and, owing to the fact that it was buried in volcanic mud, the strain was very great. The cable used in the repair work is valued at between $25,000 and $30,000. The Lord Mayor of London, Sir Marcus Samuel, has donated $3,750 from the Mansion House Relief Fund to aid the families of the crew of the cable repair steamer "Grappler," which was lost, with all on board, last May, as a result of the eruption of Mont Pelée.

TESLA FINED.—On Tuesday of last week, Mr. Nikola Tesla was fined $100 by Judge Foster, of the General Sessions in New York, for failing to appear as a talesman on the jury panel for the court of that term. Next day Mr. Tesla appeared before the judge and obtained a remission of his fine, and also got an extension of time until October 16. As to his failure to report for jury duty, Mr. Tesla explained that the summons was overlooked because he had been absorbed in some very important work on Long Island. "When I become absorbed in my work," he said, "I forget everything else."

CHICAGO ELECTRICAL ASSOCIATION.—The next five papers before the Chicago Electrical Association are as follows: October 17.—"The Place of Correspondence Schools in Electrical Education," by Harris C. Trow, instructor in electrical engineering, American School at Armour Institute of Technology. November 7th.—"The Development of a Small Alternating-Current Motor," by H. I. Finch, superintendent, Emerson Electric Manufacturing Company, of St. Louis. November 21st.—"The Electrical Features of the Aurora, Elgin and Chicago Railway," by Howard Brooks, assistant electrical engineer of the above road. December 5th.—"The Early Development of European Incandescent Lamps," by Capt. A. de Khotinsky, late managing director of incandescent lamps factories, at Paris, France; Rotterdam, Holland; Gelnhausen, Germany, and Marlboro, Mass. January 16.—"The Third-Rail System for Electric Railways," by H. M. Brinkerhoff, general manager, Metropolitan West Side Elevated Railway Company.

AMERICAN ELECTROCHEMICAL SOCIETY.—At a meeting of the directors of the American Electrochemical Society, held at Philadelphia, October 2, 1902, the following applicants for admission to membership were elected: Halbert K. Hitchcock, Floreffe, Pa.; Robert A. Witherspoon, Niagara Falls, N. Y.; Edwin J. Murphy, Lynn, Mass.; G. A. Burr, Etzatlau, State of Jalisco, Mexico; Mrs. M. J. Reed, Philadelphia, Pa.; John P. Jackson, State College, Pa.; Willard E. Case, Auburn, N. Y.; Arthur E. Gibbs, Niagara Falls, N. Y.; J. C. Roberts, Niagara Falls, N. Y.; G. G. Herbert, Detroit, Mich.; W. O. Snelling, Union City, Pa.; Max M. Haff, Niagara Falls, N. Y.; Samuel Weil, Niagara Falls, N. Y.; Edwin J. Houston, Philadelphia, Pa.; Lewis E. Saunders, Niagara Falls, N. Y.; George W. Fletcher, Brooklyn, N. Y.; Ernst J. Berg, Schenectady, N. Y.; Isaiah L. Roberts, New York; Wesley S. Block, New York; Henry Arden, San Francisco, Cal.; Oscar Pickering, Cleveland, Ohio; Ray Hill White, Niagara Falls, N. Y.; Loren R. Vorce, Cleveland, Ohio. These admissions bring the membership of the society to 414.

PARIS UNDERGROUND ROAD.—The Paris Metropolitan Underground Railway, says a special cable dispatch, has been running more than two years, but has never paid a dividend, though the shares are steady at nearly double their par value. Though only a short line from the Porte Maillot to Vincennes, it has killed one large omnibus line, and in seven months has carried over 32,000,000 passengers. The first extension from the Etoile to the Place Blanche, along the line of the outer boulevards, is now complete, and opens to-morrow. This brings a very important new current of traffic from the northwest to the east, and may double its receipts.

FROST WARNINGS BY ELECTRIC LIGHTS.—It is proposed to use electric light signals at night and flags by day to warn the fruit growers of the Santa Clara Valley as to the approaching weather conditions. Prof. A. G. McAdie, of the Weather Bureau, at San Francisco, has suggested that during the months of February, March and April the orchardists be warned by colored lights of the approach of frosts, which would enable them to smudge by burning oil, etc. During September, October and November the approach of showers could be indicated. An electric tower, 220 feet in height, located in San Jose, Calif., can be seen over the greater part of the county.

THE PACIFIC CABLE.—A special dispatch from Victoria, B. C., of October 6, says: The cable steamship "Colonial," the largest cable vessel on the seven seas, to-night completed her epoch-making work in laying the longest section of cable in the two hemispheres. The Bamfield Creek to Fanning Island stretch of the "All Red" British Pacific cable is completed from the station on the Vancouver Island coast to within 175 miles of the British Isle. The "Colonial" has dropped 3,540 miles of cable, all of which is now imbedded in the ooze of the Pacific. When the last reports were flashed to Bamfield Creek by the operators on board the ship, there were but 180 miles more to lay—not a day's work.

SCHOOLHOUSE TELEPHONES.—Telephones for each of the New York public schools are suggested by Commissioner Nathan L. Jonas. Fire protection is the principal reason urged, it being pointed out that many schools are not equipped with alarms. Mr. Jonas says the plan was first suggested by a request from the City Superintendent for a telephone for each of the district superintendents and by the statement that the Brooklyn schools were unprotected. He said that the system, with a central office in the Board of Education building, could be installed for $52,512, or much less than the cost of connecting all of the schools by fire alarms, and that the system could be used for other emergencies. City Superintendent Maxwell does not believe telephones necessary, and does not favor the plan.

INDIANA MUTUAL TELEPHONE COMPANIES.—The managers of the Mutual Telephone Company, of Shelby County, Ind., met in Shelbyville, Ind., October 4 and effected an organization for the purpose of securing uniformity of rules and regulations calculated to better the service to the patrons. A fee of 5 cents will hereafter be charged to everyone using a telephone belonging to these companies who is not a subscriber. It was asserted that telephone service in the county was too free; that improvements and new appliances are necessary, and money must be provided to procure them. The following gentlemen were elected officers of the new association: M. A. Theobold, of Morristown, president; C. E. Pile, of Marietta, vice-president; Perry Harris and Lewis Creek, second vice-president; William Ensminger, of Blue Ridge, treasurer; D. B. Wilson, of Shelbyville, secretary. The association will hold monthly meetings.

THE NEW YORK ELECTRICAL SOCIETY will open its 1902-1903 season on Wednesday, October 22d. This, the 227th meeting of the society, will be held, by courtesy of the American Institute, in the lecture room of the Institute, at 19 West Forty-fourth Street. Mr. Charles R. Pratt will lecture on "Electric Elevators." The lecture will comprise a brief history of electrical elevators, the present state of the art, and what is being done towards developing a high-speed electric elevator. The lecture will be freely illustrated with lantern slides. President Sheldon has appointed the following committees: Finance—H. A. Lardner, chairman; G. Herbert Condict. Membership—W. S. Barstow, chairman; C. O. Baker, Jr., Willard S. Bennett, Reginald Pelham Bolton, E. H. Mullin and C. L. Wilcken. Examining—H. V. A. Parsell, chairman; W. I. Donshea. Reception—Hobart D. Betts, T. C. Martin, H. A. Sinclair, G. H. Guy. Papers and meetings—G. H. Guy. There are already a large number of applications for membership to be presented at the opening meeting. The society commences this season under highly favorable conditions, both as to membership and finances.

LETTER TO THE EDITORS.

Proposed Electrical Units.

To the Editors of Electrical World and Engineer:

Sirs.—In reading the editorial in your issue of September 27th, on the system of electrical units which formed the subject of a paper read by the writer at the Niagara Falls meeting of the American Electrochemical Society, I note you say that the system is "based upon the coincidence that 500 amperes flowing for one day will liberate almost exactly one cubic meter of hydrogen, which will weigh almost exactly one pound." Permit me to correct this statement by saying that it is the 100-ampere current for one day, or the kilocrith col, which will liberate the cubic meter of hydrogen. The 500 amperes or the pound col is that which will liberate within 0.59 per cent. of a pound avoirdupois of hydrogen.

Since the discussion of the paper, I have secured from Dr. Edward Morley the atomic weight of silver with hydrogen as unity, based upon his determination of the weight of one litre of hydrogen. The figure thus given for the atomic weight of silver is 107.11, somewhat lower than the figure which I used. Accepting this figure as being very nearly correct, I find upon calculation that the pound col or 500 amperes for one mean solar day lacks just 0.59 of one per cent. of freeing one pound avoirdupois weight of hydrogen. The kilocrith col, or 100 amperes for one mean solar day, liberates 0.34 of one per cent. in excess of that necessary to fill the cubic meter. Calculating the hydrogen freed by 100 amperes for one siderial day, or for one true revolution of the earth on its axis, the cubic meter is almost exactly filled there being an excess of only 0.07 of one per cent.

Independent of the electrolytic current, I have noted the following striking agreement, which points to some kind of a connection, if it is not pure accident, between the number of seconds in a mean solar day and the mass of a cubic litre of hydrogen. The three values in the second column below are the values of gravity at the north pole, at 45 degrees latitude, and at the equator. It will be seen that, dividing 86,400 seconds in a mean solar day by these values, as a mean result we secure, to within 2.4 parts in 10,000, the weight in dynes that one litre of hydrogen will show if weighed with a spring balance at the three places named:

Seconds in mean solar day.		*Value of gravity*		*Weight in dynes of one litre of hydrogen*	
86,400	÷	983.11	=	87.884	
86,400	÷	980.61	=	88.108	Mean result.
86,400	÷	978.1	=	88.334	
Grammes in weight litre of hydrogen					
.089873	×	983.11	=	88.355	
.089873	×	980.61	=	88.130	Mean result.
.089873	×	978.1	=	87.905	

In the foregoing we have used the three values of gravity in both instances, as it better enables studying the agreement, but it is with the mean value of gravity which determines the mean pressure of the atmosphere that we have to deal, as the litre of hydrogen at the mean pressure of the atmosphere and at zero C. weighs, as Dr. Morley has found, .089873 — .000027 grammes. It can be shown that if the two figures in the above, 88.108 and 88.130 were in perfect agreement, then if the weight of a litre of hydrogen were multiplied by the square of the mean value of gravity, the resultant figure would be 86,400, the number of seconds in a day. The result actually obtained from the above is 86,421.5 seconds, thus showing a variation of 21.5 seconds from exact agreement. It is to be noted, however, that the limits of possible error in Dr. Morley's determination are sufficiently great to be outside of this variation. Hence, it cannot be known at the present time whether the agreement is absolute, unless some demonstration can be made, proving that such an absolute agreement is a necessary consequence of the magnitude of the various C. G. S.

units involved in their relationship to the mass of the earth and the mass of unit volume of the gas, hydrogen, which is unity in the table of atomic weights. The specific gravity of hydrogen with water as unity of specific gravity is represented by the figure .000089873, hence, this odd number is the one which enables the conversion of the specific gravities of all gases with hydrogen as unity of specific gravity, to their specific gravities with water as unity, and the relationship above pointed out therefore naturally reaches to all elements and compounds in chemistry when their atomic and molecular weights are taken into consideration.

Should this relationship prove to involve absolute agreement, it is interesting to note that the number of seconds in a mean solar day, divided by the weight in dynes of a litre of hydrogen, gives us the value of gravity at 45 degrees latitude and sea level, or, again, the value of gravity is equal to the square root of the quotient of the number of seconds in a mean solar day, divided by the weight in grammes of a litre of hydrogen, and that these ratios could be substituted for *g* in the ordinary equations for the values of velocity, space, time and energy where the value of gravity is involved. Hence it is, if this connecting link can be proven fundamental, the periodic law in chemistry, the law of gravitation, and probably Coulomb's law of attraction between electrical bodies can probably all be brought within the scope of some broader generalization.

CLEVELAND, OHIO. ALFRED H. COWLES.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Utilization of Materials in Dynamo Design.—S. P. THOMPSON.—A British Association paper, in which he discusses the specific utilization of the materials in relation to the armature; a small armature requires, of course, only a small field magnet; Mavor has introduced the conception of the "active belt," meaning by this term the entire mass of the peripheral structure of the armature down to the roots of the armature teeth, and consisting of iron, copper and insulation. It is in this active belt that the whole inductive generation of e. m. fs. takes place; and it is also on this active belt that the whole of the mechanical forces, as between armature and field, are exerted. Mavor discussed the energy spent in this active belt, and in order to obtain figures that could be compared with one another for different machines, he calculated the relation between the output of the machine and the volume of the active belt, not under the actual conditions of use, but on the supposition that in all machines the field was equally strong and the peripheral speed alike; *i. e.,* he ascertained, for a number of different machines, the number of ergs per second per cubic centimeter of active belt at unit velocity in unit field; this number, although varying from one machine to another, was found to be about 5. This measures simply the current density (or the number of c. g. s. units of current per square centimeter) in the cross section of the active belt; as 10 amperes per square centimeters, or 322 amperes per square inch. The present author extends this conception of the active belt still further, and considers not only the mean number of amperes that traverse each square inch of it parallel to the shaft, but also the mean number of magnetic lines that traverse each square inch of it radially; and at the same time he considers the speed with which it moves forward tangentially. He gives some formulas, and shows that the power in watts per cubic inch is a product of three factors. The first factor is the gross current density per square inch axially in the active belt. The second factor is the gross magnetic density per square inch "radially" in the active belt. The third factor is proportional to the peripheral velocity. He has made a detailed analysis of some 50 modern direct-current generators, of sizes above 50 kw, with slotted armatures. If these three factors are taken for any particular machine, one has at once a means of comparison between its design and that of other machines, in respect to the specific utilization of the materials. Some of the numerical results are given. By multiplying those three factors for any machine, one gets its specific output in watts per cubic inch of active belt. In the machine considered, the value of this varies between 45 and 120 watts per cubic inch. But in one case the value runs down to 15 watts per cubic inch, though the machine is by a first-class maker; and in one case the figure rises to the value of 192 watts per cubic inch. This machine is the 1,600-kw generator described by Hobart before the Glasgow Engineering Congress. A high peripheral speed, and a high degree of saturation of the iron teeth conspire to give this machine a remarkably great output in proportion to its size and weight.—Lond. *Elec.,* September 19.

LIGHTS AND LIGHTING.

Conduction in a Nernst Lamp.—BOSE.—A paper on the electrolytic nature of the process in the Nernst lamp. He attempts to explain the curious fact that a Nernst lamp will burn hundreds of hours with direct current which should theoretically electrolyse it in about five minutes. He assumes that in the oxides which make up the conductor, the velocity of migration of the cations is probably very much smaller than that of the anions. Hence the chief part in the current conduction is probably taken by oxygen ions, while the metallic ions in a stationary state undergo no displacement. The oxygen evolved at the anode diffuses back to the cathode in the interior of the rods, and there oxidizes the metal again. The oxygen of the air which surrounds the rod and also penetrates into it, encourages the process and leads to the well-known increase of durability of the lamp as against its behavior in a vacuum. The following observations confirm this theory. In a vacuum the rod gradually assumes a darker hue and a metallic aspect, which disappears on exposure to air. The vacuum around the glowing rod can never be carried as far as it can when the rod is cold.—*Ann. d. Phys.,* No. 9; abstracted in Lond. *Elec.,* September 26.

POWER.

Limits of Power Transmission.—An article on the physical limits of electric power transmission, which are fixed by the voltage used. The pressures developed in the armature coils of alternators must reach their higher limits at a point much below 50,000 and 60,000 volts. In the largest transmissions with alternating current there is, therefore, no prospect that step-up and step-down transformers can be dispensed with. In none of these instances where transformers are working at 40,000 to 60,000 volts is there any indication that the upper limit of practical voltage has been reached; on the contrary, transformers have repeatedly been worked experimentally up to and above 100,000 volts. He then discusses the line construction and gives some numerical data. He calls attention to the fact, demonstrated at Telluride, that with 47,300 volts on each line the leakage per mile between the two wires 15 inches apart was 10 times as great as the leakage between the two wires 52 inches apart; he concludes that leakage through the air may be reduced to any desired extent by suitable increase of distance between the wires of the same circuit. But to carry this very far involves radical changes in line construction, as it seems to involve the use of a separate pole for each wire of a circuit, the wire to be mounted at the top of its pole. This construction calls for three lines of poles to carry the three wires of a three-phase transmission. Each of these poles may be of only moderate dimensions, say 30 feet long with 6 or 7 inch top. The cost of three of these poles will exceed by only a moderate percentage that of a 35 or 40 foot pole with an 8 or 10 inch top, such as would be necessary with 12-foot cross-arms. The distance between these poles at right angles to the line may be anything desired. Extra long pins and insulators of the umbrella type at the pole tops will easily give a distance of two feet or more between the lower wet edge of each insulator and the wood of the pin or pole. Such line construction would probably safely carry two or three times the maximum voltage of present practice.—*Eng. Mag.,* October.

Power Equipment of Manufacturing Plant.—An illustrated article on the power equipment of the new works of the British Westinghouse Company, at Trafford Park, Manchester, where actual manu-

facturing has just commenced. The power supply is by alternating currents. The generating plant contains four three-phase generators, two of 750-kw each and two of 250-kw each, the voltage being 440, and the frequency 25. There are also two exciters and a rotary converter, giving 550-volt direct current for special purposes throughout the works, such as for certain testing, for arc lighting, etc. There are other converters in the testing department. Practically the whole of the power is developed by induction motors with squirrel-cage rotor, running direct on the 440-volt supply circuit. The motors are used direct coupled or belt connected to independent machine tools. —Lond. *Elec. Rev.*, September 12.

Power Plant in North Wales.—An illustrated description of the hydro-electric power plant near Blaenan Festimiog, in North Wales. The company gives a 24 hours' supply, providing power to slate mines and quarries for hauling, pumping, mill driving, etc., and also electric light for the streets and for private consumers of the town. Direct current is supplied at 500 volts for power purposes, and at 230 volts for lighting, heating and small motors. The company has taken the pumping by contract, which enables it to supply power for this purpose, at the most convenient times to itself, for equalizing the load on the generators, and consequently the load factor is good. Motors are at present connected to the mains to the extent of 400 hp, and 3,000 lamps of 8 cp. There are two 560-volt, 90-kw, direct-current generators, and a battery giving 140 ampere-hours if discharged in one hour. In the town the voltage is reduced to 230 by means of a motor-generator.—Lond. *Elec. Rev.*, September 12.

Steam Turbines.—PARSONS.—A brief abstract of a British Association paper. The largest steam turbine of the Parsons type made so far is of some 5,000 hp; he discussed especially the use of steam turbines in the mercantile and naval marine, and also mentioned its use as a reversed apparatus, *i. e.*, as a rotatory pump for water or for compressing air. In the discussion, Crompton stated that electrical engineers would welcome the steam turbine as a pump, inasmuch as it gives them a high-speed rotary pump which they can couple directly with an electric motor. Replying to an inquiry as to the use of superheated steam in turbines, Parsons stated that the approximate improvement in economy of heat is one per cent. for each 10 degrees of superheat, up to 200 degrees superheat. One of the difficulties in the use of very high degrees of superheat is the unequal expansion of the turbine chamber when the steam is turned on.—Lond. *Elec.*, September 19.

REFERENCES.

Large Gas Engines.—HUMPHREYS.—An abstract of a British Association paper on recent progress in large gas engines. Gas engines of 1,200 hp and 1,500 hp are already working, and others of 2,000 hp to 4,000 hp are being constructed. He gives data on several manufacturers which show that there has been rapid progress. The future of the gas engines for central station purposes depends on the ability of gas engines to drive alternators in parallel. Numerous instances were given in which gas-driven alternators are regularly at work in parallel, giving good results.—Lond. *Elec.*, September 19.

Hydro-Electric Plants.—DE LA BROSSE.—The first of a series of illustrated articles on hydro-electric plants in the Alps. After some general introductory notes the Rhone power house at Jonaga is described.—*The Elec. Age*, October.

TRACTION.

Electrolysis by Return Currents.—LARSEN.—An account of experiments in which he investigated the question of how far the electrolysis of gas and water pipes by return currents of tramways can be diminished by changing the direction of the current at regular intervals. Two sets of tests were made; in one, the direction of the current was reversed once every hour, in the other once every day. The results seem very promising, for by reversing one a day the electrolytic action is reduced to one-fourth, and by reversing once an hour it is reduced to one-thirtieth. Moreover, if the direction of the current is always the same, the result of electrolytic action is that holes are eaten into the pipes, while with the current reversals the reduced electrolytic action which is still left is distributed more uniformly with considerably less bad effects.—*Elec. Zeit.*, September 25.

Some more experimental investigations by the same author on the same subject. Each of nine pieces of iron or steel tubes, 2 inches in diameter, was placed vertically in the center of an iron cylinder, 10 inches in diameter; each of these cylinders with its tube rested in an upright position on an insulating clay plate, and the space between the cylinders and tubes was filled with earth. Direct current was sent from the tubes to the outside cylinders, all these different "cells" being connected in series. The results show that the loss of weight per ampere-hour was practically the same under the different conditions of the experiments, and was independent of the current density, the voltage, the kind of iron, the percentage of sodium chloride and of whether the circuit was continuously closed or periodically interrupted.—*Elek. Zeit.*, September 18.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

British Central Station.—An illustrated article on the lighting station of Stamford, which has a population of 8,000. So far 3,000 lamps of 8 cp have been installed, and 4,000 more have been applied for. There are two steam-driven, 480-volt, 90-kw, direct-current dynamos, supplying a three-wire system. The balancing is effected in the usual way by means of rotary balances and boosters. There is a storage battery of 260 cells, giving 350 ampere hours.—Lond. *Elec. Eng.*, September 19.

ELECTRO-PHYSICS AND MAGNETISM.

Velocity of Light in an Electrostatic Field.—FESSENDEN.—A brief communication. Some time ago he drew the theoretical conclusion that the velocity of light should accelerate in an electrostatic field. In preliminary rough experiments made by him, he now finds that this is indeed the case, although the velocity actually observed is only 80 per cent. of that predicted by him. He also mentions briefly that by a development of his vortex theory, the difference between positive and negative electricity can be explained. The difference is said to be merely one of circulation, *i. e.*, the simple vortex "singularity" is to be taken as the negative electron, and when a number of the vortex "singularities" are so grouped that their circulation is closed, they behave as positive electrons. Hence the positive electron is simply an agglomeration of negative electrons, so grouped as to have a closed circulation.—*Science*, September 19.

Positive Electrons.—W. WIEN.—A German Bunsen Society paper in which he gives an account of a long series of experiments in which discharges in vacuum tubes were made with perforated cathodes; the positive electrons which travel towards the cathode pass through its perforations and can then be investigated in the same way as the negative electrons in cathode rays, etc. He used the method applied by Kaufmann for his researches on Becquerel rays. The results obtained by the author concerning positive electrons differ greatly from those formerly obtained for regular electrons. For the positive electrons the ratio of mass to change varies greatly; it may be that the gas ions themselves are the positive electrons, but this is not yet sure. While the negative electrons in cathode rays maintain the same ratio of mass to change all along their path, the positive electrons change this ratio along their path; it is possible that they gradually combine with negative electrons, so that their positive charge is gradually neutralized. Differences in the color of the fluorescence produced make it possible that chemical influences take part in the phenomena.—*Zeit. f. Elektrochemie*, August 14.

Radioactivity.—J. J. THOMSON.—A long editorial on a recent lecture held before the British Association, on Becquerel rays and radioactivity. It was the Röntgen ray which first gave the clue to the true action of uranium and other phosphorescent bodies, and it was Becquerel who first followed up this clue. His experiment is described, which conclusively proved that the radioactive emanations were self-originating and independent of any previous influence on the radioactive material. He made experiments showing the discharge electrification by the presence of radioactive matter, and discussed the work of Prof. and Mrs. Curie. Three special radioactive substances have been detected: radium, polonium and actinium. Of these, polonium and actinium have never been obtained in a sufficiently high degree of concentration to make their presence visible in the spectroscope. Only by the evidence of radioactivity can their existence be detected. The radioactivity test is "millions of times more sensitive than chemical analysis, and thousands of times more sensitive than the spectroscope." The percentage of radioactive matter in many substances in which these properties have been detected is "far less than the percentage of gold in sea water." In the case of pure radium, matter is being thrown off so slowly by radioactivity that it would occupy one square centimeter of surface a million years to throw off only one-thousandth of a milligram of the substance. On the other hand, the energy thrown off is at a far

more rapid rate, being sufficient within the million years to melt a layer of ice a quarter of a mile thick. It remains yet to be explained how the radium maintains its supply of intrinsic energy. Placed in contact with barium or thorium—or, indeed, with almost any substance—a piece of radium will gradually impart to the neighboring substance its own radioactive properties, and will itself lose those properties; if now the two substances be separated for a time, it will be found that the barium will gradually lose the properties which contagion has imparted to it, while at exactly the same rate, the depleted radium will restore itself to its normal radioactivity; the explanation is still a mystery.—Lond. *Elec.*, September 19.

Generation of Röntgen Rays.—TOMMASINA.—An article in which he formulates the following novel view of the formation of Röntgen rays. The electric flux starting from the anode follows the lines of electric force, forming its own conductors, which consist of polarized alignment of radiant matter, as is the case in the production of electric phantoms of conducting powders in liquid dielectrics. The flux being of an oscillating character gives rise to a periodical destruction of the contacts, and this produces vibrations which become visible in the form of luminescence. The cathode is not the only source of cathode or X-ray, as these may also be generated at the walls of the tube, and generally at any point where the anode flux is reflected. It is not necessary, as alleged by Semenov, that the anti-cathode be insulated. Cathode rays can be produced in a conical tube in which an electrode is placed at the top of the cone, and another in a side tube, by joining the former electrode to the positive pole of an induction coil through a water resistance, and leaving the other electrode and the other pole insulated. This would apparently mean that the impact of positive ions is sufficient to elicit negative ions and produce Röntgen rays. The production of the latter, which require a high velocity of impact, could hardly be due to the impact of slow positive ions.—*Comptes Rendus*, August 11; abstracted in Lond. *Elec.*, September 19.

Dimensions of Cathode Phenomena.—HEHL.—An account of an investigation of the dimensions of the different cathode layers under various circumstances, *i. e.*, of Goldstein's first, second and third cathode layers which are now known as the canal rays, the Hittorf or Crookes dark space, and the negative glow light. The most characteristic quantities in a vacuum discharge are the cathode drop, which is independent of the pressure, but dependent upon the gas and the metal, and the current density existing when the cathode is incompletely covered with light.—*Phys. Zeit.*, September 1; abstracted in Lond. *Elec.*, September 12.

Atmospheric Electricity and Earth Currents.—WALKER.—An article in which he gives a summary of various observations made by others and himself, and discusses the various causes which have been suggested for the earth currents. He remarks that it is not impossible that on the mountains, where the effect of solar radiation is greater in the less dense atmosphere, the ultra-violet rays may modify the earth's negative charge to a greater extent than at low elevations, and produce the result that is manifested in the earth current. As these rays must fall in different phases at different places, there would also be present the conditions favorable to extensive electrical eddies in the air—Lond. *Elec.*, September 12.

Pyromagnetism and Piezomagnetism.—VOIGT.—A discussion, from the point of view of the electron theory, of the question whether the phenomena of pyro-electricity and piezo-electricity have magnetic analogies. He comes to the positive conclusion that such magnetic analogies actually exist, though they are probably very small. He is engaged in a systematic search for crystals showing the new magnetic properties. So far, the results have been practically negative.—*Ann. d. Physik.*, No. 9; abstracted in Lond. *Elec.*, September 12.

Solar Protuberances and Terrestrial Magnetism.—SIR N. LOCKYER.—An account of an investigation in which he reaches the following conclusions: The epoch of magnetic storms classed by Ellis as "great" and those of the greatest chromospheric activity of the sun near its poles are identical. The general curve of terrestrial magnetic activity is nearly the same as that of the protuberances near the solar equator.—*Comptes Rendus*, August 25; abstracted in Lond. *Elec.*, September 12.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Alkaline Chlorides with Platinized Platinum Anodes.—FOERSTER AND MUELLER.—A German Bunsen Society paper, giving the results of a long experimental investigation. The average e. m. f. required for the electrolysis of alkaline chlorides is smaller for platinized platinum anodes by 0.5 volt than for bright platinum. The formation of the chlorate is about the same, although it starts somewhat later at the platinized anode than at the bright platinum, and the platinizing of the anode is of influence only upon the electrolytic processes preceding the formation of the chlorate. They made a very long investigation of the causes of this influence of the platinizing of platinum. The difference of voltage between the electrolysis with bright and with platinized platinum anode depends upon the nature of the electrolyte and more or less upon the current density; with sodium hydroxide and sodium chloride it also changes considerably with the time.—*Zeit. f. Elektrochemie*, July 31.

Formation and Disintegration of Alloys at Cathodes.—HABER.—A paper in which he first makes some theoretical remarks on the potential of electrodes of alloys; they have a certain distinct potential difference against an electrolyte, which can be calculated theoretically. In the second part he gives a general review of the phenomenon of the pulverization of metallic cathode; the special case treated by him is a simple, purely electrochemical one. At a cathode in an alkali solution an alloy of the cathode material with the alkali metal is formed electrochemically, and has the property of being decomposed in water or aqueous solution with a simultaneous pulverization. This has long been known to be the case for mercury cathodes, but it is also the case for lead and tin. Alloys which pulverize contain a relatively high percentage of the alkaline metal, while alloys with a lower percentage decompose water quietly, without pulverization, but with a formation of a sponge on the cathode get a spongy surface; there is a great difference in this case between surface. Some metals, especially platinum, do not pulverize, but get a spongy surface; there is a great difference in this case between acids and alkalis.—*Zeit. f. Elektrochemie*, August 7; a brief reply, by Billitzer, to some critical remarks of Haber, in *Zeit. f. Elektrochemie*, August 28.

Electrolytic Copper Refining.—PHILIP.—The conclusion of his long serial on the financial basis and design of electrolytic metal refineries. The increase in the current density is not only limited by the question of prime cost, interest and depreciation, but also by other important factors, such as the alteration of the mechanical character of the electro-deposited copper and the alteration of its chemical nature. Unless some special means are used, the copper which is deposited with current densities much above, about 14 or 15 amperes, per square foot, tends to take a chrystalline and loose form, and if the electrolyte contains many impurities the high current density is favorable to the precipitation of arsenic and antimony with the copper. Economy in copper is attained by using all the vats in series, and having the vats as large as possible. The amount of copper is also less the greater the current density. He finally makes a few remarks on the size and the number of the vats, and on the voltage of dynamos for copper refining.—Lond. *Elec.*, September 26.

Electrolytic Preparation of New Alloys.—COEHN.—A German Bunsen Society paper. Ammonium, like sodium, can be deposited on a mercury cathode, and then forms an alloy, but it was impossible to get an ammonium deposit with a cathode of wood metal. He tried to deposit alloys of light and heavy metals from aqueous solutions by depositing both metals at the same time from the solution. It has been repeatedly stated that the electrolytic deposition of nickel can be improved if a magnesium salt is added to the solution; he believes it is because an alloy of nickel and magnesium is deposited; pure nickel does not adhere firmly, while a nickel magnesium alloy does. He tried to obtain in the same way an alloy of aluminum and magnesium, but was not successful.—*Zeit. f. Elektrochemie*, August 14.

Electrolytic Production of Soda and Chlorine.—GLASER.—An account of laboratory experiments, in which he investigated the Solvay-Kellner mercury cathode process on a small scale. The principal results are as follows: A low ampere-hour efficiency is mainly due to the depolarizing action of the chlorine on the alkali amalgam; the decomposition of water is of less importance. A good efficiency can be obtained only at high-current densities, when no diaphragm is used. With specially prepared diaphragms the efficiency is good also at lower-current densities.—*Zeit. f. Elektrochemie*, August 7.

REFERENCES.

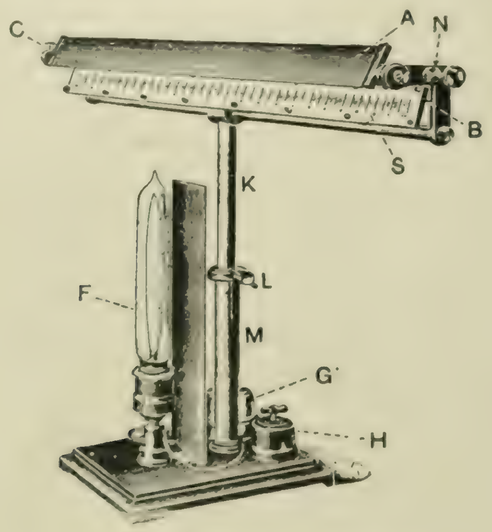
Chlorates.—J. B. C. KERSHAW.—The first of a series* of illustrated articles on the electrolytic manufacture of chlorates. After

some introductory notes on the reactions and their equations, the Gall and Montlauer chlorate cell and the Carlsen chlorate cell are described.—*Elec. Rev.*, October 4.

Rotation of Layers of Sulphuric Acid and Water in a Magnetic Field.—Urbasch.—A reply to Drude's critical remarks, in which he maintains the correctness of his observations and also makes some remarks on Nernst's diffusion theory.—*Zeit. f. Elektrochemie*, August 7.

Units, Measurements and Instruments.

Objective Readings.—Edelmann.—An illustrated description of a new arrangement to give objective readings. While the spot of light is superior to the reading telescope, as it enables several observers to take readings at the same time and to be less straining to the eye, it has the disadvantage that it requires a dark room, and that the observer's head is often in the path of the beam. With translucent scales the reading is indefinite and depends upon the point of view. In the author's arrangement these drawbacks are



APPARATUS FOR OBJECTIVE READINGS.

eliminated and all the advantages of the objective reading retained. In the adjoining diagram, M is a column in which the rod K can be moved up and down and fixed by L. It carries the celluloid scale, S, loosely hung in it, and is finally adjusted by the screw N. The mirror, A, is turned at B and fixed at C. The lamp is an incandescent lamp, F, with a thin central filament and thicker lateral filament. The latter does not glow, and the glowing filament thus provides a single straight line. H is a switch, and G an insertion key. The scale is read from the other side, through the mirror, and no darkening of the room is necessary.—*Phys. Zeit.*, August 15; abstracted in Lond. *Elec.*, September 26.

Silver Voltameter.—Farup.—An illustrated description communicated by Nernst, of a new form of silver voltameter, which while facilitating the weighing, is in general just as exact and considerably more exact when very small currents are used. The solution consists of about 10 grams of silver nitrate and about 15 grams of cyanide of sodium, dissolved to 100 cc. of solution. With this electrolyte it is absolutely necessary to exclude oxygen, for if the oxygen of the air finds access, a silver plate will dissolve considerably in a solution of cyanide of sodium. The principle feature of his apparatus consists in keeping the oxygen away from the platinum cathode by means of properly arranged sheets of silver. In order to remove all the oxygen originally in the electrolyte, it is necessary to set up the voltameter for some time before the circuit is closed. The weighing of the silver is done in the ordinary way: at the end of the test, the platinum electrode is weighed without any other care, except that it is cleaned in distilled water and dried for a few seconds over a flame.—*Zeit. f. Elektrochemie*, August 14.

Telegraphy, Telephony and Signals.

Hollow Conductors in Wave Telegraphy.—Turpain.—An account of an investigation of the effect of using hollow conductors, both as regards protection from penetrating waves and concentration of waves inside of them. An exciter was enclosed in a box lined with tin, about 25 cm. square. A receiver, comprising a coherer, a relay and a bell and battery, was enclosed in a similar box. Each box had a circular hole, 14 mm. in diameter, through which a conductor was introduced, consisting of a bare wire, a tube, or a leaded cable, 10 meters long. When the transmitter and receiver are both completely enclosed, no action between them is possible. Also, when the holes are open and are jointed across by a metallic tube, no action is noticed. But when the tube enters the boxes without touching the tin, or when the boxes are removed, a decided response is seen. In these cases the tube appears to concentrate the waves upon the receiver. The action is still better when a cable with metallic covering is substituted for the tube. In this case the core of the cable joins the two pieces of apparatus, and the leaden wrapping serves to concentrate the waves. This concentrating action is not impaired by peeling off a short length of the leaden wrapping, so long as there is no metallic connection between the core and the portion of the wrapping attached to the receiving box. If the other portion of the wrapping is connected with the core, it makes no difference. These observations give hints with regards to Hertzian wire telegraphy; the metallic wrapping of every submarine or subterranean cable should be continued right up to the transmitter and receiver. Each of the latter should be contained in a hollow conductor connected with the metallic wrapping. Under these conditions a powerful concentration of the electric waves is obtained, which would be impossible if the waves passed from the core to the metallic wrapping of the cable at the point where the cable commences. Beyond that point the waves would be dissipated in the ground or in water. The experiments may be utilized also for wireless telegraphy. The author proposes that both transmitter and receiver should be enclosed, and joined to the air wire by means of a cable with metallic wrapping. The experiments show that no inconvenience is caused by connecting the wrapping of the transmitter cable to the air wire itself. As regards the receiver, a connection between the cable wrapping and the air wire would constitute a very effective and convenient protection of the receiver against waves emitted from the station. This connection could be interrupted when receiving.—*Comptes Rendus*, September 8; abstracted in Lond. *Elec.*, September 26.

Miscellaneous.

Presidential Address.—Dewar.—A reprint of his long presidential address to the British Association, a large portion of which deals with a summary of recent very low temperature researches, including some resistance determinations.—Lond. *Elec.*, September 12, 19.

New Book.

Die Internationalen Absoluten Masse Insbesondere die Electrischen Masse. Fuer Studirende der Electrotechnik in Theorie und Anwendung Dargestellt und Durch Beispele Erlautert. By Dr. A. von Waltenhofen. Braunchweig: Friedr. Vieweg & Son. 306 pages, 42 illustrations. Price, 9 marks.

The science of electricity was fortunate in that most of the quantities involved in it could not be measured in feet and pounds, and therefore a new system of units had to be evolved; and, thanks to the continental foreigners who realize the advantages of a rational system of units better than we or the English do, that new system was made a rational one, and was based on the absolute system. It is not strange therefore that the absolute and the electrical systems of units should naturally be treated of together, even though the former are separate and distinct by themselves. That this well-known and distinguished author has included both, with special reference to electrical units, is, therefore, not unreasonable, especially as the absolute systems are more closely related to the electrical than to the others. But there does not seem to be an equally good reason for enlarging the book to nearly double the number of pages of the second edition, to include an "introduction" to electricity. The latter had better have been a separate book, as that subject has been treated in many other books, while there are few thorough books, as this one is, on the absolute systems.

In this third edition the author has revised and enlarged the sections on electrical and magnetic units with special reference to the applications of electricity, including such subjects as permeability, the predetermination of dynamo characteristics, efficiency, current and voltage of dynamos, etc. which latter do not really belong to a treatise on units. Another section treats of the theory of poten-

tials. Another is on galvanometers. The section on self-induction has been revised and enlarged, but the greatest additions have been made in the parts on the theories of alternating currents, including polyphase and oscillatory currents. The sections on the transmission of power, calculation of lines, heating of wires, etc., have also been enlarged slightly. The book is primarily for students of electricity, but is intended also to be a reference book for physicists and electrical engineers. While it seems to accomplish the first object, we cannot say the same for the other, as a reference book should be practically complete, which that part is not.

The first part, comprising less than a third of the book, is a thorough, systematic, and apparently very good treatise on the various sytems of units, divided into mechanical, magnetic, electrostatic and electromagnetic, with the absolute systems as a basis common to them all. While he mentions several absolute systems based on the millimeter, centimeter or kilometer, yet they are all mass, length and time systems; and we regret to see that he does not seem to have included some of the other interesting absolute systems which have been suggested, based on other fundamental measures, such as energy, force, etc., some of which are not without their advantages.

We are pleased to see that he specifically states that the time unit called the second which is used in all these systems, is the mean solar second and not the sidereal second, which latter is really the more rational for a fundamental unit; but the solar second being the one indicated by our time pieces, was wisely given the preference for practical reasons. Whether it is the solar or the sidereal second that is used in the absolute system seems to be very rarely stated in books, even by careful writers. The difference between the two is quite appreciable. We are also pleased to see that he shows clearly that the loosely used term energy is synonomous with work, and does not include power, as is often supposed.

It is to be regretted that he is not accurate with his constants, which he gives to only a few places of figures. Nor does he give tables of equivalents. One would have expected to find very accurate and full tables of equivalents in such a book. The kilogram moreover is said to be the weight of a cubic decimeter of water, which might have been explained in such a book as this, in a foot note, to be only approximately correct though sufficiently so for most purposes. The exact relation is still to be determined by experiment, as it is not fixed by theoretical relations as many suppose, owing to the unfortunate way in which the international kilogram was defined. Nor is the meter really an exact decimal fraction of an earth's quadrant, as he claims. There is an inexcusable error in his definition of our ton weight which is not the same as our obsolete ton capacity measure, as he states it to be.

The second part, comprising about two-thirds of the book, may be said to be a treatise on electrical and magnetic calculations from the academic standpoint, including both the highly theoretical ones and to some extent the practical ones. The general contents of it have already been noticed above as the newer additions to the third edition. It seems to be somewhat unbalanced in that some subjects are discussed at length while others are either not considered at all or only briefly. If its purpose, however, is only to serve as various examples in electrical calculations, it seems to do well what it is intended for.

It is to be greatly regretted that the author, or perhaps the publisher, insists upon the use of the old style German type which well deserves the name of eye-poison. Most scientific books in German are wisely printed in the Latin type, or what might now be termed the international type. All Germans can read both, but few outside of Germany read the old German type. It is a pity that this distinguished author has thus restricted the use of this book, and has classed himself with the Chinese, Japanese, Russians and some savage tribes, in using national instead of international letters.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Next meeting Oct. 24, paper by C. P. Matthews on "An Integrating Photometer for Glow Lamp and Sources of Like Intensity."

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

Northwestern Electrical Association, Secretary, Thos. R. Mercein, Milwaukee, Wis.

Ohio Electric Light Association, Secretary, J. H. Perkins, Youngstown, Ohio. Next meeting, Columbus, Oct. 14, 15 and 16, 1902.

Old-Time Telegraphers' and Historical Association, Secretary, John Brant, 195 Broadway, New York.

Pennsylvania State Street Railway Association, Secretary, John Ruth.

The Electrical Trades Society (member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Vermont Electrical Association, Secretary, C. C. Wells, Middlebury, Vt.

Electrostatic Ground Detectors.

An electrostatic ground detector has been recently placed on the market by the Fort Wayne Electric Works, which is very simple in construction, and is claimed to possess many features not found in other instruments. In theory, also, it differs somewhat from other ground detectors.

In all types of electrostatic ground detectors the principle of the

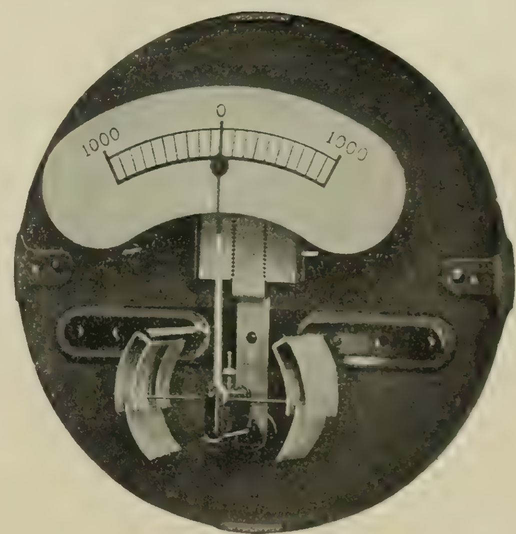


FIG. I.—MECHANISM OF GROUND DETECTOR.

electrostatic voltmeter is employed, the deflecting torque being created by the attractive force between electrically charged surfaces. In most single-phase ground detectors the line terminals are connected to two plates, or two sets of plates, which are stationary, while the movable plate or vane is connected to earth. When no ground exists, the movable member is attracted equally by the two stationary parts connected to opposite sides of the line, but as soon as one side of the line is connected to earth, or grounded, the partial neutralization of the charges on the movable vane and the grounded line produces an unbalanced condition between the attractive forces of the two stationary plates and the movable vane, and causes a deflection of the pointer attached to the vane toward the grounded side. The amount of the deflection indicates the strength of the ground, a direct ground throwing the pointer to the limit of its motion in the direction of the grounded side, while a leakage or partial ground is indicated by a slight deflection.

In the Fort Wayne single-phase electrostatic ground detector, the line terminals are connected to stationary members composed of sheet aluminum, stamped and pressed into a shape not unlike a double rake with curved pointed teeth. The charge produced by the line potential is concentrated on these points according to a well-known law of electrostatics. The movable member consists of two similar sets of points carried on opposite ends of an arm mounted on a shaft

set in jewel bearings. These points are free to move in or out between the double sets of stationary points. The moving parts are in no way connected to the circuit, but receive their charge from a set of points that are charged by another group directly connected to the earth. A delicate torsion spring connects the shaft to these stationary points, and together with light adjustable weight on the shaft maintains the pointer at zero position under normal conditions.

The application in this instrument of the theory of the concentration of an electric charge at a point makes practical the use of an extremely light moving part, which is still further lightened by making it of aluminum. The result is a sensitive instrument whose accuracy is permanent since wear on jewels or shaft is inappreciable.

FIG. 2.—GROUND DETECTOR.

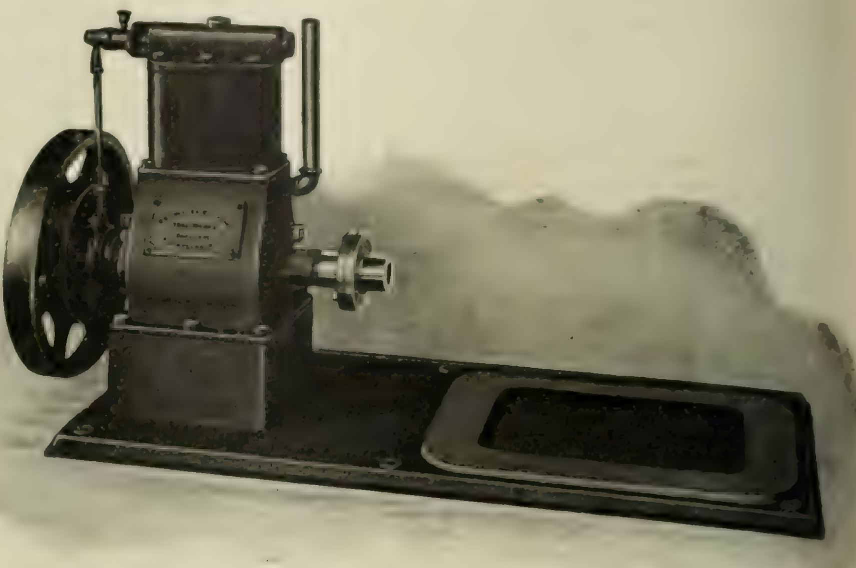
The entire mechanism of the instrument is rigidly mounted on and thoroughly insulated from a solid metal base, which is designed for mounting on switchboards. The cover is easily removed without disturbing the adjustment or connections, which are all made from the back. The scale is silvered brass mounted in the top of the case, similarly to other round switchboard instruments. The middle of the scale is the zero, or "no-ground" position of the pointer.

The instrument is connected permanently in circuit through graphite sticks carried on hard rubber insulators mounted on a marble base designed for mounting on the back of the switchboard. The resistance of these graphite sticks is sufficient to protect the instrument and the circuit from accidental grounds or short-circuits within the instrument itself.

These ground detectors may be used on two or three-phase circuits, two instruments being required in either case. For two-phase two-wire circuits, two ground detectors and two sets of three graphite resistances are employed, while but one set of four resistances and two instruments are necessary for two-phase, three-wire or three-phase circuits.

Acme Automatic Engine.

The Rochester Machine Tool Company, Rochester, N. Y., is manufacturing a small type of automatic engine especially adapted for direct connection to electrical generators, one of which is shown in the accompanying illustration above. The engines are manufactured from ½ to 8 hp on the basis of 100 lbs. steam pressure, though they are built strong enough for a working pressure of 200 lbs. It is claimed that the engines run smoothly at any speed from 100 to 800 r. p. m. and regulate to within [illegible] per cent from no load to full load. The governor, as will be seen, is of the fly wheel type and is claimed to be extremely sensitive. These machines are particularly applicable for work in connection with small independent units for use at times when it is not practicable to operate the main plant, or when repairs are being made. Among the applications named are installations in office buildings, night service in hospitals, running search lights, etc.



ACME AUTOMATIC ENGINE.

"Ceco" Alternators.

In the issue of last week appeared an account of some of the direct-current machinery manufactured by the Christensen Engineering Company, of Milwaukee, and we give below a description of the type of alternator made by the same firm. All the "Ceco" alternators, whether belted, engine type or direct coupled are of the revolving field type, thus leaving the armature stationary and easily accessible. By this form of construction the difficulties of properly insulating the armature coils which have caused much trouble in rotating armatures are eliminated.

The frame consists of cast-iron housings, into which rings of laminated steel with inwardly projecting teeth are assembled, thereby forming slots for receiving the armature windings. The armature is designed with six slots per pole, so that it may be wound or rewound for single, two or three-phase as required. The armature frames for the belt-driven alternators are cast in one piece, while the frames for the direct-driven machines are divided horizontally. Instead of the usual practice of having several coils for the same machine, all the armature coils for each "Ceco" alternator are of the same size and shape so that they are interchangeable. The coils are specially insulated, so that they will stand without injury the highest temperature that will ever be reached in service.

250 KW. THREE-PHASE "CECO" ALTERNATOR.

The poles are built up of laminated steel upon a cast-iron spider.

which is mounted upon a forged steel shaft. In the large sizes the laminated poles are assembled upon a steel ring which is carried on the shaft by means of the cast-iron spider. The individual poles are in all cases easily removable with their coils, without dismantling the machine. The field coils are composed of rectangular copper strap bent on edge. The collector rings are made of cast-iron, and carbon brushes are used, thus reducing to a minimum the tension required, as well as the wear of the parts. Standard frequencies are 60 and 25 cycles per second. With the exception of the smaller sizes, "Ceco" alternators can be wound for any voltage up to 15,000. The temperature rise when running continuously with full load at any power factor will not exceed 35° C. in the armature of 40° C. in

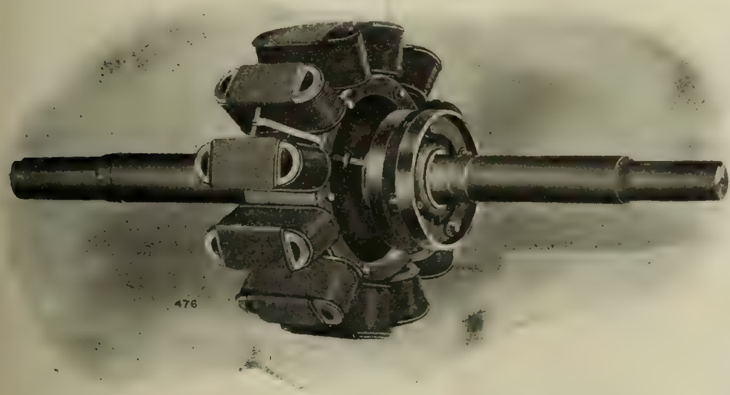


FIG. 2.—REVOLVING FIELD FOR "CECO" ALTERNATOR.

the fields. At 25 per cent. current overload the corresponding temperatures will not exceed 40° C. and 50° C. The machines are all designed so that they will carry satisfactorily a 50 per cent. current overload for two hours at any power factor without injurious heating.

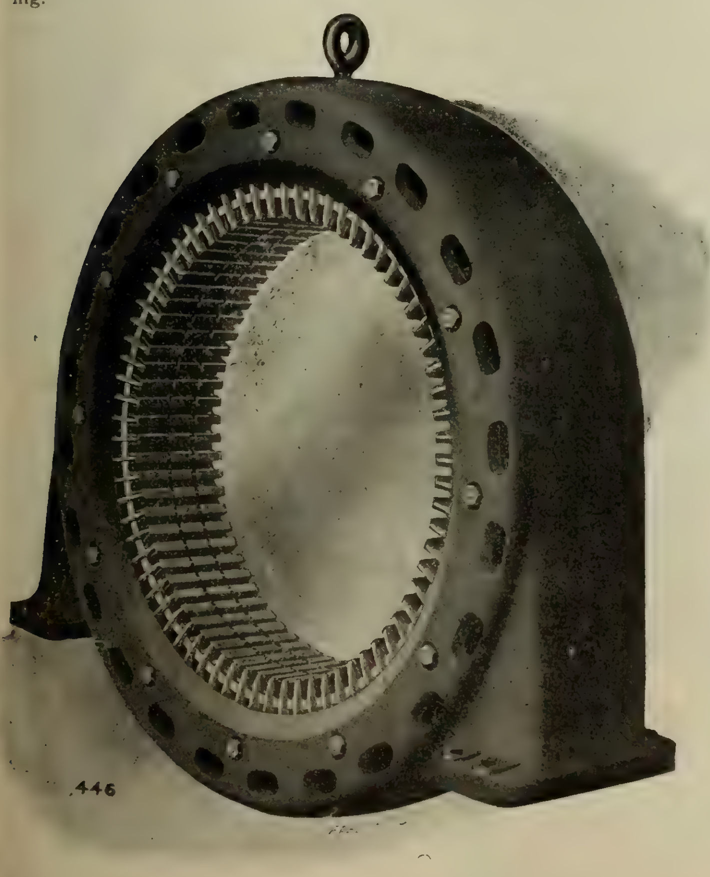


FIG. 3—ARMATURE FRAME FOR ENGINE-TYPE "CECO" ALTERNATOR.

The present works of the Christensen Engineering Company were completed but two years ago, and no expense was spared in providing every facility for the rapid, accurate and economical manufacture of its product. The equipments of machine tools, cranes, special machines, etc., is unusually extensive, modern and complete. The foundation for a 250-foot extension to the main machine shop, which is 186 feet in width, has just been completed. There are three stories, and this extension will provide 88,000 additional square feet of floor space.

High-Voltage Insulator.

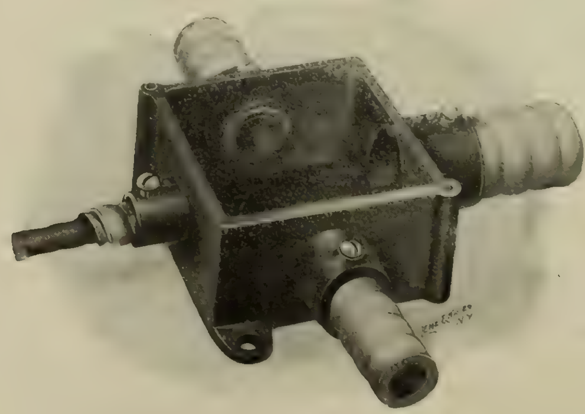
Fred M. Locke, of Victor, N. Y., has recently brought out a modified type of high-voltage insulator, illustrated herewith. This insulator is somewhat similar to that shown in a recent issue, but is

HIGH-VOLTAGE INSULATOR.

slightly higher, and is provided with three petticoats, as shown in the engraving. It is 14 inches across the hood. This insulator has been tested up to 160,000 volts, and is made for any voltage up to 100,000 volts line pressure.

Junction Box.

The accompanying illustration shows a junction box, manufactured by the Sprague Electric Company, which contains four different sized fittings. This box meets a requirement that arises when it be-



JUNCTION BOX.

comes necessary or desirable to use different sizes of flexible metallic conduit or cable, or both, and will be appreciated by wiring contractors. The fittings may be placed as desired when the order is accompanied by a sketch showing their sizes, number and location.

Echoes of the Street Railway Convention.

The proceedings of Friday, the last day of the American Street Railway Convention, at Detroit, are noted elsewhere in this issue. Our special supplement brought the proceedings down to the morning of that day, and included a large number of notes on various exhibits and well-known firms, etc., represented. Below are given a few further items of interest of the same character:

Porter Railway Switch Company, Detroit, had an ingenious "electrical operator," for trolley tracks. It will supply an unlimited amount of current to the car while the trolley is resting on the 3-foot brake in the trolley wire, and is furnished in conjunction with a Porter rocker switch.

EXHIBIT OF GENERAL ELECTRIC COMPANY.

Detroit Trolley and Manufacturing Company, through its president, Mr. W. S. Macdonald, showed an ingenious form of trolley base, with 50 one-inch steel balls running in two races, and giving remarkable ease of sweep to the motion of the trolley pole, while thus facilitating its steadiness of contact with the trolley wire.

Pneumatic Railway Equipment Company, of Cleveland, exhibited in working order their ingenious device, called the "air electro trolley control," by which electro magnets working on valves of an air chamber will throw the pole clear of the wire or assist in its prompt restoration. It is under the instantaneous control of the motorman. It can be cut-out when desirable, leaving the pole to be handled freely around a car barn, and it rotates freely on a swivel point. The device is, indeed, very ingenious, and was shown in operation by Messrs. Robert C. Beebe and G. R. Tomb.

Dearborn Drug and Chemical Company, of Chicago, had an exhibit of their lubricating oils and greases, and barrels of their "solution" for boiler treatment. Their specialties in this line are too well known in the electrical field to need discussion here. The company distributed souvenirs, including, for the ladies, bottles of perfume from their Dearborn laboratories. They were represented by Messrs. R. F. Carr, W. B. McVickar, G. W. Spear and Otto Flugel.

American Steel and Wire Company had a fine display in the main hall of their conduits and cables, trolley wires, line material, fencing for right of way, rail bonds, etc., all artistically disposed; while overhead was a name sign carrying nearly 400 incandescent lamps. The company distributed a neat leather pocket-book, and were represented by Messrs. C. S. Knight, Jr., F. A. Keyes, T. A. Sheppard, G. Chandler, W. C. Bogue, W. H. Van Sicklen and H. T. Pratt.

The Union Switch and Signal Company represented by Mr. T. H. Patenhall, showed an equipment of its electric staff instruments for block systems on high-speed electric railways.

Chase-Shawmut Company were represented by Mr. Frank D. Masterson, who distributed a handy little pamphlet of electrical data. He represented the Chase-Shawmut flexible rail bond, which has a soldered contact giving high conductivity, and of which the installation cost is small.

Creaghead Engineering Company, of Cincinnati, had an interesting exhibit of their overhead line material, their Bourbon strain insulator and their Creaghead incandescent lamp. The company were represented by Mr. A. E. Payne.

Dallett & Co., of Philadelphia, distributed literature in regard to their various electrical supplies and specialties.

Stromberg-Carlson Telephone Manufacturing Company had an exhibit of their well-known apparatus. Their system is in use on the interurban roads around Detroit.

American Arithmometer Company, of St. Louis, made an interesting and timely exhibit of their ingenious and beautiful Burroughs adding machine.

Westinghouse, Church, Kerr & Company were represented by Mr. Carl M. Vail, their energetic young secretary and treasurer. The Michigan woods are full of trolley systems carried out under W. C. K. direction.

H. B. Camp Company, noted briefly last week, had an interesting display in the smoking room of their well-known vitrified clay conduit, in single and multiple duct, for electric railway and other service. They were represented by Messrs. H. H. Camp and C. C. Laird.

Nungesser Electric Batteries were represented by Mr. T. G. Grier, of Chicago, who had an exhibit of them in the gallery.

R. D. Nuttall Company, of Pittsburg, Pa., exhibited their well-known gears and pinions, especially those for high-speed work. They showed also their trolley stands. They were represented by Messrs. F. A. Estep, G. W. Provost and A. S. Partridge.

Union Mica Company, of New York, were represented by Mr. Albert Korst, and had on hand an exhibit of its mica board, flexible mica varnish cloth, mica segments, rings for motors, generators, etc.

Crocker-Wheeler Company, of Ampere, N. J., organized on Thursday afternoon, a most interesting trolley trip to the Rochester power house on the Flint Division of the United Railway Company, of Detroit. Two well-filled cars were dispatched about 2:30, under

NATIONAL CARBON COMPANY'S EXHIBIT.

the direction of Messrs. Putnam A. Bates and F. B. De Gress, and a delightful ride of some 30 miles was made out into the pretty rural region lying back of Detroit, illustrating to the fullest extension the manner in which the trolley has banished isolation for the farmer and brought all the comforts and conveniences of the remote city to his very door. Not only were passenger cars flying in every direction up and down rural lanes, but at frequent switches were freight and express cars, laden with goods or with farm produce, from fresh milk to the last bushel of husked corn. The Rochester plant, 26 miles out, recently illustrated in these pages, might well be called a Crocker-Wheeler railway power house. It contains a fine 400-kw Crocker-Wheeler generator, driven by Ball & Wood compound condensing engine and two 200-kw Crocker-Wheeler

units, similarly driven. Circuits radiate widely from this plant, and the sterling stability of the apparatus is evidenced by the continuous overloading to which it has been subjected for months in meeting

KELLOGG TELEPHONE EXHIBIT.

the demand for current. During the trip cigars and dainty descriptive bulletins were served out, while at the power house, sandwiches, coffee and punch refreshed those who had been enjoying the spin through the crisp autumnal air.

Mr. C. G. Curtis, the inventor of the Curtis steam turbine now exciting so much attention, arrived to listen to the discussion on the general turbine question, and returned immediately to New York.

The Stuart-Howland Company, of Boston, Mass., had an exhibit of their overhead trolley specialties in a parlor at the Cadillac Hotel. The exhibit included their overhead brackets and other forms of their overhead suspension for single and double trolley. They made an exhibit also of their rib trolley wheel, and distributed a souvenir medallion, which was an exact facsimile of it. The company were represented by Messrs. H. W. Smith, of Boston, and H. De Steese, of New York.

The McRoy Clay Works, of Brazil, Ind., were represented by Mr. E. F. Kirkpatrick, the Chicago manager. This company made no exhibit, but had among the delegates present a great many customers for their conduits for trolley mains and feeders.

The J. G. White Company, of New York City, were represented by Mr. C. G. Young, who returned not long since from the Philippines, and Mr. H. S. Collette, representing also the San Juan Light and Power Company, of Porto Rico. The White interests were represented also by Mr. S. G. Averell and Mr. E. L. West.

Maltby Lumber Company have yards near Detroit for their well-known pole business, whence they supply many street railway companies, as well as other concerns in the lighting, telephone and telegraph field. Visits to the yards were made by trolley and launch.

Samson Cordage Works, of Boston, were represented by Mr. F. J. Coakley, the specialties of this concern having as many friends and patrons in the trolley field as in that of lighting

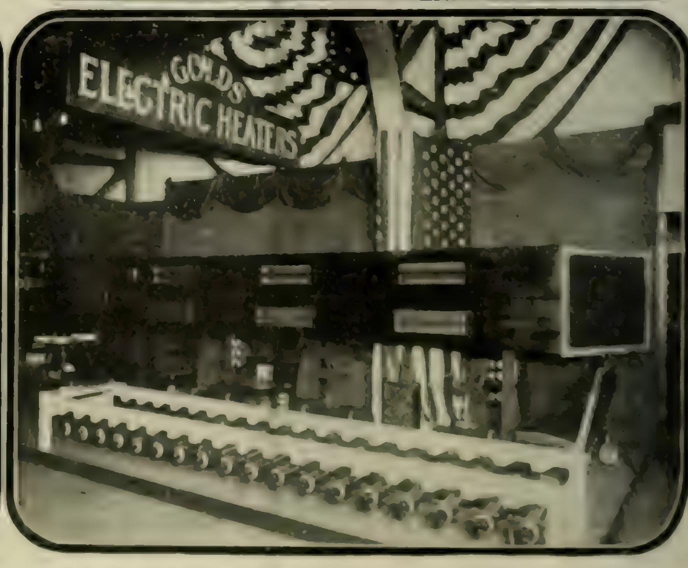
Westinghouse Electric and Manufacturing Company had a splendid exhibit of apparatus, the most prominent item of which was a 1,500-kw rotary converter of standard type, which was not erected when the convention began. The ease with which installation was completed and the machine set in operation induced the belief that the tardiness was in reality intentional, in order to give the company a plausible opportunity to show how readily the apparatus could be set up and operated. It was certainly a striking performance. Another notable exhibit was the set of multiple control apparatus, consisting of sets of controllers, etc., for two cars, and four motors, all arranged on Baldwin trucks for demonstration. The exhibit of motors embraced various small and large types for urban, suburban and long-distance work. There was also an exhibit of induction motors and transformers. Much attention was also bestowed by delegates on the display of detail apparatus such as starting resistances for cars, canopy switches, automatic car circuit breakers; overload circuit breakers, iron fuse blocks, lightning arresters, and voltmeters and ammeters. The exhibit was indeed one of the most complete and effective that a great manufacturing company has ever sent to a street railway convention. Appropriate literature was distributed, and a large staff was on hand to conduct the exhibit, etc. The company were represented by Vice-President F. H. Taylor, W. M. Probasco, L. A. Osborne, Arthur Hartwell, W. H. Whiteside, C. E. Skinner, A. Whitley and J. M. Duncan, of Pittsburg; T. P. Gaylord, C. W. Regester and Irvin Dryer, of Chicago, and C. B. Humphrey, R. E. Drake, C. W. Underwood, W. E. Parker, Geo. B. Dusinberre, F. B. H. Paine, J. R. Gordon, R. S. Brown, N. S. Braden, D. D. Pendleton, B. T. Brady, H. B. Shute, N. W. Storer, S. W. Kier, H. P. Davis, P. N. Lincoln, C. Renshaw, H. N. Cheny, C. F. Medbury, W. B. Wriaks, M. Baxter, J. L. Crouse.

Exhibits of Gould Storage Battery Company, American Steel and Wire Company and H. W. Johns-Manville Company.

WESTINGHOUSE EXHIBIT.

Ludlow Supply Company had an exhibit which included the specialties of the Crouse-Hinds Electric Company and the "automotoneer" of the Garton-Daniels Company; also the Morris Electric Company, and the Johnson "trolley retractor."

National Lead Company, whose exhibit was noted last week, included in their display during the convention a bearing lined with their Phœnix babbitt, which had been in continuous service on the Detroit United System since August, 1901, and which was going right back into service as soon as the convention was over. It was an astounding exhibit of ability to stand hard work without any perceptible wear. There were also a number of other bearings that had been in steady use and had been removed only in order that they might be exhibited at the convention and then restored to the apparatus.



A Group of Prominent Exhibits

Electric Storage Battery Company.—One of the most interesting exhibits was that of the Electric Storage Battery Company, of Philadelphia, manufacturers of "the chloride" accumulator. This company had on view several standard types of their railway cells, in lead-lined wooden tanks and in glass jars. The capacity of the former cell is 2,000 amperes at the hour rate, of the latter cell 240 amperes at the hour rate. Several samples of vehicle types of the exide battery were also on exhibition. Two standard blue Vermont marble switchboards, of the type commonly erected by the Battery Company, were also installed, showing the special apparatus used in connection with railway installations. One of the most interesting features of this exhibit was the special differential type railway booster. Besides this exhibit on the floor of the Armory, the company referred, as part of their display, to the three batteries on the system of the Detroit United Railway. The first of these batteries consists of 276 cells installed opposite the main power house of the system. This battery has been in daily operation for the past two years, and by absorbing fluctuations on the system, greatly reduces the daily engine hours. Its capacity is 2,500 amp.-hours at the hour rate, which capacity is fully utilized once every day on the peak of the load. The second battery consisting of 250 cells is located about two miles from the power house at the corner of Hancock Avenue and Third Street. Its capacity is 2,200 amp.-hours at the hour rate. It is operated in connection with a standard differential type booster. It is used on the peak of the load once or twice a day, as conditions demand, to maintain the proper voltage within a radius of a mile from the battery house. Before this installation was made, a variation in voltage of even 100 volts occurred, the pressure on the peak dropping as low as 375 volts. After installing this battery a voltage variation of from 480 to 500 was the maximum. The third battery on this system is located about eleven miles from the power house, on the Wyandotte Division, at Ecorse. It consists of 276 cells, of a capacity of 240 amp.-hours at the hour rate. This battery is used as a regulating line battery, in connection with a booster operated at the power house end of the line, a feeder running direct to the battery and the line being fed by feeders from this point. Before the installation of the battery, the pressure of this division varied between 200 and 750 volts. The pressure of this division is now maintained between the limits of 550 and 600 volts, enabling them to better maintain schedules as well as materially reducing the maintenance cost of the electric equipment of the cars. The Electric Storage Battery Company was represented by Charles Blizard, manager, sales department; J. Lester Woodbridge, engineer, sales department; E. Vail Stebbins, manager, Cleveland office; G. H. Atkin, manager, Chicago sales office; R. H. Klauder, manager, St. Louis sales office; R. B. Daggett, manager, San Francisco sales office, and J. E. Lockwood, president, Michigan Electric Company, the Detroit agent of the Electric Storage Battery Company. A booklet describing the plant of the Detroit United Railway Batteries and several other installations was distributed by the Battery Company during the convention.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 9 per cent. for 60-day loans. The unsettled condition of the stock market continued throughout the week, owing to continued high rates for call money and the lack of loans on time, even at very high figures. Speculative buying power was absent, although the reports of progress toward a settlement of the coal strike caused a rally on Thursday; the market, however, receded on account of the uncertainty about the results, and closed dull. In Boston, General Electric closed with 8¼ points off, and American Telephone and Telegraph 3½ points. Tractions and electrics in the New York market were all weak and lower in sympathy with the general condition of the market. Brooklyn Rapid Transit closed at 61⅞, a net loss of 2⅛ points. Metropolitan Street Railway reached 140½, but receded to 136½, which was the closing quotation as well as the lowest of the week, this being a net loss of 2½ points. General Electric closed at 177¼, after having reached 182½. The closing quotation represents a net loss of 7¾ points, and was also the bottom figure of the week. Westinghouse lost 5½ points net, closing at 211½, which was a rally of 2½ points from the lowest price, 214 being the highest. Western Union fluctuated between 92 and 90⅛, closing at 90⅜, this representing a net loss of 1⅞ points. American Telegraph and Telephone lost 4 points net, closing at 163½, which was ½ point above the lowest quotation of the week, 164 being the highest. Other closing quotations were: American District Telegraph 38½, a net loss of ½ point, and American Telegraph and Cable 95, a net gain of 1 point. Following are the closing quotations of October 14:

NEW YORK.

	Oct. 7.	Oct. 14.		Oct. 7.	Oct. 14.
American Tel. & Cable.	92	92	General Electric	180	181
American Tel. & Tel..	165	163	Hudson River Tel.....	108	—
American Dist. Tel....	36	37	Metropolitan St. Ry...	136½	138
Brooklyn Rapid Transit	61½	62	N. E. Elec. Veh. Trns..	—	—
Commercial Cable	—	—	N. Y. & N. J. Tel....	160	—
Electric Boat	23	23	N. Y. E. V. T. Co....	12½	12¼
Electric Boat pfd......	35	35	Tel. & Tel. Co. Am..	—	—
Electric Lead Reduc'n..	2¾	3¼	Western Union Tel....	90¾	90⅞
Electric Vehicle	—	4	West. E. & M. Co.....	200	210
Electric Vehicle pfd....	10	9	West. E. & M. Co. pfd.	210	210

BOSTON.

	Oct. 7.	Oct. 14.		Oct. 7.	Oct. 14.
American Tel. & Tel..	163½	163½	Western Tel. & Tel. pfd.	98½	—
Cumberland Telephone .	—	—	Mexican Telephone	2⅛	2
Edison Elec. Illum....	275*	—	New Eng. Telephone....	139	135
Erie Telephone	—	—	Westinghouse Elec.	102	104
Western Tel. & Tel....	—	—	Westinghouse Elec. pfd.	—	104½

PHILADELPHIA.

	Oct. 7.	Oct. 14.		Oct. 7.	Oct. 14.
American Railways	52½	—	Phila. Traction	98	98
Elec. Storage Battery..	—	—	Phila. Electric	8⅝	8 11/16
Elec. Storage Bat'y pfd.	—	—	Pa. Elec. Vehicle......	—	1
Elec. Co. of America..	9½	9¾	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	Oct. 7.	Oct. 14.		Oct. 7.	Oct. 14.
Central Union Tel.....	—	—	National Carbon pfd....	100¾	99
Chicago Edison	—	—	Northwest Elev. com ..	36	—
Chicago City Ry.	212	210	Union Traction	17	17
Chicago Tel. Co........	—	—	Union Traction pfd....	50	49
National Carbon	30	31⅞*			

* Asked.

SAN FRANCISCO TROLLEYS.—The firm of Talbot J. Taylor has issued a circular letter treating of the affairs of the United Railways Investment Company, of San Francisco, whose shares have just been officially listed on the Stock Exchange. "Stocks of good street railways," say Messrs. Taylor & Co., "are now a favorite investment. The earnings show steady increases, as they are dependent only upon the growth of population and wealth, which in a young and industrious community are certain to take place. Especial reasons for believing that San Francisco street car system will be highly prosperous at the present time are as follows: The consolidation just effected will bring about a saving in the proportion of operating expense to receipts. The immediate substitution of electric cars for cable and horse cars on those portions of the system where it will be advantageous will result in great additional saving. The refunding of the outstanding 5 per cent. and 6 per cent. bonds with the general mortgage 4s, which will be begun immediately will result at once in a saving of $65,000 per annum, when completely effected in a saving in fixed charges of $215,410 per annum. The introduction of oil as fuel in San Francisco has cut the fuel bill of all manufactures and power plants situated there in half. While this is a tremendous saving in itself for the San Francisco street car system, it is unimportant as compared with the indirect effects which will come from the fact that no city in the world will show in the next two years, and for many years to come, such rapid increase in population and wealth, and consequently such great increase in the gross receipts of the street car system."

CONNECTICUT TROLLEYS.—The Worcester and Connecticut Eastern Railway has sold $2,050,000 4½ per cent. first mortgage sinking fund gold bonds to Thompson, Tenney & Crawford. The total issue authorized is $3,100,000, of this amount $1,050,000 is held in escrow to be issue for improvements and additions, construction and acquisition of connecting railways. The Worcester and Connecticut Eastern Railway owns what was formerly known as the Peoples Tramway Company, the Thompson Tramway Company and the Danielson & Norwich Street Railway Company, and will control through leases the Worcester and Webster Street Railway and the Webster and Dudley Street Railway. The total mileage will be about 55 miles and will operate between Worcester, Mass., and Moosup, Conn., with a branch line to Foster Center, at which point connections will be made with the electric road to Providence, R. I. It is the purpose of the company to build a branch to Bayville, Attawaugan, Ballouville and Pineville, and also to extend the main line of the road from Moosup to Norwich, Conn. The railway owns a valuable hydraulic plant of 2,000 hp on the Quinebaug River, two miles south of Danielson, and eventually this plant will generate sufficient current to operate its entire system. In addition to this, there is located at Oxford a 1,200 hp steam and electric plant, which will be used as an auxiliary plant when necessary. The following are the directors: H. H. Porter, Jr., Chas. F. Brooker, Geo. J. Brush, Edwin Milner, F. S. Curtis, H. M. Kochersperger, Fred. A. Jacobs, E. D. Robbins and E. N. Sanderson.

DIVIDENDS.—The Cincinnati, Newport and Covington Light and Traction directors recently declared a dividend for the quarter of 1 per cent. This was a disappointment to stockholders, who had expected a payment at the rate of 4½ per cent. for the year. One of the officials of the company, however, stated that only 1 per cent. was declared in order to do away with the small fractional dividend, and that in all probability 1¼ per cent. would be declared three months hence. The directors of Milwaukee Electric Railway and Light Company have declared the regular quarterly dividend of 1½ per cent. on the preferred, payable November 1. The United Traction Company, of Albany, N. Y., have declared the regular quarterly dividend of 1¼ per cent., payable November 1. The net earnings for the quarter ended September 30 were $91,299, whereas the dividend requirements for a quarter amount to only $62,500.

ELECTRICS IN ATLANTA, GA.—The Boston Stock Exchange has listed $18,000 preferred 5 per cent. non-cumulative shares and 50,000 common shares par $100, of the Georgia Railway and Electric Company. This company is a consolidation of the Atlanta Railway and Power Company, Atlanta Rapid Transit Company, Georgia Electric Light Company and the Atlanta Steam Company. It controls all the street railway and electric lighting facilities in Atlanta and suburbs, and furnishes all of the municipal lighting. The balance sheet shows a bonded debt of $7,850,000 and a profit and loss surplus of $114,917.

NORTHERN OHIO TRACTION REORGANIZATION.—Official announcement is made of the reorganization plan of the Northern Ohio Traction Company. The new company is to be incorporated with $7,500,000 capital stock and the same amount in bonds. The present preferred stockholders will receive in exchange for their stock a 5 per cent. 30-year gold bond and 100 per cent. of the new stock. The common stockholders will receive one-half in 4 per cent. 30-year gold bonds and 200 per cent. of the same stock as is given to the preferred holders, there being but one kind of stock.

THE AUGUSTA TROLLEY DEAL.—The new company which, as announced in last issue, has absorbed various electric railway and other properties in this city, has applied for a charter. It will have a capital of $800,000 preferred and $4,000,000 common stock. There will also be an issue of $3,000,000 bonds, $2,000,000 of which will be used to retire outstanding bonds, and $1,000,000 will be set aside for improvements and extensions at the command of the trustees. The Railways and Light Company of America has been employed to operate these combined interests by the purchasing syndicate.

LONG TROLLEY LINE.—Cleveland, Ohio, reports that a new syndicate has incorporated the Ohio and Pennsylvania Traction Company, which may be capitalized at $2,000,000, and plans another trolley line from that city to Pittsburg.

Commercial Intelligence.

THE WEEK IN TRADE.—The coal strike and the growing scarcity and need of anthracite is the thought uppermost in the minds of the people in the East at the present time. Every effort to bring about a settlement of the differences between the miners and the operators has failed, but the opinion seems to prevail that the end of the strike must be near at hand. This belief, however, may be based only on the hope of getting a supply of coal before the real cold weather sets in. Uncertainty as to the future supply of fuel is widely noted by the mercantile agencies, and it is pointed out that the scarcity of coke at the West—this being entirely distinct from the anthracite shortage, and due to car shortages complained of throughout the entire year—is displacing some industrial workers in the iron trade. Aside from the fuel scarcity, a satisfactory business prospect exists. Fall jobbing is better than anticipated. Recorders note difficulty of fulfilment, indicating lack of depressing stocks. Spring trade advices are better than usual at this date and predictions as to the coming holiday business are optimistic. The curtailment of the iron production resulted in a smaller output for September than for previous months, but of late the domestic output of pig has shown signs of increasing. Rails, plates and structural iron are active, strong and sold ahead heavily into 1903. Other industries are active, and the east and west movement of freight, swelled by larger grain receipts and heavy buying by the West at the East is proving profitable to the railroads. General activity is reported from the Northwest with improving retail trade, and from the Pacific Coast a generally good business is reported. Export trade is large there, and building activity is exceptional. Southern trade advices are, on the whole, rather good. The railway gross earnings for the month of September were exceptionally favorable; the ratio of gain shown for the month was the best returned since April of this year. The copper market remains quiet; buyers and sellers stand apart awaiting developments. Consumption, it is said, is not as good as heretofore. The closing prices are 11½ @ 11¾c. for Lake, 11.40 @ 11.50c. for electrolytic, 11.37 @ 11.50c. for casting stock. The business failures for the week ending October 9, as reported by *Bradstreet's*, number 170, as against 164 the week previous, and 183 the same week last year.

SOME C. & C. FOREIGN AND DOMESTIC ORDERS.—The C. & C. Electric Company, 141 Liberty Street New York, has just secured a contract for a complete lighting and power plant, which is to be installed in the Mexican mines of the Mexico Commercial Company, of Baltimore, Md. The plant will consist of a 40-hp horizontal engine, direct connected to a 25-kw generator; switchboard, arc lamps, wiring installation, etc. The company, report says, has receipts within the past few days of a number of orders for generators, motors, etc., for the domestic trade. The Rogers Locomotive Works, at Paterson, N. J., are to be furnished with a 150-hp belted generator for power purposes. In addition to the 30 odd machines previously reported for installation in R. H. Macy & Company's new store, at Thirty-fifth Street and Broadway, New York, a 30-hp motor for driving glass cutting macninery and a smaller vertical motor for operating a package distributing table have been ordered. The Chicago City Railway Company, of Chicago, Ill., has requisitioned for four 35-hp and three 25-hp motors, which are intended to be utilized for driving blowers and exhausters. The American Machine and Foundry Company, of Brooklyn, has ordered a complete 40-kw installation, including switchboard. Keasbey & Mattison, of Ambler, Pa., has contracted for three 30-hp motors. The Standard Steel Works, of Burnham, Pa., are to be furnished with one 50-hp and one 30-hp motor, making over 400 hp in motors supplied them during the last few weeks. A 75-kw generator switchboard, etc., has been ordered for a chemical plant in Mississippi. A complete equipment for an electric crane, consisting of three motors, is to be supplied the American Sanitary Company, of Bayway, N. J. Two 75-kw generators, engines, equalizers, etc., have been ordered for a new apartment house, to be built in New York by Wm. C. Dewey. Six 20-hp motors have been ordered by the Standard Plunger Elevator Company, to be used for operating drills for making holes in their elevator plungers at the Bellevue Stratford Hotel, Philadelphia. Another order just to hand calls for a 25-kw direct-connected generator for the Southern Indiana Railway Company, of Bedford, Ind.

THE ALLIANCE MACHINE COMPANY, Alliance, Ohio, organized some months ago for the manufacture of electric traveling cranes and other heavy work of similar class, is completing its large plant there, and will soon be in a position to take care of orders for the heaviest types of cranes. Among others, the company has on its books the following orders: Worth Brothers Company, one 50-ton and four 10-ton cranes; Bethlehem Steel Company, one 100-ton crane; Colorado Fuel and Iron Company, two 25-ton, two 50-ton, three 15-ton, two 20-ton and three 10-ton cranes; Union Steel Company, five 10-ton, three 5-ton and one 10-skull-cracker cranes; Pittsburg Valve and Foundry Company, two 15-ton, four motor cranes; Carnegie Steel Company, one 10-ton, three motor crane; Alabama Steel and Wire Company, two 15-ton four motor cranes; and American Steel and Wire Company, one 15-ton crane. In addition to these orders the company will build two large traveling tables for the Carnegie Steel Company, and twelve rod-reeling machines for the Colorado Fuel and Iron Company.

H. M. SALMONY, 95 Mortimer Street, London, W., England, is desirous of representing abroad American manufacturers who are seeking to introduce their specialties in an effective way at a comparatively small cost. It is Mr. Salmony's idea to visit the best districts of England, France, Belgium, Holland, Norway, Sweden, Germany, Spain, Italy, Switzerland, Austria-Hungary, Russia, Turkey, etc., and while doing so to make with his manufacturers' samples an American electrical trading exhibition. He also proposes to circularize the local buyers and to advertise such visits and the names of the concerns represented. Mr. Salmony proposes to do this on a commission basis, supplemented by an annual contribution towards expenses. This gentleman is well known in America, and speaks most of the European languages fluently, being thoroughly familiar with the Continent. He invites communication, therefore, in regard to this project, and states that before undertaking it he will again visit America in order to acquaint himself with the goods and the parties who manufacture them.

THE ALBERGER CONDENSER COMPANY, of 95 Liberty Street, New York, reports the following among important orders recently received for high vacuum condensing apparatus: Belt Light and Power Company, Pennsylvania Sugar Refinery, Sharon Steel Company, Port Huron Light and Power Company, Hartford Street Railway Company, Binghamton Light, Heat and Power Company. The equipment for the above plants consists of Alberger barometric or surface condensers with improved vacuum and circulating pumps and the necessary appurtenances for producing the high vacuum required by the use of steam turbines which are being installed in most of the above plants.

BALL ENGINE CONTRACTS.—The Osborn Water and Light Company, Osborn O., has recently purchased an additional unit from the Ball Engine Company, Erie, Pa. The Vose Piano Company, Boston, Mass., purchased recently a direct-connected unit, consisting of a Westinghouse generator, direct connected to a Ball engine. The Grand Crossing Tack Company, Chicago, has put in operation a direct-connected outfit, consisting of a Crocker-Wheeler generator, direct connected to a 175-hp engine, built by the Ball Engine Company.

A NEW YORK HOTEL.—Long Acre Square, New York, is to have a $750,000 apartment hotel, upon which work has been begun on the plot at Forty-third Street. Henry B. Mulliken and Edgar J. Moeller are the architects of the structure, which is to be twelve stories high and of the French Renaissance type. The building will have its own heating and lighting plants. Among the features of construction is an electric fountain, which is to be directly beneath the skylight which lights the dining room.

THE ILLINOIS CAR AND EQUIPMENT COMPANY, of Hegewisch, Illinois, just outside of Chicago, has recently purchased a large amount of electrical apparatus which will be used for the operation of wood turning machinery. An order on the Westinghouse Electric and Manufacturing Company includes two 250-kw and one 200-kw two-phase alternators, together with a four-panel switchboard and the following induction motors: two 100-hp, five 75-hp and one 50-hp.

EQUIPMENT FOR TWIN CITY POWER STATION.—The Twin City Rapid Transit Company, of Minneapolis, is now letting contracts for the equipment of its new power station. The boilers will be Babcock & Wilcox. The contract for the coal and ash handling machinery has been awarded to John A. Mead & Company, of Bowling Green Building, New York. The machinery will have a capacity for handling 70 tons per hour, and will cost about $35,000.

MOTORS FOR GRAIN ELEVATOR.—The Steel Storage and Elevator Construction Company has adopted electric power distribution for a large grain elevator which will be erected for the Canadian Pacific Railway at Fort William, Ont. A recent purchase from the Westinghouse Electric and Manufacturing Company includes a direct-current generator and a number of direct-current motors for the operation of this elevator.

THE BROWNING ENGINEERING COMPANY of Cleveland, Ohio, has recently purchased from the Westinghouse Electric and Manufacturing Company a large number of railway-type crane motors ranging in capacity from 25 to 50 hp.

CONTRACT FOR STREET SIGNS.—The New York Edison Company has secured the contract to furnish and maintain blue glass electric sign boxes in Manhattan for $12.50 a year each, and stencil signs for $10 a year.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended October 11: Antwerp—13 pkgs. material, $1,177; 2 pkgs. machinery, $350. British West Indies—206 pkgs. material, $3,194; 100 pkgs. machinery, $21,997. British Possessions in Africa—5 pkgs. machinery, $778; 86 pkgs. material, $1,254. Berlin—2 pkgs. material, $175. British Australia—272 pkgs. machinery, $10,165; 62 pkgs. material, $2,498. Brazil—1 pkg. machinery, $60. Bradford—3 pkgs. machinery, $175. British Guiana—10 pkgs. machinery, $1,890; 14 pkgs. material, $285. British East Indies—20 pkgs. material, $415. Central America—21 pkgs. material, $306. Colchester—4 pkgs. material, $542. Cuba—126 pkgs. material, $3,225. Chili—10 pkgs. material, $149. Copenhagen—6 pkgs. machinery, $1,633. Dutch West Indies—3 pkgs. material, $54. Frankfort—1 pkg. machinery, $120. Glasgow—140 pkgs. material, $2,156. Hamburg—30 pkgs. material, $4,287. Havre—84 pkgs. material, $2,682. Hayti—3 pkgs. material, $20. Liverpool—160 pkgs. machinery, $10,470; 23 pkgs. material, $767. London—33 pkgs. machinery, $3,505; 130 pkgs. material, $6,716. Mexico—24 pkgs. material, $1,846; 18 pkgs. machinery, $670. Portuguese Possessions in Africa—16 pkgs. material, $1,185. Patrar—6 pkgs. material, $150. Peru—12 pkgs. material, $697; 12 pkgs. machinery, $600. Santo Domingo—71 pkgs. material, $552. Southampton—110 pkgs. material, $8,052. Stockholm—3 pkgs. material, $572; 1 pkg. machinery, $150. U. S. Colombia—9 pkgs. material, $163. Venezuela—8 pkgs. material, $215.

PELTON WATER WHEELS.—The Pelton Water Wheel Company reports having just closed a contract with the Vancouver Power Company, of Vancouver, B. C., covering three Pelton wheel units, with a combined capacity of 10,000 hp. The wheels are for direct connection to electric generators; the power to be used for electric railway and manufacturing purposes in the vicinity of Vancouver. The Pelton Company has under construction at the present time Pelton water wheels aggregating 30,000 hp, all of which are to be used in connection with electric transmission of power. The wheels will have a capacity of 3,200 hp each. They will be direct connected to generators, to be built by the General Electric Company. There are also to be two exciter units of 200 hp each. The head will be 390 feet. The Pelton people have also secured a contract for an extension of the plant of the San Rafael Paper Company, Mexico. A mile of steel-rivetted pipe, varying from 28 inches to 32 inches in diameter, will be built. A 600-hp water wheel has also been ordered.

BIG PRODUCER GAS PLANT.—Mr. F. W. Snow, president of the Ramapo Iron Works, Hilburn, N. Y., is about to build the largest producer gas plant hitherto constructed in this country. Considerable electrical equipment will be installed. The plant will serve as a central electric lighting plant for a radius of some 25 miles within Hilburn, and will also furnish energy for large manufacturing plants in the vicinity. The plant will also supply gas for lighting, heating and foundry work to nearby shops. Westinghouse, Church, Kerr & Company have been allotted the contract for the engines which will represent a total capacity of 1,215 hp. There will be three direct-acting gas engines of 350 hp each and a 125-hp engine, also a 40-hp one. The generators will be supplied by the Westinghouse Electric and Manufacturing Company. There will be three 225-kw alternating-current machines and one 75-kw; also a 22½-kw machine for direct connection to the smaller engines. The plant will be operated by producer gas, as manufactured by the process controlled by the Loomis-Pettibone Company, of 52 Broadway, New York.

HYDRO-ELECTRIC DEVELOPMENT IN MEXICO.—The great Passasiachic Falls, situated near Ocampo, in the State of Chihuahua, Mexico, have been purchased by Manuel Siqueros, a capitalist of Juarez, Mexico, and Manuel Gameros, a prominent mining engineer of Chihuahua. They have organized a company to utilize the power derived from these falls for the generation of electricity, to furnish power for an extensive railway system and for a number of mills and mines of that section. These falls are situated in the midst of one of the richest and most extensive mining sections of Mexico. The water has a sheer drop of 1,800 feet over a precipice, and it will not be a difficult engineering task to utilize this power for generating an abundance of electricity for all the requirements of that region. The company proposes to build an electric railway for handling ore, etc., between the town of Minica, at the terminus of the Chihuahua and Pacific Railway and the mining camps of Altos, Ocampo, Pinos and Concheno.

MONTEREY ELECTRIC TRACTION.—Important contracts will be let shortly for the equipment of an electric traction system in the city of Monterey, Mexico. The American Engineering and Contracting firm of Macklin & Dillon, of Monterey, have, as already noted in these pages, been granted a concession to build an electric road of about five miles in length. It is intended also to convert two of the principal existing horse-car roads in the Mexican city, which in all are about 12 miles long. The new electric traction system will, therefore, be about 17 miles in length, and is estimated to entail an expenditure of about $1,000,000. The banking house of Sperry, Jones & Company, of Baltimore, Md., is financing the enterprise. Mr. A. W. McLimont, president of the Federal Electric Company, Washington Life Building, has been retained as consulting engineer by the American interests. He is now on his way to Monterey.

EUROPEAN EQUIPMENT FOR TOKIO ROAD.—The 100 car trucks and equipments for the Tokio Street Railway Company, which have been ordered from Frazar & Company, of Japan, 63-65 Wall Street, will be built by Dick, Kerr & Company, Limited. The contract has been allotted in England, because of considerably better prices and more favorable terms of delivery obtained on the other side. For similar reasons, the contract for the rails, though secured in the first instance through an export house of large American interests—the China and Japan Trading Company, Limited, 32 Burling Slip, New York, will be executed in European mills. There will be about 20 miles of rails. The contract for the poles and special track work has been allotted to the Japanese house of Okura & Company, which concern has an office in the Bowling Green Building, 11 Broadway, under the management of M. Yamadax.

ELECTRICAL EXPORTS.—The U. S. Treasury returns for August show a good condition of electrical exports. The export of electrical instruments for the month was only $262,231, while in August, 1901, it was $451,120; but for the eight months of this year it was $2,388,119, as compared with $689,923. It is evident that the downward fluctuation last August was but accidental and temporary. The export of electrical machinery for August, 1902, was $558,826, as compared with $457,275, and for the eight months this year, $3,896,547, as compared with $3,919,574 last year and $3,590,419 in 1901. The total export of electrical apparatus and appliances therefore this year is $6,284,661, or at the rate of over $750,000 per month for the eight months, or $9,000,000 roundly for the year. This shows that the trade can be sustained and built up.

THE LOCKE INSULATOR MANUFACTURING COMPANY has taken over the business of Mr. Fred. M. Locke, and is now doing business with a capital stock of $150,000, of which $125,000 has been subscribed for and sold. The remaining $25,000 will be issued and sold, as needed, under and by order of the board of directors. The officers of the new company are as follows: Fred. M. Locke, president; Henry M. Parmele, vice-president; Willis D. Newton, secretary; M. W. Burke, treasurer. The directors are the above and C. P. Brown, Chas. H. Fairchild and W. A. Higinbotham. The new company starts out with very bright prospects, the Locke insulators being very widely and favorably known.

THE STOREY MOTOR AND ELECTRIC COMPANY.—A great deal of interest has been aroused in the electrical field in New York City by the announcement of the news that Mr. Henry E. Fanshawe has been elected a director of the Storey Motor and Electric Company, Harrison, N. J., and that he takes his place on the board this week. This gentleman is one of the most aggressive and progressive men in the development of electrical industries, and has a wide circle of friends and acquaintances. Should he take an active part in the management, which presumably will be the case, the Storey motor is likely to become far better known than is already the case, but certainly not beyond its deserts.

MOTORS FOR FRANCE.—The Goudey-McLean Company, of 88 Maiden Lane, N. Y., which concern represents the export interests of several American manufacturing concerns of electrical machinery, supplies, etc., has recently secured contracts for 17 motors from its French office—the Goudey-McLean Company, of New York, 17 Rue de Turenne, Paris. These machines are intended for machine-shop use. The American Electrical Syndicate, of Amsterdam, which is the Holland agency for the Goudey-McLean Company, has just sent in a substantial requisition for a general line of electrical material.

MOTORS FOR MEXICAN LIGHTING PLANTS.—The New England Motor Company, of Lowell, Mass., has secured a contract through the Federal Electric Company of 141 Broadway, for several direct-current generators, varying from 33 hp to 2 hp, for shipment to Mexico for lighting use.

TO PURCHASE FOR BIG BRITISH CONCERN.—The Morris Electric end of the recently formed American Union Electric Company, of 15 Cortlandt Street, it is reported, will act as American purchasing agent for the British Electric Traction Company, Limited, of London.

ELECTRICALLY-DRIVEN SOUTHERN CEMENT PLANT.—The Southern States Portland Cement Company, of Atlanta, Ga., is about to construct a large plant at Rockmart, for the manufacture of cement. All the machinery will be operated by electricity.

General News.

THE TELEPHONE.

CARROLLTON, ILL.—The [illegible] Telephone Company is now ready for business, and will proceed at once to build about forty miles of line in the eastern part of the county.

SPRINGFIELD, ILL.—Party lines are to be abandoned by the Central Union Telephone Company in Springfield. Persons whose party line telephones are taken out and independent lines substituted in all probability will be called upon to pay the regular rental for independent service.

CHICAGO, ILL.—Two tunnels under the river have just been finished by the Illinois Telephone and Telegraph Company, one at Harrison Street and one at Wells Street, thus giving connection with the Union and Northwestern railway depots. They are six feet wide and seven and one-half feet high, the same size as those under the downtown streets.

LEBANON, IND.—The Lebanon Telephone Company has increased its capital stock from $5,000 to $30,000.

DELPHI, IND.—The Carroll Telephone Company, with principal exchange in this city, has decided to reconstruct its entire plant, the improvements to cost $20,000.

MUNCIE, IND.—The Kinloch Long Distance Company, of Missouri, was licensed to do business in Indiana. Its capital is $30,000. The Indiana headquarters will be at Muncie.

PETERSBURG, IND.—The difficulty between the labor unions of this city and the Cumberland Telephone Company has been adjusted, the company agreeing to employ only home union men.

SOUTH BEND, IND.—The South Bend Home Telephone Company, owned largely by Ft. Wayne capitalists, has given a mortgage on its new plant here for $400,000. The company will make a number of extensions and otherwise improve its service.

TERRE HAUTE, IND.—The Citizens' Telephone Company has now in active use in the city of Terre Haute 1,312 telephones and orders are received daily for more. The numbers begin with 1 and run to 1,312 consecutively.

INDIANAPOLIS, IND.—The new branch exchange of the New Telephone Company began its service a few days ago, and is serving 1,200 patrons; it has a capacity for 3,000 however. The new exchange is located in a new three-story brick building and is equipped with all the modern improvements.

GREENSBURG, IND.—The Independent Telephone Company, of Decatur County, which had its origin two years ago, is claimed by its directorate to be one of the best systems in the country. Beginning with 1,352 miles of wire and 200 subscribers, the lines have been extended all over the county and 956 telephones are now in use. Of these 53 per cent. are in farm residences and villages. The remainder are in the city of Greensburg. The company has long distance connections with surrounding towns and with Indianapolis. The apparatus is of the Stromberg-Carlson Company. On the country lines, three or four telephones are put on one line, but in the city the lines are individual. For local service the company charges stockholders 80 cents and $1.50 a month for residences and business houses respectively. The rates to non-stockholders are $1.25 and $2 a month, respectively.

DOWS, IA.—The West Morgan Telephone Company has been incorporated with a capital of $5,000.

DAVENPORT, IA.—The Independent Telephone Company will build a line to Milan to connect with the rural exchanges.

DALLAS, IA.—The Marion County Farmers' Mutual Telephone Company has been incorporated, with a capital of [illegible], by Ed Wagner, R. Ke[illegible], R. A. Mullen and others.

BURLINGTON, IA.—The Burlington & Augusta Telephone Company, of Burlington, has been incorporated with a capital stock of $5,000. The officers are E. W. Romkey, president; Henry Magel, vice-president; Nils C. Hansen, secretary and treasurer.

ABILENE, KAN.—The Brown Telephone Company, of Abilene, has been chartered with a capital of [illegible].

HENRYVILLE, KY.—The Cumberland Telephone Company has purchased the People's Union Telephone Company of this place. The latter concern has one hundred subscribers.

LOUISVILLE, KY.—It is expected that by November 1 the long distance connection of the Home Telephone Company will be completed to Owensboro, Henderson, Bowling Green, Lexington, Ashland, Evansville, Huntington and French Lick. Connection will also be established with Indianapolis, Ind.

BRISTOL, MASS. The Farmers' Mutual Telephone Company has been incorporated at this place with a capital of $10,000. A. M. Round is president and A. H Sweet, treasurer.

GRAND RAPIDS, MICH.—The Citizen's Telephone Company has obtained control of the system of the Missaukee County Telephone Company, including exchanges at Cadillac and McBain, and [illegible] miles of toll lines.

GRAND RAPIDS, MICH. This city is now connected with Toledo by an independent telephone line through the exchange of the Citizens' Company. This connection also opens an important field of toll line connections in Ohio.

MINNEAPOLIS, MINN.—The Minnesota Mutual Telephone and Telegraph Company, of Minneapolis, has been incorporated, capital stock [illegible], of which [illegible] is represented in Wisconsin.

ST. PAUL, MINN.—The Howard Lake Telephone Company, of Howard Lake, Wright County, Minn., has filed articles of incorporation. The capital stock is $50,000 and the incorporators are John A. Peterson, O. J. Olson, John L. Munson, J. W. Custer and Nels Monson, of Stockholm; A. G. Custer, W. H. Eddy and P. E. Eddy, of Victor; H. A. Workman and G. A. Koenig, of Howard Lake.

HANNIBAL, MO.—The Bluff City Telephone Company, of Hannibal, has been incorporated by C. H. Brown, B. E. Hixon, V. T. Strong and others [illegible]

JEFFERSON CITY, MO.—The Jefferson City Telephone Exchange was purchased Oct. 2 by Messrs. Lester S. Parker, Houck McHenry and A. M. Hough. The exchange was owned by the Capital Telephone Company, of this city, and was considered an excellent plant, being newly installed. The purchasers announce that there will be no change in rates.

PHELPS, N. Y.—The Inter-Ocean Telephone and Telegraph Company has been granted franchises in this place and Avon.

EASTON, N. Y.—The Easton and South Cambridge Telephone Company was organized and started business last month. It is now operating 8 miles of line and 16 telephones, and will probably extend its lines. The officers are F. O. Ives, president; Elias Borden, secretary, and Edward Skiff, treasurer.

CHATHAM, N. Y.—The Chatham Co-operative Telephone Company, of Chatham, has been incorporated to build and operate telephone lines in Co[illegible]. The capital stock is [illegible], and the directors are [illegible] G. Babcock, Augustus N. Van Deusen, Norman Ashley and Elizabeth B Gibbons, all of Chatham.

MEDINA, N. Y.—The Orleans County Rural Telephone Company is making rapid progress in extending its lines in and about Lyndonville. The company proposes to extend its line several miles along the lake road, [illegible] from Kuckville. The officers are; President, Walter Tuttle, of Lyndonville; vice-president, Kenneth Hedley, of Yates; secretary and treasurer, [illegible] Coe, of Yates.

ROCHESTER, N. Y.—The Interlake Telephone Company has been incorporated [illegible] of [illegible]. The company will operate through Ontario, Wayne, Seneca, Yates, Cayuga, Onondaga, Oswego, Tompk[illegible], [illegible]ler, Livingston, Steuben, Wyoming, Genesee, Orleans, Allegany and Monroe Counties. The directors are George R. Fuller, Albrecht Vogt, Jacob Gerling, H. Wheeler Davis, William S. Hall, Ezra M. Higgins and Joseph W. Taylor.

CHARLOTTE, N. C.—The Washington & Aurora Telephone Company has been incorporated with a capital stock of $25,000.

BAINBRIDGE, OHIO.—The Bainbridge Telephone Company will build lines in Aurora township.

AKRON, OHIO.—The Akron People's Telephone Company is establishing an exchange in the neighboring village of Warwick.

CADIZ, OHIO.—The Harrison County Telephone Company is establishing an exchange at Scio. A good list of subscribers has been secured.

WELLSBURG, OHIO.—Negotiations are pending for the sale of a controlling interest in the Wellsburg Telephone Company to outside capitalists.

EAST TOLEDO, OHIO.—The Toledo Home Telephone Company is rapidly connecting up its subscribers in East Toledo. The company has secured ab[illegible] 600 subscribers on this side of the river.

CINCINNATI, OHIO.—The Cincinnati Telephone Company has place[d] upon the market 3,465 shares of treasury stock for the purpose of securing money for needed extensions and betterments of the service.

KENTON, OHIO.—The grocers' association has decided to use but one telephone. The rates of both companies are the same, but the Kenton Teleph[one] Company has about twice as many subscribers as the Bell Company.

NEWARK, OHIO.—The Newark Independent Telephone Company has lease[d] new quarters and a new central energy board will be installed. Work will [be] pushed and it is expected the new system will be in operation by Dec. 1.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company has inaugurate[d] a fire drill for the employees of its exchange. Recently the ninety young ladies of the morning shift descended by the fire escape from the eighth flo[or] of the building in six minutes from the first tap of the alarm gong

CLEVELAND, OHIO.—Four injunctions have been granted restraining the City Trust Company, of Buffalo, N. Y., from delivering 10,313 shares of the stock of the Consolidated Telephone Company to B. G. Hubbell, president of the company. The petitioners are large holders of the stock and their holdings are now deposited with the City Trust Company, of Buffalo. It is claimed that Mr. Hubbell is about to take possession of the stock and that he has no right to do so.

NORWALK, OHIO.—The Local Telephone Company, which has absor[bed] the exchanges at Norwalk, Milan, Berlin Heights, Chicago Junction, Plymouth, Greenwich, Attica, New Washington, New London and several smaller towns [in] this section, is offering to investors $15,000 of six per cent. non-taxable cumulative preferred stock, a part of an authorized issue of $150,000. The company's profits for the ensuing year are estimated at $18,000, or more th[an] double the amount required to pay dividends on the preferred stock.

NASHVILLE, TENN.—The Cumberland Telephone Company desires to co-operate with the city in establishing a conduit system in the streets of this p[lace].

GLOUCESTER COURT HOUSE, VA.—Mr. A. W. Withers has be[en] elected president of the Tidewater Telephone Company. The company will mak[e] some extensions.

PETERSBURG, VA.—The Petersburg Telephone Company has been incorporated. The capital stock will be between $50,000 and $100,000. Mr. Wm [illegible] McIllwaine is president.

RICHMOND, VA.—The Southern Bell Telephone Company is gradually acquiring local companies by securing a controlling interest in their [illegible] and will finally take them over as part of its own system. The Hampton Telephone Company, at Hampton, Va., and the Mutual Telephone Company [of] Petersburg are recent acquisitions.

MILWAUKEE, WIS.—An advance in the toll rate of the Wisconsin Telephone Company has gone into effect. The general toll tariff for the State [is] readjusted on a two-minute instead of a three-minute basis, as the [illegible] period, as heretofore. The one-minute business has been found unprofitable but an arrangement will be made whereby the demand for it can be met.

ELECTRIC LIGHT AND POWER.

DOVER, DEL.—The Urban Heating and Electric Company, of Wilmington, has been incorporated, with a capital stock of $100,000, by G. W. Kimball, W. L. Missimer and L. L. Shockley, all of Wilmington.

BRUNSWICK, GA.—The Mutual Light & Water Company has applied for incorporation, the purpose for which the company was organized being to purchase, construct and equip electric lighting and power systems, and carry on a system of water works in the city of Brunswick. The new company has taken over the plant of the Brunswick Electrical Supply Company. The petitioners are A. B. Coley, of Brooklyn, N. Y., George A. Prentiss and C. M. Acklen, of Elliott City, Md., E. H. Mason, E. Brobston and E. Fendig.

WAUKEGAN, ILL.—Plans are under consideration for the erection at Waukegan of a $300,000 electric power plant for Samuel Insull and Frank Baker, of Chicago, to supply electricity to all towns along the north shore from Waukegan to Evanston and the Waukegan and Fox Lake Electric Railway.

MARION, IND.—The Marion Light and Heating Company has purchased ground upon which to build a large heating and lighting plant.

INDIANAPOLIS, IND.—The Bristol Power Company, of Elkhart, has filed articles of incorporation with the Secretary of State. The company will construct a dam across St. Joseph river, build a power house, generate and furnish electric light and power to all the towns and cities of Elkhart and St. Joseph Counties. The capital stock is $500,000. Directors: E. A. Sanders, Joseph Dusham, M. V. Beeger, H. H. Porter, Francis Bosson and W. G. Gasbett.

JERSEY CITY, N. J.—The Municipal Light and Power Company, capital $2,000, has been incorporated by William C. Sherwood, Richard F. Tully, and H. A. Bingham.

PRINCETON, N. J.—The Princeton Electric Light Company, the Princeton Gas Company and the Hopewell Electric Light, Heat & Power Company have been purchased by local capitalists and will be merged into a single company to be known as the Princeton Lighting Company. The new company will be capitalized at about $500,000. It has contracts now to supply six or seven towns surrounding Princeton with light, and is going to lay out between $50,000 and $75,000 on an addition to its plant at Rocky Hill.

ELMIRA, N. Y.—The Chemung County Gas Company, Elmira, has been incorporated to supply gas and electricity to Elmira Heights, Horseheads and other places; capital, $500,000. Directors: Denman Blanchard, North Andover, Mass.; Andrew J. Miller, New York; M. H. Arnot, Elmira.

SYRACUSE, N. Y.—At the annual meeting of the Syracuse Lighting Company it was announced that $500,000 would be spent in new buildings and equipment, and the capacity of the plant be doubled. The following directors were elected: Robert C. Pruyn, of Albany, Stephen Peabody, James C. Bishop and Frederick Strauss, of New York; Howard L. Clark, Providence; Charles Andrews, Horace White, Hendrick S. Holden, Ceylon H. Lewis, Albert K. Hiscock, John Dunfee, John J. Cummins and Louis L. Waters, Syracuse. The board of directors elected the following officers: President, Ceylon H. Lewis; vice-president and treasurer, John J. Cummins.

WILLISTON, N. D.—There is an opening for an electric light plant in this place. Mr. L. H. Dow may be addressed on the subject.

AKRON, OHIO.—The city council has approved the new contract with the Northern Ohio Traction Company for furnishing electric light to the city. The contract is an extension of the old lighting franchise.

NORTH BALTIMORE, OHIO.—Dr. Henry has secured a ten year franchise for electric lighting with a contract from the village for 40 arc lamps at $70 per year. For many years the town has been paying $85 per lamp.

LORAIN, OHIO.—The Citizen's Gas & Electric Company has increased its capital stock from $150,000 to $600,000. The company will acquire the gas and electric lighting plants at Elyria and Lorain and the merger will take place within a few days.

CINCINNATI, OHIO.—Through the burning out of some of the main feed wires in the underground system of the Cincinnati Edison Electric Light Company recently, the entire city was left in darkness and many places of business were without power until repairs could be made. The theaters were forced to close and newspapers were obliged to set type by hand.

CINCINNATI, OHIO.—The Miami & Erie Canal Transportation Company will commence the operation of its electric boats between Cincinnati and Dayton before November 1. The company has arranged with the Cincinnati Traction Company for power, pending the completion of the company's own power houses. It is stated that the company has applications for shipments amounting to over 800,000 tons per annum, sufficient to keep between fifty and sixty boats busy.

PITTSBURG, PA.—It is stated that all of the new coaches to be built by the Pennsylvania Railroad Company for its main line service will be equipped with electric lights and storage batteries. Many of the old coaches have been sent to the shops to be wired for the electric lighting system. The construction of an electrical plant at Allegheny has been authorized, and two or three others will be built at division points on the lines west. A plant has just been completed at Cleveland.

HARRISBURG, PA.—The following named electric light companies have been chartered here recently: The Dorranceton Electric Light Company, Dorranceton, Luzerne County; capital, $1,000. The Courtdale Light, Heat & Power Company, Courtdale, Luzerne County; capital, $1,000. The Kingston Township Light Company, Kingston, Luzerne County; capital, $1,000. The Luzerne Electric Light Company, Luzerne, Luzerne County; capital, $1,000. The Plymouth Electric Light, Heat & Power Company, Plymouth, Luzerne County; capital, $1,000. The Kingston Light, Heat & Power Company, Kingston, Luzerne County; capital, $1,000. The Dorranceton Light Company, Dorranceton, Luzerne County; capital, $500. The Hillside Light Company, Kingston Township, Luzerne County; capital, $[illegible]. The Plymouth [illegible] Light Company, Luzerne County; capital, $[illegible].

NEWPORT, R. I.—Alfred Gwynne Vanderbilt has installed a large electric light and power plant at Oakland Farm, his summer home at Portsmouth. He has built a brick power house about a hundred yards from the residence and put in a [illegible]-hp single cylinder [illegible] engine. By use of a storage battery the dynamo will be run only during the late afternoon and evening.

MEMPHIS, TENN.—The Memphis Electric Light & Power Company and the Equitable Gas Company have been merged.

CHATTANOOGA, TENN.—The Tennessee Coal, Iron & Railroad Company is making preparations for the erection of a large electric power plant for the lighting and operation of its mines at Ensley, Ala.

COVINGTON, TENN.—Arrangements have been perfected for closing the sale of the Covington electric light plant to the city, the price being $[illegible]. An expert electrician has been engaged to overhaul the entire system. The lines will be extended and the plant improved generally.

PALESTINE, TEX.—Messrs. Hunter and Taylor, of Greensboro, N. C., have received an option on the Palestine electric plant, which is good until January. They propose to buy the plant, enlarge and extend it, and put in electric street railway system.

SEATTLE, WASH.—The building of a municipal plant is being discussed, the power to be received at 40,000 or 50,000 volts from a generating point 35 miles out of the city.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The Fresno Inter-Mountain Railroad Company, which was recently incorporated in California, has Fresno as its principal place of business. The directors are S. N. Griffith, L. L. Gray, G. I. Helm, G. M. Taft and M. Wallace. The capital stock is $500,000.

ELKHART, IND.—The $40,000 necessary to secure the Elkhart, Winona, Warsaw & South Bend Electric line has been obtained and work will begin at once.

JASPER, IND.—A corps of civil engineers has completed the survey for an electric railway from this place to Mitchell by way of French Lick and West Baden. This line is likely to form a link of the Indianapolis and Louisville trunk line.

LAPORTE, IND.—The Chicago & South Shore Railway Company has completed and opened its line from this city to the Chautauqua Grounds on the north shore of Pine Lake. The company is pushing the work on the Michigan City division.

WABASH, IND.—The Wabash-Logansport Traction Company, in order to get a level and straight line between this city and Logansport will lay a new track on the north side of the river between this city and Peru. The present circuitous route on the south side of the river will be used as a local line while the new route will be employed for fast through service.

WINCHESTER, IND.—The Union City, Winchester & Muncie Traction Company, of Winchester, has filed articles of incorporation. This company filed articles last July, but surrendered the charter obtained then and received a new one. The capital stock is placed at $275,000. Joseph E. Lowes, of Dayton, Ohio, is president and John E. Feight, of Dayton, Ohio, secretary. Theodore Shockney, of Union City, is the principal Indiana man connected with the company.

EVANSVILLE, IND.—The Evansville & Princeton Traction Company has closed a contract with the Westinghouse Company for $72,000 worth of electrical equipment for its power house and road. The contract calls for two 400-kw generators for the power house, two 300-kw rotary converters, two substation equipments, switchboards, etc., and for each of the ten cars four 55-hp motors. The company has filed a mortgage in favor of the Chicago Title & Trust Company to secure $400,000 of bonds issued by the company.

FRANKFORT, IND.—At a meeting held in this city Sept. 26 by capitalists of Chicago and Aurora, Ill., Lafayette and this city, steps were taken for the organization of a company to build a system of interurban lines with this city as the center. The plan is to build a line from Kokomo to Lafayette and from this city to Logansport with an ultimate outlet to Chicago. The capitalists present were R. S. Vivan and W. D. Ball, of Chicago, Wm. George, Charles Karoley and V. A. Watkins, of Aurora, O. V. Darby, of Kokomo, and D. A. Coveter, of this city. This company will incorporate in a few days.

DETROIT, MICH.—The Windsor Street Railway Company has commenced surveys for its extension to Ojibwa and Amherstburg. This road was purchased some time ago by the Detroit United Railways.

ST. LOUIS, MO.—The stockholders of the St. Louis & Suburban Railway have voted to increase the capital stock from $3,000,000 to $7,500,000. The indebtedness was increased by the issue of bonds to the amount of $7,500,000. Of the new bonds, $2,300,000 will be reserved for the purpose of retiring bonds of the company to the same amount, being all its bonds now outstanding, and to insure the payment of them.

NEW YORK, N. Y.—Electric trains are now in regular operation on the Sixth Avenue elevated line. The steam trains have not been entirely discontinued, however. The process of substitution will take place gradually. The Second and Third Avenue lines have been in full electric operation for many months. The Ninth Avenue line is being prepared for electric power.

NEW YORK, N. Y.—It is reported that George Gould is a prominent figure in the plan to merge the New Jersey trolley systems having Newark as the center. The roads which are to be merged are the White Line, running from Hoboken to Paterson and Singac; the Elizabeth and Plainfield and the North-Jersey Traction Company's system, operating in Jersey City, Bayonne, Newark, Elizabeth, the Oranges, Montclair, Caldwell, Verona, Irvington, Hilton, Maplewood, Belleville, Franklin, Passaic, Arlington, Harrison and Kearny.

STONEVILLE, N. C.—A project is on foot to build a trolley line between Stoneville and Spray, N. C., the power to be supplied by an electric plant at Spray.

MARIETTA, OHIO.—Stockholders of the Greencastle, Waynesburg & Mercersburg Turnpike Company are considering the building of a traction line along the turnpike from Greencastle to Marietta.

TOLEDO, OHIO.—It is stated that the Toledo, Bowling Green & Southern Traction Company has secured a private right of way from Bend to Dunbridge and into Toledo. Heretofore the company has operated into Toledo from Perrysburg over the tracks of the Toledo & Maumee Valley Railway, but it is now proposed to build its own line into Toledo.

PORTLAND, ORE.—The City and Suburban Railway Company of Portland is enlarging its power plant at Inman, Poulsen & Co.'s sawmill. A large Babcock tubular boiler has been delivered on the ground and will be set up at once. For the new generator and engine the excavation has already been completed and this portion of the plant will be installed at once on concrete foundations. The improvements will give an addition of about 500-hp. This will be needed for the operation of the St. John line which is now being fitted with electrical apparatus throughout its entire length, and for several other extensions.

THE AUTOMOBILE.

AUTOMOBILE MANUFACTURERS.—At a meeting of the executive committee of the National Association of Automobile Manufacturers, Mr. H. Ward Leonard, formerly third vice-president, was elected first vice-president to succeed A. L. Riker; Frederic Martin Lande, formerly secretary, was elected second vice-president, succeeding Dane E. Aianhard; Charles Clifton was made third vice-president; Harry Unwin, formerly assistant secretary, was made secretary, and Windsor T. White was elected to the executive committee. The members have generally signified their intention of adopting the standard form. In addition to trying to standardize the number of spke and lug holes for single-tube tire rims and the rim sections for double-tube tires, the association proposes to bring about the adoption of a standard section for solid tires.

NEW INDUSTRIAL COMPANIES.

THE ROSSMAN ELECTRIC CO., ot Jersey City, N. J., has been incorporated; capital, $2,000. Incorporators: Frederic P. Warfield, Geo. McHawley and Thos. McEwan, Jr.

THE NATIONAL TROLLEY MANUFACTURING COMPANY has been incorporated at Rochester, N. Y., capital $100,000. Directors: Stephen Rauber, Robert Seibert and R. T. Ford, of Rochester.

THE CRESCENT ELECTRIC COMPANY has just been formed at Evansville, Ind. J. B. Greene is the general manager. The company proposes to do a general contracting, construction and electrical supply business.

THE WESTERN MOTOR COMPANY, of Logansport, Ind., has incorporated with $400,000 capital stock. The company has purchased a plant and will manufacture automobiles, electric and other motors and do a general foundry business. Robert Parker, Edwin Rutember and E. H. Wolcot are directors.

THE ELECTRIC MILK COMPANY, of Schenectady, N. Y., has been incorporated. Capital $10,000. The directors are J. O. Carr and Rob't H. Fraser, of Schenectady; William T. Ford and William W. Zelie, of Cohoes; Le Grand Rexford and William A. Graves, of Rexford Flats, and George H. Smith, of Visscher's Ferry.

THE STANDARD TECHNICAL CO., of New York, has been incorporated to manufacture electrical machinery. The capital stock is $2,000. The directors are L. Sweet, H. L. Case and W. V. Goldberg, New York.

G. H. WALBRIDGE & CO., have been organized in Morristown, N. J., to manufacture electrical apparatus. The capital stock is $400,000, and the directors are G. H. Walbridge, E. B. Bruckman and G. M. Broks, of New York.

THE ELKHART FROG AND CROSSING WORKS COMPANY, Elkhart, Ind., has been incorporated. The capital stock is $30,000. The company will manufacture railroad frogs, switches and crossings and other appliances for steam and electric railways. J. W. Fuldhoun, F. A. Reed, John Wiley and H. A. Jevat are directors.

THE UNITED STATES CONSTRUCTION COMPANY has been incorporated at Toledo, Ohio, by Louis H. Gound, J. P. Degnan, Charles Komrofoky, Sherman Bond and John Haley for the purpose of constructing electric railways, lighting plants and telephone lines. Capital stock, $1,000. This company is doing the construction work for the Toledo, Columbus, Springfield & Cincinnati Railway of this city.

OBITUARY.

MR. FRED BATHURST, well known to a large circle of electrical engineers and others in this country, died in England, Sept. 26, of heart failure, resulting from asthma, to which latter disease he had been subject for some years. Mr. Bathurst was a pupil of Prof. Ayrton at the City Guild's Institution, at Finsbury, upon leaving which he joined the staff of Woodhouse & Rawson. Coming to this country shortly afterwards, he connected himself with the Edison General Electric Company, remaining when this was merged into the General Electric Company. About seven years ago Mr. Bathurst returned to Great Britain to introduce there the conduit system of interior wiring. In papers before electrical bodies, contributions to the columns of the electrical press and otherwise he constantly urged the merits of the system, with the result that they came to be generally recognized in Great Britain. A few years ago he was awarded a gold medal and £25 offered by the Society of Arts for a paper on the prevention of fire risks. The genial disposition of Mr. Bathurst made for him hosts of friends in this country, who will keenly feel his loss.

PERSONAL.

MR. N. F. BRADY, treasurer of the New York Edison Company, has just returned home after a very interesting and enjoyable European trip lasting a couple of months.

MR. CLARENCE MACKAY arrived in New York last week on his way from San Francisco to Europe. His father is now understood to have left an estate of about $80,000,000.

MR. T. W. MILLER, treasurer of the Goudey-McLean Company, of 88 Maiden Lane, New York, is now in Europe for the purpose of visiting several of the agencies of the company.

MR. E. D. ADAMS, the banker, prominently identified with the development of Niagara power and other great enterprises, has just returned from Europe on the Kronprinz Wilhelm.

MR. A. A. BLISS, treasurer and general manager of the New England Motor Company of Lowell, Mass., was in New York this week en route for Norfolk, Va., on a Southern business trip.

MR PAUL J. KREUSI, of the Sunlight Lava Mfg. Co., Chattanooga, Tenn., has been visiting the north on a holiday, looking up trade connections and making plans for future development of the business.

MR. L. W. STANTON, superintendent of equipment of the Federal Telephone Company, of Cleveland, Ohio, has been a visitor to the Atlantic seaboard, in connection with independent telephone work.

MR. E. D. BLACKWELL, of the Neshobe Electric Company, Brandon, Vt., has been visiting New York and studying up the latest ideas and wrinkles in wiring, for the benefit of the customers of that lighting system.

MR. PHILIP DAWSON, M. I. E. E., has become a partner in the consulting engineering firm of Kincaid, Waller & Manville, whose practice will be carried on at 20 Great George Street, Westminster, London.

MR. LEONARD BIGOT, of Buenos Ayres, is now in the United States for the purpose of placing contracts for considerable electrical equipment, including cranes, etc. He may be found at the Export Club, Tontine Building, 82-88 Wall Street.

MR. F. L. HUTCHINSON, the advertising and agency manager of the Christensen Engineering Company of Milwaukee, Wis., has been visiting the East in the interest of the new generators and motors now being put on the market by that progressive concern.

MR. GEORGE F. PORTER, until recently the secretary of the National Electric Light Association, has just received from that body a superb set of engrossed resolutions illuminated on vellum, testifying to his good work in the ten years during which he held the office.

MR. SEYMOUR FOLWELL, who was formerly manager of the offices recently closed in New York of the British electrical engineering and contracting firm of Robert W. Blackwell & Company, Limited, is now with the Cutter Electrical and Manufacturing Company, of Philadelphia.

PROF. R. A. FESSENDEN has, we are informed, resigned his position with the government, in which he was engaged in the development of wireless telegraphy, in order to conduct experiments with his wireless telegraph system. Experimental stations will be established in the neighborhood of Norfolk, Va.

MR. W. M. MORDEY, the well-known English electrical engineer, and his partner, Mr. Dawbarn, have been appointed consulting engineers for a lighting and trolley scheme for the city of Johannesburg, South Africa, and about 100 square miles of the Rand country. Both gentlemen are visiting the Transvaal in connection with this work.

MR. L. B. STILLWELL enjoys the well-deserved compliment of occupying the first page of *Harper's Weekly* of October 11, as one of the Americans of to-morrow. But we like neither the portrait nor the skimpy biographical sketch that accompanies it. As in Mr. Vreeland's case, the portrait is a distinct failure, as showing the mental calibre of the man.

MR. H. F. PARSHALL, the electrical engineer, before he left for London, presented to some of his more intimate friends here copies of a photograph of himself riding a camel in the vicinity of the Sphinx and the Great Pyramid, which keep each other company in the Egyptian desert. Mr. Parshall visited the Nile region this year for some professional work.

MR. JAMES P. GILBERT, who has been the general superintendent of the New York and Ohio Company, Warren, Ohio, manufacturers of Packard lamps and transformers, has resigned his position, and will take the general management of the Standard Electrical Manufacturing Company, at Niles, Ohio, manufacturers of the Standard incandescent lamp.

MR. HARDIN H. LITTELL, the veteran street railway manager of Buffalo, N. Y., has accepted the presidency of the Springfield & Central Illinois Railway Company, organized to take over the Springfield Consolidated Street Railways and suburban lines. Mr. Littell was president of the Louisville City Railway for many years and afterwards had charge of the Buffalo lines after reorganization.

MR. W. J. HAMMER returned to New York, October 6, from a four-months' visit to Europe, during which he made a study of the latest electrical and engineering developments, visiting for this purpose England, Norway, Sweden, Denmark, France, Italy, Switzerland and Belgium. While in Italy Mr. Hammer spent several days inspecting the Valtellina three-phase railway.

Over forty miles of the road was in operation and all of those connected with the railway expressed great satisfaction at the efficient manner in which the road operated.

EDUCATIONAL.

STREET RAILWAY ENGINEERING COURSE.—Mention has been made previously in these columns of the excellent practical work being done in both day and night courses at Lewis Institute, Chicago. It has recently been announced that, beginning Oct. 7, a course will be given with classes two nights per week in street railway engineering practice. This course will take up different types of construction and equipment and costs. H. M. Wheeler, of the Engineering Department of the Chicago Union Traction Company, is the instructor, and the course promises to be one of much practical benefit and engineering excellence.

POPULAR SCIENCE LECTURES.—Dr. H. Leipziger, on behalf of the New York Board of Education, is beginning his regular winter course of lectures in the public schools. In several centers electricity will form the subject of a course. Thus, Theodore I. Jones will deliver a course in public school No. 3, Grove and Hudson Streets. In Institute Hall, No. 218 East 106th Street, W. W. Ker, teacher of physics in the Hebrew Technical Institute, will give a course on the same subject; also in the Young Men's Institute, No. 222 Bowery, Prof. E. R. von Nardroff, teacher of physics at Erasmus Hall High School, Brooklyn, will give eleven lectures on physics and electricity in the Young Men's Hebrew Association Hall, 92nd Street and Lexington Avenue, and in St. Bartholomew's Lyceum Hall, No 205 East 42nd Street. Prof. W. C. Peckham, of Adelphi College, will give four lectures in public school No. 3 on "Chemistry and its Relations to Electricity."

Trade Notes.

CONDUIT CONTRACT AWARD.—Mr. G. M. Gest, the conduit contractor, has been awarded the contract for all the underground conduit work to be installed by the Brooklyn Heights Railroad Company this season. This contract amounts to over $25,000.

WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently taken the agency for the new Nernst lamp. It states that it is carrying a complete line of these in stock, and is prepared to ship promptly from St. Louis stock any size or voltage.

THE NOXEM TELEPHONE RECEIVER, which has been put upon the market by the telephone department of the Electric Appliance Company, Chicago, is having a large sale among the telephone companies and manufacturers. Circulars giving full description and prices are now being distributed.

STERLING LAMPS.—The spiral filament found in the Sterling Special incandescent lamp is proving more than an interesting topic of conversation. The value of this filament lies, it is said, in its giving a full 16-c. p. from the tip of the lamp. Mr. William Coale, treasurer of the Sterling Electrical Mfg. Co., Warren, Ohio, was a recent New York visitor.

FORT WAYNE BULLETINS.—The Fort Wayne Electric Works, Fort Wayne, Ind., in their bulletins Nos. 1025, 1030 and 1032 describe and illustrate, respectively, direct-current belted generators, single-phase generators and direct-current belted motors. The bulletins are of the standard form, and give tables of dimensions of the machines, besides illustrations of details and completed machines.

THE BULLOCK ELECTRIC COMPANY is planning a large addition to its plant at Norwood, Ohio. At the present time the company has under construction a building 300x177 feet, but the addition planned for will be 900x177 feet. It will be erected south of the present plant and will be of one story, of brick and steel construction. The company is preparing to build electrical machinery of the largest sizes.

THE PELTON WATER WHEEL COMPANY recently issued one of the handsomest catalogues ever produced on the subject of water wheels. This catalogue is handsomely illustrated with half-tone engravings, showing various parts and styles of Pelton wheels. It also contains colored half-tones of interesting scenes connected with the company's hydro-electrical work, etc. It is a most interesting and useful publication.

BALL ENGINES.—Among recent sales by the Ball Engine Company, Erie, Pa., have been engines to the Blaine Coal Company, Lock No. 2, Pittsburg, which has recently installed an electrical service; to the American Tobacco Company, Allen & Ginter Branch, Richmond, Va., for direct connection to a Crocker-Wheeler generator; and to the Athens Cotton Oil Company, Athens, Tex., a 125-hp engine to run an electric plant.

ELECTRIC COOKING.—The Simplex Electric Heating Company, Cambridgeport, Mass., in a little pamphlet, gives a good deal of interesting information about electric cooking. The advantages of this method of cooking are clearly pointed out and the features of the various utensils manufactured by this company are also described. This pamphlet is an interesting discussion on this subject and will well repay a careful reading.

DE REMER WATER WHEEL.—This water wheel which is used in many hydraulic plants in the West is illustrated and described in a pamphlet of the Mine and Smelter Supply Company, Denver, Col. The design of the bucket used in this wheel is claimed to be a new development in hydraulics, and the bucket has been classed as a tangential impact. Various statements are made in support of the claims for superiority of construction and design.

RENOLD SILENT DRIVING CHAIN.—The principle of design and construction of the Renold high speed silent driving chain is clearly illustrated and described by the Link-Belt Engineering Company, Nicetown, Philadelphia, in a neat little pamphlet just issued. All interested and power transmission will find in its 32 pages matter of lively concern to them. This system of transmission was fully described and illustrated in ELECTRICAL WORLD AND ENGINEER of Jan. 18 last.

THE ELECTRIC STORAGE BATTERY COMPANY has just finished the installation of a storage battery plant at Oakland Farm, the summer home of Alfred Gwynne Vanderbilt, near Portsmouth, Va. The installation consists of a Hornsby-Akroyd 16-hp kerosene engine belted to a Westinghouse direct-current generator capable of furnishing current for 150 16-c.p. lamps. The storage battery consists of 63 chloride cells capable of furnishing 63 amperes over a period of eight hours.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, states that the demand for its new type Peerless incandescent lamps is greater than ever. It states that the factory has recently doubled its capacity, in order to take care of the enormous output. It is now making some very attractive prices on this lamp. It says that the reduction in price has nothing to do with the quality of the lamp, as it is making better lamps to-day than ever before. It has a very attractive little booklet which gives more detailed information about incandescent lamps in general, and Peerless in particular, which will be mailed upon application.

THE WARD LEONARD ELECTRIC CO. has recently filled a large number of orders for its banks of interlocking theatre dimmers. During one week in August, orders were received for 16 banks of interlocking dimmers, many of which were from theatres which are improving their existing lighting effects. Among the dimmers supplied were the following: Three banks for the Princess Theatre, Melbourne, Australia; one bank aggregating 1,300 lights for a large theatre in the City of Mexico; dimmers for the Lyceum Theatre, Detroit, Metropolitan Opera House, St. Paul, Bijou Theatre, Harlem Music Hall and West End Theatre, of New York City. It has also recently supplied several large banks of dimmers for use in English theatres.

THE CHINNOCK ELECTRIC EQUIPMENT CO., 39 Cortlandt St., New York, has secured the contract for installing the switchboard and motors, including the electric wiring for the Merchants' Refrigerating Co., Jersey City. This plant is one of the largest refrigerating plants in the world. There are 11 Otis elevators to be installed, including the isolated plant which will consist of two 100-kw generators and 13 motors. The contract for elevators has been awarded to the Otis Elevator Company. The contractors for this plant are Messrs. V. J. Hedden & Son. The same company has received the contract for installing the power transmission plant for the new factory of the Tuttle & Bailey Mfg. Company, Brooklyn, for installing 17 motors. These motors are from 5 to 30 horsepower. The contract for the equipment, including generators, motors, etc., is now in operation.

NEW YORK TRADE SCHOOL.—A course of ten lectures for journeymen electrical workers will be given during the coming winter season by the New York Trade School, First Avenue, 67th Street, New York. The dates and subjects of these lectures are as follows: October 31, Units of Electricity; November 14, Electrical Currents; November 28, Electric Light Wiring; December 12, Electric Motors; December 19, Dynamos and Generators; January 16, 1903, Methods of Testing; January 30, Switchboards, Rheostats and Circuit Breakers; February 13, Storage and Primary Batteries; February 27, Arc Lights, Open and Enclosed; March 13, A Complete Generating Plant. Ten lectures for journeymen steam engineers will also be given at the same institution, one every two weeks, beginning with October 22. The lectures in both branches will be conducted by Mr. Arthur A. Hamerschlag.

CRANE POCKET CATALOGUE.—The Crane Company, Chicago, Ill., has just issued a new edition of its pocket catalogue. This catalogue is of unusual size, containing no less than 464 pages, and is bound in heavy boards. It covers the Crane Company's complete line including standard, medium, low-pressure, extra heavy and hydraulic goods in brass and iron, engineers' supplies, tools, pipe, etc. It is profusely illustrated with views of the various devices manufactured by this company, and at the back contains some tables very useful to engineers and mechanics in general. At the front of the book there are illustrations of the Crane Company's various branch offices, including the home establishment, there being twenty-one in all. This book will no doubt be very valuable to engineers, and a copy of it may be obtained by any one interested by simply addressing the home office or any one of the branch houses.

AIR COMPRESSORS.—An artistically illustrated and otherwise well-gotten-up catalogue of air compressors has just been brought out by the Chicago Pneumatic Tool Company, 95 Liberty Street, New York. These compressors, although designed primarily for the operation of pneumatic tools in shop and field, riveting, drilling, chipping, hoisting, etc., are also suitable for all of the customary employments of compressed air power. The catalogue contains new illustrations of all of the latest types of compressors and a complete description and illustrations of the chief features of design. It also contains all necessary data pertaining to standard styles of compressors; an article on the uses of compressed air and much valuable information relative to the proper installation of compressed air equipment, besides various tables. A copy of the catalogue will be sent free on application to anyone interested in this line of work.

CHARLES H. BESLY & CO. report their general business as very good. The month of September, just closed, was one of the largest in the amount of sales they have ever enjoyed. They are making many shipments of their Gardner grinders to various parts of the country. At this season of the year they are closing many contracts with agricultural people for their celebrated Helmet oil, Badger and Bonanza cups, these having been adopted by the following well-known makers of agricultural machinery: International Harvester Co., McCormick, Plano and Deering Divisions, Avery Mfg. Co., Port Huron Engine & Thresher Co., Sandwich Mfg. Co., Safety Shredder Co., Newark Machine Co., Parsons Band Cutter and Self Feeder Co. and others. They are receiving numerous orders for complete shop equipments, and for tools and supplies for repairs and replenishing. Their new 300-page general catalogue will be mailed free on application.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 7, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

710,414. CONTROLLING DEVICE FOR ELECTRIC GENERATORS; J. H. Bickford, Salem, Mass. App. filed March 19, 1900. The work circuit is supplied by a dynamo or a storage battery; when the battery is being discharged, it is completely in series with the work circuit and when being charged by the dynamo it is in two parts in parallel on the dynamo circuit, sufficient resistance then being in circuit tc bring down the voltage to the point for charging.

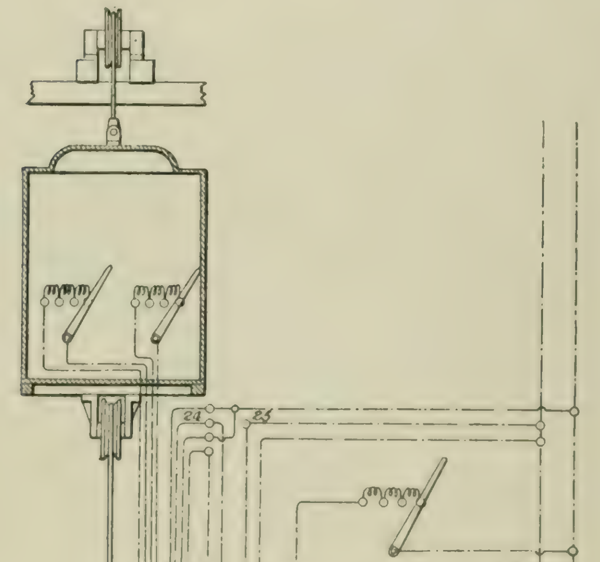
710,425. FRAME FOR DYNAMO ELECTRIC MACHINES; A. J. Churchward, Brooklyn, N. Y. App. filed Sept. 12, 1896. The pole pieces are of such size and shape that they will become magnetically saturated sooner than the cores of the magnets.

710,429. ELECTRIC BODY APPLIANCE; P. J. Collins and C. G. Boland, Scranton, Pa. App. filed Jan. 22, 1902. A number of contact plates arranged in the garments of the wearer, are connected through a little switchboard with a source of current carried at the belt.

710,469. TROLLEY; J. F. Kerr, Paterson, N. J. App. filed Aug. 8, 1901. The wheel is mounted on a crank at the upper end of a vertical oscillating stud.

710,473. ELECTRIC LIGHT SWITCH; H. W. Lawrence, Denver, Colo. App. filed Dec. 28, 1901. Details.

710,488. BUSHING FOR ELECTRICAL CONDUITS; M. Mauer and W. J. Billings, New York, N. Y. App. filed Feb. 17, 1902. The bushing is held in place around the outer end of the conduit by entering an eccentric opening in the wall of the outlet box and being turned to bring engaging shoulders together.



710,625.—Electric Elevator.

710,516. ICE CLEANER FOR TROLLEY WIRES; F. N. Root, Kalamazoo, Mich. App. filed Jan. 23, 1902. Ice cutting wheels are arranged adjacent to the trolley wheel.

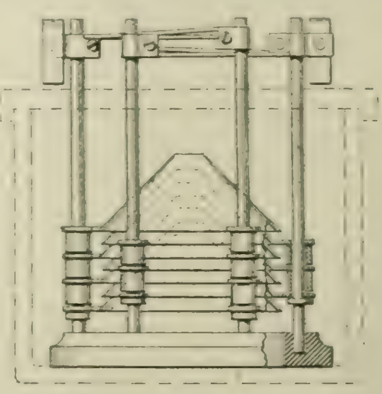
710,532. RAIL BOND; C. Sprague, Boston, Mass. App. filed Feb. 24, 1902. The ends of a laminated bond are dipped in solder and encased in a copper sheath.

710,541. ELECTRIC MOTOR OR GENERATOR; J. A. Titzel, Sr., Franklin, Pa. App. filed Dec. 13, 1900. Detail.

710,581. ELEVATOR; J. D. Ihlder, Yonkers, N. Y. App. filed Jan. 2, 1902. The speed of the elevator is automatically reduced in proportion to the load, before stopping.

710,597. SPEED CONTROLLING GOVERNOR; H. N. Motsinger, Pendleton, Ind. App. filed Feb. 15, 1902. A dynamo is bodily mounted on a pivot and is swung by the action of a centrifugal governor to alter the friction between a pair of friction-driving disks.

710,625. ELECTRIC ELEVATOR; R. C. Smith, Yonkers, N. Y. App. filed July 10, 1899. The armature and field of the motor rotate in opposite directions, their relative speed rates being controlled electrically.



710,870.—Storage Battery.

710,627. MAGNETIC TOY; L. J. Sullivan, Boston, Mass. App. filed Nov. 29, 1901. Permanent magnets are used to rotate an artificial flower and bring into view certain words or phrases.

710,659. GAS CAP FOR ARC LAMPS; E. H. Belden, Dayton, Ohio. App. filed Oct. 7, 1901. Details.

710,667. DEVICE FOR AUTOMATICALLY UNROLLING THE PAPER RIBBON IN MORSE APPARATUS; L. Cerebotani, Munich, Germany. App. filed Nov. 27, 1901. Details.

710,669. ALCOHOLIC LIQUID PURIFIER; C. C. Clark, Philadelphia, Pa. App. filed April 4, 1902. The liquid passes through a chamber containing electrodes, which cause the sediment and solid matters to be deposited.

710,691. MAGNETIC TRACTION WHEEL; B. B. Hill, St. Petersburg, Russia. App. filed Jan. 28, 1902. An iron rim containing a coil can be adjusted to the rim of an ordinary car wheel for the purpose of transforming it into a magnetic traction wheel.

710,716. ELECTRIC MOTOR; G. H. Reynolds, New York, N. Y. App. filed Dec. 5, 1900. A modification of patent No. 710,625.

710,736. CONTROLLER FOR BEER OR OTHER PUMPS; E. S. Baldwin, Peabody, Mass. App. filed July 16, 1900. Details.

710,787. CEILING ROSETTE FOR DROP LIGHTS; C. F. Lewis, New York, N. Y. App. March 28, 1902. The rosette is made to straddle the moulding to avoid cutting the same and the wires are passed continuously over the top of the base and beneath the cap.

710,788. GOVERNOR FOR WATER WHEELS OR OTHER MOTOR DEVICES; L. Lyndon, New York, N. Y. App. filed Oct. 23, 1901. A dynamo driven by the water wheel is automatically controlled by an electromagnetic device.

710,794. RAIL BOND; E. P. Morris, East Orange, N. J. App. filed July 9, 1901. The ends of a flexible bond are passed through and secured in openings in the heads or end pieces.

710,802. ELECTRIC GAS LIGHTER; A. Radiguet, Paris, France. App. filed Feb. 28, 1902. Details.

710,829. ELECTRIC CLOCK; W. F. Winslow, Winsted, Conn. App. filed Oct. 19, 1901. The spring is wound at intervals by an electro magnet.

710,854. MAIL BOX; P. P. I. Fyfe, Concord, N. C. App. filed Sept. 14, 1901. An electric alarm is applied to the letter box to show when mail is placed therein or the box is being tampered with.

710,870. STORAGE BATTERY; H. P. King, Osgood, Ind. App. filed May 16, 1902 The plates are conical in shape and strung upon vertical standards.

710,872. ALARM DEVICE FOR TANKS; M. Kubitzky and R. B. Stewart, New York, N. Y. App. filed Feb. 7, 1902. A float with a metallic top plate closes an alarm circuit when the liquid rises to a certain level.

710,892. STARTING DEVICE FOR ELECTRIC MOTORS; T. M. Pusey, Kennett Square, Pa. App. filed Jan. 8, 1902. The rheostat arm is moved by a clock frame controlled by a solenoid having a high and a low resistance coil in two different circuits, the latter coil tending to neutralize the effect of the former.

710,914. ELECTRIC OPERATION OF ELEVATORS BY SINGLE PUSH BUTTON SYSTEM; J. D. Ihlder, Yonkers, N. Y. App. filed Dec. 6, 1897. Details by means of which a dumb waiter or freight elevator can be called to any floor by the operation of a push button at that floor.

710,933. BATHING TUB FOR DIPOLAR GALVANIC BATHS; J. Zwiebel, Neu-Ulm, Germany. App. filed Dec. 12, 1901. A bath tub or non-conducting material having rods arranged along each side and movable electrodes thereon to be grasped in the hands.

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NEW YORK, SATURDAY, OCTOBER 25, 1902.

CONTENTS.

OHIO ELECTRIC LIGHT ASSOCIATION.

Elsewhere we print a report of the meeting at Columbus, of the Ohio Electric Light Association, with brief abstracts of such papers as were available for that purpose. One of the papers, treating in a practical manner with heating from central stations, is reserved for printing in full in a following issue. This is by far the best of the local electric light associations, and many similar organizations would be greatly benefitted by taking it as a model. The list of papers read annually is always extensive, the topics are almost invariably of live interest, and as a rule are treated by engineers and central station managers qualified for the task. The contributions from manufacturing companies are intelligently worked into the programme, the topics to be treated apparently being fixed by the Association. At Columbus, for example, one entire session was devoted to meters and another to alternating series arc lighting, at which sessions technical representatives of companies exploiting these classes of apparatus in turn read papers relating thereto, some of which went beyond making a mere commercial presentation of the subject. The growing custom of manufacturing companies to detail members of their technical staff to prepare papers for presentation at the meetings of electrical associations is fraught with much benefit for the members of such bodies if intelligently availed of, and the Ohio Association has been able to profit largely from this source by giving to the matter the necessary thought in constituting its programmes.

Two of the sessions of the meeting were assigned to the important managerial question—how to increase the revenue from a central station plant. Perhaps because in the past the subject has been so thoroughly threshed over, no particularly novel views were presented in its discussion. Stress was laid on the value of intelligent and unflagging solicitation for new business; intelligent in that the solicitor should make a study of existing conditions, and thereby be in a position to advise a prospective customer as to the most economical disposition for his case. The matter of rates cropped up, and though the equity, both to seller and consumer, was acknowledged of the modern systems which base charges partly on current used and partly on other considerations, yet sight was not lost of the difficulty in their introduction, due to obtuseness of consumers to such other considerations, and to the fact that gas companies—the doughty competitors of electricity—do not make any discrimination between clas of customers.

By long odds the most promising means advocated for increasing the incomes of central stations, and more particularly the smaller ones, is the addition of steam heat to the station output. One of the contributors of papers gave figures showing that the smaller central station plant is practically idle so far as earnings are concerned about 70 per cent. of the time, and that in small towns people cannot be persuaded to use light at unaccustomed hours, while it is practically impossible to develop in such places a power load at profitable prices. While these conditions are not ideal with respect to the utilization of a central station equipment for heating purposes, yet the experience of the past several years in the case of numerous small stations has been that the addition of a steam heating equipment is a profitable move. Of many reports made on the results of such an addition, we cannot recall one which has been unfavorable, in every case a satisfactory profit having been shown. While the

uncertainty with respect to the depreciation of the underground piping will require some years of experience to settle, it seems now well established that a central station in a small town is not taking an undue risk when it installs a heating plant, to be run in connection with its electrical business; and it is quite possible that the future will also demonstrate that a further advantage may be derived from the addition of an ice-making plant as a complement to the heating plant. With steam heat as a by-product in the winter and ice in the summer, the smaller central stations showing a profit would cease being in the minority.

AUTOMOBILE RELIABILITY.

The recent reliability contest from New York to Boston and back, organized by the Automobile Club of America, was a brilliant success in many respects. As was to have been expected, electricity played no part in the trial, the distance being 500 miles, and the means for charging along the route being still of a very crude and unorganized character. But that is a detail of insignificance in view of the fact that no serious proposition has yet been made to use electricity for such extended trips. The American gasoline and steam vehicles engaged in the run did remarkably well, and their makers in general have every reason to be proud of them. When one considers the condition of the roads along a large part of the route, or for that matter between any two great American cities, it is simply marvelous that the vehicles should have come through so well. Out of the 75 automobiles which started on this memorable run, 67 were in at the finish in good shape, and it is understood that at least a score of them have perfect records. This compares with a similar endurance test made recently by the British Automobile Club, when only two out of 88 starters showed up with perfect records at the end of a run of 650 miles. Some day the roads here may compare with those of England and France, but meantime it is one compensation that the ill condition of the highways here, due to the rapid development of the steam road and the trolley car, has taught automobile manufacturers how to put the design and the stuff into their vehicles that will stand the worst weather and the roughest banging about.

Combined with the track records which are being made, this showing is cause for the heartiest congratulations of all who believe that the practical success of the automobile art is destined to ameliorate conditions of urban life and to improve facilities for country travel. We remain very firm in our conviction that electricity is destined to play a large part in the urban development of automobilism, but we see in this no reason for failing to rejoice at the excellent demonstration of the sterling qualities of American steam and gasoline vehicles. They are not perfection yet by any means, but they have made some tremendous strides toward it in the last year.

GERMAN ELECTRICAL PROGRESS.

A recent bulletin issued by the United States Department of State, includes some very interesting figures by Consular Agent Harris, on "electrology" in Germany. We do not like the word very much, but the figures are valuable. It is stated in the report that there are 80 electrical engineering joint stock companies in Germany with a capital of $125,000,000, and that three of these companies employ nearly 30,000 persons. It is also stated that in 1901 these concerns exported to other countries electrical apparatus worth $3,831,690. The interesting fact is further noted that in Germany more than half the steam engines and turbines turned out are used for driving dynamos. It likewise appears that in the works of the companies named, there are 1,950 engineers employed, who are college men with technical training.

It is rather difficult to determine from these figures just how many of these concerns are manufacturing, and how many are of the consulting and constructing types. The three concerns named as employing 30,000 are, however, in the manufacturing class. The recent United States statistics on electrical manufacturing showed that there were, in 1900, in this country 580 distinctive electrical manufacturing establishments, with a capital of $83,000,000, an output of $91,000,000, and a roll of 46,000 employees of all kinds. It is obvious from the comparison which we are enabled to institute that in proportion to the capital invested, the German electrical industries employ a much greater number of hands, and from this two inferences may be drawn, and possibly three. It would certainly seem fair to assume that labor is not quite so efficient, that automatic processes are less in vogue, and probably that labor is not so well paid. These 46,000 American officials and employees received nearly $25,000,000 during 1900, and the 40,000 wage earners received $20,000,000, giving an average over the latter number of $500 per head. It is incredible that electrical labor in Germany is paid at anything like the rate indicated by these figures.

Deductions as to the relative number of engineers employed are rather difficult to make, but we might point out that the 1,950 engineers mentioned as employed by these 80 companies in Germany represent a body larger than the total membership of the American Institute of Electrical Engineers. This may not mean much, as President Scott on the basis of kilowatt capacity employed in electrical work in this country has figured, with the imaginative ability of a Col. Sellers, that the Institute ought to have at least 25,000 or 30,000 members. We are inclined to think that with so large a number of employees of the wage-earning class, the amount of supervision and superintendence in Germany is much larger than it is here. As to the figures of electrical export, we note that the German total for 1901 was less than $4,000,000. In our own country it has already reached twice that amount, and this year is between $9,000,000 and $10,000,000. It is possible, however, that the German figures given do not include some items brought to account in America, but even then the comparison is very much in our favor. Germany is the leading electro-technical country in Europe, and is our most active competitor in the broad field of the world's markets. And while we are glad to find her electrical industries show up so well, we do not think that the figures quoted are other than encouraging as to American pre-eminence and opportunity. It must not be forgotten that much of our success is due to German hands and to German minds, made welcome here.

THE ARMATURE REACTION OF ALTERNATORS.

This is a fascinating and favorite theme in recent years. It has also considerable practical importance, since the regulation of alternators depends upon it. It is not so long ago that the best alternators had such large armature reaction that they could not be made to give more than about 50 per cent. above full-load current when run on short-circuit, and this fact was availed of to extol the safety of the machines and their immunity from injury in cases of accidental short-circuit. At the same time this immunity was gained at the expense of very poor inherent regulation of pressure, and much superexcitation of the field magnets was necessary in order to maintain normal pressure under inductive loads.

The modern alternator has gained in regulation, but it is no longer safe to short-circuit it with impunity. The degree of regulation under load, and particularly under a load of assigned and expected power-factor, becomes of much importance in central-station practice. Alternators are becoming larger and larger year by year, and it is

practically impossible to load them in the factory. In fact, the full load of such machines may not be found until several years after the machine has been constructed. For these reasons, therefore, any method that is reasonably simple and reliable, by which the regulation can be computed, is very advantageous as giving a criterion in lieu of the missing full-load test. There is no rigidly accurate method for determining regulation from factory tests at light load, and it does not seem as though a rigidly accurate method could be arrived at, owing to the great difficulty which surrounds the subject, and the effect of the magnetic saturation of the active iron in the machine. If it were not for the saturation of the iron, the problem would be greatly simplified.

Nevertheless tentative methods are in use which yield results that are fairly reliable, and which may be regarded as first approximations. Thus, the standardization rules of the American Institute of Electrical Engineers offer such a method. It may not be absolutely correct, but it supplies an approximation and affords a criterion by which the regulation of an alternator may be gauged beforehand. The article of Prof. Guilbert, the first installment of which appears on page 658, deals with the subject at considerable length. It treats the matter from the standpoint of a designing engineer, rather than from that of factory tests. It is, however, interesting and well worthy of study from either standpoint.

College and Professional Training.

The American college president is just now in a most embarassing dilemma. Hemmed in between the futile pottering of the elementary and secondary schools and the strenuous demands of the professional schools for more and better training, he is face to face with a most serious educational problem. The American college has been for many years the backbone of our whole educational system. Of its immense usefulness and high importance the achievements of its graduates bear witness. Of late it has often been decried by that class of our fellow countrymen which holds that a finer and more valuable ethical training is to be found in apprenticeship in a broker's office, but those who thus protest furnish their own sufficient condemnation. In our own profession such doubts are settled once for all by the action of the great electrical companies in demanding a college education in those who cast their lot with them for technical training. But we Americans are a hurrying and restless race, and too often grudge the time that it takes to make a well-grounded man or a scholarly institution. We demand of a college the celerity and concrete results best exemplified in a pork-packing establishment. But the present anomalous status of the college is due perhaps more to its own laudable but ill-judged ambition than to the pressure of the times. For many years President Eliot, one of the most able and progressive educators of this generation, bent every energy toward lifting the college by its bootstraps to the plane of the foreign university. This programme demanded that the fitting schools should play the rôle of the German gymnasia, but twenty years of industrious goading has failed to produce the desired result, and the chief effect has been to push the college into the existing dilemma. With a very few conspicuous exceptions, university remains purely a brevet rank in American education.

And now that the conditions of the times demand longer and more thorough professional training than ever before, the college is indeed hard pressed. It is crowded from above by the necessity for more time in the professional schools, and for a nether millstone it finds the secondary school that its own hands have fashioned. And truth to tell, the college is losing heart. It has virtually surrendered its last year to professional electives, but the sacrifice has not served its purpose. The latest suggestion from no less eminent a source than President Butler, of Columbia, is for a two-year college course leading to post-graduate training, and a parallel four-year course for such as may desire it. We hope this experiment may not be tried, for its success would mean the disintegration of the college as it has been, and the introduction of nothing to take its place. The American student is not fit for post-graduate university work at the end of his sophomore year, and will not be until his training in the secondary schools is more thorough and less diffuse than it ever yet has been or is likely to be for some time to come. Nor can one successfully serve two masters, college and university. If the American college is to remain a part of our educational system, it must stand by its old ideals and neither retreat nor compromise. It is capable of giving a splendid training for professional study, or in the so-called humanities, but it cannot do either in two years now any more than it could a quarter of a century ago. It cannot turn out well-grounded men by the simple process of tagging them A. B. at the end of three years, and it would do its noblest work in repressing the tendency to hurry instead of encouraging it. We grant that there have been those who found a sound education outside of college walls, but we do not believe that any man who has made a deep and strong mark on the world's progress ever regretted the time spent in his education, save in that it was too short.

We grant readily enough that there is a demand for saving of time in modern education, but in so far as it voices a legitimate criticism it had better be directed at the elementary and secondary schools than at the college. These have, partly through unwise pressure from the colleges and partly through the misguided efforts of educators who spell their title in large capitals and are so devoid of a sense of humor as to take themselves seriously, been so filled with bogus humanities and trumpery science that they have scant time left for the fundamentals of a sound education. When a child starts in a kindergarten at six, learns his letters at seven, to write at eight and the multiplication tables at nine; when he dabbles in sloyd and nature study, bad music and worse art; when he potters around three or four kinds of kindergarten laboratories acquiring pseudo knowledge which he must unlearn later—it is small wonder that he turns up a year or two late at college and hunts there for electives that will not strain his undeveloped powers of concentration. If the college would do the greatest possible service to education it should sharpen its axe, not to decapitate itself according to the present program, but to hew out of its curriculum the courses that demand a diffuse preparation in the secondary schools, and out of these latter the time-wasting requirements. The student who knows a few things thoroughly when he enters college is better fitted than he who has a smattering of many. This is the secret of the success of the German gymnasium. Its graduate may be totally ignorant of the Italian Renaissance, but he knows his Latin and his algebra. There are few American colleges that turn out men so soundly and thoroughly educated, so capable of using their knowledge and of taking care of themselves anywhere on earth, as those that don the blue from West Point and Annapolis, and there are no colleges with so simple requirements for admission. But the boy who wins his appointment in competition is pretty sure to know this little thoroughly, and in so knowing it he has the key to all that follows, and of this all, none consists of educational hobbies. If the colleges would get grimly down to work and force the elementary schools to teach less and better, they would turn out men to whom the professional schools would be no toilsome task. And with the time thus saved, we should hear no more wails of too much time spent in education. The colleges have the remedy in their own hands—if they are hard pressed, they have only themselves to thank.

The Function of the St. Louis Exposition Machinery Building.

By Charles T. Malcolmson.

THE architecture of the Machinery Building, for the St. Louis Exposition of 1904, may be characterized in general as purely classic, bordering on Italian Renaissance. It is flanked by four towers following out the general style of the building, while the entrances are treated in such a manner as to harmonize perfectly with its architecture and form quite a leading feature in the design.

The building is 525 x 1,000 feet, and is located practically in the center of the Exposition Grounds. It is one of the group of buildings of the main panorama which forms about the Art Hill as a focus. The eastern façade lies along one of the radii of approach to the Grand Basin, while the northern façade faces the main artery of travel, connecting the two natural divisions of the grounds, of which Skinker Road is the dividing line. Beginning with the western end of the building and running south and behind it is the Street of the Midway.

Certain machines belong essentially to the Machinery Building, and may be broadly divided into "machinery for the generation and transmission of power" and "machinery for making machinery." The western wing of the building will be devoted to the exhibitors' power plant and the Westinghouse plant, all exhibits used in the generation and transmission of power not included in these plants, together with items classified as "general machinery" and "fire apparatus." In the eastern wing will be placed "machine tools" for working in metal and wood, and "arsenal tools." Traveling cranes and all other facilities for handling heavy machinery will be available the entire length of the western wing, and heavy machine tools will be located in the northern end of the western wing, to take advantage of these facilities.

France, ever quick to recognize the forces at work, evolved a classification upon a new principle. The authors of our classificcation have but developed this idea. Beginning with the building as indicative of the department, each exhibit will follow the group and class subdivision, and must be installed in its proper class, regardless of nationality, to be considered for award. This method of installation gives the producer a chance to show, the buyer to see what is for sale in the world's market; it gives the designer the benefit of foreign ideas, the student and interested layman the opportunity to study the race characteristics as revealed in the product of each country.

The general division of floor space in the Machinery Building will be effected by two main obligatory aisles running longitudinally from east to west. In the center section of the western wing will be placed the plant purchased of the Westinghouse Company. This plant consists of four direct-connected 2,000-kw units. The engines are of the vertical multiexpansion type, running condensing, and the generators are three-phase machines, generating 25-cycle alternating current at 6,600 volts. Its boiler plan will be located in the boiler house, contiguous with the Machinery Building, and will consist of sixteen 500-hp boilers of the Babcock & Wilcox type, generating steam at 150 lbs. gauge pressure. The boilers will be automatically stoked. All accessories to complete the plant, such as pumps, feed water heaters, etc., will be furnished under the contract, together with the design of the plant and its installation.

One of the most comprehensive ideas for machinery exploitation ever conceived has been planned in the exhibitors' power plant, and the encouragement already received from prospective exhibitors on both sides of the water, augurs well for its success. This plant will include steam engines, steam turbines, gas engines, vapor engines, water motors, all forms of electric generating apparatus, pumps, pumping engines, boilers, etc. etc., as actual working exhibits in the diversity of their application. The interest will be chiefly due to the great variety of the prime movers, and the working test covering the entire operating period, upon which will be based the awards. A complete record, covering all the material elements of a test, of all boilers, engines, generators, pumps and other machines and apparatus installed in this exhibitors' power plant will be kept. This data will be collected under the supervision of a competent engineer, will be incorporated in the report of the machinery department to the United States Government, and will be published by the Government together with the awards. No such record has ever been accessible to the public before.

MACHINERY BUILDING, ST. LOUIS EXPOSITION.

The clou of the Centennial of 1876 was the Corliss engine; mammoth beyond expectancy for that period of our engineering. Chicago showed her 10-hp gas engine with pride. But the development in the last decade, in size and efficiency of these classes of engines and of steam turbines is phenomenal. It is not strange that increasing interest will be awakened in the student and layman alike, that the engineer will find here material for many hours of study in the greatest massed exhibit and variety of types ever before collected and installed as a working exhibit.

Europe is coming to the front and showing her interest in this great universal exposition by assurances to exhibit with us. Gebr. Korting, of Hanover, Germany, will install a 1,000-hp, 2-cycle gas engine; the De Laval Steam Turbine Company, of Stockholm, a 3,000-hp steam turbine, and Durr & Company, of Dusseldorf, a 2,000-hp in water tube boiler, as working exhibits. The excessive cost of fuel in these older countries has forced upon their engineers the necessity of high economies. We are prone to think that our apparently inexhaustible fuel supply will take care of our low efficiencies in prime movers, sacrificed on the altar of first cost. It is to this end that an international comparative working test of power generators will have exceeding interest to the purchaser as well as the manufacturer, for the trend of modern American practice is certainly towards better economy in the operation of power plants

The Rowland Rapid Telegraph System—II.

MANNER IN WHICH THE SIGNALS ARE RECEIVED.

SINCE the two ends of the line are in all respects alike, any description which will apply to one end will also apply to the other.

Referring to Fig. 7, L is the main line and R_a the main line polarized relay. This relay has two insulated tongues which vibrate synchronously with the alternating current waves arriving over the line L. The tongue t_s controls the synchronizer, S, which operates in the manner described above. The tongue t_p has the functions to be described. C is a "receiving" commutator, practically identical in construction with the "sending" commutator described above. Sweeping around this commutator, which has 52 segments, there is a brush, or trailer, t_p. This trailer is connected by gearing to the rotating synchronizer S, but with a speed reduction of 13 to 1. The commutator may be rotated through a small angle, giving an adjustment, so that when the trailer t_r is in the centre of a segment the relay tongue t_p is at that instant against either a left-hand or a right-hand contact. R is a resistance of several hundred ohms, to the terminals of which is connected a 110-volt direct-current circuit.

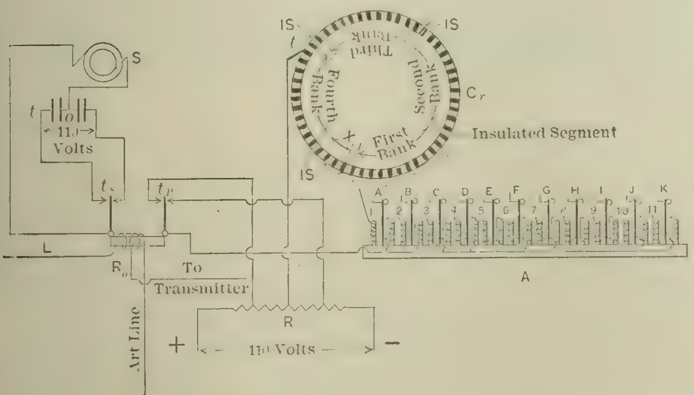


FIG. 7.—DIAGRAM OF CIRCUITS AT ONE STATION.

A is a bank of small polarized relays, called the "selecting" relays. There are, in reality, four such banks of 11 relays each. Only one bank, however, is here shown.

Each of these four banks correspond to a keyboard at the sending end of the line. One terminal of each of these relay coils is connected to a segment in one of the groups of 11 segments of the commutator C. The other terminals or "tails" of all the coils of all the relays are connected to the insulated tongue t_p of the main line relay R_a. As the tongue of this relay vibrates between its contact points and the trailer travels over the commutator segments, synchronously with the vibrating tongue, the 44 relays will receive, in succession, momentary currents through their coils. The relays 1, 3, 5, etc., of each bank will receive a current through their coils in one direction, and the relays 2, 4, 6, etc., a current in the opposite direction. Thus, the tongues of the relays of even number would receive an impulse in one direction, and those of an odd number in the opposite direction. The windings, however, of relays of odd numbers are reversed, and this makes the tongues of all the relays receive, in succession, an impulse in the same direction as the trailer passes over the segments of the commutator to which they are attached. Thus, while the current on the line is unmodified, the tongues of all the "selecting" rays will receive an impulse in the same direction once each time the trailer makes a complete revolution. These repeated impulses, together with the magnetism in the tongues of the relays, hold them against their back-stops and away from the contact points A, B, C, etc.

The cut-out wave on the line will now be indicated in the following manner: When the wave is cut out, the main line relay tongue t_p will at that instant cease to vibrate and will remain against the contact point to which the previous wave had carried it. The trailer in the meantime passes on to a segment such that, if the main line relay tongue had been carried over, the selecting relay attached to that segment would have received an impulse to take it against its back stop. Now, however, this selecting relay will receive a current through its coils in a reverse direction to what it would have received had the main line relay tongue continued to vibrate. Its tongue will, therefore, be thrown against its contact point and will remain there until the trailer has made a complete revolution. When the trailer returns to the segment to which the relay is attached, unless some wave is again cut out, the relay will receive an impulse which will return its tongue to its back-stop again.

Thus, waves which are cut out at the far end of the line are reproduced at the near end by the tongues of the selecting relays which correspond to the wave cut out, being thrown against their contact points A, B, C, etc., and there remaining during one revolution of the trailer. As each of the four keyboards at the far end of the line operates a corresponding bank of 11 selecting relays at the near end, the depression of any key of the keyboard, which cuts out two waves, will cause two relay tongues in the bank corresponding to that keyboard to be thrown against their contact points. A practiced observer could readily interpret the cut-out wave signals sent over the line by merely observing the movements of the tongues of the selecting relays. Tongues 1-3 sent over might be interpreted to mean A, 1-4 to mean B, etc., through the 45 possible combinations given above.

But in the present system these signals are automatically translated into ordinary figures and letters of the alphabet which are printed upon a sheet of paper eight inches wide. It now only remains to show how this is accomplished.

AUTOMATIC TRANSLATION OF THE SIGNALS INTO PRINTED CHARACTERS.

The page printer, by means of which 41 different characters may be printed in type, involves the following essential features:

1st. A light type-wheel of steel about 2 inches in diameter, on the circumference of which the 41 characters are engraved. This type-wheel revolves continuously at the end of a horizontal shaft, which turns synchronously with the trailers.

2d. A light paper carriage which carries the paper that is fed from a roll underneath the type-wheel when new lines are made.

3d. Devices for thrusting the paper forward to make the lines, and sideways to space the letters, and a back carriage device to return the paper to a position where a new line of printing is to start.

4th. A small printing magnet, which operates a hammer or platen which strikes the paper up against the lower side of the rim of the wheel, at the moment when the character to be printed has turned to its proper position above the hammer.

5th. A set of four polarized relays, called the "distributing" relays, which serve the purpose of making contacts at proper moments for sending current to the printing magnet to print, to a liner magnet to line the paper, to a spacer magnet to move the paper sideways, and to a back magnet which allows the carriage to return the paper to the proper position for beginning a new line.

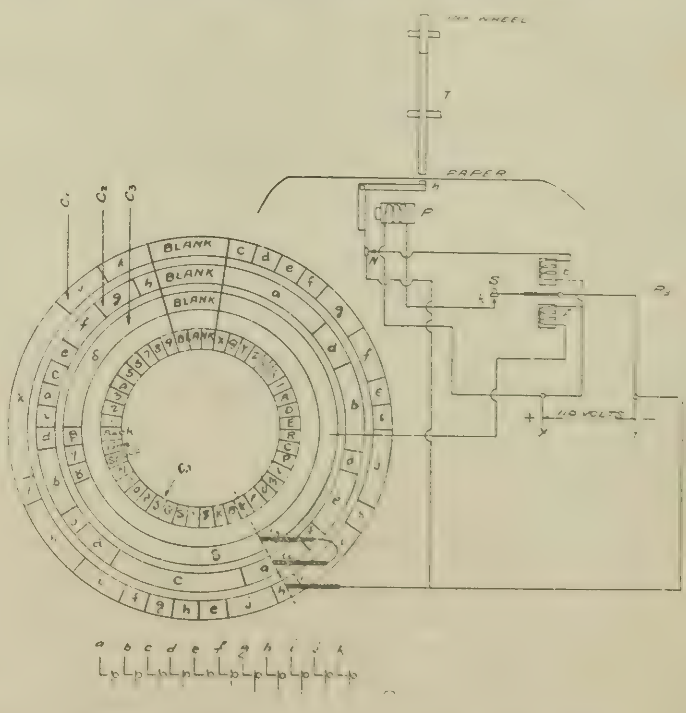


FIG. 8.—DIAGRAM OF COMMUTATOR AND CONNECTIONS.

6th. A so-called "combination commutator," the function of which will appear from the following description:

Fig. 8 shows diagrammatically the combination commutator, the

tongues and contact points of one of the four banks of the "selecting" relays, and also a part of the connections of a page printer. The combination commutator is made up of three parts or circles, C_1, C_2, C_3. Each of these circles is divided into segments of different widths with insulation between. t_1, t_2, t_3, are three brushes, or trailers, which sweep together around the commutator in the same time as the trailers on the sending and receiving commutators, and, being on the same shaft with the type-wheel, turn also with it. These trailers, as they come to bear upon different combinations of segments of the commutator, complete, together with contacts made by the relays of one of the four banks, circuits which actuate magnets that print the character and shift the paper. R_d is one of the four "distributing" polarized relays. The current, through its coil b, brings its tongue against the back-stop S, and a current, through its coil f, brings its tongue against the contact point k. P is a small printing magnet, which, when energized, causes the hammer or platen, h, to strike the paper up against the rim of the revolving type-wheel.

This is done so rapidly that the type-wheel may continue in constant rotation, although being attached to the shaft by means of a spring, it may, momentarily, pause. X and Y are the positive and negative terminals of a 110-volt direct-current circuit. The spacer, liner and back magnet, and the distributing relays which actuate them, are, for the sake of clearness, not shown in the diagram. A letter is now printed as follows: Two half-waves having been cut out of a group of waves to which the bank of selecting relays R_a belongs, two of these relay tongues are thrown against their contact points, where they remain until a reverse impulse returns them to their back-stops. Suppose contact is made with the contact points a and h, then, after a certain time, the trailers t_1 and t_2 will have arrived on segments of the combination commutator, which are respectively connected to the contacts a and h, and the trailer t_3 will then be in this case on the segment S. It may be noted that the inside circle C_4 shows the position of the letters on the type-wheel corresponding to the combinations of segments on the combination commutator. The following circuits are now completed. The current starting from the positive pole X passes through the coil f of the "distributing" relay R_d throwing its tongue against the contact k. Thence it passes to the segment S and out through the trailer t_3 and into the trailer t_2, thence into the segment a of the commutator connected to the contact point a. From there through the tongue of the relay and by the frame of the relays of the bank to the tongue making contact with contact point h, thence to the segment connected to this contact point h, and thence by the trailer t_1 and its connection back to the negative terminal Y. It may be stated, in passing, that all segments of the combination commutator are connected to the contact points of the same letter of the bank of relays R_a.

At the instant that the above occurs, the type-wheel, T, has turned into a position so that the letter engraved upon its rim, and which corresponds to the combination of segments a-h on the combination commutator, is just over the platen h. In this case the letter would be V. At the same time, contact being now made at k, a circuit is completed which makes the platen strike the paper up against the type-wheel and so prints the letter. This circuit is from X through the coil of the printing magnet, P, to the contact k and back through the relay tongue to the negative pole. At the instant, or just before, the platen, h, strikes the paper against the type-wheel, a contact is completed at N which permits a momentary current to pass through the coil, b, of the relay R_d, thus returning its tongue to its back-stop. A further circuit, which is not here shown, is also automatically completed, which causes the paper to shift sideways under the wheel through the distance of a space between letters, that is, "spacing up" is automaticaly accomplished.

In this manner 38 characters may be printed. Three combinations as g-b, k-b, k-d, are reserved for spacing, lining and backing the paper at the will of the operator at the far end of the line. The segments a, y, b, on the combination commutator are attached to coils of the polarized relays, not shown, which distribute current to magnets that performed the above function. If the operator at the other end of the line should neglect to send the "back signals" which returns the paper and attempts to print beyond the edge of the sheet, then the carriage will carry the paper back automatically when the end of a line of printing is reached. This, however, a practiced operator never does, because at the sending end an automatic device on the keyboard shows the operator just how far he has printed on a line.

The operator being able to space, line or back carriage at will, paragraphing, etc., can be accomplishing the same as on an ordinary typewriter.

Corresponding, of course, to each of the four keyboards at the other end of the line, is a page printer and a bank of "selecting" relays. All four of these page printers appear to be operating simultaneously.

The waves in the extra group X (Fig. 2) are used, one to automatically ring a bell if anything disturbs the synchronism or the printers are turned off, and one is used to "find the letter" when the apparatus is first started up. Finding the letter means bringing the trailers of the sending commutator, at one end of the line, and the receiving commutator, at the other end, upon corresponding segments of their respective commutators. For example, when the apparatus is first started up and synchronism has become established, the trailer on the sending commutator, at a particular instant, might rest on, say, the 20th segment, and that of the receiving commutator on the 50th segment, but an automatic device, operated by one of the cut-out half-waves of group X, will cause the trailer on the receiving commutator to lag behind until it is at the same instant on the segment of the same number as the trailer of the sending commutator. When this has taken place the two trailers continue to revolve in perfect synchronism, and always maintain the same relative position on their commutators.

Marconi on the "Carlo Alberto."

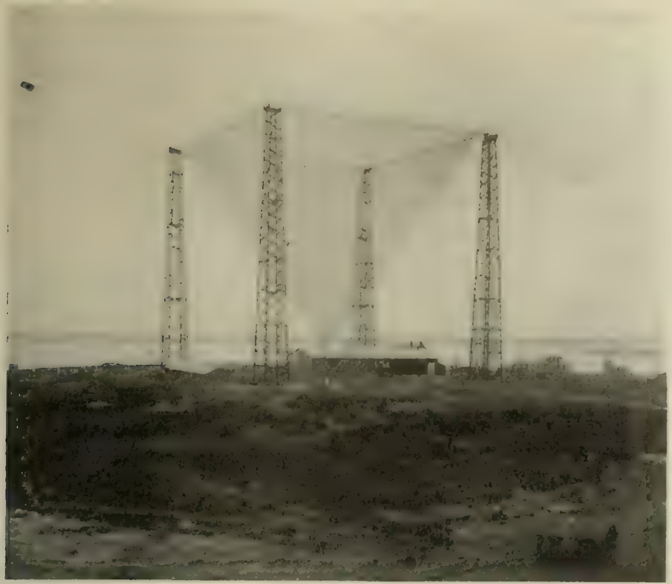
Marconi, after having achieved new scientific distinction, and having royal honors conferred upon him by both the Czar and the King of Italy, is now on his way across the Atlantic on the "Carlo Alberto," to make a transatlantic test of the long-distance stations at Glace Bay, Cape Breton, and at Cape Cod, Massachusetts.

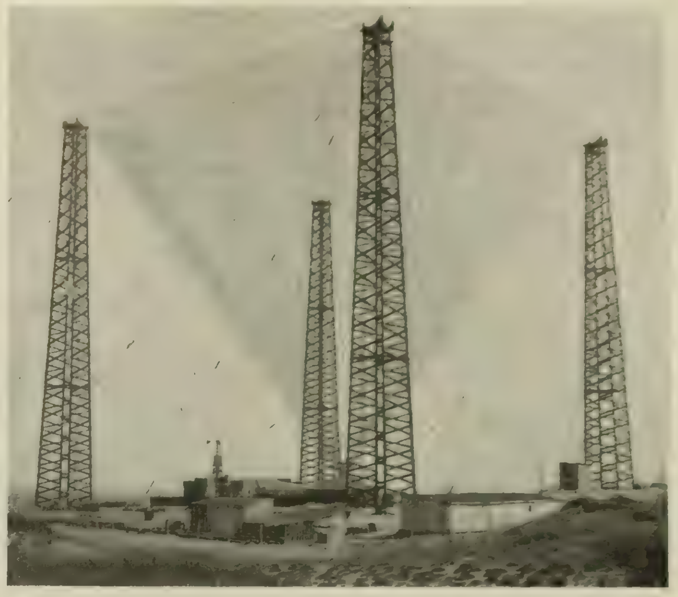
The Mediterranean trip of the young inventor, who left England on August 23rd on the Italian flagship, was memorable in many ways.

THE "CARLO ALBERTO."

Throughout the entire journey he was in daily communication with the station at Poldhu, Cornwall. The last messages for the King and the Minister of Marine were received on the tape inside of Spezia Harbor. It was there that Marconi left the warship to visit the King. He had been informally summoned by two despatches from the latter, and left the "Carlo Alberto" escorted to the train by a group of admirals, commanders and other officers of the navy. While landing,

all of the crew had crowded to the masts, and, waving their hats in the air, saluted him with tremendous hurrahs and "Addio, Marconi!"





Figs. 2 and 3.—Terminal Stations at Glace Bay, Cape Breton, and Cape Cod, Mass.

During the trip, a copy of the despatches Marconi received was given equally to sailors and officers, so that everyone on board knew of any new happenings.

The experiments on the "Carlo Alberto" were intended to demonstrate that valleys, hills and mountains between the seas would not interrupt the communications. The most difficult experiment was made at Gibraltar, while entering that port and proceeding under the high fortified rock. The fog made navigation difficult, but the ship passed to anchor with the aid of the ringing of bells on the ships at anchor. Here a long despatch, relating to the Czarina of Russia, was received from Poldhu station over the Pyrenees and the high rock of Gibraltar. The series of important experiments were made under the most adverse conditions of time and locality, and all of the experiments were mathematically controlled by chronometer and Greenwich time. The celebrated letter "S" call sounded the preparatory signal for a message from Lord Kelvin, which was sent to Kiel to the young inventor, congratulating him upon his success, the message reading: "Marconi, Kiel. Thanks to Admiral for permission and yourself for sending telegram of your most interesting success. Heartiest congratulations. Lord Kelvin."

MARCONI AND MARQUIS SOLARI.

The accompanying illustrations give a view of the "Carlo Alberto," taken at Cronstadt; views of the wireless stations at Cape Breton and Cape Cod, and portraits of Marconi and Marquis Solari, with whom the inventor has been working on terms of the greatest friendship.

Disturbances to Telegraph Lines by Three-Phase Railway.

By Cesare Pio.

The Lecco-Colico-Chiavenna-Sondrio Railway, recently inaugurated in the North of Italy, is, as is well known, operated with three-phase currents at 3,000 volts, the primary voltage being 20,000 volts. The transmission lines are three wires, situated in a vertical plane and the secondary lines are constituted by two overhead trolley wires and by the rails for the return. When the first test of trains was made, the disturbances to telegraph were so great that communication had to be suspended, even that relating to the railroad service. In order to avoid these troubles the return circuit of the telegraph line was changed in direction by utilizing the stream of the Adda River. Later some inductive coils with closed magnetic circuit were connected in series with the telegraph lines, and finally a return circuit was added to all these lines. The latter was the only remedy which proved successful and gave good results.

It was also demonstrated that all the troubles were caused by the secondary current of 3,000 volts, the primary current of 20,000 volts having no influence in telegraphic communications. As a consequence of the good results obtained, the telegraph engineers of the Italian government conceived the idea of combining all the returns in a single wire; but this idea was soon abandoned, as the return of the different telegraph lines would have to be of very large cross-section. The number of wires was then doubled for all the telegraph circuits running along the railway lines. Over 400 miles of wire was laid, with all the necessary special work at crossing points, the poles were strengthened, and the whole work was accomplished in 16 days under direction of an inspector of the government telegraphs.

Some advantages resulted also from the adoption of inductive coils with closed magnetic circuit, but it was noted that the advantage was inversely proportional to the speed of telegraphic communication. Therefore, the use of such coils is not advisable with Wheatstone or Baudot machine telegraphic apparatus. The remedy just described cannot, however, be considered a complete solution of the problem, for while the change from single to double line has been possible in the present case, it would be an easy matter with respect to the main railway lines where the number of wires is enormous, and where often there are two sets of poles, one on each side of the track. Besides economical objections, there are also technical objections with respect to through lines, owing to loss of time, as was demonstrated in Lecco. The only practical solution of the problem seems to be to put underground all telegraph lines.

Tests of a 25,000-Volt Direct-Current Transmission Line Between St. Maurice and Lausanne, Switzerland.

In a paper read at the recent congress of "La Houille Blanche," M. Thury gave an account of tests made on the 9th and 10th of September last on the St. Maurice Lausanne line, 20,000 volts, direct current. The line running from St. Maurice to Lausanne is a constant-current high-tension transmission line, carrying 150 amperes with a voltage that will attain 25,000 volts. This figure will not be reached until the load develops on the Lausanne system, which includes lighting and railway service.

M. Thury considered it advisable to test the line under conditions approximating as much as possible to actual working conditions, and he therefore built a testing dynamo for obtaining 25,000 volts direct-current.

The line has a total length of 36 miles and the length of the conductors is therefore 72 miles. These conductors are carried on 1500 pine poles and 3,000 insulators. The insulators were manufactured by the celebrated Italian manufacturer of porcelain, Richard Ginori, Milan, and are of the same type as on the Paderno-Milan three-phase line, with two petticoats. The line consists of two copper conductors of 150 mm^2 section and a total resistance of 13.3 ohms.

The testing outfit included the 25,000-volt dynamo supplying current up to 1.5 amperes, and measuring instruments of Hartmann & Braun, included an astatic voltmeter and a milliammeter with a scale extending to 30 milliamperes, divided into 150 divisions.

The voltmeter was connected in shunt across the line from one of the two wires to the ground and the ammeter was inserted for reading the current sent from the machine. The first series of tests was made between both conductors together and the ground, connected successively with the positive and the negative pole of the machine. The time of electrification in each of the tests was one minute. The current was maintained for 30 minutes. The following are the average results of the tests.

Ten tests were made between wires at 20,000 volts, the ammeter reading being 0.013 ampere. This result was obtained in dense cloudy weather when the insulation was relatively poor, but the energy consumed amounts to only $20,000 \times 0.013 = 260$ watts.

If this figure is reduced to the loss per insulator, we find it to be 0.0866 watt per insulator.

In fine weather the same voltage applied showed a current of only 0.0111 amperes. The total resistance was therefore 1,802,000 ohms, and the resistance per mile, 173 megohm; energy consumed in watts 220 and per insulator 0.073; percentage of loss, 0.07 per cent.

The insulation between ground and both wires together in fair weather was found to be, at 20,000 volts, as follows:

(1) Negative pole to the line, the insulation was 0.877 megohms, or megohms per insulator $0.877 \times 3000 = 2631$ total.

(2) Positive pole to the line, the insulation was 0.740 per insulator, or $0.740 \times 3000 = 2220$ total.

In bad weather, the insulation from positive pole to the line was at 20,000 volts 864,000 ohms; at 10,000 volts 1,115,000 ohms; at 4,000 volts 1,177,000 ohms. With the negative pole to the line it was at 20,000 volts 882,000 ohms; at 10,050 volts 1,082,000 ohms; at 4,080 volts 1,180,000 ohms; at 2,000 volts 1,250,000 ohms.

These tests show that the insulation decreases with the increase of voltage, but very much less relatively to that between the conductors and the ground. This insulation includes switchboard connections of the motors, lightning arresters, etc.

The effect of polarity is also very noticeable. M. Thury emphasized the good results obtained from the tests, which as he observed, had been made on the line under service conditions.

Some of the insulators were in poor condition of repair, and an examination showed that twenty of the insulators had been broken by stones. M. Thury considers that the tests are much more important than if made on a line recently overhauled. Since the current through the insulation is so low no electrolysis is to be feared, and the power loss can be increased 100 times without reaching 1 per cent. of the power transmitted.

As compared with alternating current tests, the direct current shows higher insulation, due to the greater maximum voltage of the latter for the same effective voltage, not to mention the effects of capacity which so largely influence the results of line tests with alternating current.

A series of tests was also made on a ground return circuit. The earth resistance between St. Maurice and Lausanne, a distance of 56 kilometers, was found to be exactly 1.4 ohms, the greater part of which is located at the contact of each set of terminals with the ground, the earth resistance proper being extremely low; and this total resistance of 1.4 ohms was proved to be practically independent of the distance. M. Thury expressed the opinion that should a test be made between two terminals earthed thousands of miles apart, the total drop in volts would be of the same value.

Independent tests were made on each of the terminals for verification of the figure above given for total resistance, and these tests exactly checked, the figure for the total resistance at the St. Maurice terminal being 1.233 ohms while at Lausanne the resistance was 0.167 ohm.

The difference of resistance at these two terminals is due to the fact that at Lausanne a good lightning arrester ground was used, connected with the water conduits of the station by means of a copper wire. At the St. Maurice terminal on the other hand, the grounding was made by a connection with a set of old track rails laid in the soil near the station. The soil showed a peculiar resistivity, the potential difference at 150 feet radius from that terminal being equal to the difference of potential as far as Lausanne.

Voltmeter readings were taken to indicate the total loss between the terminals, the spare conductor being used for this purpose as a pilot wire. The drop in volts, or resistance around terminals, was obtained for each station by means of connections made to iron spikes in the ground.

Discussing ground return, M. Thury said that at first sight this would appear to be a danger, but added that the conditions in the case cited are not so favorable as in railway work for developing electrolysis. The track rails in railway work are in contact with a large extent of ground and usually they run parallel to water or gas mains. The leakage from the rails to the piping can take place over the whole distance and around the total surface of the rails in the ground. On the contrary, in the case of deeply laid earth connections which present a comparatively short length and small surface, there is but small chance of large currents going to neighboring conduits.

M. Thury advised that the earth connections be made very carefully, and not to attempt a false economy in these connections, as the corresponding line copper would in any case cost a great deal more. He advocates the use of carbon for the positive connections and iron for the negative connections.

As to the objection sometimes made to the grounding between one pole and the machine base with reference to the high potential apt to be found between the windings and the base of the machine, he said that this does not apply if the base is insulated from the ground properly, and such is the case in all high-voltage direct-current Thury installations. He added that experience has shown that these high potential differences may be easily compensated for by means of high resistances between the base and the windings, the use of which resistances is not objectionable if they are above the value of one megohm.

Telephones and Telegraphs in Madeira.

Consul T. C. Jones writes from Funchal: The last census gives Funchal a population of 50,000 people. The city is spread over a large area, stretching up and down hill, and yet it has no public telephone. The postal service is not of the best. The common communication is by note and messenger. Several of the leading business houses have private telephones. The different villages of this island have telegraph and postal communications with this city. A wire connects with the light-house at Point St. Lourenzo, 20 miles away, and gives news of approaching steamers from the north about three hours before their arrival. The local telegraph charges are 6 cents for the first word and 1 cent for each additional word. The postal service is triweekly, and the mails are carried on foot. It seems to me that here is an opening for an enterprising American. An English company got the concession for the electric light plant, and I understand it pays well.

Deterioration of Storage Battery Plates.

BY M. U. SCHOOP.

I TRUST you will permit me to add a few words to the interesting article of Prof. A. L. Marsh, contained in your issue of September 13, and especially with reference to the statement that in a good lead storage battery (for traction purposes), the negative plates (spongy lead) last at least two or three times as long as the positive plates (peroxide of lead), I should like to make a few remarks. Speaking of stationary batteries as made by most of the Continental manufacturers, it is doubtless true that the life of the negative plates is longer than that of the positive ones, simply because the ratio of the capacity of a new negative plate to a new thoroughly treated positive plate is as 1 : 2.

If the terminal pressure of a relatively new storage battery during its discharge is divided into its components, it will be found in the case of most of the modern storage batteries that the rapid fall of pressure of the storage battery is due to the exhaustion of the positive plate. In the course of time there will be, according to the excellence of the battery, a more or less evident variation of the capacity ratio, regardless of whether the positive plates are pasted or of the Planté type. This variation means that the capacity of the negative plates becomes slowly less, beginning from the first day that the battery is operated and caused by the peculiar shrinking of the spongy lead, a fact which up to this time has never been thoroughly explained. Probably the capillary spaces in the spongy lead are closed up by the lead which is being gradually thrown down by a galvanic process—which among storage battery experts is known as "leading."

After about two years the ratio between the positive and negative capacities is no longer as 1 : 2, but as 1 : 1.5. After two more years, the peroxidation of the lead grating has progressed so far, or the active mass has become so spongy that a renewal of the positive plate is found necessary. By closely inspecting the negative plates, the active mass shows small tears, the spongy lead is disintegrated and the union between it and the lead support has become less secure. An accurate test of the capacity of the negative plates would show that the capacity is only about one-half of what it was at the beginning; and if new positive plates are now inserted, then the rapid fall of pressure is caused no longer by the giving out of the positive plates but by the giving out of the negative ones.

The above evidence I have gathered during ten years' practical experience with lighting and power batteries which had a normal use. In almost every case the life of the negative plates in stationary batteries is considerably longer than that of the positive plates, while the cases in which second positive plates are renewed while the negative plates remain in the battery are very scarce.

In the case of traction storage batteries, of which the article in question mainly treats, and in which a large capacity with a minimum of weight and space is essential, the conditions are different, in so far that the builder has no longer an interest in giving the negative plate a much greater capacity than the positive one; the space reserved for the electrolyte is very small, and for that reason a very concentrated solution must be used. Another point which must be taken into consideration is the frequent rise in temperature of the acid during the operation of the battery, which causes the sulphating of the negative plates.[1] In the case of storage battery cars in which the hard rubber jars are placed close to one another, and where there is generally no ventilation at all, I have often noted at the end of the charge temperatures of from 50° to 60° C.

The local action of the sulphuric acid on the spongy lead is least when the density of the acid is from 1.150 to 1.170 (at 15° C.). This density is the one used by most manufacturers of stationary batteries. For traction purposes, however, the electrolyte must be much stronger, on account of lack of room, and when the battery is loaded, the density is generally from 1.250 to 1.300. In this case the action of the acid on the lead is three times as great as when the density is 1.150. This in my opinion is a very important point to which too little attention is being paid by manufacturers. It is certain that in nearly all traction batteries the life of the negative and positive plates differs but little, and the problem to construct the faultless spongy lead plate for traction purposes is certainly as difficult of solution as to construct a peroxide of lead plate which has a long life.

The statement by Prof. Marsh, however (page 410), is perfectly correct, that while the sulphating can in a measure be checked by careful handling of the battery, the sulphating is detrimental to it, and that it is in a large measure the cause of the rapid destruction of the plates.

In his conclusion, Prof. Marsh expresses the opinion that future endeavors to improve the lead storage battery must be mainly in the direction of increasing the porosity of the active mass; the electrolyte must also be improved so that the formation of secondary lead sulphate (which plays no part in the current production) is no longer possible, regardless of the density of the acid.

That the porosity of the active mass determines the coefficient of usefulness of the latter—the coefficient of usefulness, meaning the relation of the active mass, which takes part in the electrolytic reaction to that of the mass which takes no part in this reaction—requires no further proof, but the transformation of a certain amount of Pb or $PbSO_2$ into $PbSO_4$ always has a definite relation to a certain amount of sulphuric acid of a definite density, as the reactions which take place on the two plates correspond to the so-called sulphate equation, the correctness of which is no longer questioned. If it were possible to completely utilize the active mass which is present (coefficient of usefulness equal to 100) instead of only about 1/3, then three times the amount of sulphuric acid would be necessary.

The prospects, therefore, of improving the life and capacity of the plates of the modern lead storage batteries may be designated as very slight.

[1] See *Zeitschrift für Elekt.*, Vienna, 1901, on "The effect of temperature rise of the acid on the capacity of lead storage batteries," by M. U. Schoop.

Strength of Flywheels.

In an article in the September number of the *Monthly Bulletin* of the Fidelity and Casualty Company, Mr. Wm. H. Boehm discusses "racing" as a cause of flywheel accidents. The formula, $S = WV^2 \div 2.56$, is given to express the stress tending to burst a flywheel rim asunder, bending stresses being neglected. As a cubic inch of cast-iron weighs .26 lb., this gives for cast-iron wheels $S = V^2 \div 10$, approximately; that is, the stress tending to burst the rim of a cast-iron wheel is one-tenth of the square of the velocity of the rim in feet per second.

From either of these formulæ it is seen at a glance that the stress in the rim of a wheel increases with the square of the speed, or, to put it another way, the factor of safety on speed is always the square root of the factor of safety on strength. If the speed be tripled, for example, the stress in the rim becomes nine times as great as before; that is, with a factor of safety of nine on strength, there is a factor of safety of only three on speed. It will be understood from this that the stress increases enormously for even a slight increase in speed.

Consider the usual cast-iron, sectional, belt-wheel having flanged and bolted rim-joints located between the arms. Such joints average a strength of only one-fifth the strength of the rim, and no joint of this kind can be designed that will have a strength greater than one-fourth the strength of the rim. If this wheel had at normal speed a factor of safety of 12 in the rim, then with joints of maximum strength the factor of safety in the joint would be only 3 on strength or 1.73 on speed. That is, an increase in speed of 73 per cent. would burst the wheel.

The wide gulf will be noted between the apparent factor of safety of 12 on strength and the real factor of safety of 1.73 on speed. This is, however, only another warning that things are not always as they seem. As a matter of fact, few wheels have a margin of safety of 73 per cent. on speed. In the accident at the Amoskeag Mills, in which a 30-foot wheel wrecked the building, killed two girls and badly injured the assistant engineer, the evidence proved that an increase in speed of only 20 per cent. caused the disaster. Many wheels in use to-day are running on a narrower margin than this.

It will now be understood why racing is so frequently a cause of flywheel accidents. Some slight accident to the governor or valve gear of the engine occurs, and away goes the wheel, causing a costly if not fatal wreck. The stress in the rim increases so rapidly with increase of speed that sound wheels, amply safe at normal speed, go to pieces without warning, and apparently without cause.

The Armature Reaction of Alternators—I.

By C. F. G[illegible]

MUCH has been written in recent years on the subject of the armature reaction of alternating-current machines—dynamos, motors and rotary converters. Most of the authors who have occupied themselves with the question have given graphical expressions for the result of their studies. The numerous diagrams thus published unfortunately do not always lead to identical results, and especially to results identical with those obtained from direct tests. Very often there is only accordance in the case of small inductions, that is to say, only so long as the magnetic flux can be considered proportional to the magnetomotive force which produces it. Accuracy requires that in addition the diagrams shall take account of the increase of stray field flux, due to the presence of current in the armature.

It is true that some diagrams have been established taking into consideration higher saturations, but nevertheless limited to the armature magnetic circuit not approaching saturation, the field-magnet circuit alone being saturated. Most of these diagrams are based on one or on two hypotheses, relating to what M. Blondel has named "transverse reaction," or reaction due to the current in phase with the vectorial direction of the no-load e. m. f. This hypothesis, which has been accepted by some and rejected by others, is in reality only admissible in certain particular cases rarely found in practice. It has seemed to the writer that it might be useful to discuss, not all the diagrammatic methods thus far proposed—which would carry us too far—but to classify them in a small number of groups according to similar qualities or similar defects, and to consider them in this form, laying stress more particularly on those which approach nearest to exactitude. First, there will be established in a rigorous manner some important formulas, most of which have not heretofore been published.

I.—MEAN DIRECT AND TRANSVERSE ARMATURE MAGNETOMOTIVE FORCES.

In any single-phase or polyphase alternator the magnetomotive force at a point of the armature is a periodic function of time. This function in itself plays only a secondary rôle in the study of alternators. What it is important to know is not only the distribution of the magnetomotive force in the gap and its variation in the function of time, but especially its distribution at the pole faces as viewed by an observer carried therewith, and particularly the mean value of that distribution for a half period.

It is this mean value which defines approximately the number of supplementary ampere-turns necessary to be added to the field to compensate for those of the armature, and which permits of the determination of the armature flux between no-load and a given load, whether for the same flux in the field or for a constant excitation.

The knowledge of this mean or equivalent magnetomotive force is not, however, sufficient. As has been shown by Blondel, the action of the armature ampere-turns gives rise not only to a direct reaction, but also to a transverse reaction, the effect of which is to retard the instant of maximum field flux without modifying it in value, at least if the armature teeth are little saturated.

The first or direct reaction is produced solely by the component of the induced magnetomotive force in quadrature with the direction of a vector representing the voltage at no load; and the secondary or transverse reaction is due to the component in phase with the same vector. These two reactions will be taken up in turn, commencing with direct reaction.

Magnetomotive force equivalent to the ampere turns of the current in quadrature.—The evaluation of the ampere-turns, or, to use the expression of Blondel, "the ampere-turns equivalent to the ampere turns of the wattless current" has been made by several writers. Besides the old formula[1] still employed by some engineers,

$$F = \frac{m}{2} N I \sqrt{2}. \qquad (1)$$

(in which m is the number of armature phases, N the number of turns per pole and per phase, I the output assumed to be entirely wattless, and F the equivalent magnetomotive force in ampere-turns), there have been given formulas somewhat more rigorous. Such are those of Kapp, Arnold and especially the tables of Blondel. The formulæ of Kapp, which are given without demonstration, and those of Arnold, are approximately the same. If designating by a the peripheral difference between the axes of two poles, and by b the width of the polar surface, the formula of Arnold is in the case when the e. m. f. curve is sinusoidal,

$$F_1 = m \frac{\sqrt{2}}{\pi} k \frac{\sin \frac{b}{a} \frac{\pi}{2}}{\frac{b}{a} \frac{\pi}{2}}. \qquad (2)$$

*If the current is dephased with relation to the no-load voltage by an angle, Φ, it is evidently necessary to modify the value of F in formula (2) by sin ψ.

Kapp assumes the factor k as equal to unity. This factor takes into account the width of the induced coils, and is nothing else than the reduction factor of the resultant e. m. f., in that the two conductors of a small coil are the seat of dephased voltages of a value differing by half a period.

Its value in the formula of Arnold is, in the case of a single coil wound in two slots,

$$k = \sin \frac{b'}{a} \frac{\pi}{2},$$

b' being the distance between the axes of the two consecutive slots.

The formula of Arnold, though quite mathematically exact, is not absolutely rigorous, for the reason that it is not the real value of the field which should intervene in the expression of the equivalent ampere-turns of the armature but the width where it enters the armature, of the spreading flux from the pole surface, a width dependent upon the gap and the form of the polar surface, and which always approaches the distance between the poles except when the width is quite small (less than about .6); or for fields with projections, and armature coils lying very near to the gap.

This width is deduced immediately from the representative of the lines of force on the drawing of the machine. A purely mathematical demonstration, however, will be given of the Arnold formula. The formula to be established will permit of the calculation of the equivalent magnetomotive force of the armature in every case. There will first, however, be considered the case of a single-phase machine, that of a polyphase machine being derived directly therefrom.

[1] Formula (1) is derived by supposing that for each phase the armature acts as if there were along its periphery a constant magnetomotive force equal to half the maximum ampere-turns of the armature, $NI\sqrt{2}$. This hypothesis is based upon the theorem of Leblanc which decomposes an alternating magnetomotive force of fixed direction into two constant magneto-motive forces, one revolving in the same sense as the armature and the other in the opposite sense and which may be annulled more or less by the damping effect of the mass of the field. It is thus only rigorous in the case of single-phase alternators provided with a practically perfect damper, such as the Leblanc damper, by a perfect damper being understood one whose resistance is negligible with respect to self-induction. For the other cases it is necessary to take greater or less account of the effect of the magnetomotive force revolving in the opposite sense.

Western Union and the Railroads.

The fight between the Gould and Cassatt interests opened in earnest at Pittsburg last week, when the Western Union Telegraph Company, a Gould corporation, filed a bill in equity against the Pennsylvania Railroad Company to restrain the defendant from taking away from the Western Union the right to use the telegraph lines along the Pennsylvania tracks. The plaintiff avers that the removal of its lines by the defendant was in violation of the contracts between the two companies, and that the Pennsylvania Company is without authority in attempting to terminate the agreements by serving notice, as it did in June, 1902.

The original contracts under which the lines were operated were made in 1853 and 1859, and the plaintiff asserts that they are still in force, and that the action of the defendant is in violation of them. The bill says that the termination of the agreements by the defendant, as set forth in the notice of June 2, 1902, and the forcible removal of the Western Union Telegraph lines by the defendant as threatened, "is contrary to the stipulations and obligations of said contract, and is contrary to and will be destructive of the rights of your orator, and work irreparable loss, damage and injury to your orator, to the public and to the United States, which could not be compensated in money."

It is held that a grant by the United States to construct and maintain telegraph lines on the Pennsylvania Railroad was made upon a full-valuable and continuing consideration, paid and rendered by the Western Union to the United States. The bill sets forth the Western Union Company owns and operates 192,000 miles of poles and cables, 900,000 miles of wires, has 22,000 offices, and transmits 60,000,000 messages yearly.

Predetermination of the Conditions of Operation of Dynamos, Picou Method.

Referring to the following diagram, and using Hopkinson's notation, the no-load effective flux is $\phi_u = f(4\pi n i)$. Calculating the flux we have to produce under load, Mr. Picou gives the following formula:

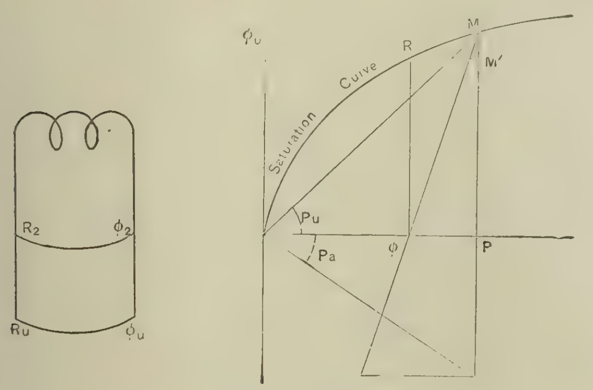
$$\phi_u + P_2 P_u \frac{1}{P_u + P_2} (4\gamma m I) = f\left(4\pi n i - \frac{P_u \gamma m I}{P_u + P_2}\right),$$

which is similar to Hopkinson's well-known formula:

$$\phi_u + \frac{v - 1}{v} 4\gamma m I = f\left(4\pi n i - \frac{4\gamma m I}{v}\right).$$

From the armature no-load saturation curve, Mr. Picou plots the load curves by the construction shown in Fig. 2, which applies to direct-current machines as well as to alternators.

Mr. Picou shows a graphical determination of the cross magnet-

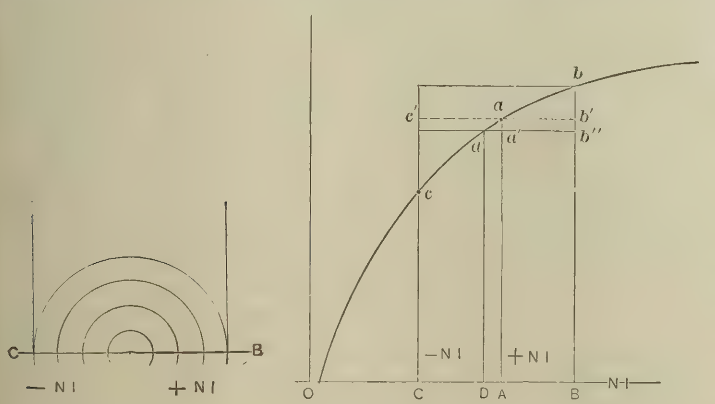


FIGS. 1 AND 2.

ization of the machine under load and its effect for reducing the effective flux ϕ_u. He assumes the transversal flux from the armature crosses the pole piece as represented in Fig. 3.

In Fig. 4 the curve Oa represents the saturation curve, and Aa is the average flux or induction corresponding to the ampere turns $O A$.

The half width of the pole $A B$ is overexcited by the ampere-turns $N I$, and the flux of the half width $A C$ is weakened by the ampere-turns $N I$. The part $A B$ is more saturated, and the flux ϕ



FIGS. 3 AND 4.

$(N I)$ represented by the triangle abb', is less than the flux ϕ $(-N I)$, represented by triangle acc'. Thus the total flux is $\phi + \phi\,(N I) + \phi\,(-N I) < \phi$.

Mr. Picou gives a construction for the final flux $D\ d$, consisting in lowering down the ordinate line $b'c'$ till we have equal areas for both triangles $ab'b$; $ac'c$ (Fig. 4). $dbb'' = dcc''$ final flux $= Dd$. The ordinate line $b''\ c''$ cuts Aa at a' point; $A\ a' = D\ d =$ final flux; $a\ A =$ initial flux; $a\ a'$ represents the loss of flux, ϕ_u, due to the cross magnetization.

The diagram of alternator armature reaction shown by Mr. Picou is similar to Blondel's and Potier's well-known diagrams. An actual application of the method has been made in well-known cases, including direct-current machines tested by Hopkinson, and the drops of voltage have checked exactly with the tests.

The case of Leblanc's alternators has shown a relative harmony between graphical determination and tests. Mr. Picou considers Leblanc's alternator as one of the most complex machines ever built, the calculations of which are greatly complicated by the presence of its field damper circuits. Most of practical cases, therefore, will check with a much greater accuracy.

Irrigation Electric Power Pumping Plant in Utah.

By C. W. Arthur.

One of the largest pumping plants in the world, and probably the largest using electricity as a motive power, has just been completed on the shores of Utah Lake, in the State of Utah.

Utah Lake is situated some 30 miles from the city of Salt Lake, and has an area of 93,000 acres. Its principal sources of supply are the streams flowing into it from the American, Spanish and Provo's Canyons, its only outlet being the Jordan River, which flows north and empties into the Great Salt Lake. The waters of this river are owned and controlled by five large and several small canal companies, who furnish water for irrigation purposes in the Great Salt Lake Valley. By agreement with the owners of the land adjacent to Utah Lake, these companies have the right to raise the water flow to a point 3 feet 1 inch, known as a compromise level, above the low-water mark. At present the lake is 3 feet lower than that point, as a result of which the discharge is less than 75 cubic feet per second; this is insufficient to supply the demands made on the several canal companies. In view of these conditions, which prevail during the irrigation months of June, July and August, the several canal companies united and installed a pumping plant at the head of the Jordan River, for the purpose of lifting the waters of the lake into the river, and thence into the several canals.

At the outlet a tight dam was built, and here upon a pile and timber foundation the pumps were placed. The plant consists of four 40-inch special, low-running, double-suction centrifugal pumps, of the Byron-Jackson type, weighing about 12 tons each, fed with a suction of 40 inches, terminating in a 48-inch discharge. Each pump has a pumping capacity of 100 cubic feet per second under a head of 5 feet 5 inches, which is equivalent to a flow of about 65,000,000 gallons every 24 hours.

Each pump is independently driven by a 100-hp Westinghouse induction motor, operated at 5880 r. p. m., and is provided with an auto-starter. The power for the operation of this plant is furnished by the Salt Lake City Water and Electric Power Company, whose plant is situated some 12 miles distant, in the Jordan Narrows—the canal companies controlling the pumping plant agreeing to furnish to the electric company for generating the power to operate the pumping plant, one-third of the amount of water in excess of the natural flow of the river.

Power is transmitted to the plant at a potential of 16,000 volts, and is delivered to the motors through three Westinghouse step-down transformers of 175 kw each. Current is also furnished a 3-hp motor for the priming of the pumps.

The pumping plant is about 900 feet from the lake outlet. A new channel has been dredged for the river, the pumps are placed directly in the channel on a platform built of piles as a base. A tight dam was constructed across the river, and the water is forced through this dam, the pumps raising the water in the river at their outlet about 3 feet higher than it was at the intake. As the lake level becomes lower the difference in the levels will be increased. Six large gates just west of the pumps prevent the water from flowing back into the lake, but may be raised when the lake level is higher and let the river take its natural flow.

The plant was installed under the directions of F. C. Kelsey, civil engineer for the canal companies.

What Arco Thinks.

A cable dispatch from Berlin to the newspaper press says: Count Arco, one of the inventors of the Slaby-Arco system of wireless telegraphy, has been appointed one of the delegates to attend the international conference on wireless telegraphy proposed by the German Government. Count Arco says the adoption of international regulations for wireless telegraphy is entirely practical from a technical point of view. The Slaby-Arco Company will soon erect a station in France, in order to receive messages from Atlantic liners.

Eighth Annual Meeting of the Ohio Electric Light Association.

The eighth annual meeting of the Ohio Electric Light Association was held October 14, 15 and 16, at the Chittenden Hotel, Columbus, and was by far the most successful meeting in the life of the Association. The attendance numbered about 75, and 24 new members were admitted by election. On Tuesday evening the Columbus Edison Company and Erner-Hopkins Company gave a theatre party, an entire section of boxes having been reserved for this purpose at the Empire Theatre. Other entertainments provided by the local committee were an electric automobile excursion and a luncheon at the Country Club. Following are the officers elected for the ensuing year:

President, A. W. Field, Columbus, Ohio; vice-president, S. M. Rust, Piqua, Ohio; secretary-treasurer, J. H. Perkins, Youngstown, Ohio; advisory committee, D. L. Gaskill, Greenville, Ohio; E. J. Bechtel, Toledo, Ohio, and Samuel Scovil, Cleveland, Ohio Executive committee, E. H. McKnight, Middletown, Ohio; George Matt, Lancaster, Ohio; F. E. Valentine, Urbana, Ohio; W. F. Hubbell, Wauseon, Ohio, and A. C. Blinn, Sandusky, Ohio. Finance committee, George Hayler, Jr., Van Wert Ohio; W. F. Raber, Mansfield, Ohio, and John Miller, Springfield, Ohio.

In the absence of President White, the meeting was called to order, on Tuesday, by Vice-President E. H. McKnight, of Middletown, who presided over its deliberations and contributed materially to the success and interest of the sessions. The address of Mr. McKnight, who is at the head of two electric light plants—in Middletown and Bowling Green, respectively—and president of an electric railway line, was full of practical suggestions as well as recalling some interesting reminiscences of the formation of the Ohio Association. While fully alive to the interests of the stockholders of companies and keen to perceive and adopt every suggestion looking to increased efficiency of operation and economy of cost, Mr. McKnight believes that the way to make friends of the people is to treat them as if they were your friends, and this policy he endeavors to carry out. He urged that in order not to be subjected to unnecessary annoyances, electric lighting companies be encouraged to give the very best possible service at the least cost to consumers, that a reasonable return for their capital invested and risk assumed will admit. Mr. McKnight advocated a strenuous campaign toward having a commission appointed similar to the railroad commission, or securing the passage of laws relating to central stations modelled after those of the State of Massachusetts.

Mr. Edward Yawger, of Westinghouse, Church, Kerr & Company, read a paper on "The Present Development of the Steam Turbine," accompanying it with blue prints illustrating a number of tests made on a 400-kw turbine. He gave a general description of the design and principles of the machine, and its great mechanical simplicity, as compared with the modern reciprocating engine, pointing out that the governing mechanism is not called upon to control the steam in any way after it has passed the admission valve, and that mechanism can be very simple and only remotely connected with the turbine itself. For the turbine there was claimed increased economy, better regulation, smaller repair and maintenance account, and reduced installation cost as compared with a given standard of economy; also smaller percentage of depreciation.

The paper elicited much interest, the discussion taking the line of requests for further details as to how small turbines could be manufactured, variation of efficiency with varying load, relative speeds, etc. Mr. Yawger stated that it was easier to run a steam engine in parallel with a turbine than with another steam engine. In reply to a query by Mr. McKnight, the author stated that he thought the comparative cost of a 400-kw turbine and that of an engine of high grade and same capacity would be very nearly equal, although the less cost of foundation and building required would tend to bring down the cost below that of a reciprocating engine plant. The installation would be cheaper all along the line in the case of the turbine.

The topic following was: "On What Lines Shall We Reach New Business to Improve our Load Curve and Increase our Net Earnings?" Papers on this question were submitted by Messrs. E. J. Bechtel, superintendent of lighting, Toledo Railway and Lighting Company; Mr. Geo. Hayler, Jr., manager, Van Wert Gas, Electric Light and Power Company, and Mr. L. G. White, superintendent electrical department, Columbus Edison Company, and were followed by general discussion. Mr. Bechtel contended that gas being a concededly cheaper illuminant (Mr. Bechtel comes from a natural gas city), the effort should be to increase the efficiency and reliability of the electric service to such a degree that people will not be tempted to forsake it because of accidental break-downs and establish habits of using gas which may cling to them thereafter. In determining rates of charges for a station operating different systems, the respective load curves should be considered separately rather than the station load curve as a whole. That system of charging which stimulates long-hour burning is best. In Toledo a systematic method of employing card indexes is practiced so as to keep track of the conditions with different consumers; this the contract department has access to. This department should be in the hands of courteous, enthusiastic and business like men, who have at heart both the good of the consumer and the company. This department should keep in close touch with architects' clubs and individual architects. Mr. Bechtel advocated judicious advertising, souvenir novelties, etc. The credit and contracting departments should be in no wise connected. Meters should be properly looked after and maintained.

Mr. White, of Columbus, urged personal soliciting. In towns too small to admit of the time of one man being solely given up to this feature, some certain portions of his time should be set apart for this. The most desirable load curve for daylight hours is the motor load. Electric elevators are good business. Many small shops can be secured which do not at present employ power, and when power is introduced they will probably use more and more light on dark days, when otherwise it would not be employed. The load curve can be materially improved by the substitution of the enclosed arc lamp in place of the incandescent lamp. Where a shopkeeper has, say, a dozen incandescents, he will turn on every other one during a part of the burning hours; whereas if the arc is installed of capacity equalling the aggregate of incandescents, it would be turned on at first and kept on all through the period. Attention should be paid to the matter of rates.

In the discussion following, Mr. Bechtel said he thought there was more lost in poor contracting and in consumers that are not secured because not solicited properly, than in any other part of the system. Mr. Perkins held that in many cases it would be possible to suit a customer with respect to rates providing his wants varied from the usual lighting hours. In Youngstown a card system was maintained of agreements and special arrangements to suit certain conditions, so that when any one else had to take the same matter up, he could approach it sufficiently informed. They had in his city accomplished much by supplying railway service; electric elevators and machine shops had also proved profitable sources of revenue by the use of single-phase current and it would have been almost impossible to give service in some outlying districts with any other system.

Mr. Fairbanks incidentally referred to the case of the Farrell Foundry and Machine Company, of Ansonia, Conn., where it had been found that an exhaust steam heating plant for the works could be combined with an electric drive with just one-half the boiler installation that they had employed for a high-pressure heating system. The discussion then took a side line, referring to the subject of steam heating and hot water heating, which was taken up the day following under the regular assignment. It here developed that Mr. Gwynn and Mr. McKnight differed totally in their ideas as to charging or estimating cost of heating, Mr. Gwynn holding that it was policy to heat only one room if a consumer desired only that, and Mr. McKnight's plan being to require the consumer to take heat for an entire residence. Mr. McKnight employs thermostats, while Mr. Gwynn does not, but practically makes his plant a thermostat for the entire system.

Mr. Colwell wished to know if any one had an appreciable load from electric cooking, and if that would ever amount to anything. Mr. McKnight stated that he had cooked flapjacks on an electric stove in competition with a coal stove and he had his on his plate some minutes ahead. He was asked if he had made any estimate of comparative cost, and replied that he had not treated that matter seriously. A gentleman present reported that in Traverse City, Mich., the current had been used to some extent for chafing dishes, etc., and that bills that had been $2.50 ran up to $5 and $6 a month. During some months of the year this might be a profitable branch.

Mr. McKnight again called attention to the value of introducing current for any other purpose as stimulating its use for lighting, since if on the premises its great ease of use would tend to its use for light. He had in Middletown a number of electric sadirons taking current.

and heard no complaint on the score of cost. Mr. Bechtel reported that electric curling irons are employed in Toledo to some extent, and also warming tables and sadirons. It was very handy to heat water in a sick room, etc. Mr. Raber, of Mansfield, gave a special rate for electric automobiles provided they were not charged during the peak, and had found this profitable business. Mr. Bechtel reported the same experience, his rate being 3 cents per kw-hour. Mr. McKnight several years ago adopted the plan of furnishing lamps, but now thought it bad policy. He now held it better to charge for all supplies. It was objected by some that if the consumer bought his own lamps he might buy a poor article and indirectly reflect upon the quality of light furnished, but Mr. McKnight in such case felt his own conscience was clear.

Mr. Perkins mentioned a case where a certain manufacturer who had a good many renewals, thought he could buy his lamps cheaper, and did so, but the lamp used so much more current that it proved a losing speculation, and the manufacturer was glad to purchase thereafter of the company. Mr. Raber reported that having had trouble with excessive lamp renewals, close track was kept of renewals for a considerable period, and after ascertaining the percentage, the price of current was increased sufficient to cover that item, and it was now no longer a matter that concerned them. They sold their lamps at cost in some cases; in others furnished them free on renewals. Mr. McKnight saw no objection that could reasonably be urged to making a fair charge for all material supplied consumers; otherwise the station would lose.

On Wednesday morning, the first subject for discussion was, What is the present state of meter development? How shall we handle our meter department to obtain (1) least cost of operation; (2) least disturbance to consumers; (3) maximum efficiency?

Papers on the subjects were presented and read by Messrs. F. G. Vaughan, of the General Electric Company, Lynn, Mass.; H. P. Davis, of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., and Mr. F. J. Alderson, of the Stanley Instrument Company, Great Barrington Mass. On the part of the central stations, a paper was presented by Mr. E. H. Beil, of the Youngstown Consolidated Gas and Electric Company.

Mr. Vaughan after pointing out the various kinds of meters that could not be obtained for various purposes in the open market, said that the behavior of meters should be studied with reference to varying conditions, such as variation of frequency, variations in voltage, different conditions under inductive and non-inductive and mixed loads, and also when current is supplied from different types of machines affecting the wave forms. The longest life compatible with efficiency is important. Laboratory tests are not alone sufficient, but meters should be tested carefully under actual conditions of service. Annual inspections were necessary. The author considered methods of testing, and contended for inspection upon premises in all cases. Manufacturers, he stated, are giving the meter problem close attention with a view to securing the best results for all concerned.

Mr. Davis's contribution to this question was entitled, "Some Pertinent Features of the Modern Meter." After referring to the excellence to which the modern meter has been brought by manufacturers, it was pointed out that the causes which preclude permanency are: (1) Aging of the permanent magnets; (2) Variations due to changes of voltage, temperature, frequency, etc.; (3) Wear upon the bearings. Manufacturers fully realize these difficulties, and are bending every effort to meet and remedy them. Friction is the most important source of error, as resulting chiefly from the weight of the moving part and consequent wear. His paper considered this element of friction in some detail, and its causes; also the relation which torque bears to the friction as affecting accuracy of the meter. He strongly advocated the importance of a high ratio between torque and friction, this to be obtained by minimizing friction through keeping the weight of the moving elements at as low a figure as permissible for strength. He described a new cup and ball bearing, which his company has introduced to fulfill this condition, and the superiority of which it is claimed tests made at the engineering laboratory of the Westinghouse Electric and Manufacturing Company have demonstrated.

Mr. Alderson's paper while not directly referring to the Stanley meter, enumerated points of excellence that are claimed especially for it. The writer maintained that every meter should be tested before it is put upon the line, and the manufacturer held to his guarantee if the meter fails to respond to test. It is a prevalent custom for electric companies to adopt a meter for testing purposes of the same make as they are using on their lines as a standard. This is not good practice, for the same meter may be developing faults peculiar to that make, and consequently lost sight of. Undoubtedly, the best method of test according to the author is to use an indicating wattmeter in series with the recording wattmeter to be tested. Testing by "tested" lamps is unreliable for close results. The results secured by magnetic suspension were referred to and commended, and the importance of the most accurate meters in removing causes of dissatisfaction on the part of consumers was emphasized.

The discussion on this subject was somewhat long, and developed variation in practice among station managers, some holding that meters should remain permanently in adjustment without necessity for frequent inspection. Mr. Field considered that this was as unreasonable as if a man were to expect his watch to remain a good timekeeper without being given a periodical cleaning and oiling up. Mr. Perkins said that at his station a card index was kept of meters, and if variations in bills occurred which could not be accounted for otherwise, the meter was at once examined and inspected, without waiting for the customer to complain; so far as possible complaints were anticipated, and their cause inquired into in advance. Many of his customers were in the habit of sending notice to the office if an extra amount of light would be required for an especial occasion. By keeping track of this it was often possible later on to reconcile the increased bill satisfactory to the consumer.

Mr. E. H. Beil, of Youngstown, in his paper stated that inefficient meters are a constant source of dissatisfaction and loss of custom. Meter cases should be well made, stiff and dust-proof, and should require the minimum amount of skill in installing. Terminals do not receive sufficient attention from manufacturers, and should be made heavy and have at least two good screws for securing the wire in same. Meters should be so set that the heat generated by a poor contact will not destroy the entire meter. Means of adjustment should be provided so that the meter may be easily calibrated. The moving element to be light as possible, and sliding contacts minimized. In Youngstown a test room has been established, with both alternating and direct-current instruments for testing. The stop-watch method is used, and a running test sometimes made to determine whether the recording dial is all right. All meters are tested when received from manufacturer; and thereafter, as may be found necessary by occurrence of variance in consumers' bills, etc. No regular inspection is made. Twelve hundred meters are installed. Of 800 of one make in use, some 50 required repairs to shafting or jewels, etc. Of a lot of another maker, received about 18 months ago, none have required any repairs. Thirty meters of still another type installed gave the most trouble, but a comparison of these as used on a 500-volt circuit would probably be invidious as they are then operating under altogether different conditions.

At the invitation of Prof. F. C. Caldwell, of the Ohio State University, the Association visited that institution on Wednesday evening. An address was delivered by Prof. Edward Orton, Dean; Prof. Embury Asbury Hitchcock, M. E., professor of experimental engineering, and Wm. T. Magruder, M. E., professor of mechanical engineering, also assisted in receiving and entertaining the visiting body. Among other objects of interest, a Nernst lamp installation was shown in operation. A number of students from Prof. Caldwell's class in engineering attended the sessions of the convention upon invitation, which, by vote, was extended to the faculty and students.

Wednesday afternoon the business of the convention was devoted to legislative matters referring to a proposed municipal code, and the proposed repeal of an arc light bill passed at the instance of the railroad companies. This was followed by papers and discussion upon hot water heating as an adjunct to electric lighting plants, a topic to many of the station managers of growing importance and in which they were greatly interested.

Acting President McKnight, of Middletown, submitted the first paper on this subject, the opening sentence of which furnishes the keynote to its contents. Mr. McKnight says: "Owners of electric lighting plants have long desired to increase the earning capacities of their properties without appreciably additional expense. This has led to an investigation of the utility of exhaust steam as a means of heating buildings. Wherever this business has been added to an electric light plant it has proven its salvation, especially where

competition has been keen and profits small." This paper will appear in full in a following issue. The information it gives is especially applicable to smaller cities, but not too small to permit of a fair day-load, or where a day-load can be created.

Mr. E. F. Gwynn, of the Delaware Electric Light and Power Company, followed, and gave a detailed description of his method of installing the heating system, construction of trenches, laying of pipe and properly covering and protecting them. In the discussion following, Mr. Gwynn stated that his company had during the last winter and covering the twelve months then ending, paid a coal bill of $6,800, and sold heat to the amount of $7,800, with an increased operating expense in coal bill over the previous year when the system was not in use or installed of something like $1,000. In the heating plant proper there was represented an investment of some $32,000. There must also be considered interest on this investment of some $1,600. The average horse-power last winter was 190 for the day; there are up to 425 horse-power installed. Mr. Hayler, of Van Wert, reported that they were selling heat, and had to use live steam at times last year, simply because they had no day-load. The coal bill for five months from the 25th of November until the close of the season was increased not quite 50 per cent. If they could operate the lighting plant continuously for 24 hours they could afford to sell their current at a sufficiently low price to pay for fuel; then the gross returns from heating would be net profit.

Mr. Hoit, of Cleveland, held that where it is possible to secure water for condensing, and particularly in plants where they have no day-load, a better revenue could be secured than by attempting to use exhaust steam for heating purposes. If it is possible to maintain a day-load on the plant equal to a light load, so that the plant will be in operation for 20 hours out of the 24, the advantage gained by using the exhaust steam for heating is about the advantage gained in condensing. However, the cost of the investment on installation for heating purposes must be considered as a matter of expense to be charged against the heating system as compared with a condensing plant.

On Thursday morning, at request of Vice-President McKnight, Mr. D. L. Gaskill, of Greenville, took the chair and presided during the remainder of the meeting. Mr. C. R. McKay, of the General Electric Company, Lynn, Mass., presented a paper on the topic, "What is the reliability, regulation, power factor and efficiency of present forms of alternating-current series arc lighting apparatus?" with reference to constant-current transformer systems. Following this a paper by Mr. Thomas Spencer, of the Helios-Upton Company, Philadelphia, was read by the secretary, which devoted especial attention to the inductive regulator and step-up transformer system. He thought that the most important question to be considered in connection with the subject was the relative advantages of differential and shunt lamps for use on alternating-current circuits. He was of opinion that the shunt lamp does not materially assist the regulator, and that the differential lamp would avoid the danger of "pumping." Carbons are together in the differential also when the lamp is not burning, and the cut-out is mechanical and can be made very simple, thus assisting the reliability of the system. On account of the presence of the series coil in the differential lamps, the terminal average is necessarily higher than that of the shunt lamp, and more than that, it is not possible to change the current on the line without readjusting differential lamps, which can be done with the shunt. The system considered shows up a very good efficiency of 95 per cent. Where transformers are used this efficiency is lowered to about 91 per cent. To a certain extent the efficiency decreases when the system is operated at less than full load. On the whole, series alternating-current arc systems, as now operated, are in every way a commercial success, and will certainly grow in favor as time goes on and the good points are better understood.

Mr. W. A. Layman, of the Wagner Electric Manufacturing Company, St. Louis, next presented a paper on variable secondary step-up transformer systems. In the discussion, Mr. Bechtel, of Toledo, reported very good results with three 100-light transformers in operation for one to two years and a half; service reliable and no repairs. Their experience had taught them it was better to burn up lightning arresters in the station than cable outside that could not be so easily repaired. Three hundred alternating and 75 direct-current enclosed lamps were taken care of by one trimmer with a wagon equipment and trays. In the summer, the lamps are trimmed once every five days; in fall and spring once every six days; in summer once every seven days. He desired to know of the supply men what impedance is absolutely necessary in a circuit to insure steadiness of light. Mr. McKay replied that when an underground cable had been in use for some time, it is rather hard to tell just what may be happening to it. There might have been a weak spot in the cable to cause the unsteadiness complained of; but it is not likely that the unsteadiness was due to the carbon resistance being in circuit.

Mr. Layman said that in regard to how much self-induction was necessary to keep the lamps nicely balanced, Mr. Spencer had recommended 75 per cent., but he thought a lamp circuit could be burned with excellent results with a power factor of 85 per cent.; Mr. Perkins favored about 81 per cent., but Mr. Layman thought this depends on the construction of a particular lamp. Mr. Perkins referred to the matter of arrangement of circuits, and said he had had occasion to rearrange the Youngstown circuits, using the station as the center of distribution, and running the different circuits out radially like the spokes of a wheel. Circuits should be laid out originally, with an average of 40 lamps, leaving leeway for additions. A better power factor should be sought for on lower loads. Mr. Bechtel believed it was necessary to be careful not to lay out too many circuits so as to avoid increasing the fixed charges for copper investment and for extra transformers. The fixed charge expense will almost offset the expense of rearrangement complained of by Mr. Perkins. Circuits should be so laid out that they can easily be changed. Mr. Doud stated that his company did not now recommend the use of single circuits of 100 lights, but rather to limit to 75 lights.

Mr. Gaskill stated that his company had lately installed for street lighting, series 7.5-ampere alternating-current lamps, using two 50-light tub transformers; although at first some opposition was experienced he doubted if now the people would go back to the former system. Their plant was of the size usual in towns of 5,000 to 7,000 inhabitants, the present installation being 300-kw. He had formerly been using the open-arc system, and though it had originally operated very satisfactorily, of late years the cost of repairs was excessive, and depreciation rapidly increasing. They had contracted with the city some seven and a half years ago for a ten-year term, at $84.50 per lamp. They had been able by the present change in system to offer a lower rate and to secure a renewal of their contract for another ten years, while reducing their operating expense materially. Their present contract called for $78 per lamp, 7.5 amperes, with a guaranteed delivery of 450 watts at the lamp terminals. Under the Ohio law the council cannot make a contract that does not go into full force during their term of office, and, therefore, could not consider a bid from other parties if offered; but by the present company making the offer at a reduced rate before the expiration of the existing contract an arrangement was consummated satisfactory to all parties. The suggestion was offered for others.

Mr. Beckstein, of the Sandusky Gas and Electric Company, has been using the transformer system for past five or six months, and he referred to the great saving in operating expense secured thereby. Mr. Bechtel conformed this observation. After some further discussion along this line, the papers programmed having been completed, the convention voted to take up routine business. The report of the finance committee, Mr. Raber, chairman, showed that the treasury is in good condition. Columbus was named as the next place of meeting. It was considered by some members that the date of October is too late and too far into the busy season, and August was favorably spoken of as a suitable date.

A Buffalo Diploma.

The buildings and grounds committee of the late Pan-American Exposition, at Buffalo, N. Y., has issued recently a very handsome "commemorative diploma" to several of the officials most actively engaged on the work of the exposition, "to whom the award of a gold medal was made by the board of directors of the Exposition Company." Such an honor is well deserved, and is much appreciated by the recipients, but one of the mysteries and deep disgraces of the thing is that neither Mr. Rudolph Ulrich, the landscape artist, Mr. Luther Stieringer, the consulting electrical engineer, nor others, have been included. When one recalls the magnificent and memorable work of those two men, it must arouse indignation everywhere that they should be passed over with such studied neglect. The buildings and grounds committee ought to be heartily ashamed of itself, and the board of directors, too.

The Indiana Mutual Telephone Convention.

The fifth annual meeting of the Indiana Mutual Telephone Association was held in the German Club House, Indianapolis, October 14. The meeting was called to order by G. R. Frazer, of Connersville, president, and will be remembered as the most successful and enjoyable convention ever held by the Association. About 75 members and quite a number of supply men and electrical experts were present. In his annual address, President Frazer said that the attendance of so many interested and earnest telephone men eager for the exchange of experiences in a common undertaking was exceedingly gratifying. Five years ago, when a fragment of their present membership met for the purpose of inducing some reliable company to install a plant in Indianapolis, with a view of knitting their plants together with toll lines, giving an entrance into the State Capital, and for the further purpose of developing the great field, not a few entertained grave doubts—not doubts of the good faith and sincerity of the new telephone company, but doubts of its ability to meet the Central Union in the largest city in the territory. Who among the most sanguine at that time dared to hope for the great success that had attended the efforts of the New Telephone Company?

Mr. Frazer warned the members of the association not to take on a troubled look because some well-meaning farmers on the outer edge of the fields were installing exchanges on their own account. If they can furnish that service better and cheaper they are the ones to do it. They should not care how near their city exchanges the farmers build their lines, but should let it be forcibly understood that they did not build and maintain their city exchanges in a cheap way, and would give connection only on terms that are fair and just.

President Frazer, who is an excellent presiding officer, next took up the subjects presented by the programme, and was successful in bringing out a free discussion by the members present. On the mater of franchises, Hugh Daughtery, of Bluffton; J. W. Weik, of Green Castle, and R. C. Stephenson, of Rochester, discussed the necessity of laws defining the rights of telephone companies and the rights of the people. It was contended by Mr. Stephenson that a telephone line established along a public highway was in no sense an additional servitude; that as a means of communication and as a public carrier, its use of the highway was not only in accordance with the progress of the age, but was primarily contemplated in the purposes of public highways. Other speakers deemed it advisable to ask the next legislature to enact laws providing for franchise rights to be granted by county commissioners, and also providing for condemnation proceedings against private property for telephone purposes. As a result of this discussion, a committee was appointed to draft necessary bills and attend the sessions of the legislature to urge the passage thereof. It was suggested by Mr. C. S. King, of Wabash, formerly a member of the legislature, that this committee be authorized to discourage or thwart any adverse or drastic legislation; that it was a matter of vital importance that no law be passed to compel one company to make a connection with another in the absence of a specific contract. "Such a law is threatened," said he. This revelation appeared to awaken considerable interest among the members and resulted in the adoption of the following resolution:

Whereas: A number of independent telephone companies in the State of Indiana have granted to certain other independent companies connections with their exchanges without first entering into an explicit written contract governing such connections;

And whereas: In many cases such arrangements have led to much confusion and the violation of written contracts heretofore entered into by independent telephone companies, and have occasioned litigation and encouraged attacks upon the doctrine of the right of independent telephone companies to control their business by contract;

Therefore, be it resolved: That the Independent Telephone Association, of Indiana, condemns the practice of granting such connection other than by explicit written contract, in which each company shall have the right to refuse business which shall tend to violate its existing contracts; and be it further

Resolved: That the Association recommends that each independent telephone company in this State shall refuse connection with such companies as have been organized and are operated in cities, towns and communities already supplied with independent telephone service, and which, after such organization, attack the doctrine of the right to control the telephone business by contract.

Hugh Daugherty, of Bluffton, a member of the litigation committee appointed by the National Association, made a lengthy and comprehensive statement regarding the great legal battle that has been going on for the past few years in the shape of defending suits brought by the Bell Company for the alleged unlawful use of patented devices. etc. He said that while they had won every case in the trial courts, several were now pending in the courts of appeal that required the most careful service and the most convincing arguments. Much was due to the manufacturers for their assistance in the defense of litigation brought by the Bell Company. He earnestly insisted that the interests of all present had been protected by the successful defenses made thus far against the Bell Company, and declared it to be vitally important that the fight be continued until the victory is complete. He said such litigation required skilled and learned lawyers, and was in every way expensive, but the outcome meant everything to the independent telephone people. "The litigation committee has expended $37,000 up to the present time, and we have personally obligated ourselves to pay $12,000 more, of which amount we are asking $2,000 from Indiana," said he. Mr. Daugherty said that the Bell Company had spent over $100,000, and had in its employ the best lawyers in the country, some of whom are under contract to give their entire time to the prosecution of these appeals in the higher courts.

The following officers were elected for the ensuing year: President, R. C. Stephenson, Rochester; vice-president, J. W. Weik, Green Castle; secretary-treasurer, Harry B. Gates, Indianapolis. At six o'clock the convention adjourned to the dining room and were entertained by the New Telephone Company and the New Long-Distance Telephone Company of Indianapolis. The convention was a success in every way, was representative in character and conspicuous for its earnestness. The new president, Mr. Stephenson, promised that with the aid and co-operation of the members he would increase the membership and endeavor to have every county in the State represented at the next meeting. He said much of the success of the convention was due to the officials of the New Telephone Company, and after a vote of thanks to that corporation and to the German House Club, the convention adjourned.

Electric Underground Situation in London.

Special cable dispatches from London state that a dramatic development in the fight for the control of London's "tube" railroads occurred on October 21, when it was learned that Speyer Brothers, who are financing Charles T. Yerkes's plans, had bought control of a large company hitherto allied with the Morgans' scheme of transportation, thereby not only reducing the scope of the Morgans' projected line by many miles, but actually threatening it with legal obliteration.

The latest move in this Morgan-Yerkes rivalry was announced at the session of the House of Commons' "Tubes" Committee, by Sir Edward Clarke, who, as counsel for the London United Electric Railways, withdrew the bill providing for the construction of the road, which up to this morning had always been part of the Morgan line, and covered the district westward between Hammersmith and Piccadilly, and southward between Clapham and the city. The Morgans had originally intended to cover these points, but as the London United already had certain powers from the amalgamation effected a year ago and the Morgans' project had passed through Parliament under the title of the London United and Piccadilly and City Railroad, Balfour Browne, who is counsel for the joint bills, expressed surprise in behalf of the Morgan interests at Sir Edward Clarke's announcement, which left him scarcely half the length of the road over which he had been arguing for nearly a year, and requested time to consult his principals.

Amid a sensation the committee adjourned. Mr. Browne then announced that the Morgans were ready to go on with such road as they had left, namely, between Piccadilly and the city, and that they would take the earliest opportunity to introduce a new bill, asking for the powers of which they had so unexpectedly been deprived by the defection of the London United, owing to the Speyers securing control of it.

Counsel representing the Yerkes' interest demanded that the Piccadilly and City Road must also be withdrawn, as it had now no legal status, having been presented to Parliament as part of the London United scheme, which was now non-existent; in other words, declaring that the Morgans now had no legalized tube project at all. The matter was taken under advisement by the committee until October 23.

Underground Work for Telephone Exchanges—VIII.

By Arthur V. Abbott, C. E.

OBSTACLES.

Of all the problems to be solved by the engineer that of surmounting the obstacles presented by various street structures is the most difficult—not only in design of a way to place conduits in unreasonably restricted space, but because it is usually very difficult—sometimes impossible—even with the utmost care and skill to foresee the existence of insurmountable barriers until a large portion of the work has been done and considerable expense incurred. Electrical subways are usually among the last of street structures to be introduced, consequently they must content themselves with what space remains after sewer, gas, water, etc., have each appropriated all of the street they could occupy. If the real condition of the sub-soil of city streets was accurately known, a possible location could usually be selected, but as the office of the city engineer is usually a political position, it may be confidently predicted that any information derived therefrom as to location of street obstacles is inherently incorrect, and the subway designer can be quite sure that pipes and other impedimenta to conduit location are certainly not where the records show them to be. Wherever else they actually are, is quite another matter, and one which the telephone engineer must find out for himself as best he may. This state of affairs is perhaps no surprise when such subterranean complications exist as are depicted in Figs. 47 and 48, showing the corner of Harrison and Washington and Market and Washington streets, Chicago, and in Fig. 49 an excavation in Union Square, New York. Still, as no permit to open a city street can be gained save through its Department of Public Works, nor work therein prosecuted excepting in the presence of a city inspector, whose salary is charged against the corporation making the excavation, it seems strange that accurate records are not kept.

FIG. 47.—HARRISON STREET AND WABASH AVENUE, CHICAGO.

FIG. 48.—MANHOLE, MARKET AND WASHINGTON STREETS, CHICAGO.

When the construction of a conduit is determined upon, the first step is a careful topographical survey of the proposed location, giving all of the surface features, including street alignment, grades, the location of fire plugs, car tracks, gas and arc lamps, catch basins, drains, etc. This information will at least give a rough idea of what exists below the pavement, though there is an equal assurance of many additional obstacles. An appeal to the City Hall will now supply a fair idea of what is likely to be encountered, but with no very accurate information as to where it is. Consultation with the other corporatons—gas, water, sewer, electric light, telephone and telegraph companies—will yield many illuminating side lights, and wth all the information thus gathered, a careful ground plan, together with probable cross sections at each street corner, should be plotted, showing the expected location of existing structures. Thus armed, the engineer may plot a proposed design for his conduit, and manholes, and will usually find that almost an ideal one can be obtained. Proceeding to the ground, a series of test holes along the entire proposed location should be dug at every street corner, and, if suspicious circumstancs arise, at intermediate points—for a little wasted street trench will pay for many test holes. At each pit, the location of the sub-structures encountered, both vertically and horizontally from the curb, must be noted. This information enables the designer to prepare a set of drawings, as shown in Fig. 50, embracing a general ground plan and all test pit sections. Usually this examination will reveal a gas pipe, catch basin, or something else located just a few inches away from its supposed position, and exactly in line with the desired conduit, which must be moved or a new location sought. But once having settled—from test pit information—the position of obstacles, the designer can proceed with a fair sense of security; though even with such precautions cases have arisen within the experience of the writer, when sub-structures so deviated from their rightful course between test pits as to require removal before conduit space could be obtained. Obstacles may some times be surmounted by the use of slight curves, either vertical or horizontal, in the conduit, though this is not a practice to be commended. Usually gas, water and electric light companies are cordial, and willing on the payment of reasonable expense, to make such slight changes in the location of their property as will enable a conduit to be placed, so that by one expedient and another the engineer must thread his way from corner to corner.

VENTILATION.

Few instances in engineering practice illustrate so forcibly the existence of the unexpected as the subway explosions attending the introduction of the first conduits in New York City. Particular pains were taken to make the conduit presumably air tight—constructed of wrought iron pipe, with threaded joints, equipped with double-covered gasketed manholes, it seemed an impossibility that it should be otherwise than hermetically sealed. But a brief period of operation had elapsed before the public was astonished by a series of explosions that took place in the various subway manholes. Investigation showed that owing to the porous character of the cast iron pipes employed by gas companies, a large proportion of their product leaked away in the surrounding soil, completely saturating it. In many cases the illuminating gas was slightly heavier than the atmosphere, and the manholes formed convenient settling places into which, in spite of the precautions taken to secure tightness, the gas gradually accumulated, and from various accidental causes occasionally became ignited, producing disastrous results. Such a state of affairs is a serious public menace, and two methods are now in current practice to avoid danger from this source. These may be described as the "*artificial*" and "natural" ventilation methods. The "artificial" ventilation method may be accomplished in either of two ways. In New York the expedient of laying alongside the cable ducts an additional air pipe, opening into each of the manholes, and terminating at some convenient point in a blowing station, equipped with a powerful fan, has been adopted. The conduit is made as nearly air tight as possible, so that the office of the fan is chiefly that of maintaining a counter-pressure transmitted through the air pipe to all manholes, thus keeping the whole system under a plenum, and preventing the entrance of any gases

whatsoever. That this is the surest and most efficient way is little questioned, but it is too expensive for any but the largest and most important installations—the necessary blower plant for a medium-

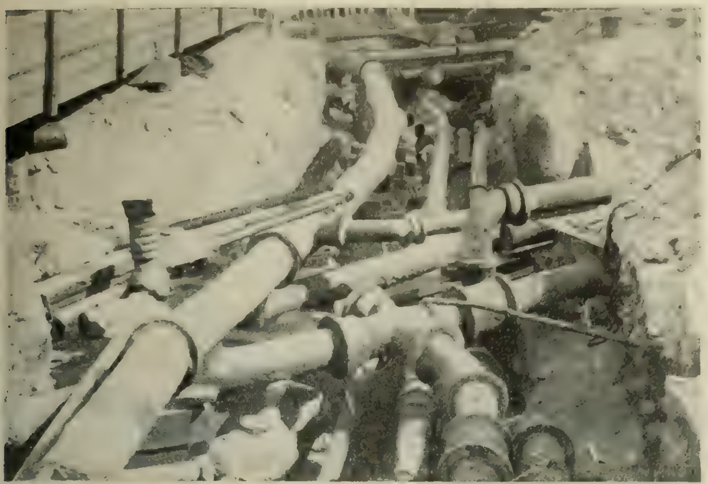


FIG. 49.—A NEW YORK STREET CORNER, SHOWING UNDERGROUND PIPE CONSTRUCTION.

sized conduit system costing from $60,000 to $80,000, while the annual maintenance expense amounts to from $15,000 to $20,000. To avoid this installation and operating expense each of the various manholes may be connected with a small standpipe made of 3-inch or 4-inch casing tube (conveniently attached to adjacent buildings), which operate as chimneys to create an air current in the manholes, thus removing noxious gases. While this plan reduces initial expense and obviates maintenance charges, it is burdened with the objection that it constantly operates to produce a slight vacuum in the manholes; and so, while it offers an escape for the gases, it invites their entrance. Both systems of artificial ventilation are illustrated in Fig. 51. The most recent practice in conduit construction indicates that if prior and subsequent to the introduction of the cables the ends of the ducts are carefully packed to impede as much as possible the entrance of gases into the manholes, and if the covers are perforated as thoroughly as adequate strength will permit, sufficient ventilation will naturally take place to prevent the formation of explosive gaseous mixtures. Conduit systems are, therefore, now universally installed by dispensing with special methods to produce ventilation, equipping manholes with open covers in the belief that sufficient precautions against subway explosions are thus secured.

RODDING.

Upon the completion of a conduit, provision is necessary for the introduction of cables. This is usually accomplished by what is known as the process of "Rodding." Workmen are supplied with a number of light jointed rods, either of wood or pipe, of such a length as to be readily handled on the inside of the manholes. It is desirable that the joints should be hook joints instead of screwed joints, so that the rods may not unscrew as they are forced through the duct. Rod after rod is introduced into a duct, the succeeding one being attached to the preceding one by its proper joint. In this manner the rods are gradually pushed from one manhole into the next one. As soon as the first rod arrives in the second manhole, a rope is attached to the end of the rod in the first one, and the workman in the second manhole pulls the rod and its attached rope along, disjointing the successive pieces as fast as they arrive. Then the rope is attached to a fish wire—usually a piece of No. 10, B. W. G., galvanized iron wire, which is pulled into the duct and left in place to serve as the primary means for pulling through the duct the rope to which the cable is subsequently attached. After the fish wire is in place it is desirable to plug each end of each duct with a hard wood plug, in order to prevent the incursion of gas into the manhole, and to avoid the collection of all sorts of debris in the ducts themselves. Where many ducts are to be rodded simultaneously the process of pneumatic rodding may be conveniently employed. By this plan the workman in one manhole is furnished with what is technically called a "mouse." This consists of a small spool-shaped piece of wood carrying a leather washer on each of its ends, that closely fit the bore of the duct. To the rear end of the mouse a light line is attached. In the other manhole the workmen are provided with an air pump carrying a leather cup that enables it to be readily attached to the mouth of the duct. The mouse being placed in the end of a duct a few strokes of the air pump produces a sufficient vacuum to cause the mouse to fly swiftly through the duct, dragging

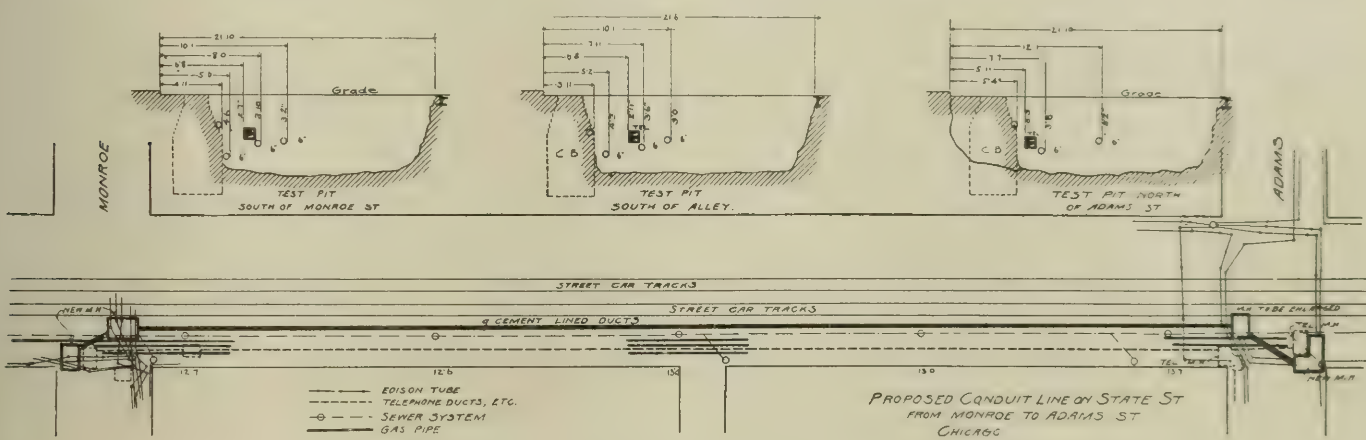


FIG. 50.—TEST PITS.

the cord after it and make its appearance at the end where the air pump is applied. When ducts are reasonably free and clear, and a

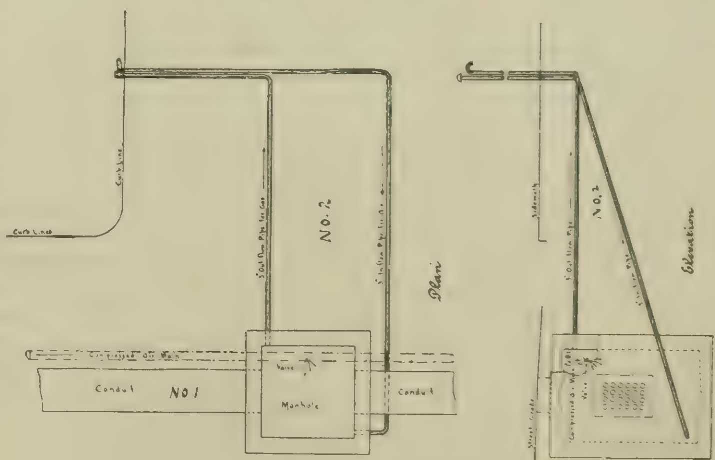


FIG. 51.—VENTILATING SYSTEMS.

large number are to be rodded, this process materially reduces the necessary time and expense.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

ARTIFICIAL GRAPHITE.

A patent has just been issued to Mr. E. G. Acheson, on a method for the artificial production of graphite, which is the logical outcome and sequence of his prior work. It will aid in understanding the relation and importance of the present method to briefly outline Mr. Acheson's previous work in this line.

His first observation was that coke might be freed from its impurities, and its conductivity largely increased, by the direct passage of a heating current; shortly afterward he discovered that carborundum and other carbides might be directly transformed to graphite by the employment of sufficient heat to volatilize the non-carbon element. Later observations led to the conviction that the conversion of carbon to graphite by any method of resistance heating depended upon the presence in the carbon of definite proportions of such carbide-producing elements as silicon, iron and calcium, and that, therefore the two methods above noted were substantially identical in so far as the chemical reactions were concerned; and that such impurities need not be present in proportion sufficient to react at once with the whole of the carbon, but that the transformation into graphite may be progressive in character, carbides being formed and decomposed, and the volatilized non-carbon element entering into combination with adjacent portions of the carbon. It was also observed that an artificial mixture of carbon with impurities was unnecessary since non-coking coals and certain varieties of charcoal contain mineral ingredients, proper in kind, sufficient in quantity and suitably distributed.

According to the present disclosure, it is found that in the case of volatile impurities the original distribution is unimportant. If, for instance, petroleum coke in the form of lumps and in rough admixture with iron or iron ore be suitably heated in an electric furnace, the vapors of the metal so permeate the enitre mass as to determine its complete transformation into graphite.

CAST ARTICLES OF REFRACTORY COMPOSITION.

Mr. Charles B. Jacobs has discovered a novel method leading to a new and seemingly valuable product. By subjecting acid silicates, such as the compound $Al_2\ O_3\ 2SiO_2$, which forms the base of ordinary fire clay and kaolin, to continued fusion at the high temperature of the electric furnace, a certain proportion of the silica is volatilized as white fumes, leaving a melt which solidifies into a hard, tough mass of waxy appearance, having the chemical composition of the known normal silicates of aluminum, but possessing distinct physical properties, and being therefore a new product.

For effecting the fusion, any usual type of electric furnace may be employed: as an example, it is stated that a current of 100 volts and 1,500 amperes will bring about 200 pounds of the material into fusion in twenty minutes, and that the continuance of the fusion for 40 minutes more suffices to volatilize one-half of the silica, leaving the normal salt. The fused mass is run into metal molds of any desired shape. The uses suggested are for bricks for paving, building and furnace construction, tiling and refractory conduits of various kinds.

PURIFICATION OF SUGAR JUICES.

The latest electrolytic method for the purification of sugar juices emanates from Kiew, Russia, the inventor being Albert Baudry. Chemically considered, the process is substantially that known abroad as Urbain's, with the addition of certain dialytic features, adapted from still earlier art. The cell employed in the first treatment is divided into three compartments, of which the central one contains the juice and anodes. The external compartments containing the cathodes are filled with water, and are separated from the anode compartments by diaphragms of parchment. The anodes are of soluble metals, such as zinc, aluminum and lead. Upon passage of the current the bases of such salts as the juice may contain are transferred to the water around the cathodes. Before this operation the juice has received the usual treatment with sulphurous acid.

After concentration the juice resulting from this preliminary treatment is again electrolyzed in a similarly constructed apparatus, the polarity of the electrodes being now reversed so that the water surrounds the anodes. The acid radicals of the salts are now removed from the juice and the sulphurous acid which is injected during the second treatment is reduced by the hydrogen to hyposulphurous acid, the great decolorizing power of which is exerted under favorable conditions. The syrup may undergo a still further treatment in a third electrolytic vat, wherein both anodes and cathodes are immersed in water, the solution passing through intermediate compartments. This supplemental dialytic treatment seems to be precisely the method proposed many years ago by Despeisses. The claim that the conjoint use of the methods of Despeisses and Urban yields excellent results as regards increase in the coefficient of purity, and particularly the elimination of extractives and colors would seem to be well founded.

New Telephone Patents.

The Patent Office on September 30th issued no less than six patents supposed to pertain to telephony. The qualification "supposed" is used advisedly, for while one of the patents, which the inventor states is applicable to both telegraphy and telephony, may be of some use to the former art, it is not in any way apparent what service it can render in telephony. The device referred to is termed a "Selective Call," the mechanism of which is akin to the ordinary electrically-controlled mechanical gong, except that in order to signal any one of several instruments to the exclusion of the others on the same line, all must be provided with pendulum escapements, which are to be synchronously started by receiving simultaneous and successive taps from an electromagnetic device responding to a manually-operated circuit closing key. The operator must observe his own pendulum to determine when and how many times to close the circuit, on the supposition that all pendulums will reach the normal amplitude of vibration simultaneously.

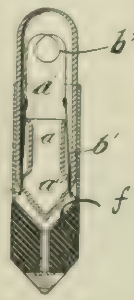


FIG. 1.—SIGNAL LAMP.

Taking up the other patents in the order of their serial numbers, one having for title, "Signal-Lamp for Telephone Switchboards," granted to F. R. McBerty and F. H. Loveridge, and assigned to the Western Electric Company, relates to a cheap method of construction of telephone incandescent lamps. The lamps are adapted to a socket; at one end the terminals of the lamp and socket must register, and at the other end is a translucent lens which must be illumined with maximum efficiency. Fig. 1 shows the invention well, where a is a tubular stem with a raised portion, a', which is adapted to be sealed to the body of the lamp in a manner to not only support the filament but to form a seal of such small mass that the liability to cracking is reduced. The loop in the filament, b^2, makes the end illumination a large proportion of the whole. The terminal mounting

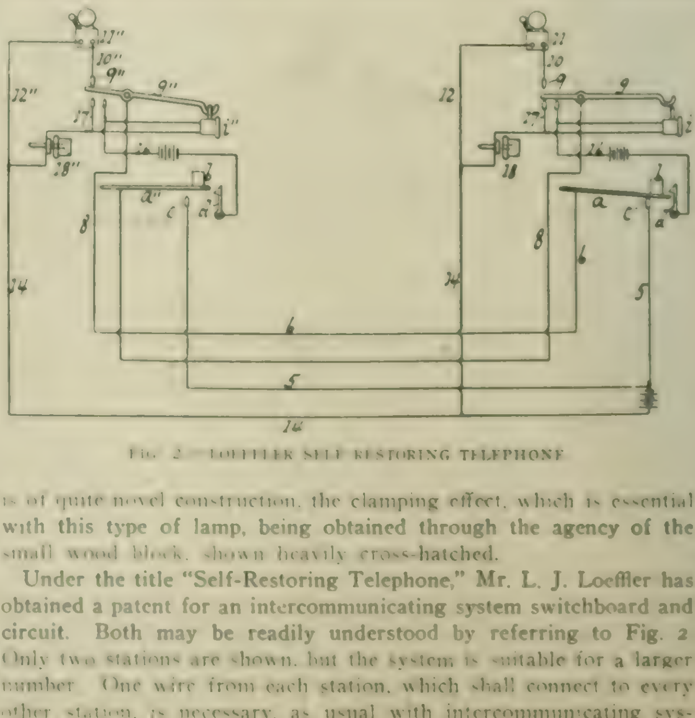


FIG. 2.—LOEFFLER SELF-RESTORING TELEPHONE.

is of quite novel construction, the clamping effect, which is essential with this type of lamp, being obtained through the agency of the small wood block, shown heavily cross-hatched.

Under the title "Self-Restoring Telephone," Mr. L. J. Loeffler has obtained a patent for an intercommunicating system switchboard and circuit. Both may be readily understood by referring to Fig. 2. Only two stations are shown, but the system is suitable for a larger number. One wire from each station, which shall connect to every other station, is necessary, as usual with intercommunicating sys-

tems. At b is represented one of a number of push-buttons, arranged in a vertical line, each of which corresponds to one station. Each button bears upon a strip of metal, a^1. Beneath the row of springs is a dog, d, whose position is so controlled by the hook switch that when the receiver is off the hook it overlaps the springs, while with the receiver on the hook the dog is swung clear of the springs. Now, suppose the receiver hook is up, then if button b is depressed to its fullest extent the spring will slide over and past the dog, and contact will be made between the spring strip and the battery bar, c.

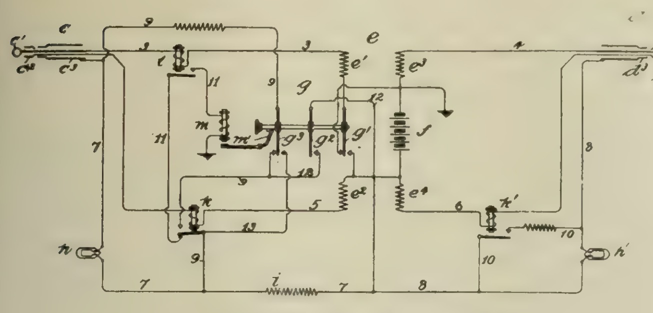


FIG. 3.—DEAN TOLL APPARATUS.

In this position no electrical contact exists between the dog and spring strip. This is the condition of circuit at the right-hand station, which is shown calling the left-hand one. When the button is released, it is caught by the shoulder of the dog, thereby completing the talking circuit. Whenever the receiver is returned to the hook, the latter throws back the pawl, disengaging the spring strip and clearing the line automatically for further use.

Patent No. 710,309, granted to Mathias Weisser, is purely a design patent, showing and claiming one of the many ways of making a transmitter case of thin sheet metal, and the method chosen does not appear to have any particular merit. Both of the remaining patents of the issue are assigned to the Western Electric Company, the one being an invention by William W. Dean, of Chicago, and the other by F. R. McBerty.

Mr. Dean's patent, No. 710,318, describes telephone switchboard circuits, especially adapted to a special toll-charging system, wherein a manually-operated counting device is located at the instrument of the subscriber, so electrically controlled at the central office that on the completion of a connection, conversation is refused until the registering of the call automatically restores the circuits to their normal condition. The way in which this result is accomplished can be best followed out by referring to Fig. 3, which shows a modified cord circuit of the Bell Company's common battery system. The subscriber's lines are provided with the usual lamp, as well as line and cut-off relays at the subscriber's station; in addition to the usual apparatus there is included two push-buttons, one of which is connected to the mechanism of the message counter as well as to the electrical circuit, and which will hereinafter be referred to as "key a"; the other button concerns the electrical circuit only, and will be

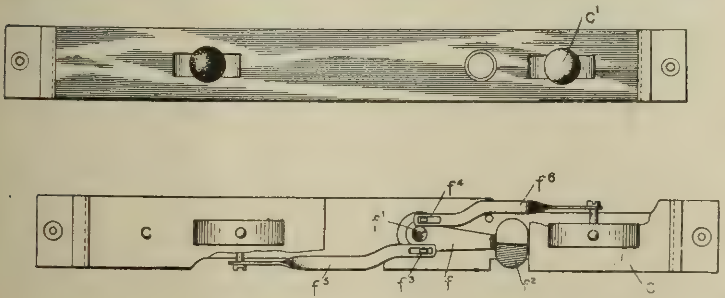


FIG. 4.—M'BERTY SELECTIVE CALLING APPLIANCE.

known as "key b." On the central office operator receiving a call according to the accustomed manner, before completing the connection she presses the controlling key (shown diagrammatically, all other keys being omitted from the drawing for convenience), which immediately locks in the depressed position. This operation results in the normal ground connection being removed from the middle terminal of the repeating coil, e^1, battery connection being established in its stead. Thus the same pole of the battery is connected to both sides of the subscriber's line, and relays k and l are both de-energized. The supervisory lamp, which is normally controlled by the subscriber's hook switch through the agency of the relay k, does not, however, light, as a contact of the control key in its depressed position supplements that of the relay.

The operator now proceeds to complete the connection. At this stage, the calling subscriber can hear all that goes on, through his repeating coil whose circuit is still effective for this purpose. He cannot, however, transmit, for no current is flowing through his transmitter, both sides of the line being at the same potential. When he hears the response of the called party has answered in order to hold conversation with him the subscriber originating the connection has only to push his key, a, which registers a call, and at the same time energizes relay l, releasing the control key and re-establishing normal talking conditions. In case through some failure the connection is never completed, the calling party may signal the operator to restore his service by depressing key b, this acting so to ground the line that relay k operates, acting through the lower contacts of the control key to neutralize the effect of the shunt on the supervisory lamp.

Mr. McBerty's invention is a useful contrivance for ringing keys, used in connection with selective signal two-party lines, and consists of an indicator to show the operator which party was last called. This device is very simple, and is so well shown in Fig. 4 as to need no further explanation. The indicator becomes of particular service at those times when through failure to respond, it becomes necessary to ring the desired party a second time, as on the one hand it relieves the operator of trusting to memory as to which party was desired, with the consequent errors; and on the other hand it relieves the subscriber of the annoyance of being asked repeatedly as to which was desired.

The Patent Office issue of October 14 includes two patents relating to telephony. One of these, having the title "Telephone Transmitter," has reference only to the application of the telephone to the use of the deaf. The invention consists in the hinging together of two or more telephone transmitters, which are to be connected in the same electric circuit and forming a portion of a telephone set designed to enable the deaf to hear what transpires in their immediate neighborhood. By the aid of the several transmitters hinged together, the user may conveniently point the mouthpieces at different angles, and thereby collect sounds approaching from several directions. The patent for this device is granted to Mr. M. R. Hutchinson, and assigned to the Akouphone Manufacturing Company, of New York.

The second patent relates to a printing telegraph and its application to telephone systems. By means of this instrument it is proposed to enable one telephone subscriber to leave a message for a second one should he for any reason be not available for conversation. Mr. William F. Smith, of San Francisco, is the patentee, and the invention so far as described is only applicable to magneto-telephone systems with local battery transmission. The circuits are so arranged that when the central office operator has in the usual way connected a desired line to the one from which a call for it originated, if the called subscriber fails to answer, the calling subscriber may print out a message upon a strip of paper, provided at the called station, for that subscriber's future information.

As usual with printing telegraph apparatus, the record is made upon a strip of paper which is brought into contact with the proper portion of a type wheel. This type wheel is revolvable upon its shaft, step by step, each step corresponding to one of the characters. The power to revolve the type wheel and to lock it after each step is supplied through falls and ratchets associated with electromagnets, which are connected to the subscriber's line irrespective of the telephone hook switch, the circuit being so arranged as to be telephonically balanced.

The sending mechanism, which is adapted to make and break the connections between the battery and the electromagnets a definite number of times, corresponding eactly with the location of the desired character upon the type wheel, is operated by the subscriber through the agency of a slide button. This slide button runs over a scale, giving all characters which it is possible to send, and when placed opposite any one of these and released, the automatic return of the button to the normal position performs all necessary operations at the receiving station. These operations embrace the rotating of the type wheel, making the impression, advancing the paper and resetting the apparatus.

As an accessory to a telephone system with its stations scattered over a considerable territory, this apparatus does not appeal strongly

to one, because all past experience has shown that simplicity of apparatus at the subscribers' stations is one of the first essentials to a successful telephone installation. Considering this fact, the necessary accuracy of the motion of the various parts of the receiving and transmitting mechanisms and the comparatively complicated nature of them seem prohibitive to a general application of the invention where any failure to record would probably be a source of such annoyance to the subscriber as to far outweigh the advantages gained from its installation.

Ionization of Gases.

At a meeting of the Franklin Institute, September 25, Dr. Geo. F. Stradling read a paper on the subject of "The Ionization of Gases," an abstract of which is given below.

It has been shown that by the passage of the electric spark through steam as well as by the passage of current through alkali salt vapors, products appear which conform in quantity to Faraday's laws of electrolysis. By a variety of processes a negative ion, which is not the same in mass as the negatively charged ion of liquid electrolysis, can be separated from the atom. The remainder having a positive charge differs according to its origin, while all negative ions seem to be alike in rarefied gases. The chief agencies in the production of ions are: (a) Rays from radioactive substances—Becquerel rays. (b) Röntgen rays. (c) Ultra-violet light. (d) Kathode rays. (e) Certain chemical processes. (f) High temperature. (g) Electrostatic stress. (h) Impact of moving ions. (i) Spontaneous production.

These are not all independent. Both positive and negative ions, when the ratio of electric force to gas pressure is sufficiently low, become attached to groups of molecules. Generally the negative ions move more rapidly than the positive ones. However, in the case of ions produced by high temperatures it seems that higher speed goes with the positive ion.

Among the things explicable by the theory of ions are: Many of the phenomena of the discharge of electricity through gases; the tending of the electric current through a gas toward a maximum as the e. m. f. rises; the discharge of hot conductors at a lower potential when charged negatively than when positively charged; possibly the weight changes accompanying chemical action observed by Sanford, Landolt and Heydweiller; the occurrence of auroræ; the luminescence of nubulæ.

Atmospheric air contains ions. By their presence is explained the discharge of electrified bodies which takes place independent of the leakage across the insulators. While the rate of dissipation of the charge is greater for both positive and negative electricity on mountains than on the lowlands, it is far greater for negative, because the negative charge of the earth having a very high density upon the peaks attracts thither great quantities of positive ions. The dissipation is much more rapid on clear than on dull, foggy days.

If a charged body be surrounded by a cage of wire similarly charged, the latter attracts ions, some of which pass within it and thus accelerate the discharge of the body inside. If the cage and body are oppositely charged, the discharge is made slower.

Ebert insulated a portion of the earth, let its charge be dissipated by the rain of ions constantly occurring, and again connected it to the earth. Then a current flowed from the insulated part to the earth. It took in some cases only five minutes for the discharge by ions to be completed. This undoubtedly shows a very high rapidity of discharge for the earth.

The origin of the atmospheric ions is to be sought in the action of ultra-violet light in the upper regions of the atmosphere and in kathode rays developed there by negatively charged particles arriving from the sun.

Commercial Cable and Postal's New President.

The directors of the Commercial Cable Company on October 15 elected Clarence H. Mackay president and George G. Ward chairman of the board and of the executive committee. Mr. Ward will continue to be vice-president and general manager. Mr. Mackay was also elected president of the Postal Telegraph Company and of the Pacific Postal Telegraph Company. He succeeds his father, the late John W. Mackay, in all these posts.

Chairman Ward contradicted a published report that the Commercial Company's Pacific cable would go no further than Honolulu. The contract for the entire cable to Manila has been let, he said, and the line to Honolulu will be working by January 1. The line to Manila, it is expected, will be ready for operation by July. The company has made no contract to lay a cable from Honolulu to Fanning Island, a recent despatch from Honolulu to the contrary notwithstanding.

Wireless Telegraphy on a Moving Train.

During the passage of the special train on the Grand Trunk Railway, between Toronto and Montreal, on October 13th, bearing the members of the American Association of General Managers and ticket agents from Chicago to Portland, wireless telegraphic signals were received by the party as the train passed St. Dominique station, at the rate of 60 miles an hour. No special attempt was made to signal to a great distance, but the train remained in touch with the station for from 8 to 10 miles. Two vibrators, 10 x 12 feet, connected with an induction coil of the usual pattern (8-inch spark), served to transmit the waves from the station, while on the train itself the waves were received by a coherer of the ordinary type. A relay rendered the signals audible to the passengers by ringing bells in three cars. The collecting wires were run through the guides for the signal cord inside the train, and extended about one car length on either side of the coherer. Owing to the natural vibration of the train it was impossible to have the relay at the most sensitive point, but the distance to which it was possible to keep the train in touch with the station was considered very satisfactory by the various officials. The apparatus was loaned for the experiments by the Physical Department of McGill University, Prof. E. Rutherford and Prof. H. T. Barnes, assisted by Mr. H. L. Cooke, being present to look after the adjustments. Dean Bovey and Prof. C. H. McLeod, of the Engineering Department of McGill, also witnessed the experiments.

CURRENT NEWS AND NOTES.

MASTER ELECTRICAL MECHANIC FOR NAVY YARD.—An examination will be held October 29, at the New York Navy Yard Brooklyn, to fill a position of master electrical mechanic. The rate of pay is $6.00 per day.

A CORRECTION.—In the article by Mr. Virginius D. Moody, printed in our issue of October 18, a typographical error appears in the formula for computing the full-load current. As given, the equation reads, $I = \frac{Kw \times 2}{E \times 1.73}$.
This is to be corrected by removing the numeral 2 from the numerator.

A COAL BATTERY.—Hugo Jone, a chemist for the city of Chicago, who has figured in the newspaper press as an investigator of the problems of obtaining electrical energy from coal, is reported to have one of his cells now undergoing tests by City Electrician E. B. Ellicott. No details of this new cell are given out by Mr. Jone, except that it is a gas cell. Mr. Jone claims to have tested the cell enough to be satisfied that the efficiency of the process is considerably ahead of the usual method of generating electricity by steam power. About a year ago Mr. Jone gave a newspaper account of a battery of his, but the present battery is stated to be a decided improvement over the one upon which he was then working.

CORRESPONDENCE SCHOOLS.—"The Place of Correspondence Schools in Electrical Education" was the subject taken up at the Chicago Electrical Association the evening of October 17. Harris C. Trow, of the American Correspondence School, read a paper on that subject, and a lively discussion followed. Some points were brought out of considerable interest, as showing the results of correspondence instruction. It seemed to be the general sentiment of the meeting that the best of correspondence schools are doing good work, and that the pupils taking the full courses undertaken were well rewarded. The fact was brought out that the expenses to the schools of carrying pupils through the full courses is more than the tuition, and but for the profits on those dropping out, the tuition would have to be much higher. The pupils who stay by are the ones that get their money's worth.

JOHN FRITZ DINNER.—The requests for tickets for the John Fritz Medal Banquet, at the Waldorf-Astoria ballroom, on October 31, have become very numerous, and had already reached about 400 early this week. The indications point to an attendance of not less than 500. All the presidents of the four national engineering societies will be present, and the deep interest manifested in each branch attests the popularity of the idea of founding this gold medal, the first of the kind in the United States, due to the co-operation of men engaged in different fields of professional engineering. Tickets for the dinner, including wines and cigars, cost $12; and for ladies in the ballroom boxes, including light refreshments, cost $3. The Dinner Committee will be greatly assisted if orders, with check, are sent at once to Mr. John C. Kafer, The Engineers' Club, 374 Fifth Avenue, New York City.

MUNICIPAL ELECTRICIANS.—Following is a list of the officers of the International Association of Municipal Electricians, elected at the recent meeting in Richmond, Va.: President, W. H. Thompson, Richmond, Va.; vice-president, Jere Murphy, Cleveland, Ohio; second vice-president, A. C. Farrand, Atlantic City, N. J.; third vice-president, W. A. Barnes, Bridgeport, Conn.; fourth vice-president, C. L. Williams, Meridian, Miss.; secretary, F. P. Foster, Corning, N. Y.; treasurer, Adam Bosch, Newark, N. J.; executive committee: Walter M. Petty, Rutherford, N. J.; Elmer G. Loomis, Allegheny City, Pa.; William Brophy, Boston, Mass.; Austin S. Hatch, Detroit, Mich.; J. B. Yoekel, Baltimore, Md.; W. Y. Ellett, Elmira, N. Y.; F. C. Mason, New York; G. F. McDonald, Ottawa, Canada; William Crane, Erie, Pa. Next year's convention will be held at Atlantic City, N. J., the date to be announced later.

THE PRESIDENT'S TROLLEY ACCIDENT.—The finding in the inquest following the accident in which President Roosevelt's body-guard, William Craig, was killed here early in September, filed on October 15, says that the "unlawful acts of James T. Kelly, conductor, and Euclid Madden, motorman," of the electric car which ran into the President's carriage, "contributed" to the death of Mr. Craig. The finding was by Special Justice Hibbard, who states that the horses attached to the President's carriage were going at the rate of six miles an hour, and the car at from 15 to 25 miles an hour. He also finds that there was a misunderstanding on the part of the street-car companies of the city as to what thoroughfares were to be closed to traffic during the President's visit. No evidence, the report says, was found to show that the car was not running at regular schedule, or that the officials of the road had given any orders for it to be run otherwise than under normal conditions.

A. I. E. E. LOCAL AT PITTSBURG.—The committee of the Institute on local organization had a meeting under its auspices at Pittsburg, on October 13, where there gathered together over 125 young men, mostly college graduates, at the call of the chairman of the committee on local organization. The meeting was called to order by the chairman, who made a few remarks about the scope of the work of the American Institute of Electrical Engineers, the advantages of membership in it, followed by an address by the president, Mr. Scott, reading of the paper prepared by Mr. Lamme, and discussion of it by Messrs. Lincoln, Scott, Storer and others. After the meeting, a large number of application blanks for membership in the Institute were given away, and demands for more were registered. The meeting was a great success, and a temporary committee was elected to meet and prepare a scheme for organization and to call the next meeting, announce speakers, etc.

TELEPHONY IN NEW YORK.—The new International Telephone Company, with a mortgage of $100,000,000, proposes to give New York City a taste of independent telephony. The officers are: President, S. B. Rinehart, of Waynesborough, Pa., president of the Frick Company and Citizens' National Bank of Waynesborough; vice-president, Charles W. Mackay, of New York; treasurer, William B. Ehlen, of Baltimore, Md. Secretary Fay states that the company was originally organized to manufacture the patents of Ellis F. Frost, of Washington, and it was later decided to enter the telephone field, using the devices invented by Mr. Frost. These include a combined transmitter and receiver, and a circuit system that are said to cost one-half the price charged for the ordinary desk telephones, and a cable and battery system, for which the claim is made that the cost of construction and maintenance will be one-half that of the cheapest telephone system in use to-day. Mr. Fay said that the company has no fear that it will make money on the lines they intend to establish and operate at the low rate to be charged. So far as known, the company has not an inch of underground conduit or cable with which to start operations.

BELATED TRANSFORMER PATENT.—In our issue of May 3, notice was made of a fundamental transformer patent, granted April 22, to Elihu Thomson, on an application filed November 2, 1885. Owing to the interest in this patent, we reprint below from the current issue of the *American Electric and Automobile Patents Monthly* a list of the references cited in examination of the application: Interference with application of K. Zipernowsky and M. Deri, Buda-Pest, Hungary and Vienna, Austria; C. F. Brush, Cleveland, Ohio; W. E. Sawyer, Washington, D. C.; W. K. Freeman, Astoria, N. Y.; A. Bernstein, Boston, Mass.; R. M. Hunter, Philadelphia, Pa.; patent to Gaulard and J. D. Gibbs, Middlesex County, England, 351,589, October 26, 1886; E. Thomson and E. T. Houston, Lynn, Mass.; R. N. Dyer, Menlo Park, N. J.; T. A. Edison, Llewellyn Park, N. J.; Westinghouse Electric Company, Pittsburg, Pa., Decision favorable to Thomson.—*Telegraphic Journal*, April 1, 1879, p. 117. Brush, 219,209, September 2, 1879. Edison, 265,786, October 10, 1882; 278,418, May 29, 1883; 287,516, October 30, 1883. See R. Kennedy's article in London *Electrical Review*. Zipernowsky and Deri, 3,379, 1885, England; 33,951, 1885, Germany. *Elektrotechnischer Zeitung*, 1885, pp. 290, 286-390.

BREMER ARC LAMP.—A patent, issued October 14 to Hugo Bremer, Neheim, Germany, relates to the manufacture of composite electrodes of arc lamps, the claims covering a self-flushing electrode containing an intimate mixture of carbon and an akaline earth fluoride in excess of 10 per cent., with or without from one to three per cent. of a compound of boron, potassium or sodium. From 20 to 50 per cent. of calcium or magnesia fluoride is mixed with calcined carbon, and to avoid any tendency to flicker of an arc, there is added from one to three per cent. of borax, boric acid, or potassium or sodium carbonate or silicate. The high chemical affinity between the fluoride and the calcium causes the calcium fluoride for the most part to remain undecomposed even in the temperature of the arc. Such vapors of the fluoride as may form and condense at the slightly colder edges of the carbon again become liquid and fall in drops, carrying with them any small particles of solid slag which may have been deposited by the metallic oxide. In this way the calcium fluoride acts not only as a means for increasing the light yielded by the arc, but also as a flux for the alkaline earths, so that a much larger percentage of such material as fluoride of calcium may be used, or of various other of the alkaline-earth compounds—such, for instance, as calcium carbonate. Moreover, the presence of the fluorine results in a warm, soft, yellowish-red light, approximating the color of sunlight. Thus an arc is obtained of high light efficiency, of agreeable color and very constant in its operation, and electrodes which keep themselves free from accumulating slag. Fluorides of certain other metals or alkaline earths may be employed, provided they are selected with a view to producing the required fluid slag and flux.

LETTER TO THE EDITORS.

High-Potential Effects.

To the Editors of Electrical World and Engineer:

Sirs.—In the ELECTRICAL WORLD AND ENGINEER of August 23, 1902, under the title, "Geissler Tube and Condenser Effects," I described the effect on a rotating disc having a small piece of mica with tinfoil glued to each of its opposite faces, when one piece of tinfoil was connected first to the one side of a spark-gap under a disc, and then to the other side. The piece of tinfoil on the side opposite to that which was attached to an electrode was earthed.

What follows gives the results obtained when the secondary of a small high-potential coil was attached to the electrodes under a rotating disc, an end to each electrode. The condenser of the high-potential arrangement consists of two Leyden jars. The sparks are made between small steel balls. There is nothing unusual about the construction of the high-potential coil, it consisting of the ordinary primary and secondary. Two Leyden jars are used to increase the capacity.

I found that the disc, when connected up as above described, rotated from perfect rest always in one direction; but if started in

the opposite direction, the velocity increased and it continued to rotate that way. When rotating, say, from left to right from rest, and then allowed to come to perfect rest by cutting off the current in the primary of the induction coil or by using a blower as formerly described, upon reversing the current in the primary of the coil, the disc would start and rotate from right to left. The rotations were all rapid, which is partly owing to having increased the current in the primary of the induction coil in order to keep up the snapping spark between the two balls in the primary of the high-potential coil. The disc used was a very fine one and gave with the induction coil alone rapid rotations.

It was clearly shown that there is a main discharge from each side of the secondary of the high-potential coil, similar to the discharge from the secondary of an induction coil, but of higher potential; and that either the reversals as they appear in Geissler tubes when connected in the secondary of the high-potential coil are superinduced on the main discharges, or there is an infinitesimal period of time between a main and a reversal discharge.

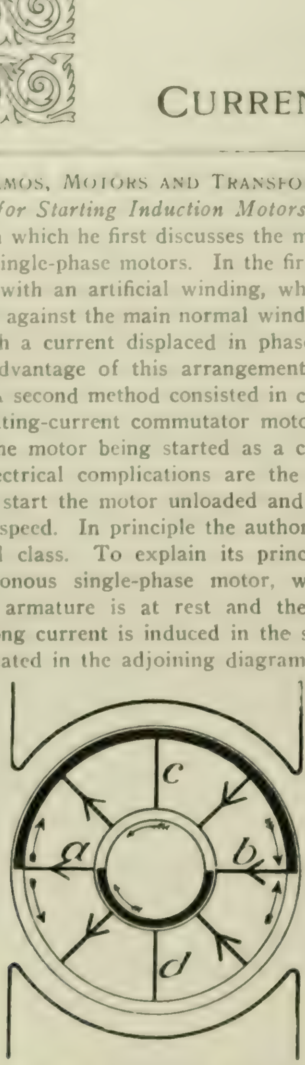
The induced reversals in the Leyden jar of an influence machine occur at exit of the charges, a reversal on each side for each discharge. That it takes place at the exit of the charges leads to the belief that they occur after the main discharges, their images, as it were, appearing in the secondary discharges of the high-potential coil.

Baltimore, Md. ALFRED G. DELL.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

A New Method for Starting Induction Motors.—Schwartz.—An illustrated article in which he first discusses the methods which have been used to start single-phase motors. In the first, the single-phase motor is provided with an artificial winding, which is displaced in space by 90 degrees against the main normal winding, and this winding is supplied with a current displaced in phase against the main current. The disadvantage of this arrangement is the very large starting current. A second method consisted in combining the principle of the alternating-current commutator motor with that of the induction motor, the motor being started as a commutator motor; mechanical and electrical complications are the disadvantages. A third method is to start the motor unloaded and to load it when it has run up to full speed. In principle the author's new method belongs to this third class. To explain its principle he assumes a bipolar non-synchronous single-phase motor, with short-circuited armature. If the armature is at rest and the stator current is switched on, a strong current is induced in the squirrel-cage armature. This is indicated in the adjoining diagram, in which, for the



STARTING INDUCTION MOTORS.

sake of illustration, the external circle represents the front short-circuiting ring and the internal circle represents the rear one. For the sake of clearness the stator is represented by two poles. When the rotor is at rest, all lines of force pulsate in straight lines connecting the two poles. The winding, *ab*, is cut by all lines of force, so that the maximum e. m. f. is induced in it, while no e. m. f. is induced in *cd*. The currents in the bars on the armature (represented by the radii) flow in the indicated directions. Those parts of the short-circuiting rings in which the current flows in a clock-wise direction, is indicated as dark black, while in the other parts of the short-circuiting rings the currents have the opposite direction. The rings, therefore, have a tendency to move, but cannot do so, as long as there is equilibrium. Experiments have shown that a very small lateral direction of the armature in the one or the other direction is sufficient to break the unstable equilibrium and to start a rotation of the rotor. As soon as the position of the rotor is somewhat unsymmetrical, the one short-circuiting ring will be outside of the field and the other ring can follow the impulse which acts on it. Moreover, the rotor and stator currents tend to repel one another, like the primary and secondary of a transformer, but they cannot follow this force as long as the position is unsymmetrical. In order to really start the motor, it is necessary to lengthen the axle of the rotor and to arrange so that the rotor can easily move in the axial direction. The first part of the process consists in pushing the rotor out of its normal position in the axial direction, when the stator field is supplied with current. When the rotor is pushed out it is sufficient to move the rotor by one-half or three-quarters of a revolution by hand or by mechanical means, and the rotor then comes up to speed. When it reaches synchronism, the rotor is drawn back automatically into its former normal position. The fact that the rotor runs up when out of its position, is explained as follow: It is known that single-phase motors without auxiliary winding run up in speed when they are given a small push, provided the phase difference between e. m. f. and current in the rotor has a certain critical value; Arno states that the phase difference of 68 degrees is the best, and he accomplishes this by inserting a resistance in the rotor; in the present case the displacement of the rotor out of the field causes a diminution of the self-induction, which has the same effect. In this way the rotor runs up to synchronism when not in its normal position in the field; when synchronism is nearly reached, the rotor current is very small, and the magnetic attraction acting upon the iron core now prevails and the rotor is drawn into its normal position in the field; at this moment the coupling of the rotor to its load is automatically accomplished by a special mechanical device which is described in detail and illustrated; this device makes it impossible that the coupling can take place at an earlier moment. The first small motion of the rotor when it is out of its normal position may be produced by hand, or in the ordinary way by adding to the rotor an auxiliary phase which may be very small in this case, much smaller than in the ordinary single-phase motors. Furthermore, it is possible to place a piece of iron on the armature axle, which has an important ffect on the starting. By this arrangement a good starting torque is obtained with a considerable decrease of the starting current, so that it is possible to provide larger motors also with a short-circuited armature. If this piece of iron is provided with a winding, there is, so to speak, an auxiliary armature which may be used to further increase the starting torque. By suitably choosing the resistance of this winding, it is possible to make the maximum starting torque take place at the first moment when the rotor is started. After the motor has run up to normal speed, this auxiliary winding is superfluous and is disconnected, which is done automatically when the rotor is drawn into the field in the axial direction.—*Elek. Zeit.*, September 4.

Heyland Motor.—An account of the discussion which followed the reading of the paper of Heyland at the annual meeting of the German Association of Electrical Engineers. The paper itself has already been abstracted in the Digest. Georges referred to his old motor, built in 1891; he did not follow up the matter on account of the greater complications of this type of motor, compared with the ordinary induction motor; the Heyland motor represents a combination of the Georges motor and the induction motor; to understand its action, it is easiest to assume two separate windings, one being connected to the commutator and the other being a short-circuit winding. He says the Heyland motor might be called a shunt motor, in which the winding connected to the commutator is sup-

plied with an essentially constant voltage; he suggests also investigating an analogous series motor. Heyland replied that his motor is of an essentially different type from the Georges motor; a part of the observations made with the latter are also valid for the former, but in entirely different proportions; his motor is essentially an induction motor. Eichberg said that he had repeated the experiments of Georges and found that there were no sparks whatever when the speed was one-third of synchronism; he thinks that the Heyland arrangement has the disadvantage that a small value of the resistance connected in shunt with the commutator segments is unsatisfactory for starting, while with a high resistance the behavior at full speed is worse; he says that the characteristic feature of the Heyland motor lies in the fact that the excitation is made from the rotor, and, therefore, with an essentially smaller frequency; from this results a smaller number of voltamperes. Heyland says he thinks it is possible to build ordinary commutator motors for three-phase currents, and, perhaps, also for single-phase current, which do not spark; it will only be necessary to choose the number of segments so large that the reactance voltage of the coil between the segments is below a certain limit; it is different with the Heyland motor, as the so-called reactance voltage may have any value, and the number of segments is influenced only by the ohmic loss of voltage in the winding and can be made very small. Arnold referred to experiments with a 5-hp single-phase commutator motor, as built by the Wagner Company; he applied the Heyland compensation to it by inserting resistances between the commutator segments instead of short-circuiting them; the power factor could thus be brought to nearly unity; but the current which had to be supplied to the rotor was relatively large; by changing that current the speed can be regulated; at no-load the speed changes between 1,400 and 1,700 when the rotor current is changed from 0 to 115 amperes; the synchronous speed was 1,500, so that considerable over synchronism was obtained; this was the greater, the greater the resistance between the segments. It is peculiar that with a loaded motor the speed decreases with increasing rotor current. He does not think that the Heyland 'evice is suitable for small motors, but that it is of value for large motors, and that the compensation and compounding of the generators has a great future. In reply to a question, Heyland said that his generators, when operated in parallel, run non-synchronously, just like ordinary induction motors; they generate their magnetizing current themselves; if the speed of all machines is held constant, the frequency of the generated current decreases with the load and the slip. If the non-synchronism of the different machines differs, *i. e.*, if the speed of the one or the other machines varies, the frequency attains an average value, in the quicker machines the field lags more and the machine is automatically loaded to a greater degree. It is impossible for machines working in parallel to fall out of step; sparking is also excluded. Ziehl made some remarks on the speed regulation of these machines; with a four-pole motor at 1,500 revolutions, he has found that without the shifting of the brushes it could be brought up to 2,500 to 3,000 revolutions. The speed variation due to shifting of the brushes is very peculiar; if the position of the brushes is changed, the speed varies according to a distinct law. When all three brushes have been shifted around by a full revolution, there is a periodic change of the number of revolutions, the number being sometimes positive and sometimes negative; when changing from positive to negative, the machine is entirely at rest.—*Elek. Zeit.*, August 21.

Bearings.—DETTMAR.—An illustrated description of an apparatus for testing bearing oils and bearing metals. He tested several kinds of oil and has found that there is no relation whatever between the quality of the oil and its price. Among six sorts which are suitable, he found the cheapest one to be the best, while the most expensive one was the next one in quality. The Lahmeyer Company has changed the kind of oil which they use, which represents a saving of $500 per year.—*Elek. Zeit.*, August 21.

REFERENCE.

Induction Motor.—BODENSTEINER.—An article giving in diagrams the results of tests of the losses in a 170-hp 500-volt, slow-speed, three-phase induction motor.—*Elek. Zeit.*, August 21.

LIGHTS AND LIGHTING.

Lighting.—LUMMER.—A very long, illustrated lecture held at a conversazione of the Berlin Electrical Society, on "The Aims of Lighting Engineering." After a historical introduction, he discusses the measurements of light: the Bunsen and the Lummer-Brodhun photometers, the Hefner unit of light, and gives in a table the following series of the photometric economy of the usual sources of light, the figures representing the price in cents per Hefner candle-hour, based on the average prices in Berlin: Incandescent gas light, 0.65; Bremer arc light, 0.5 to 0.75; arc light without globe, 1.25; acetylene incandescent light, 1.5; kerosene, 1.75; arc light with globe, 1.75; Nernst lamp, 2.5; ordinary electric incandescent lamps, 3.5 to 5.0; acetylene, 3.75; argand burner gas light, 3.25; bat-wing burner gas light, 5.25. He then discusses the nature of the different sources of light: luminescence and lighting due to heating. He then deals with the physical principles of light and heat radiation, proves the existence of invisible heat rays and discusses the separation of heat and light rays by absorption of the heat rays in water, etc. He distinguishes between red heat and gray heat (just before red heat) and analyses the physiological phenomena. He discusses Kirchhoff's law of absorption and emission of light, and speaks at length on the absolutely black body and its realization in practice; he discusses the distribution of the energy in the spectrum of the black body, the laws of radiation of bright platinum, the laws referring to the energy maximum and the formula for the distribution of energy. He shows how these formulas can be used to determine the temperature of a black body from its radiation. With the use of such theories the temperature of lights can be determined, or at least given within limits: arc lamp between 4,200 and 3,750° C., Nernst lamp 2,450 to 2,200, Welsbach light 2,450 to 2,200, ordinary incandescent electric light 2,100 to 1,875, candle 1,960 to 1,750, argand lamp 1,900 to 1,700. The temperature of the sun and of fixed stars has also been determined, that of the sun is about 6,000 degrees. Some of the fixed stars have a temperature higher than that of the sun by several thousand degrees. He remarks that the present art in lighting is still far from the ultimate in the production of light without heat. He then discusses the dependency of the illumination upon the temperature. The total radiation is proportional to the fourth power of the absolute temperature, the product of the absolute temperature and of the wave length at which the energy has a maximum, is constant; the maximum energy is proportional to the fifth power of the temperature, while the energy physiologically felt as light increases still more quickly with the temperature. In the yellow part of the spectrum the illumination is doubled if the temperature of the black body is increased from 1,800 to 1,875 degrees, *i. e.*, by about 4 per cent. Concerning the total illumination, he states that if the temperature is increased from 2,000 to 4,000° C., *i. e.*, in the ratio 1 to 2, the illumination is increased in the ratio 1 to 4,000; the carbon in arc lamps has a temperature of 4,000 degrees, the filament of an incandescent lamp 2,000 degrees, hence the arc lamp emits per unit of surface about 4,000 times more light than the incandescent lamp. The sun which glows at 6,000 degrees, emits 600,000 times the illumination per unit of surface of the incandescent lamp. The aim of the light engineers should be to find substances which can be heated up to 6,000 degrees without being destroyed, as at this temperature the energy maximum is within the visible spectrum at the part where our eye is most sensitive. Three overhead incandescent lamps, each of 300 hours' life, are more economical than one normally burning lamp of 1,000 hours' life. In practice, a similar thing is often done, by using 105 or 100-volt lamps in 110-volt installation. This use should be made a principle. The larger sale of lamps of limited life would tend to reduce the selling price. The advantages of the Nernst lamp are due to its elevated temperature. Concerning the temperature of the osmium lamp, nothing definite is yet known. The highest temperature on the earth is in the arc lamp. The introduction of suitable salts in the electric arc is a distinct progression, because more favorable substances are used for producing the light. The vapors of the lithium and strontium salts heated in the arc to enormous temperature do not emit a continuous spectrum, but mainly colored light. These arc lamps become similar to the Geissler tubes, in which the gas in the dilute state is excited to light emission by electro-luminescence. These newest arc lamps represent a connecting link between the light due to heat and that due to the luminescence of colored vapors. The mercury vapor lamp seems to be a pure luminescence lamp. If this is so, the light would be entirely due to free vibrations of electrons, while in the ordinary sources of light there are forced oscillations of the electrons, caused by the molecular movement, due to heat. The paper contains a very large amount of information, and in an appendix is given a long list of references to publications and papers on this subject.—*Elek. Zeit.*, August 28, September 4.

Osmium Lamp.—An article giving a report of a German daily paper concerning the osmium lamp. The German Incandescent Gas Light Company, which owns the patent right for the osmium lamp, no longer enjoys its former remarkable financial condition; it paid dividends up to 130 per cent. several years ago, 28 per cent. a year ago, and probably less this year. The chief reason is the uncertainty concerning the osmium lamp on which exceedingly sanguine expectations had been based. In the report of the company, of 1900-1901, it had been stated that it was hoped to so increase the manufacture of this lamp in the winter season as to yield profits in the new year. As recently as July last the company repeated the assertion that the lamp would be placed on the market in the coming season, and a few days ago it was stated by the company that the prices and conditions of sale have not yet been fixed. The chief obstacle seems to lie in the impossibility of constructing lamps having a sufficiently high electrical resistance, as the osmium wire is either so long or so thin that at white heat it is unable to retain its original shape. The company claims to have surmounted the difficulty.—Lond. *Elec.*, October 3.

REFERENCE.

Suspension of Incandescent Lamps.—An illustrated description of a method used by a French company for the suspension of incandescent lamps. It enables one to set a lamp in a certain position, according to the requirements of the case, and to light and extinguish it in any position. In a spherical wooden box there is a movable globe, to which is fixed the support for the lamp.—*L'Ind. Elec.*, August 25.

TRACTION.

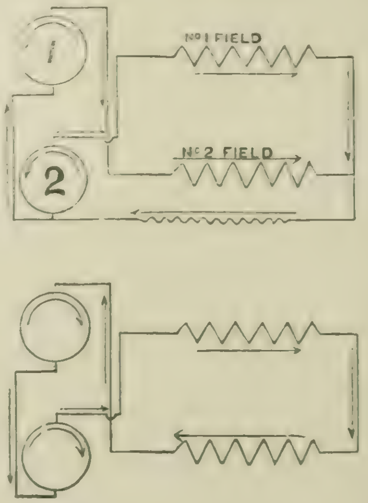
Taeggi High-Speed Telpher Postal System.—DIGBY.—An illustrated description of the scheme proposed by Taeggi for the transmission of letters, newspapers and parcels along an aerial electric railway, at speeds as high as 400 km. per hour. The system is now under the consideration of an expert committee, appointed by the Italian Postal Minister. The area to be served is divided into districts of varying importance, the less important connections branching off from the main lines. The "aerial way" consists of four wires, which also act as conductors; on the two lower wires run the roller or trailer wheels of the despatch box, while the top wires, which are placed sideward, carry the motor or driving wheels. Three other wires are the main feeders for the supply of high-tension, three-phase current of 5,000 volts to transformers, reducing the voltage to 260, from which the current is taken to the two upper and one of the two lower wires, mentioned before, for supplying the motor of the despatch box. The despatch boxes, consisting of the dust and damp-proof case of the driving motor, and the trailer box which carries the letters, are of aluminum; the weight to be carried by the aerial wires is 80 lbs., including the letters. The construction of the aerial way is shown in illustrations. Some critical remarks are added. It is doubted whether a speed of 250 miles per hour is an economic possibility, even should the unknown difficulties of current collection at such speeds be overcome. The condition of the success would lie in its having plenty of work spread over long hours, with the heavier matter, now sent by book and pencil post, sandwiched in between the rushes of business correspondence—Lond. *Eng'ing*, September 26.

Electric Brakes.—FAWCUS.—An article referring to a recent tramway accident at Glasgow. It is said that if a car can be prevented from running backwards after it has once stopped, without the use of the mechanical brake, a good deal is accomplished in the direction of security against such accidents. With the ordinary simple form of electric brake, that is, when the motors generate current to be absorbed in a resistance, the motors should be so connected that the armature of each excites the field of the other, when running in parallel, as shown in Fig. 1. If the direction of rotation be reversed, by the car running backwards and without the position of the controller handle being altered, the motors will excite and run short-circuited on one another, as shown in Fig. 2, and the car will be prevented from making any appreciable progress. In the explanation, it is assumed that the armature of one generates sufficient e. m. f. with the residual field to send a current in the opposite direction through the field of 2. This is sufficient to start the armature of 2, generating in the same direction as before (both its direction of rotation and field being reversed), and exciting field 1, whose polarity remains the same. With this arrangement it would be advisable for the motor man to always use his electric brake when stopping, and to keep his controller in the brake position until restarting the car.—Lond. *Elec. Rev.*, September 26.

REFERENCES.

Surface Contact Systems.—PAUL.—An illustrated article in which he critically discusses the Diatto system, the Dolter system and the system of the Lorain Steel Company.—*L'Ind. Elec.*, August 25.

Automobiles.—HOSPITALIER.—A very long article, in which he discusses the use of electric devices on automobiles with heat engines. The part which electricity plays in the automobile with heat engines



FIGS. 1 AND 2.—ELECTRIC BRAKES.

is that of an "elastic organ interposed between the engine and the wheels," either for simple coupling only, or for coupling and speed variation, or finally as electric transmission, the heat engine operating a dynamo the direct current of which feeds the motor or motors acting upon the wheels by more or less ingenious and more or less practical combinations and couplings. These three different applications are discussed in detail.—*L'Ind. Elec.*, August 25.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

African Lighting Station.—HOHL.—A description of the electric lighting station of Lagos, which is the capital of a British crown colony in West Africa. The plant was built by the government. There are three 30-kw, 1,000-volt, single-phase alternators. For street lighting, ten circuits are used, each containing 20 incandescent lamps of 50 cp and 50 volts in series, each lamp being provided with a short-circuiting device. For house lighting, the voltage is reduced to 100, by transformers placed in houses or in substations. The price for the kw-hour is small compared with the high price for fuel; it is 14 cents, no rent being charged for the meters; the running cost of the plant is scarcely paid for, but the government is rich. In this case electric light is cheaper than kerosene, and the number of connections therefore steadily increases. Some load curves are reproduced.—*Elek. Zeit.*, August 21.

ELECTRO-PHYSICS AND MAGNETISM.

Rule of Maxwell.—BARY.—An article on Maxwell's rule, stating that any circuit traversed by a current tends to move and to deform in such a way that the flux which it surrounds becomes a maximum. He remarks that this rule is not always applicable in this form, and should be stated as follows: any current-carrying circuit tends to surround the maximum possible external flux and to assume a maximum coefficient of self-induction.—*L'Ind. Elec.*, August 25.

REFERENCE.

Terrestrial Magnetism.—The September issue contains a paper in German, by Nippoldt, on the meteorological nature of the variations of terrestrial magnetism; a note by Beattie on work in terrestrial magnetism and atmospheric electricity in South Africa; an article by Hyde on Wilson's account of Gibbs's vector analysis; two notes in French, by de Moidrey, on the amplitude of the daily oscillation of the magnetic declination and its monthly inequality, and on the secular variation of the declination at Zi-Ka-Wei, China; a biographical sketch, with portrait, of Sir Edward Sabine; a note by Hallock on the magnetic deflection of long steel wire plumb

lines, and a note by McNair on the divergence of long plumb lines at the Tamarack mine.—*Terr. Mag.*, September.

Electro-Chemistry and Batteries.

Copper Plating.—A description of the Dessolle process of copper plating, in which the electrolyte is projected under pressure against the metallic object and the anodes. The cleansed articles are placed in a preparatory "adhesion bath," and subjected to the action of a current of 30 amperes per square meter.. They are then immersed in the principal bath, in which jets of the liquid are driven against the surface and that of the anodes, which effects the removal of gas and impurities from the bath and enables a strong current to be used, so that a perfectly smooth deposit of copper is obtained. A deposit of 1/10 mm. is obtained in 1½ hours without prejudicial effect. The price of plating metals with a good deposit of copper does not exceed two francs per kilogramme of deposit, but the economic advantage of the Dessolle process is that there is perfect adhesion of the deposit, which can be made thicker and yet be durable.—*Jour. Soc. Chem. Ind.*, abstracted in Lond. *Elec.*, October 3.

Electrolytic Reduction of Nitric Acid.—Tafel.—An investigation of the alterations which nitric acid will undergo by electrolysis in the neighborhood of the cathode, considerable amounts of sulphuric or hydrochloric acid being present. A reduction will occur with most cathodes, but these are exceptions, as, for instance, platinum. The mean products of this process are ammonia and hydroxylamine, whose ratio depends on a whole series of factors, and varies to a high degree.—*Zeit. f. Anorgan. Chemie.*, 31, 3, p. 289, 1902; abstracted in *Science Abstracts*, September.

references.

Cathodic Polarization in Dilute Sulphuric Acid.—Tafel.—A German Bunsen Society paper on a method of measuring the polarization at cathodes of different materials, analogous to Caspari's method of the over-voltage required to develop hydrogen at cathodes of different materials. Caspari found that of the metals investigated in pure sulphuric acid, lead and mercury show the highest over-voltage; these are the same metals which Tafel found to be the only suitable cathode materials for producing certain reductions. Tafel uses comparatively high current densities, and as anode a bright platinum pan, filled with sulphuric acid, in which the cathode is suspended in a fixed position. He says this method enables one to measure the polarization with an exactness of some thousandths of a volt.—*Zeit. f. Elektrochemie*, August 21.

Hypochlorous Acid.—Luther.—A German Bunsen Society paper, in which he shows that, on the basis of the measurements of Jakowkin on the hydrolysis of chlorine in aqueous solutions, it is possible to predetermine theoretically the electromotive behavior of hypochlorous acid. He makes some critical remarks on a recent experimental investigation of Mueller on the same subject.—*Zeit. f. Elektrochemie*, August 21.

Units, Measurements and Instruments.

references.

Electrometer.—Grimsehl.—An illustrated description of a very sensitive aluminum foil electrometer. In general it is similar to Kolbe's electrometer, but differs from it in essential details.—*Phys. Zeit.*, September 15.

Earth Inductor.—Chabot.—A brief illustrated description of a rotating earth inductor, in which the uncertain sliding contacts are entirely eliminated.—*Phil. Mag.*, October.

Miscellaneous.

reference.

Electric Ignition.—Soulier.—An illustrated article on the electric ignition of gas engines on automobiles.—*L'Ind. Elec.*, September 10.

Uralite.

Uralite is described by Mr. O. J. D. Hughes, U. S. Consul at Coburg, Saxony, as a new fire-proof and insulating material. It is composed of asbestos fibre with proper proportions of silicate and bicarbonate of soda and a small amount of chalk. It is the invention of a Russian artillery officer and chemist named Imschenetzky. The tests described are quite striking.

New Books.

William Gilbert, of Colchester. A Sketch of his Magnetic Philosophy. By Charles E. Benham. Colchester: Benham & Co. 96 pages.

This handsome little pamphlet is particularly opportune in view of the renewed interest in the Colchester physician from the recent publication of the Gilbert Club translation of his works; indeed, the author intimates that his little book is intended as complementary to this translation, its object being to give a popular sketch of Gilbert and his philosophy.

The author says we must not look to Gilbert as a great man of science in the sense of one having a genius for research. While he corrected undoubtedly a few glaring cases of "bad observation" on the part of other investigators, his own experiments were extremely crude, and he was not always specially accurate. It is true he stands high above all contemporaries in England in the field of physical science, but what he laid the foundation of was not so much electricity as the way which magnetics and electrics ought to be studied. In other words, he was not so much a builder of science as the architect of a truly scientific spirit. His life work consisted in the doctrine, new to England, that all scientific knowledge must be founded on practical experiment and observation alone, instead of on speculations and theories evolved out of inner consciousness—a principle in which he anticipated Lord Bacon.

It is this aspect of Gilbert—as the discoverer of true methods of investigation rather than of unknown facts and phenomena—that the author presents. The titles of the several chapters are as follows: The old magnetic philosophy; the first book of "De Magnete"; magnetic motions and electric force; the magnet's directive virtue; the variation of the compass; the dip, "orbs of virtue" and the "life of the universe"; the Copernican theory.

While in warm sympathy with his subject, the author is not chary of criticism of some parts of Gilbert's great treatise, particularly the occasional inconsistent relapses into the metaphysical speculation so severely condemned in others. An interesting fact is noted that Galileo came into possession of "De Magnete" through having a copy given him by a "Peripatetick philosopher of great fame," who desired "to free his library of contagion." It may be added that Gilbert became the champion in England of Copernicus's "heretical" theories a generation before Galileo wrote the celebrated "Diologo." It is also interesting to learn that from a philosophical club which Gilbert founded in London, the Royal Society sprang.

books received.

Reference Library of Modern Engineering Practice—Steam, Electricity, Mechanics. Illustrating and Explaining the Theory, Design, Construction and Operation of all kinds of Machinery. By Frank W. Gunsaulus, President Armour Institute of Technology, and 25 collaborators. Chicago: American School of Correspondence at Armour Institute of Technology. Ten Volumes. About 4,000 pages and 2,000 illustrations. Price, $40.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary Ralph W. Pope, 95 Liberty Street, New York. Next meeting Oct. 24, paper by C. P. Matthews on "An Integrating Photometer for Glow Lamp and Sources of Like Intensity."

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903

Northwestern Electrical Association, Secretary, Thos. R Mercein, Milwaukee. Wis.

Old-Time Telegraphers' and Historical Association, Secretary, John Brant, 195 Broadway, New York.

The Electrical Trades Society (member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Electric Storage Battery Locomotives.

By Thos. J. Fay.

In industrial service the trolley type of locomotive is objectionable primarily because the trolley wire is more or less a nuisance and generally in the way of traveling cranes and other labor-saving devices, while the fire risk is greater than the average mill owner cares to consider, particularly in the case of cotton and flour mills. In a coal mine a trolley locomotive is quite out of the question, and, indeed, we may also consider this to be true of the storage battery type as ordinarily constructed; but storage battery locomotives can be made safe in mining work by a plan which the writer has had in mind for some little time. This consists in employing a motor of the enclosed type submerged in oil, the battery and all its connections also being in a bath of oil.

It is as far back as the year 1887 that the writer, who was at the time superintendent of the Brooklyn Incandescent Electric Light Company, then using the Knowles storage battery system, experimented with storage batteries submerged in paraffine oil. As the oil was lighter than the electrolyte, there was no displacement of the latter; and since the oil did not come into contact with the elements, there was no electrolytic splitting up of the oil into its components. A fractured strap or a broken cross bar of an element with its attendant "arc" would not produce an explosion (assuming an explosive atmosphere), because of the presence of a layer of oil separating the "arc" from the atmosphere; and, besides, the oil "dampens" the arc, thus practically preventing the occurrence of the phenomenon. Finally, it may be well to point out that the cost of the oil required is a matter of no moment, and as to the added weight, we have but to remember that weight means tractive adhesion, of which we can obtain no more than enough even if we employ the heaviest battery and a locomotive of considerable weight, provided, of course, ballasting is not resorted to. Thus, unlike in the case of the automobile battery, weight is necessary to the success of the locomotive, and the rate of discharge is, comparatively speaking, low. Moreover, a long life is only assured by the use of the more substantially constructed central station types of battery, the first cost being a matter of minor consequence, provided the results realized are thoroughly good.

This is assured if the following conditions prevail—namely, the weight on the drivers must be that which will permit of skidding of the wheels before the battery reaches a dangerous rate of discharge, assuming the most favorable condition of rail adhesion—namely, a sanded track.

There are numerous other conditions governing the service that can safely be rendered by a given locomotive, such as relate to curves,

FIG. 1.—A FRENCH TYPE OF LOCOMOTIVE.

grades, track conditions, etc. The following actual tests of an electric storage battery locomotive, under conditions as stated, will illustrate the effect of gradient on battery capacity.

The weight of locomotives was 9,120 lbs., or 1,140 lbs. on each of the eight drivers. The trucks were of the radial type. The cars weighed 5,000 lbs., making a total weight of 14,120 lbs. The battery consisted of 44 cells of 9E chloride cells, and there were two 80-volt motors. The average e. m. f. was 85 volts. The current in amperes was as follows:

On a level	26	amperes.
On a 1 per cent. grade	29.4	"
On a 2 per cent. grade	33.1	"
On a 3 per cent. grade	37	"
On a 4 per cent. grade	40.8	"
On a 5 per cent. grade	44	"
On a 6 per cent. grade	47.5	"
On a 7 per cent. grade	50.6	"
On an 8 per cent. grade	53.7	"
On a 9 per cent. grade	57	"

The speed varied from 264 feet per minute on a level to 176 feet per minute on a 9 per cent. grade. The motors were series wound, two in parallel. All battery cells were in series.

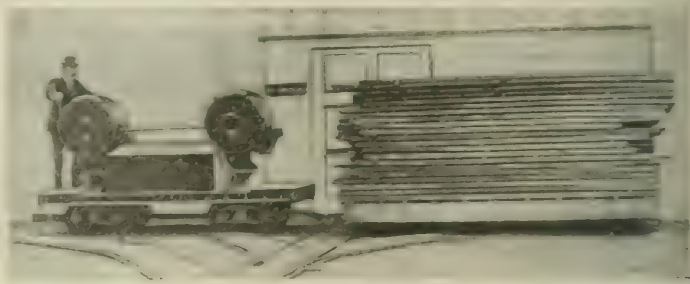


FIG. 2.—SHOP LOCOMOTIVE.

In another test with the same locomotive, all conditions were as before, excepting that the total load was increased to 30,000 lbs. The current in amperes was then as follows:

On a level	34.75	amperes.
On a 1 per cent. grade	39	"
On a 2 per cent. grade	44.5	"
On a 3 per cent. grade	48	"
On a 4 per cent. grade	53.3	"
On a 5 per cent. grade	57.5	"
On a 6 per cent. grade	61.5	"
On a 7 per cent. grade	66	"
On an 8 per cent. grade	99	"
On a 9 per cent. grade	72	"

The speed varied from 209 feet per minute on a level to 135 feet per minute on a 9 per cent. grade.

In a third test with a total load of 45,000 lbs. the current on a level was 42 amperes for a speed of 142 feet per minute. In a fourth test with a total load of 100,925 lbs, the current on a level was 70 amperes, with a speed of 80 feet per minute.

The capacity of the battery on a three-hour basis was 210 ampere-hours, so that the locomotive hauling 100,925 lbs. (total load) on a level, at a speed of 80 feet per minute, was doing its maximum safe work. The locomotive tested, which is illustrated in Fig. 2, was manufactured by the C. W. Hunt Company, under the direction of the writer. This locomotive, unlike conventional types, is so designed that the driving motors with their speed-reducing gear cases are located on upward projecting saddles above the platform of the locomotives, and by means of "Renold" chains the power is transmitted to the four driving axles. The gear cases, one at each end, are of agreeable appearance. The internal arrangement of the gearing is as shown in Fig. 3. This arrangment of gearing and motors is such that the trucks are truly radial, and with wheel base centers approximating 38 inches.

The locomotives will turn a curve of 12 feet radius with scarcely any increased energy consumption. A result such as this will appeal to even a casual observer, for it has been fully demonstrated on more than one occasion that an ordinary 40-foot, rigid wheel-base locomotive will leave the track almost every time, with a radius of curvature of more than double 12 feet, when running at even a very low speed. It is a fairly established fact that the radius of curvature for a rigid wheel base locomotive must be not less than six times the rigid wheel base centers, and for a 13-foot platform it would not be even allowable practice to space the wheels less than 4 feet 6 inches apart, giving $4.5 \times 6 = 27$ feet radius of curvature of the track. Fig. 4 illustrates an experimental 4-foot driver, rigid wheel-base locomotive. That this locomotive would serve in cases where the track is straight is fair to presume, but not in cases involving curves of short radius.

In concluding this part of the subject it is well to point out that the locomotive requiring the least expenditure of energy with a given load and speed on a given curve will run most free on a tangent, and afford more adequately protection to the battery against undue discharges, besides assuring a greater radius of action per battery charge;

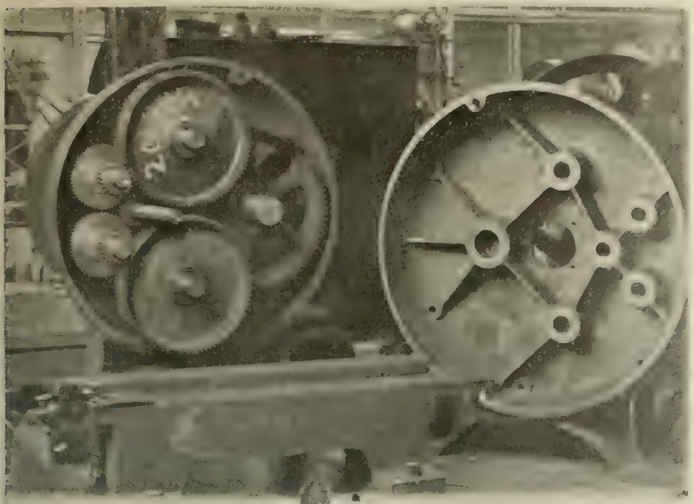


FIG. 3.—GEAR REDUCTION.

or what amounts to the same thing, a given radius of action for a less first cost of battery, although it is the writer's judgment that a liberal weight of battery is the best guarantee of long life and a satisfactory performance throughout that life.

That first cost is a matter of minor concern may be realized by reference to the following case: The operator of a cotton mill, who could not use a steam locomotive because of the fire risk, and would not employ a trolley locomotive for the same reason, has for a long time employed about 30 spans of horses in hauling raw material to his mill —about a mile—and finished product to the freight station. It is safe to assume that the first cost of his equipment is not less than $20,000, and it is equally safe to say the depreciation is 20 per cent.; so that, by purchasing a storage battery locomotive of 15 tons weight, capable of displacing his entire animal equipment, at a first cost to him of not over $10,000, he took no risk whatever. The locomotive will do all the work and employ no more than two men, whereas the animal equipment requires from 20 to 35 men. Moreover, with so many teamsters, labor trouble alone is a factor. The depreciation of the locomotive will not, in any case, exceed $1,000 per annum, but even

FIG. 4.—STORAGE BATTERY LOCOMOTIVE.

at double that amount, the cost of maintenance would be a mere incident.

Fig. 5 illustrates a 15-ton, storage battery locomotive, the general data of which are as follows: Length over all, 22 feet 6 inches; width over all, 8 feet; wheel-base centers, 8 feet 6 inches; total weight, 15,000 lbs.; battery, 48 cells, about 500 ampere-hours at an 8-hour rate; motor equipment, two 15-hp railway motors. The battery is arranged in two divisions, set up in lead-lined tanks, as shown in the plan (Fig. 6), which gives details of the connecting straps and cover. The height over all can be any desired amount, 20 inches being an excellent value. The cells are arranged in two lead-lined suitably drained and ventilated boxes, with top covers and stone insulating rests and porcelain spacers for the jars.

The motors are connected to reducing gear cases in the cab, where they are under the eye and immediate care of the motorman, the power being transmitted to the drivers by means of "Renold" chains. The rolling stock, etc., are all standard. The driving wheels are 33 inches in diameter. The speed of the locomotive was designed to be 352 feet per minute, maximum. The battery and its accessories amounted to about one-third of the total weight, and costs about 25 per cent. of the selling price. This locomotive is designed to operate on the standard broad-gauge track (4 feet 8½ inches), and will handle with ease two "Mark Hanna" coal cars, making a total load of about 175 tons. For good work it is generally a safe assumption that this type of locomotive is a better paying venture than a steam switching engine. One man (not a licensed engineer) can run the locomotive, and, besides, there is no "firing up" to do, no steam gauge to watch, no water to "pump up," and, last but not least, the locomotive is always ready. The charging being done on the "floater" system is automatic and done at odd times when the locomotive is standing idle.

The battery output in work of this class will be about as shown in the accompanying table, but will vary with conditions. The actual total output in a day, under the average conditions will never, it is thought, equal the battery capacity. Locomotives in industrial service are never called upon to work continuously.

Battery Output in Watts per Ton-Mile, Dry Track.

Level	112	watts.
1 per cent. grade	192	"
2 per cent. grade	272	"
3 per cent. grade	392	"
4 per cent. grade	472	"
5 per cent. grade	552	"
6 per cent. grade	632	"
7 per cent. grade	712	"
8 per cent. grade	792	"
9 per cent. grade	872	"
10 per cent. grade	952	"

At this rate the locomotive alone would take 14,280 watt-hours per hour from the battery on a 10 per cent. grade, at a speed of one mile per hour; thus the battery would be exhausted in four hours in mounting a 10 per cent. grade at that speed. It is plain that gradient is the bane of the battery, and a nearly level track is much to be desired. The speed of one mile per hour is fast enough, in practice, for this kind of work, drawing a full load; when running light on a level, with suitably designed series-wound motors, the speed will be

FIG. 5.—FIFTEEN-TON LOCOMOTIVE.

about four miles per hour, and it is now a fully established fact that for industrial service, to run at a greater speed is a hazard.

The speed control of shop locomotives is a matter of some moment, and a matter that the writer arrived at rather more by experiment than otherwise. Following are the data of a test made on a 5-ton "Hunt" shop locomotive, built for use in the shops of the Westinghouse Electric and Manufacturing Company, a view of which is given in Fig. 7.

With the locomotive only, on a level, first notch, the current was

11 amperes, and the speed 1.2 miles per hour; second notch, 18 amperes, 3 miles per hour; third notch, 30 amperes, 5.5 miles per hour. With the locomotive and 9 tons of car load on a level, at first notch the current was 15 amperes and the speed 1.1 mile per hour, second notch, 37 amperes, 2.8 miles per hour; third notch, 72 amperes, 5 miles per hour. With the locomotive and 20 tons of car load on a

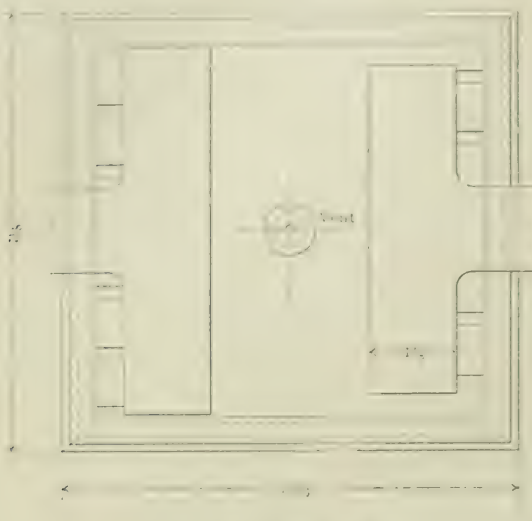


FIG. 6.—BATTERY BOX

level, at the first notch the current was 16 amperes, and the speed .95 mile per hour; second notch, 40 amperes, 2.6 miles per hour; third notch, 90 amperes 4.3 miles per hour.

The battery consisted of 48 cells of chloride and tested 96 volts on open circuit, and at a discharge rate of 40 amperes the battery registered 90 volts. The locomotive was equipped with two Westinghouse vehicle type motors, wound for 75 volts. The speed, on the whole, is too high for service in the usual run of shops; the speed control, however, proved to be very satisfactory, and for the Westinghouse shops (covering an unusual area), the speed realized was very acceptable. This small locomotive is sometimes used to haul a standard broad-gauge freight car, and does the work with ease, the narrow-gauge tracks on which the locomotive runs being laid between the broad-gauge tracks that connect the main line of the P. R. R. with the shops.

A draw-bar pull test of this locomotive showed the pull starting to be 1,200 pounds; running on curve of 12-foot rad, 600 opunds; running on a tangent, 400 pounds. The total load of the locomotive was 10,000 lbs., and that of the ten cars and load, 14,000 lbs., or a total of 24,000 lbs. This is not a test showing the limit of draw-bar pull,

FIG. 7.—FIVE-TON SHOP LOCOMOTIVE.

but rather a test showing the resistance offered by the stated load. As a matter of fact, a 5-ton locomotive might under fair conditions be expected to perform about as follows:

On a level track, 1 per cent. grade, 2 per cent. grade, 3 per cent. grade, 4 per cent. grade and 5 per cent. grade, the pull at the drawbar would be 1,300 lbs., 1,200 lbs., 1,100 lbs., 1,000 lbs., 900 lbs., and 800 lbs., respectively. This is the running drawbar pull, in pounds; the starting pull being somewhat more and limited by the wheel slip.

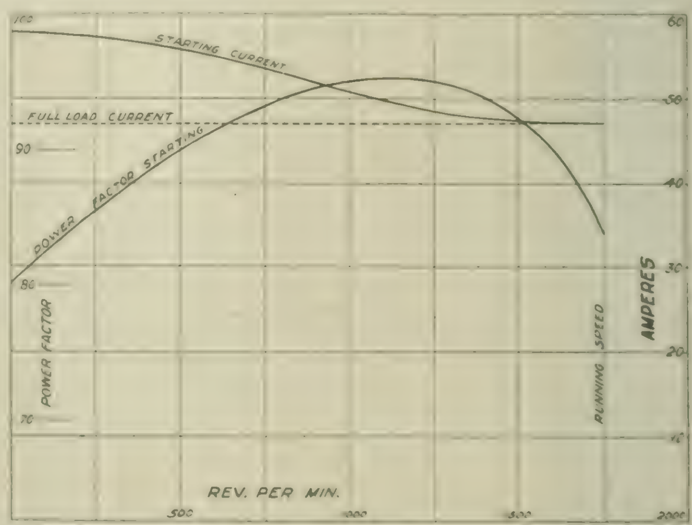
The track is an important adjunct in industrial railway work, and it is safe to say that the rails should be no lighter than the following: For a 3-ton locomotive, 12 lbs. per yard; 5-ton locomotive, 16 lbs. per yard; 7½-ton locomotive, 20 lbs. per yard; 10-ton locomotive, 24 lbs. per yard. Rails lighter than 12 lbs. per yard should not be used at all. Locomotives heavier than 10 tons will scarcely ever be required in industrial service. The spacing of ties should be close if a good track is desired, and the "ballast" might best be of broken stone, well tamped.

There are numerous other matters of interest in connection with this phase of industrial progress, not now to be mentioned for lack of space, the object of this article being to present real practical data bearing on the questions of speed, hauling capacity and energy consumption of storage-battery types of locomotives.

Holding Down the Starting Current of Single-Phase Motors.

One of the great objections to the installation of alternating-current motors on general service circuits has been the abnormal starting current and the low power factor of this starting current. This objection has existed with both the polyphase and single-phase motors. The builders of both forms of motors have sought to minimize the difficulty by the use of auto-transformers in starting, thus reducing the voltage applied to the motor, and in consequence thereof the starting current.

The Wagner Electric Manufacturing Company have just announced in connection with its single-phase motors, the introduction of a line of non-inductive starting rheostats, the use of which not



CURVES OF STARTING CURRENT AND POWER FACTOR.

only eliminates the objectionable starting current, but also performs the very desirable function of running the power factor of the starting current to a very high point. The accompanying diagram illustrates the effectiveness of the use of such a starting device, the curves referring to a 7½-hp motor operating at 208 volts and 60 cycles. It will be observed that the starting current at no time exceeds the running current by more than 25 per cent. for full-load starting torque. The power factor of the starting current also is never less than the power factor of the running current, and throughout a great part of the starting range it is very much higher than the running power factor.

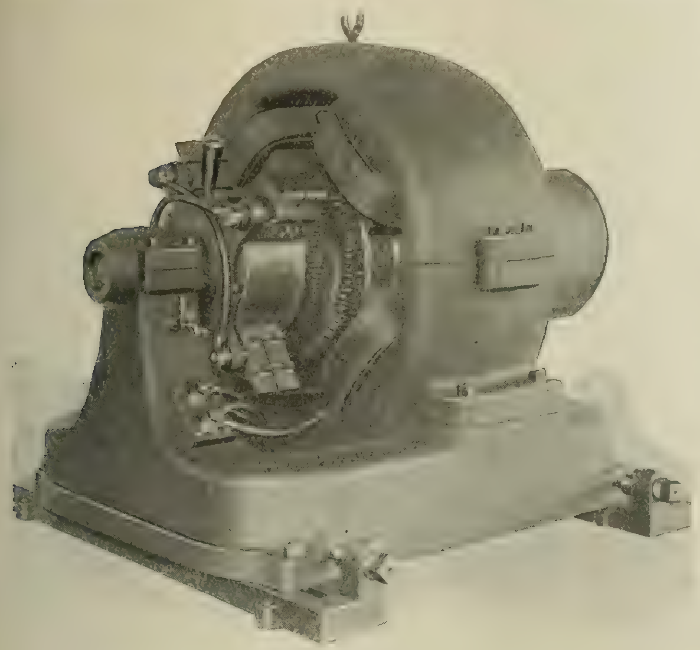
The starting rheostats by which this improvement is accomplished are ordinary non-inductive boxes, corresponding in practically every respect to the starting boxes for direct-current motors. They are practically supplied without the automatic spring release, the object of this omission, as compared with the direct-current starting boxes, being to avoid the shutting down of the motor in case of circuit switching at the central station. The motors of the Wagner Company may be started with or without these boxes, the ability to do so arising from the fact that the motors are entirely automatic in every respect.

In the smaller sizes, the majority of central stations prefer to install single-phase motors of the Wagner Company's type, without auxiliary starting devices of any kind. It will prove of advantage, however, with the larger motors, to use the rheostats; and as their use does not entail any large additional cost, it is likely that the

installation of such motors with rheostats of larger sizes will find very general application. These rheostats are connected in the supply circuit, between the main switch and the motor.

Federal Multipolar Belted Generator.

The multipolar belted generator, shown in the cut herewith, is made by the Federal Electric Company, Erie, Pa., the winding being either compound or shunt wound. The poles are of laminated soft



MULTIPOLAR GENERATOR.

steel, with removable pole shoes. The pole shoe supports the field coils, which are also removable. The armature is iron-clad, wound with formed coils. The dynamo is mounted on sliding rails, having adjusting screws for tightening the belt. These machines are made in sizes of 23, 33, 40 and 60 kw, slow speed. The same type is made for moderate speed, with poles of laminated soft steel and removable pole shoe. The pole shoe supports the field coils, which are easy of access and removable. The armature is iron-clad, wound with formed coils. The machines are mounted on sliding rails, having adjusting screws for tightening the belt, and are made in sizes of 30, 45, 55 and 70 kw.

Guy Anchor.

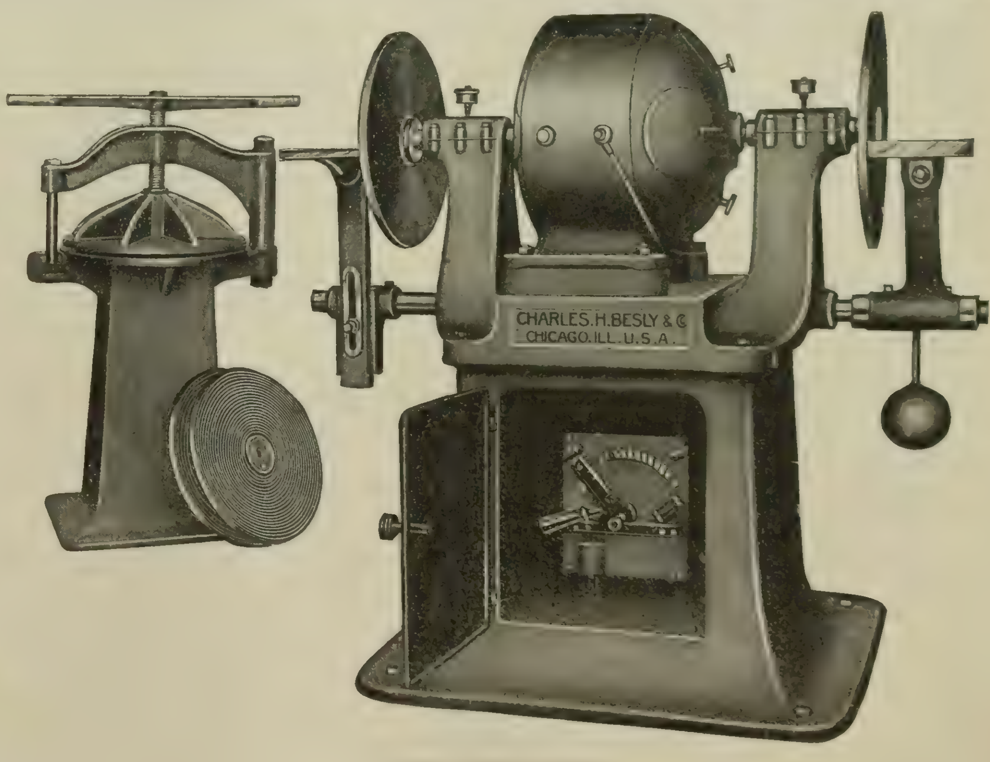
The two illustrations below show a guy anchor which is in considerable use, particularly in the West, and made by W. N. Matthews & Bro., Security Building, St. Louis. Two types of the anchor are shown, that of Fig. 1 being employed for straight line guying and on curves where there is not a great strain. Fig. 2 shows a larger type, which is employed for heavy dead-ends and corner strains, and for smoke pipes, bridge and trestle work where a great strain is encountered. Either anchor can be placed into position without digging, filling or tamping, and as they are practically in one piece, it is claimed that they will last indefinitely. Actual tests with a 5-inch anchor of the smaller type, which has a ⅝-inch wrought-iron rod, showed that a pull of 8,000 lbs. was necessary to draw it from its position from a hole bored three feet into sandy soil, and a correspondingly greater strain when bored into clay. This pull is 3,000 lbs. greater than the breaking strain of a ⅜-inch stranded guy. A 12-inch guy anchor withstood a pull of 36,000 lbs. when bored into five feet of clay. The reason that so great a pull is required to withdraw these anchors is because they are bored into the ground without otherwise disturbing it, in much the same manner that a wooden screw is put into a board.

FIGS. 1 AND 2.—GUY ANCHORS.

Motor-Driven Grinder.

The accompanying illustration shows a motor-driven Gardner grinder, manufactured by Messrs. Charles H. Besly & Co., Chicago, Ill., for the United States Mint, at Philadelphia, and driven by a 5-hp Crocker-Wheeler motor.

Gardner grinders are in use in many large manufacturing shops, among which may be mentioned those of the Allis-Chalmers Company, the Bullock Electric Company and the Northern Electric Company. These machines may be direct-connected to the motor, as in the example shown, or driven from line shafting. In the machine illustrated, the controlling apparatus is contained in the base where, when the door is closed, it is protected. The motor is mounted between the two grinding-wheel bearings, thus giving a firm construction.



MOTOR-DRIVEN GRINDER.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 6 per cent. for all dates, the tendency of the market, on the whole, being in the direction of improvement. There was renewed activity and strength of the stock market as a result of the settlement of the coal strike and the easing off of money rates. The anthracite stocks naturally advanced, but the improvement extended throughout the entire list. The United States Steel stocks, after a decline in both common and preferred, rallied from renewed inside support. All of the electric and traction stocks showed substantial gains, as noted below. Brooklyn Rapid Transit closed at 64¼, which was only ¼ point below the highest figure of the week, representing a gain of 2⅜ points. Metropolitan Street Railway made a net gain of 5 points, closing at 141½, the lowest quotation being 135. The sales of this stock aggregated 19,800 shares. On transactions of 11,600 shares, General Electric made a net gain of 11¼ points, closing at 188½, which was the highest figure of the week, the lowest being 170. Westinghouse, common, kept at 217, which represents a net gain of 5½ points, while first preferred receded 10 points, closing at 215. Western Union closed with a net gain of ⅞ points, at 92½; Commercial Cable closed at 175, a net gain of 4½ points, and American District Telegraph at 40, a net gain of 1½ points. American Telephone and Telegraph lost 1½ points net, closing at 162; 625 shares of this stock were dealt in. Following are the closing quotations of October 21:

NEW YORK.

	Oct. 14.	Oct. 21.		Oct. 14.	Oct. 21.
American Tel. & Cable	92	92	General Electric	181	187
American Tel. & Tel.	163	164½	Hudson River Tel.	—	—
American Dist. Tel.	37	39⅝	Metropolitan St. Ry.	138	139¾
Brooklyn Rapid Transit	62	63	N. E. Elec. Veh. Trns.	—	⅜
Commercial Cable	—	—	N. Y. & N. J. Tel.	—	162
Electric Boat	23	28*	N. Y. E. V. T. Co.	12¼	13¼
Electric Boat pfd.	35	45*	Tel. & Tel. Co. Am.	—	—
Electric Lead Reduc'n.	3¼	3⅜	Western Union Tel.	90⅞	91¼
Electric Vehicle	4	5	West. E. & M. Co.	210	210
Electric Vehicle pfd.	9	13			

BOSTON.

	Oct. 14.	Oct. 21.		Oct. 14.	Oct. 21.
American Tel. & Tel.	163½	165	Western Tel. & Tel. pfd.	—	100½
Cumberland Telephone	—	—	Mexican Telephone	2	2¼
Edison Elec. Illum.	—	—	New Eng. Telephone	135	139
Erie Telephone	—	—	Westinghouse Elec.	104	108½
Western Tel. & Tel.	—	—	Westinghouse Elec. pfd.	104½	108½

PHILADELPHIA.

	Oct. 14.	Oct. 21.		Oct. 14.	Oct. 21.
American Railways	—	—	Phila. Traction	98	98½
Elec. Storage Battery	—	—	Phila. Electric	$8^{11}/_{16}$	8⅝
Elec. Storage Bat'y pfd.	—	—	Pa. Elec. Vehicle	—	1
Elec. Co. of America	9¼	9½	Pa. Elec. Vehicle pfd.	—	—

CHICAGO.

	Oct. 14.	Oct. 21.			
Central Union Tel.	—	—	National Carbon pfd.	99	99½
Chicago Edison	—	—	Northwest Elev. com.	—	—
Chicago City Ry.	210	212	Union Traction	17	17¼
Chicago Tel. Co.	—	—	Union Traction pfd.	49	50
National Carbon	31⅞*	30			

* Asked

BOSTON EDISON ANNUAL.—The annual report of the Edison Electric Illuminating Company, of Boston, for the year ended June 30, 1902, is issued. The operations of the company for the last two fiscal years are given in the following table, and include, for the sake of comparison, the Boston Electric Light Company and the Suburban Light and Power Company.

	1902	1901		Changes
Gross	$2,460,158	$2,367,359	Inc.	$92,799
Expenses	1,510,427	1,449,629	Inc.	60,798
Net	$949,731	$917,730	Inc.	$32,001
Other inc.	25,981	13,948	Inc.	12,033
Total inc.	$975,712	$931,678	Inc.	$44,034
Int. and divs.	859,614	879,285	Dec.	19,671
Surplus	$116,098	$52,393	Inc.	$63,705

Lamps and motors connected as of June 30:

	1902	1901	1900
Incandescent lamps	437,834	247,935	211,471
Arc lamps	8,448	2,503	2,131
Motors, horse power	19,139	10,651	9,428

Of the increase shown for the fiscal year just closed 112,754 incandescent lamps, 5,128 arc lamps and 5,408 horse-power of motors were added in the purchase of the Boston Electric Light Company, and 22,812 incandescent lamps, 350 arc lamps and 772 hp of motors were added in the purchase of the Suburban Light and Power Company, showing an increase in new business for the year of 58,533 incandescent lamps, 561 arc lamps and 2,299 hp of motors.

Assets:	1902.	1901.
Installation	$11,951,626	$5,708,660
[illegible] wharf	225,912	225,912
Cash on hand	165,914	64,557
Stock on hand	361,160	78,440
Notes and accounts rec.	246,778	121,366
Open accounts	37,613	88,152
Total	$12,989,005	$6,286,487
Liabilities:		
Capital stock	$7,850,400	$4,310,500
Tr. mort. bonds	[illegible]	180,000
Notes and accounts paid	1,247,789	792,177
Dividends payable	[illegible]	107,762
Install. new stock	......	......
Res. for maint.	654,000	506,000
Sundry open accounts	.	41,493
Premium on new stock	1,660,387	333,535
Accrued interest and taxes	[illegible]	......
Profit and loss	[illegible]	15,109
Total	$12,989,005.	$6,286,487

During the year the purchase of the Boston Electric Light Company was completed. The affairs of the Boston Company came under the management of this company early in October of last year. The acquisition of the Suburban Light and Power Company was also decided upon during the year, and all the property and assets of that company were purchased for cash, and its affairs turned over to this company in September of last year. Property was purchased in Central Square, East Boston, and in Roxbury, for two additional substations, and suburban offices were opened in East Boston, Dorchester and West Roxbury.

BIG TELEPHONE MORTGAGE.—Capitalists of Baltimore, Washington and New York City have recorded a blanket mortgage of $100,000,000, covering all the property of the International Telephone Company of America, to the Trust Company of the Republic. The International Telephone Company is a concern recently incorporated in Delaware. Its officers, as stated in the incorporation papers filed by Josiah Manvel, as attorney, at Wilmington, on May 15 last, are: President, S. B. Rhinehart, a banker, of Waynesboro, Pa.; treasurer, Ehlem B. Harrison, of Baltimore; secretary, Henry F. Fahey, of New York, and assistant secretary, J. Miller Kenyon, of Washington, D. C. On September 25 the same attorney had a deed of trust recorded at Wilmington for $1,000,000, to secure an issue of bonds amounting to $100,000,000, said to have been chiefly underwritten by New York, Baltimore and Washington capitalists. It was stated that the company expects to enter the telephone business as a rival to the Bell system, and hopes to place the cost of telephone calls at as low a rate as that charged for mailing a letter. The fees to be paid the State of Delaware for incorporating the company were said to approximate $30,000. The Trust Company of the Republic is a new company, organized March 28. Its directorate includes George J. Gould, former Controller of the Currency James H. Eckels, Stuyvesant Fish, Thomas D. Crimmins, Perry Belmont, George C. Boldt and other prominent capitalists.

DIVIDENDS.—The directors of the American Light and Traction Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable November 1. A semi-annual dividend of $3.50 has been declared on the preferred stock of the United Electric Securities Company, payable November 1. The directors of the Columbus Railway Company have declared the regular quarterly dividend of 1¼ per cent. on the preferred stock, payable November 1. The directors of the International Steam Pump Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable November 1. The Edison Electric Illuminating Company, of Boston, has declared a regular quarterly dividend of 2½ per cent., payable November 1. The regular quarterly dividend of 1½ per cent. on West Chicago Street Railway, guaranteed by the Union Traction Company, has been declared.

GENERAL ELECTRIC RIGHTS.—A special from Boston announces that General Electric stockholders will probably be the recipients of valuable rights in connection with a new company which is being formed by General Electric interests to take over the Curtis steam turbine patents, which it has developed into a commercial success. Stockholders will probably be given the right to subscribe to this new stock, pro rata, in proportion to their present holdings.

GENERAL CARRIAGE TROUBLES.—Mr. O. F. Thomas, receiver for General Carriage, says he is preparing counter suits against Mr. Joseph Leiter and Mr. Joseph H. Hoadley, to force them to account for $20,000,000 in stock of the Carriage Company and for its charter.

ELECTRIC RAILWAY STOCK INCREASES.—Dispatches from St. Louis state that the St. Louis and Suburban Railway has voted to increase its capital from $3,000,000 to $7,500,000, and to issue $7,500,000 bonds. Approval by the Massachusetts Railroad Commissioners is noted of the issue of $948,700 additional stock by the Old Colony Street Railway, and a similar increase by the Boston and Northern Street Railway. Current reports are that the capital stock of the New York and Port Chester Railroad Company is to be increased from $250,000 to $12,000,000.

BELL IN NEW YORK.—An officer of the Bell Telephone Company is quoted as saying: "The report that several independent telephone companies, including Keystone, have planned to enter New York City in competition with the Bell Company cannot be considered in any other light than a fairy tale by those who are posted on the present New York situation. No company could possibly compete with Bell in New York without first laying a complete system of conduits. The installation of such a system in New York would cost at least $10,000,000. We have now about 81,000 telephones in New York, and there, as here, we have not a single pole line in the city proper. People do not seem to be able to comprehend that pole telephone lines in the largest cities are now practically unknown."

Commercial Intelligence.

THE WEEK IN TRADE.—In the settlement of the coal strike, the only unfavorable feature in general trade and industry disappears. All other trade developments of the week were favorable, says *Bradstreet's*. Retail trade has generally improved in most all sections, and jobbing demand is also better, particularly in the West, where reorder business is noted in larger volume than usual. Country collections have been good, and money has tended to ease up, particularly in speculative circles. The strength of the cereals is a noteworthy feature in the general situation. Business is improving on the Pacific Coast, and Southern trade advices are more cheerful. Improvement in the iron trade, as a result of the probable settlement of the coal strike, is as yet a matter of sentiment, but with the free movement of coal, eastern iron furnaces now banked are expected to resume operations. No loss of strength is shown in heavy goods; in fact, the tendency has been upward. Striking advances are shown in nearly all lines of iron and steel, as compared with a year ago. In finished materials similar heavy advances are noted, the exceptions being found in sheets, wire nails and tinplates, which are generally lower. In the copper market, business was at a standstill. Standard Lake sold at 11.75c., and electrolytic is quoted at 11.50c. @ 11.60c. The business failures for the week ending October 16, as reported by *Bradstreet's*, numbered 203, as against 170 the week previous, and 198 the corresponding week in 1901.

CHLORIDE BATTERY IN ENGLAND.—Soon after the incorporation of the Electric Storage Battery Company, in Philadelphia, a company was formed in England under the name of the Chloride Electrical Storage Syndicate, Limited. This company acquired all the patents and improvements, past and future, of the Electric Storage Battery Company, for the world—outside of the United States and Canada. Electrical development has been very slow in Great Britain, so that the company has only very recently reached a dividend-paying basis. That a vast amount of electrical work is to be done in Great Britain in the next few years is shown by the very large works put up by the British Westinghouse Company, the British Thomson-Houston Company, in Manchester and Rugby, by Dick, Kerr & Co., by Siemens Bros., and others. The Electric Storage Battery Company seeing the opportunity for a large and profitable business, not only in England but in other countries, where the low price of labor and material existing in Europe makes it possible to compete with storage batteries manufactured in America, decided to purchase control of the English company. This has been done, on a satisfactory basis, so that the Electric Storage Battery Company will now realize large profits from the English business, and will also be able to sell batteries in foreign countries and have shipments made from England. It expects thus to be in the very strongest possible position to handle the bulk of the business of the world.

TELEPHONIC PLANS.—A dispatch from Washington, D. C., of October 11, says: "The International Telephone Company, of Dover, Del., has bought the abandoned car barns of the Washington Traction Company, in Georgetown. The property embraces ten acres of land and several large brick buildings, which, it is said, the new owners intend to convert into shops for a telephone factory, with a capacity of 10,000 telephones a day. The matter is discussed here, and is significant of the truth of the great gossip going around of late about the formation of a corporation to control the telephone, electric light and street car service of Baltimore, Washington, Philadelphia and Wilmington, Del. It is said that the company will put in operation a telephone system that will fix a rate of two cents for telephone messages." This sounds like a "very large order."

THE ELECTRICAL EQUIPMENT COMPANY, Suite 939 Monadnock Building, Chicago, has been awarded a contract for the complete installation of a lighting plant for the City of Washington, Ia. The equipment includes a Westinghouse three-phase, 60-cycle generator, direct connected to an Ideal engine. Work is now under way, and the plant will be in operation about January 1, 1903. The same company has also been awarded a contract for the complete installation of a water-power electric transmission plant for the Rouge River Light and Power Company, at Rockford, Mich. The equipment includes two General Electric generators and various motors, ranging in size from 10 to 50 hp. The plant will be in operation December 1, 1902.

THE STEAM AND ELECTRIC EQUIPMENT CO., Pittsburg, Pa., reports for the past week the following orders: One Stirling boiler, 100 hp, sold Knott & Van Arnam Manufacturing Company; one 125-ampere generator, sold Ampere Electric Company; one complete installation, ventilating fans and Wagner motors for ventilating a large Pittsburg building. A consignment of motors sold to the Cohen Automatic Switch and Signal Company; Wagner alternating motor, 15 hp, sold to the Republic Beating Company, Akron, Ohio. They report business brisk.

BALL ENGINE ORDERS.—The Temple Court Building, of Denver, Colo., has recently put in operation a very complete electric plant. The engines, which were furnished by the Ball Engine Company, Erie, Pa., are direct connected to General Electric generators. The outfit furnishes power for both lighting and elevators. The John Deere Plow Company, Kansas City, Mo., has recently installed an electric plant, consisting of two Ball engines, direct connected to General Electric generators. A new electric plant has been put in operation at Wilburton, Indian Territory. The Ball Engine Company furnished the engine.

SPRAGUE ELECTRIC COMPANY.—The annual meeting of the stockholders of the Sprague Electric Company was held Tuesday, October 14, 1902, at the office of the company, in Watsessing, N. J. The following directors were elected for the ensuing year: Messrs. Allan C. Bakewell, D. C. Durland, S. M. Hamill, J. R. Lovejoy, John Markle, J. R. McKee and E. G. Waters. At a meeting of the directors, held later in the day, officers were elected as follows: President, Allan C. Bakewell; first vice-president, S. M. Hamill; second vice-president, D. C. Durland; secretary and treasurer, Harry R. Swartz.

THE ELECTRIC CARRIAGE CALL COMPANY has put its system in operation at the Metropolitan Opera House, and the device was so successful that the management has asked for a five-year contract. Since then it has closed contracts to install this apparatus at Daly's Theatre, Wanamaker's, Empire Theatre, Knickerbocker Theatre, Garrick Theatre, and through its agent, the National Electric Supply Company, of Washington, D. C., the New National Theatre and the Columbia Theatre. Orders come so rapidly that the factory is working day and night to get the apparatus out.

THE GOODALL WORSTED COMPANY, of Sanford, Me., is building a large addition to its present works, and has found it necessary to considerably enlarge the power plant. A recent purchase from the Westinghouse Electric and Manufacturing Company includes a 400-kw, two phase, alternating-current generator, which will be belted to an 800-hp Brown engine. The generator will furnish power to all departments of the plant by means of Westinghouse induction motors, and will also provide current through transformers for lighting at 104 volts.

THE ARNOLD ELECTRIC POWER STATION COMPANY, of Chicago, is acting as consulting engineer for the DeKalb-Sycamore Electric Company, of DeKalb, Ill., in the matter of rebuilding its central power plant to provide for its increasing business, and to furnish power for the interurban electric line now being constructed between DeKalb and Sycamore.

BROOKLYN SUBSTATION.—The Brooklyn Heights Railroad Company, Brooklyn, N. Y., will equip a substation on Sand Street, between Washington and Adams. It is the intention to construct a combined rotary and battery substation, which will contain 6,000-kw rotary capacity. Mr. C. E. Roehl is engineer of power transmission for the company.

General News.

THE TELEPHONE.

NEW DECATUR, ALA.—The City Council has given sixty days' notice to the Southern Bell Telephone Company to remove its poles, wires, instruments, etc., from the city. Mr. James E. Brailey and others have been granted a franchise to establish a telephone system in this place.

AUGUSTA, GA.—The City Council has adopted an ordinance granting the Bell Telephone Company permission to construct underground conduits for telephone wires.

AUGUSTA, ILL.—The Augusta-Bowen Mutual Telephone Company, Augusta, has been incorporated, capital $1,000, to operate a telephone system. Incorporators: George A. Miller, Isaac Winfield and Henry Williard.

CHICAGO, ILL.—The Illinois Telephone and Telegraph Company has leased a building on Fifth Avenue for a term of five years beginning Sept. 1, at an annual rental of $6,000. The building is to be remodeled for the purpose of a telephone exchange.

CARLINVILLE, ILL.—W. J. Finch has purchased the Chesterfield Telephone Company and assumed charge. The company has recently completed new lines, connecting Chesterfield, Carlinville, Medora, Kemper, Brighton, Piasa and all towns in the county having independent lines.

CHICAGO, ILL.—Another $1,000,000 of Chicago Telephone Company stock has been issued. This is the third installment of that amount put out this year under the act of the stockholders at the last annual meeting, authorizing the issue of $3,000,000 to pay for extensions and improvements to the company's lines.

INDIANAPOLIS, IND.—The Providence Telephone Co., of Providence, Ind., has been incorporated, with a capital stock of $5,000.

GREENWOOD, IND.—The Greenwood Telephone Company has filed additional articles of incorporation providing for the extension of its service and improvement of its plant and increasing its capital stock from $6,000 to $10,000.

INDIANAPOLIS, IND.—The Wilkinson, Simmons & Wood Telephone Company, of Wilkinson, Ind., has been incorporated, with a capital stock of $210,000. The incorporators are: John W. Reeves, W. H. Himmons, W. D. Thomas, G. H. Jackson and Walter Woods.

MONETA, IA.—The O'Brien County Telephone Company has been incorporated at Moneta with a capital of $10,000.

SEBREE, KY.—The plant of the Sebree Independent Telephone Company has been damaged by fire to the extent of $12,000. There was no insurance.

RICHMOND, KY.—The franchise for the new independent telephone system has been sold by the City Council to E. Tutt Burnam. Work will begin on the new plant within ninety days.

WESTBROOK, ME.—The Westbrook Telephone Company has applied for a franchise here.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company is having plans prepared for a new branch telephone exchange to be erected in this city at the corner of Madison and Calvert Streets at a cost of $175,000. Mr. C. D. W. Eidlitz, of New York, is the architect. The exchange will be modern throughout and the switchboard and telephone equipment, it is stated, will cost $100,000. The exchange will have a capacity of 2,000 lines and will relieve the present St. Paul and Madison districts. The company is just completing the work of laying 60 miles of conduits under ground.

YPSILANTI, MICH.—Mayor Dawson has announced his veto of the resolution granting an independent telephone franchise to Shelly Hutchinson and associates. An attempt to carry the resolution over the veto failed.

MINNEAPOLIS, MINN.—The Board of Directors of the Twin City Telephone Company have declared a quarterly dividend at the rate of 7 per cent per annum, payable November 1.

JEFFERSON CITY, MO.—The Jefferson City Telephone Company has been bought by Lester A. Parker, H. McHenry and A. M. Hough. The exchange was formerly owned by the Capitol Telephone Company.

ULYSSES, NEB.—The Ulysses Independent Telephone Company has been incorporated, with a capital of $5,000.

LINCOLN, NEB.—The Waco Telephone Company has been organized with a capital stock of $25,000. It is proposed to establish a telephone system with headquarters in Waco. J. A. Gilbert and twenty-four others are incorporators.

PERTH AMBOY, N. J.—The Hudson & Middlesex Telephone Company has been granted a franchise here.

AURORA, N. Y.—The Empire Telephone Company is constructing a line from this place to Cayuga.

ELMIRA, N. Y.—The Elmira Telephone Company has been consolidated with the York State Telephone Company which controls exchanges in Cortland, Binghamton, Glen Falls and other cities.

GASTONIA, N. C.—A new telephone company has been chartered at Gastonia by N. B. Kendrick and other stockholders. The capital stock will be $11,000.

LINCOLNTON, N. C.—The Bell Company has purchased the plant and exchange of the Lincoln Telephone Company, of Lincolnton. A number of private lines were cut out and Dr. Hunter of Stanley Creek, N. C., has been granted the right to put in an exchange in Lincolnton.

OAKES, N. D.—The Dakota Central Telephone Company, of Aberdeen, has purchased the Oakes telephone exchange and will operate it in connection with the entire system. Extensive improvements will be made.

ARCHBOLD, OHIO.—The Archbold Telephone Company has increased its capital stock from $10,000 to $20,000.

DELAWARE, OHIO.—The Citizens' Telephone Company is installing a new modern board of 1,800 lines capacity. About 1,000 will be installed at the start.

YOUNGSTOWN, OHIO.—The United States Telephone Company has established a long-distance switching station at Youngstown. Five operators will be employed at this point.

SANDUSKY, OHIO.—The Green Spring Telephone & Electric Company, of Seneca and Sandusky counties, has increased its capital stock from $15,000 to $25,000. J. C. Kanney is president.

SANDUSKY, OHIO.—The deal for the sale of the Sandusky Telephone Company to the Laning syndicate, of Norwalk, has been effected. The company will be known as the Sandusky Local Telephone Company.

PORTSMOUTH, OHIO.—The Central Union Telephone Company is installing free telephones in Portsmouth. No charge is to be made until 800 telephones are in use. There is a strong independent company in the field.

DELAWARE, OHIO.—F. M. Marriott, of the Harrison Construction Company, has organized a company with $300,000 capital stock at Pueblo, Colo., and expects to establish telephone exchanges in that place as well as at Colorado Springs. The company is also planning to build a long distance line to Salt Lake City.

ZANESVILLE, OHIO.—The Zanesville Telephone & Telegraph Company will enlarge its system. About $50,000 will be expended for the purpose. Solicitors will be put to work to regain the subscriptions which the company was compelled to cancel on account of insufficient capital at the time of the Everett-Moore trouble.

YOUNGSTOWN, OHIO.—The Beaver Telephone Company has commenced operations. Its system extends over the whole of Beaver township. The company is negotiating with the Central Union Telephone Company and the Youngstown Telephone Company for long distance service. Officers of the new company are: W. H. Ruhlman, president; C. Culp, vice-president; R. B. Metzler, treasurer; John Yoder, secretary, and S. B. Culp, manager.

PITTSBURG, PA.—The Central District and Printing Telegraph Company has declared its regular dividend of 2 per cent, payable October 31.

DYERSBURG, TENN.—The West Tennessee Telephone Company has incorporated to establish a telephone system. W. C. Paris is manager.

CENTER, TEX.—The Sabine Valley Telephone Company, capital stock $20,000, has been incorporated by E. C. Branch, W. A. King, James T. Polly and J. W. Sanders.

ROANOKE, VA.—The West Virginia Eastern Telephone Company will extend its lines from Century to Buckingham.

PETERSBURG, VA.—The recent consolidation of telephone interests in Petersburg places the Bell Company in entire control in that city. It is said that rates will be increased.

PARKERSBURG, W. VA.—The general offices of the Consolidated Telephone Company have been removed to Fairmount. General Manager Funkhauser has resigned and has been succeeded by C. W. Evans, of Fairmount.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—The Birmingham Railway, Light and Power Company has applied to the City Council for a franchise to operate a steam heating plant in conjunction with its electric lighting and street car system. The company expects to spend over a quarter of a million dollars in the new plant.

SAN FRANCISCO, CALIF.—The South Yuba Water Company's great system of water ditches and three small electric power plants are to be purchased by an Eastern syndicate headed by C. N. Felton. It is said that the purchase price, over $3,000,000, will be paid over as soon as the expert engineers complete their reports on the properties. The two electric plants at Auburn and Newcastle are operated by the Central California Electric Company and supply current for Sacramento, while the newly-installed plant at Altaville will supply Grass Valley, Nevada City, Marysville and other places.

SAN FRANCISCO, CALIF.—Water rights on the Tuolumne River near Jacksonville, Tuolumne County, Calif., have been secured by G. A. Wilbur & Co. It is estimated that from 4,000 to 10,000-hp can be developed. About ten miles of ditch and flume will be required to obtain the best results. It is proposed to transmit electric power a distance of nearly fifteen miles to Jamestown for mining purposes as well as lighting. Sidney Sprout, the electrical engineer for the enterprise, has gone to Jacksonville to ascertain the minimum flow of water. He will complete the preliminary work and a good deal of construction work can be accomplished this winter.

DENVER, COLO.—The Boulder Creek Mining and Power Company, which owns extensive properties in Boulder Creek, Colo., mining district, has been organized in Bay City, Mich., with a capital of $2,000,000. W. C. Penoyer, of Bay City, is president of the company. The company has secured from the United States and from Colorado the riparian rights in Boulder Creek, Colo., for power purposes and will soon build a plant of 10,000-hp. The company will convert the old Coburn mill six miles above Boulder into a cyanide plant of 100 tons capacity per day. The Coburn mill, where the electric plant is also to be erected, is three and a half miles above where the city of Boulder secures its water for town purposes.

BOISE, IDAHO.—The electric light and gas company of Boise is installing a [illegible]-hp electric power plant on the Payette river, 20 miles above Boise, and the plant will be completed about Dec. 1. It will cost when completed about $400,000. It is the intention of the company to light Boise and to furnish power for a number of mines in the locality. Later on the business of the company will be extended to other towns where light and power is needed.

QUINCY, ILL.—The smokestacks of the local electric light company were blown down in a tornado recently, and the city was put in temporary darkness.

FORT WAYNE, IND.—The Pennsylvania Company has approved plans for the erection of a large electric lighting plant at Conway, near here. The building and equipment will cost approximately $50,000 and is the first of several to be erected at important points on the system west of Pittsburg. Recently the officials of the company decided to equip all important yards with electric lights in order to permit the men to work by night as well as day.

MARKSVILLE, LA.—The Marksville Electric Light and Power Company, Limited, has been chartered. The contract for building and fixtures was awarded to Lyman C. Reed, of New Orleans. The officers of the Board of Directors are: Dr. Walter F. Couvillion, president; A. V. Saucier, vice-president; T. T. Fields, secretary, and L. J. Coco, treasurer.

BOSTON, MASS.—The Gas and Electric Light Commissioners have approved the petition of the Attleboro Steam & Electric Company for permission to issue $40,000 stock.

EASTHAMPTON, MASS.—The Hampton Company is installing an electric power and lighting equipment and the plant is to be electrically driven. Two polyphase generators, one direct-connected to a Corliss engine and the other belted to a water wheel will supply the current. The machines will be interchangeable, so that either one or both may be used as desired for power or lighting.

PORT HURON, MICH.—At the coming election a proposition to issue $50,000 worth of bonds for electric lighting purposes will be submitted to a vote.

DULUTH, MINN.—The capacity of the Duluth General Electric Company's plant will be doubled by the installation of a 2,500-hp engine. At a cost of $250,000 the company has changed its plant throughout, introducing a large amount of new machinery.

PRINCETON, N. J.—The University Power Company, of Princeton, has been incorporated to supply electric light power; capital, $25,000. Incorporators: Robert H. McCarter, Edwin B. Williamson and Conover English.

SAUGERTIES, N. Y.—The Saugerties Light, Heat and Power Company, of Saugerties, has been incorporated; capital, $50,000. Directors: H. B. Hord and R. C. McCormick, New York; C. W. Eichells, Jr., Ridgewood, N. Y.

MEDINA, N. Y.—The Medina Foundry Company is erecting a new plant to operate by electric power and has purchased six induction motors from the General Electric Company. The officers are: Michael Slack, president; Orren F. Butts, vice-president and general manager, and B. Edward Slack, secretary and treasurer.

WINSTON, N. C.—The Winston-Salem, N. C., Gas and Lighting Company has recently re-organized, New York and Philadelphia capitalists having secured a controlling interest in the plant. Dr. W. H. Reynolds and B. G. McAdoo, of New York, are interested.

CLEVELAND, OHIO.—Bishop & Babcock, manufacturers of tanks, etc., have completed plans for the erection of a large brick power house on Hamilton Street. They propose to operate nearly all of their machinery by electric motors.

MURFREESBORO, TENN.—Dynamos, engines, etc., will be purchased by the City Gas & Electric Company, which has had plans prepared for improvements to cost about $15,000.

SALT LAKE CITY, UTAH.—Over $100,000 worth of new mining machinery has been received at the various claims in the Buffalo Hump, Idaho, country within the past ninety days, and includes electrical equipment to the value of nearly half the cost of the entire outfit.

NEW MARTINSVILLE, W. VA.—The New Martinsville Electric Light, Heat and Power Company and the New Martinsville-Sistersville Electric Railway Company both have applications for franchises pending.

CITY OF MEXICO, MEX.—The municipal council of the City of Mexico has authorized the Compania Mexicana de Gas y Luz Electrica to place its cables underground where necessary for city service. The cables must be laid under the sidewalks.

MONTEREY, MEX.—The electric light plant of the Monterey Electric Light and Power Company is to be increased in capacity from 800-hp to 2,000-hp. Emilie Dysterud, general manager of the company, has been making an extended tour of the north and east inspecting the electric light plants of the principal cities of the United States.

SAN LUIS POTOSI, MEX.—The city council of San Luis Potosi has granted a franchise to George Waddill, representing an American company, to install a new electric light and power plant in this city. The company has a capital stock of $300,000 and has already begun the work of constructing the new plant.

THE ELECTRIC RAILWAY.

WILMINGTON, DEL.—The Delaware Suburban Railway Company has been incorporated at Dover, with a capital stock of $100,000. The company proposes to construct a road connecting with that of the Wilmington City Railway's extension at Stanton. The road will extend from there to Chesapeake City.

FAIRBURN, GA.—Citizens of Fairburn, nineteen miles from Atlanta, are agitating the question of having the electric railways of Atlanta extended to Fairburn.

MUNCIE, IND.—The Union Traction Company has been granted a franchise to extend its system from this city to Alexandria.

DALEVILLE, IND.—The Union Traction Company has been granted a franchise to extend its system from Daleville to Middletown.

WABASH, IND.—The Wabash-Logansport Traction Company, operating the Peru interurban road, has accepted a franchise and is under bond to build a city system in Wabash.

ALEXANDRIA, IND.—The New Hartford City-Alexandria Electric Company has accepted the terms of the franchise ordinance passed by the Alexandria Council, and work will begin at this point also.

KOKOMO, IND.—The [illegible] Traction Company, in addition to receiving a franchise to enter this city, has been granted a franchise for an electric lighting and heating plant in this city.

JEFFERSONVILLE, IND.—The Southern Indiana Railway Company, of Jeffersonville and New Albany, has filed articles of incorporation with the Secretary of State. The capital stock is $300,000. The directors are N. A. Street, C. R. Taylor, N. I. Keefe and M. E. Callender.

INDIANAPOLIS, IND.—The New Albany, Paoli & French Lick Valley Traction Company has filed articles of incorporation; capital stock, $100,000. The incorporators are: Thomas Taggart, Crawford Fairbanks, L. F. Dickson, of Chicago; G. J. T. Jeup, of Indianapolis, and Thomas H. [illegible] of [illegible]

EVANSVILLE, IND.—The board of directors of the Evansville & Princeton Traction Company has let the contract for the building of the power house to a New York firm. The power house is to be located at Fort Branch, half way between this city and Princeton, and will cost $72,000. The Evansville & Princeton Traction line will be in operation by April 1. Several other electric lines are being planned out of Evansville.

EVANSVILLE, IND.—The Evansville, Boonville & Rockport Railway Company has filed articles of incorporation. The road will run from Evansville through Vanderburg County to Newburg and Boonville in Warrick County and to Rockport in Spencer County. The company proposes to purchase and lease street railway systems to connect with and complete its interurban system. William Freekeld, Chas. E. Maley and E. C. Henining are the directors.

NEW ORLEANS, LA.—The Myles Salt Company intends to build an electric railway from New Iberia, La., to Berwick City, a distance of 54 miles.

NEW ORLEANS, LA.—The strike of the street railway employees was settled on the 13th inst., after a duration of 15 days. The basis of settlement is that the men shall receive 20 cents an hour, a day's work to consist of ten hours.

AUGUSTA, ME.—The Auburn, Mechanics Falls & Norway Street Railway Company has petitioned the Railroad Commissioners for articles of association. F. H. Wilson, of Brunswick; E. B. Hart, Jr., of New York; A. H. Shaw, S. R. Percy and F. E. Southard, of Bath, are the directors. The company proposes to build an electric railway from Auburn to Norway, a distance of 24 miles. The capital stock is $100,000.

WORCESTER, MASS.—The Worcester Consolidated Street Railway Company has declared a dividend of 3 per cent.

WESTFIELD, MASS.—At the annual meeting of the Westfield Electric Railway Association the following named gentlemen were elected officers: President, A. D. Stanton, of Huntington; clerk and treasurer, J. H. Dickinson. It is expected that construction work on the road will be started next spring.

SPRINGFIELD, MASS.—At the annual meeting of the Greenfield & Turners Falls Street Railway Company provisions were made for extending the road from Four Corners to Federal Street, making a loop. The bonded indebtedness is to be increased not to exceed $130,000. These officers were elected: President, Maj. F. E. Pierce; clerk and treasurer, D. P. Abercrombie, Jr.; superintendent, J. A. Taggart; engineer, C. W. Clapp; auditor, Jone E. Donovan; trustees, Maj. Pierce, D. P. Abercrombie, Jr., J. A. Taggart, C. W. Clapp, J. W. Stevens, D. P. Abercrombie, Sr., N. S. Cutler, Isaac Chenery, Albert T. Hall, Springfield, Mass.

CONCORD, N. H.—The long-talked-of railway between Concord, Dover and Rochester will be constructed. A contract for 4,000 tons of 70-pound steel rails was executed recently between the Pennsylvania Steel Company and the Rochester Street Railway Company.

TRENTON, N. J.—The Whippany & Passaic River Railroad Company, capital $375,000, has been incorporated here to build a railroad seven miles long from Whippany to Essex Falls, N. J. The incorporators are: Edward M. Shepard, Brooklyn; Herman Behr, Robert D. Foote, W. W. Cutler, Morristown; Richard W. McEwan, Robert B. McEwan, Jesse L. McEwan, Whippany, N. J.

AMSTERDAM, N. Y.—The Fonda, Johnstown & Gloversville Railroad Company has increased the wages of the motormen from 16½ to 18 cents an hour. Motormen who have been in the employ of the company for less than a year receive an increase of from 15 to 16½ cents an hour. The increase in wages was not asked for.

ALBANY, N. Y.—The Lake Erie Traction Company has obtained consent from the State Railroad Commission to issue a first mortgage for $400,000 and to increase its capital stock from $126,000 to $500,000. The proceeds from the sale of the additional securities are for the construction and equipment of the road from Westfield, Chautauqua County, to the Pennsylvania state line.

ALBANY, N. Y.—The Bull's Head & Annadale Beach Railway Company has filed articles of incorporation. The capital stock is $250,000. The company will build a line 8 miles long in Richmond Borough, New York, from Bull's Head to Annadale Beach. The directors are: James W. Hughes, Harcourt Bull, J. M. Israel, C. W. Kappes, A. E. Haskins, H. S. Weed, J. L. Doyle, W. H. Cressman, of New York, and David Murphy, of Jersey City.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company, Brooklyn Borough, has purchased for $30,000 the property of Christ Protestant Episcopal Church, at Third Avenue and Sixty-eighth Street, Brooklyn. The edifice is to be removed to make way for the construction of an inclined plane to connect the elevated railroad structure with the surface line on Third Avenue. The company plans to operate trains over the elevated road through to Fort Hamilton.

STATEN ISLAND, N. Y.—The Staten Island Rapid Transit system has established an entrance into Plainfield, N. J., over the New Jersey Central's tracks, and a schedule goes into effect which insures connection between trains from St. George, S. I., and Philadelphia, Baltimore, and Washington. Regular Staten Island expresses will make Plainfield a terminal, and the Royal Blue Line, of the Baltimore and Ohio, will stop there. East and west bound schedules have been arranged.

PORTSMOUTH, OHIO.—The Ohio Valley Traction Company has amended its charter to enable it to extend its line to Ironton.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Railway has opened through service from North Columbus to Delaware.

MASSILLON, OHIO.—The Canton-Akron Railway Company has purchased a right of way from Massillon to East Greenville, and is planning a spur line to that town.

DAYTON, OHIO.—Officials of the Dayton & Northern Traction Company are closing contracts for the extension of the line from Greenville to Union City and into Indiana.

CINCINNATI, OHIO.—The directors of the Cincinnati, Newport & Covington Light & Traction Company have declared a quarterly dividend of one per cent. on the preferred stock.

CLEVELAND, OHIO.—W. J. Prentz is in this city endeavoring to interest capital in building an electric railway from Mansfield to Ashland over which route he claims to have secured right of way.

CINCINNATI, OHIO.—The Cincinnati, Milford & Loveland Traction Company has been incorporated with $700,000 capital stock by J. M. Wilson, Claude Ashbrook, J. N. Roberts, B. H. Kroger and others of Cincinnati.

MANSFIELD, OHIO.—The Mansfield, Mt. Gilead & Delaware Traction Company has secured a franchise in Mansfield, and grading is to start at once. The road will be the connecting link between Columbus and Cleveland.

TOLEDO, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Railway Company claims to have arranged for the sale of $925,000 worth of bonds. A site has been secured at Roundhead for a large power house.

SPRINGFIELD, OHIO.—The stockholders of the Dayton, Springfield & Urbana Electric Railway have decided to increase its capital to $1,500,000 for the purpose of double-tracking and making other important improvements.

ASHTABULA, OHIO.—The Pittsburg, Lisbon & Western Railroad Company has been incorporated with a nominal capital of $10,000 by R. W. Taylor and others. The company proposes to "operate a steam or electric road from Ashtabula Harbor to Steubenville."

SPRINGFIELD, OHIO.—Directors of the Urbana, Bellefontaine & Northern Traction Company will meet October 30 to vote on increasing the capital stock to $500,000 and to complete traffic arrangements with the Dayton, Springfield & Urbana Railway. Both roads are controlled by the same interests.

CLEVELAND, OHIO.—The Ohio & Pennsylvania Traction Company has been incorporated by F. B. Krause, Charles L. Gilbert, C. C. Daugherty, L. A. Calkins and others. Temporary capital stock $10,000. The company proposes to build a direct line from Cleveland to Sharon, Pa., by way of Warren.

TOLEDO, OHIO.—J. M. Mulkey, of the Black-Mulkey syndicate, owners of the Toledo & Monroe Railway, states that negotiations with the Detroit United Railway relative to the sale of the property, have been declared off and that his people will proceed at once with the work of extending the line to Detroit.

ZANESVILLE, OHIO.—Col. A. E. Boone, who has secured franchises for several electric roads to radiate from this city, is endeavoring to secure capital to build the first line, charter for which has been taken out under the name of the Zanesville & Southeastern Ohio Railway Company, with a capital of $10,000.

TOLEDO, OHIO.—The Toledo, Bowling Green & Southern Traction Company is arranging to handle freight business on the same basis as the other interurban lines entering Toledo. The matter has been held up on account of insufficient power, but this difficulty will be remedied by the speedy completion of a new station at Cygnet.

DAYTON, OHIO.—It is reported that the Pomeroy-Mandelbaum syndicate is planning to erect in this city one of the largest power plants in the country, to be used in the operation of both the Cincinnati, Dayton & Toledo Traction Company and the Miami & Erie Canal. The officials in Cleveland are not prepared to verify the statement.

CHILLICOTHE, OHIO.—The smokestack on the new power house of the Chillicothe Street Railway, Light & Power Company collapsed a few days ago entailing a loss of between $6,000 and $10,000. The stack was 175 feet high. It is believed the accident was caused by the base being too small and not having a sufficiently solid foundation.

ZANESVILLE, OHIO.—The Zanesville Railway, Light & Power Company has been incorporated by George H. Warrington, John Ross, George M. Finch, E. F. Gunther and Thomas Braxton, Jr. Capital stock is $1,000,000. It is stated the new company has succeeded the Zanesville Street Railway and that the deal involves the construction of interurban roads from Zanesville.

CINCINNATI, OHIO.—Through the consolidation of various traction roads it is proposed to operate a line between Cincinnati and Springfield, Ohio. The Springfield & Xenia Company and the Scrugham lines will figure in the combination. Local interests prominently identified with the Elgin, Aurora & Southern Traction Co. have been given the assurance that these two properties will soon consolidate.

CINCINNATI, OHIO.—At the annual meeting of the Cincinnati, Georgetown & Portsmouth Railway the former officers were re-elected, as follows: A. W. Comstock, president; W. R. Todd, vice-president; R. E. Field, secretary-treasurer; E. W. White, general manager, general freight and passenger agent, and P. T. Dunn, superintendent. The work of converting this line into an electric system is progressing rapidly and cars will soon be in operation to Georgetown. The power house at Olive Branch is about completed.

CLEVELAND, OHIO.—It is announced that the deal for the sale by the Everett-Moore syndicate to the Grand Trunk Railway (steam) of the Detroit & Toledo Shore Line has been finally consummated, the price being about $1,600,000. It is now probable that the Everett-Moore syndicate will redouble its efforts to buy back the Toledo & Monroe Railway in order that the connection of the Ohio and Michigan systems may not be broken. The closing of this deal removes the last of the Everett-Moore difficulties so far as traction properties are concerned. The option held by Claude Ashbrooke, of Cincinnati, on the London (Ont.) Street Railway interests has expired and it will not be renewed. The syndicate will probably retain this property.

POTTSTOWN, PA.—The Pottstown & Reading Electric Railway Company has applied for a charter. J. C. Bricker, Dr. S. C. Dolley, J. D. S. Barham and F. F. McCall are the applicants. With the building of a line to Reading from Pottstown there would be a complete trolley system between the former city and Philadelphia.

NASHVILLE TENN.—The Nashville Railway Company announces that it will expend $1,000,000 in improving its system.

CLEVELAND, TENN.—An application has been made for a charter for an electric railway to run from Cleveland to Ducktown, Tenn. The cost is estimated at $400,000.

CLARKSVILLE, TENN.—Local and outside capitalists have begun securing right of way for two electric railways from Clarksville, one running to Nashville and the other running to Guthrie, Ky. T. N. Watson is interested in the former and H. N. Leech, attorney, has been granted right of way for the second road.

TACOMA, WASH.—The Hoquiam & Aberdeen Street Railway Company has issued $125,000 in bonds to be sold in the East, the proceeds of which are to be used in building an electric railway between the two principal towns on Greys Harbor.

WHEELING, W. VA.—It is announced that a four-months option has been given on the majority of the capital stock of the Wheeling Traction Company to T. H. Conderman, president of the company. The company is capitalized at $4,500,000. The property includes the majority of the city lines in Wheeling, the Steubenville, Mingo & Ohio Valley Traction Company, the Bridgeport, Bellaire & Martin's Ferry Railway and several lines under construction.

LEGAL.

RECEIVER FOR THE ALBANY & HUDSON ROAD.—Mr. Geo. T. Blakeslee, of Kinderhook, N. Y., has been appointed receiver for the Albany & Hudson Railway Company. The officers state that the appointment of the receiver is the first step in a plan for a complete reorganization of the company. The system will continue in operation.

WIRELESS LITIGATION.—The suit of the De Forest Wireless Telegraph Company against the Marconi Wireless Telegraph Company of America, E. Rollins Morse, Henry R. Shaw, Robert W. Emmons, second, and George W. Parker, of the firm of E. Rollins Morse & Bro., to recover $1,000,000, which was begun in the Supreme Court of New York State, has been transferred to the United States Circuit Court. The petition for the transfer was made on the allegation that the De Forest Company is a citizen of Maine, the Marconi Company a citizen of New Jersey and that all the members of the firm of E. Rollins Morse & Bro. are citizens of the State of Massachusetts. They offer a bond of $100. Betts, Sheffield & Betts are attorneys for the Marconi Company, and Knabe & Butler are attorneys for the De Forest Company.

RAILROAD SECRETS INVIOLATE.—At Albany, N. Y., on October 18, Justice Alden Chester handed down an important decision affecting the organization of railroad companies. The State Board of Railroad Commissioners has refused, in the case of the organization of such corporations, to make public information submitted with applications to construct and operate their proposed roads or to make public the source of financial support upon which the companies relied to carry their prospects into execution. Justice Chester, in the case of the Portchester Railroad Company, has decided that the Board has the right to keep such information confidential, denying an application made by the New York, New Haven & Hartford Railroad in this case for an order to compel the State Board to make public this information.

PERSONAL.

MR. H. O. SWOBODA has resigned his office as secretary and treasurer of the Falcon Electric Manufacturing Company of New York City.

MR. H. W. HOBBS, who has been the active man in the Hawks Electric Co., has retired from that Boston firm. After a thorough rest, he will probably enter the engineering field.

DR. F. HABER is to lecture before the Society of Chemical Industry, New York section, on "Ferrous and Ferric Acids," with experiments, on October 24, at the Chemists' Club.

MR. HUGH A. BROWN, for two months past in the Chicago office of the Crocker-Wheeler Company, has moved to the Cleveland office of that company, where he will give special attention to the electrical equipment of machine shops.

PROF. KAMMERER, in a recent address before the German Engineers' Society at Dusseldorf, spoke highly of the modern electric telephone system as developed in America, and expressed his belief that it would come into general adoption there.

MOORE-SKITT.—At Yonkers, N. Y., on October 15, Miss Edith Skitt, daughter of Mr. Alfred Skitt, the well-known Manhattan Elevated manager, was married to Mr. Edwin Webb Moore in Grace Chapel. Among those present were Mr. and Mrs. George Gould and Mr. E. V. W. Rossiter.

MR. GEORGE F. WATTS, who for some five years past has represented the Columbia Incandescent Lamp Company as sales agent for St. Louis, Kansas City, Omaha and other Western cities, has established himself in the Chemical Building, St. Louis, as a manufacturers' agent, on his own responsibility.

PROF. A. G. BELL.—The degree of Doctor of Laws will be conferred on Prof. Alexander Graham Bell, of Washington, and Henry White, Secretary of the United States Embassy, in addition to Ambassadors White and Choate, this week, by St. Andrew's University, where Andrew Carnegie is to be reinstalled as Rector.

MR. D. CLARENCE DURLAND, who is well known in the electrical field, has been elected second vice-president of the Sprague Electric Company. For the

past three years he has been assistant manager of the Sprague Company, and his promotion is evidence of his engineering and executive abilities, which he has combined to a marked degree.

MR. FRANK D. MOSES, chief engineer of the South Jersey Gas, Electric and Traction Company, has resigned. Mr. Richard Stockton, assistant to President A. R. Kuser, has also resigned.

MR. E. W. BATCHELLAR, formerly purchasing agent for the Denver (Colo.) Gas and Electric Company, has been appointed general manager of the San Antonio (Tex.) Gas and Electric Company and the San Antonio Traction Company.

MR. FRED W. PARKE, of the Westinghouse Air Brake Works, St. Petersburg, Russia; M. Schatelowitz, V. Chogiokoff and Irvin Prokhanoff, of the same concern, are now in the United States for the purpose of inspecting various electric plants. At present these gentlemen are in Pittsburg.

COL. ALLAN C. BAKEWELL, who was recently elected president of the Sprague Electric Company, has long been identified with the electrical industry, and has won many friends through his executive ability and honorable business methods. He was vice-president and general manager of the old Interior Conduit and Insulation Company, which was absorbed by the Sprague Electric Company some years ago. Previous to his present office he was for three years second vice-president and general manager of the Sprague Company.

Trade Notes.

THE ELECTRIC STORAGE BATTERY COMPANY has qualified to do business in Ohio. Its Ohio office is in the New England Building, Cleveland.

THE PHELPS COMPANY, makers of the "Hylo" incandescent lamps, Detroit, Mich, has opened an office in the Monadnock Building, Chicago, in charge of Mr. J. Wiley Phelps, and a San Francisco office at 220 Sutter Street, with Mr. Joseph Thieben as representative.

OIL TRANSFORMERS.—The Ft. Wayne Electric Company, in a neat folder, describes and illustrates the Type A oil transformers, which are made in standard capacities from .6 to 50-kw for primary voltages of 1,000 to 2,000 and secondary voltages of 50 or 100 and 100 or 200.

WOOD MEASURING INSTRUMENTS.—The Ft. Wayne Electric Works, Ft. Wayne, Ind., have issued a pamphlet entitled "Instruction Book for Wood Measuring Instruments." Instructions are given for the location, insulation, connecting-up, etc., of the several types of Wood voltmeters and ammeters, including an ammeter for arc circuits.

WESTINGHOUSE AIR BRAKE COMPANY, Pittsburg, has sent us a copy of the folder issued for the Detroit Street Railway Convention by the Standard Traction Brake Company, and devoted to the exhibition of apparatus in the Light Guard Armory, where a very fine display in regard to the Newell magnetic track brake system was made.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has been distributing a souvenir in the shape of a sterling silver match box in the centre of which on a celluloid background appears the name and address and trade mark of the company. The marked utility of this souvenir ensures a pleasing remembrance constantly recurring of the curtesy of the company.

THE FISHER ELECTRIC COMPANY, of Toledo Ohio, has been incorporated, with $10,000 capital stock. The company succeeds the Fisher Electric Construction Company, and will do a retail and general construction business. The incorporators are: J. M. Shunck, H. B. Thompson, Emil X. Schaefer and Hugh Shunck. The company has leased warerooms at 114 St. Clair Street, that city.

PROMPT SHIPMENTS. "Goods received and thanks for your prompt shipment."—The above is a sample extract from many similar letters received by the Electric Appliance Company, Chicago. This would not be extraordinary in ordinary times but in this busy year and season, they speak volumes for the system and hustle to expedite deliveries in vogue at the Appliance Company's shipping department.

PORTABLE FORGES.—The Buffalo Forge Company, Buffalo, N. Y., has issued an interesting pamphlet illustrating and describing the principal features of construction and the advantages of its portable forges, blowers, blacksmith tools, punches, shears, bar cutters, tire benders and upsetters. The illustrations of these various devices are very clear, and the accompanying tables give the various dimensions of the machines, together wth price lists.

ELECTRIC HEATING.—The American Electric Heater Company, Detroit, Mich., has issued a new catalogue (No. 18) descriptive of the wide range of electric heating apparatus of its manufacture. The extent of this line can be surmised from the fact that eight different forms of curling-iron heaters are shown. Full lines are illustrated of soldering, laundry, and other irons, no less than 16 types of laundry and pressing irons being shown.

FAN MOTORS.—Bulletin No. 68, of the Massachusetts Fan Company, Waltham, Mass., relates to the Davidson electric propeller fans of a type applicable for all sorts of ventilating practice, as in public buildings and houses, for the removal of hot and moist air, for ventilating and drying, and for the circulation of hot and cold air for the purpose of heating or cooling. The motors are wound for 115, 230 and 500 volts, their loadings being from 1/4 to 7½ horse-power.

THE NATIONAL X-RAY REFLECTOR COMPANY, 107 Dearborn Street, Chicago, reports an extensive demand for its various lines of mirror reflectors and fixtures. It has in consequence opened a New York branch at 26 Cortlandt Street, where it will carry a full stock in order to make immediate deliveries to contractors, supply dealers and the trade generally. Its reflectors are giving satisfaction wherever used, and this new departure in opening a branch in the East will be a great convenience to its customers.

ROYAL ALTERNATORS AND TRANSFORMERS.—The Royal Electric Company, Peoria, Ill., has issued a revised edition of its bulletin illustrating and describing the Royal alternating-current generator; and also a pamphlet descriptive of the Royal transformer. The Royal generator, as is well known, is of the inductor type, and the bulletin illustrates all of its features in detail. The Royal transformer is claimed to have decided advantages over the core type, which latter is stated to sacrifice efficiency to cheapness in construction and convenience for repair.

ELECTRIC LOCOMOTIVES FOR SURFACE HAULAGE.—With this title the Baldwin Locomotive Works and the Westinghouse Electric and Manufacturing Company have issued a handsome 78-page catalogue illustrating and describing a number of standard types of electric locomotives for electric haulage. About a score of the illustrations show locomotives at work which have been supplied to various concerns throughout the United States and in foreign countries. The latter part of the catalogue illustrates in detail every part of the electrical equipment, such as the controller, equipment, etc.

LINOTAPE.—To meet the demands of the trade the Mica Insulator Company, of New York and Chicago, has commenced the manufacture of a new process oil cloth in the form of tape, under the registered name of "Linotape." The foundation of the tape is a closely woven special cloth, and the coating consists of a film of "Empire" oil on both surfaces. It is claimed that the coating never cracks nor hardens, and it renders the cloth proof against acids and alkali. In some comparative tests, "Linotape" showed an insulation of 881 megohms as against 9.6 megohms for the ordinary friction tape; and a puncturing voltage of 2214 as against 1800 for the friction tape.

VULCABESTON PACKING.—The H. W. Johns Company has issued a catalogue devoted entirely to the subject of vulcabeston packing. As an illustration of the superiority of vulcabeston steam packing, the incident is cited of the drilling engine in the yards of the Westinghouse Air Brake Company, which ran for ten months with one packing of vulcabeston; before using this packing, it was necessary to repack the pump as often as once in three weeks. It is stated that this packing is adapted to any steam pressure, does not deteriorate through the action of high pressure or superheated steam, will not harden, crack or char, is pliable and easily cut, and has no expansion or contraction. With its use joints can be easily broken and repacked, a tight joint may be made on rough flanges, and it is not necessary to turn on steam to set the packing.

ENGLISH NERNST LAMP.—The Nernst Electric Lamp Company, Ltd., 82 Victoria St., London, England, sends a catalogue in which the English form of the Nernst lamp is well illustrated and described in detail. The English form of the lamp is quite different from the American, the glower being in the form of a spiral filament, which in some lamps is disposed vertically and in others horizontally. The curve of distribution of the light shows almost an equal distribution above and below the horizontal. The lamp is made in capacities from 15 to 150-cp., the consumption of current being from 1.75 to 2 watts per candle. The average life of the lamp is given as about 400 hours. The price of model A, or lamp of larger candle power, is given at $4.50, and the price of replacement pieces at 50 cents or 62 cents; the price of model B, or lamp of smaller candle power is $1.25, and the price of replacement pieces 37 cents.

HOLOPHANE GLASS COMPANY, 15 East Thirty-second St., New York, has just issued a very handsome and useful catalogue devoted to its celebrated "Holophone Globes." It is both curious and encouraging to note how this specialty has won its way into popularity on strict merit. No one who uses a holophane globe ever after disputes its utility or allows any one else to decry its value. The pamphlet discusses clearly and briefly the main lines of the argument in favor of the principle adopted and the methods of manufacture employed to secure a complete diffusion of light, without glare or glitter or abnormal points of dazzle. The various types of ribbed glass are noted and a large number are illustrated, together with the sizes, details of application, etc. The cover is a quaint and dainty piece of work. The company has commenced the publication of a periodical called *The Holophane News*, which will be issued monthly or as occasion may require.

FT. WAYNE BULLETINS.—The latest Ft. Wayne Bulletins are three in number and have for their respective subjects "Enclosed Direct-Current Power Circuit Arc Lamps," "Enclosed Direct-Current 110 volt Arc Lamps," and "Standard Small Motor Panels." The power circuit arc lamps are of the multiple series type for use with either two or five in series on 220 or 500 volt circuits. In all cases the voltage at the arc is 75 to 80 volts, and the average life of a carbon 150 hours for a current of 5 amperes. The enclosed direct-current arc lamp for 110-volt circuits can be adjusted to operate satisfactorily for any current from 4.5 to 6 amperes, the normal life of a set of solid carbons being 150 hours when the lamp is adjusted for a current of 5 amperes. The standard small motor panels are in capacities of 1/4 to 30-hp for 115, 230 and 500-volt circuits. The compactness and neat appearance of these panels are evident from the illustrations given of the same.

CARRIAGE BUILDERS EXHIBITIONS.—A fine display of apparatus was made at the convention of the National Carriage Builders' Association at Detroit, by the Westinghouse Electric & Mfg. Co., of Pittsburg, and at the Philadelphia convention of the American Carriage Builders' Association, from September 13 to 18. The exhibit showed the electric equipment made by the Westinghouse Company for use on motor vehicles and it included an Adams Express Company wagon that has been in use for seven months and is fitted with the Westinghouse double motor equipment. Another had a complete double motor equipment assembled on the frame of an express wagon of moderate size. There was also shown the skeleton frame of a standard surrey, equipped with a complete 80-volt, high-speed, plain bearing, double motor equipment. The exhibit embraced also five detached motors designed to meet the severe conditions under which the electric motor is operated and capable of sustaining for one hour a load of 100 per cent. above the normal rating, and to commutate perfectly up to an overload of 200 per cent. The frames are tubular specially designed for universal methods of suspension and to facilitate removal, inspection and repair. These motors are of 40 and 80-volt capacity, high and low speed, to meet the different requirements of passenger and merchandise transportation, up to 11,000 pounds at six miles an hour.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 14, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

710,938. VOLTMETER SCALE; W. C. Baker, Cleveland, Ohio. App. filed Feb. 15, 1902. The scale not only shows the total voltage of the battery, but also the voltage per cell.

710,943. ELECTRODE FOR ARC-LAMPS; H. Bremer, Neheim, Germany. App. filed March 3, 1900. (See Current News and Notes.)

710,946. ELECTRIC BELL; C. L. Burlingham, Chicago, Ill. App. filed Nov. 2, 1901. Details.

710,953. ELECTRIC BATTERY; A. J. Cook, Jersey City, N. J. App. filed July 20, 1901. The bottom of the jar is formed with ridges over which grooves in the elements of the battery, rest, to prevent the latter from moving.

710,990. DEVICE FOR LOCATING BREAKS AND GROUNDS ON ELECTRIC CIRCUITS; M. J. Myers, Syracuse, N. Y. App. filed June 9, 1900. Two primary coils act oppositely upon a secondary coil; the former are connected in circuit with a grounded source of electricity and to the two sides of the circuit to be tested. The current in the secondary coil gives the desired indication.

711,022. TROLLEY FOR ELECTRIC RAILWAYS; C. E. Thomas, Springfield, and J. M. Olinger, Vienna Crossroads, Ohio. App. filed July 21, 1902. The trolley harp is latched to the top of the pole, so that it can be removed when desired.

711,031. PROCESS OF MAKING GRAPHITE; E. G. Acheson, Niagara Falls, N. Y. App. filed Dec. 22, 1900. The method consists in heating carbon in an electrical furnace and introducing therein a volatile material capable of forming a carbid.

711,036. CIRCUIT CLOSER FOR TROLLEY SIGNALS; W. M. Chapman, Newton, Mass. App. filed March 9, 1901. A frame arranged above the wire and containing switch levers to be actuated by the trolley wheel.

711,037. RAILWAY BLOCK SIGNALING SYSTEM; W. M. Chapman, Newton, Mass. App. filed June 29, 1901. Details.

711,105. INSULATED RAIL JOINT; M. J. Greeney, Buffalo, N. Y. App. filed June 26,1902. The fish plates have lateral flanges facing each other at the joint, between which a sheet of insulating material is inserted.

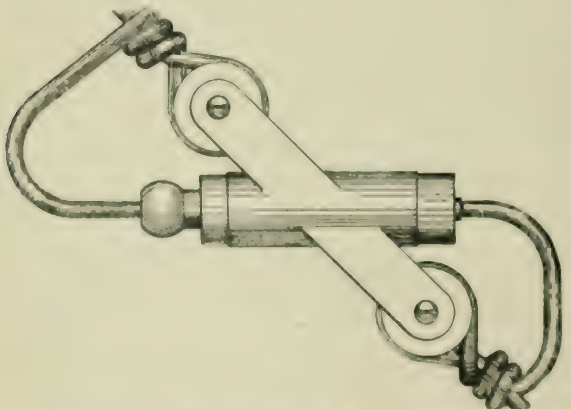
711,107. ELECTRICAL TRACTION SYSTEM; W. S. Hill, Hyde Park, Mass. App. filed March 31, 1902. The contact shoe is pivoted on the poles of a magnet and is forced by the latter into good contact with the studs.

711,122. ACCUMULATOR; J. B. Relin, Levallois-Perret, France. App. filed Dec. 4, 1901. A frame of peculiar construction in which the ends of rods, strips or the like are held.

711,123. WAVE DETECTOR; L. T. Rhoades, Phoenixville, Pa. App. filed Aug. 29, 1902. A self-recovering wave-responsive device, comprising metal terminals and a mixture of steel, nickel, carbon and vaseline between them.

711,130. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed Oct. 16, 1901. The spark gap is shunted by a condenser.

711,131. ART OF TRANSMITTING INTELLIGENCE; H. Shoemaker, Philadelphia, Pa. App. filed Aug. 9, 1902. The resistance of a material is changed by altering the strength of a magnetic field in which it is located, such alterations being caused by the arriving currents.



711,150.—Electric Fuse.

711,132. WIRELESS SIGNALING SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed Aug. 9, 1902. The apparatus for carrying out the preceding method.

711,150. ELECTRIC FUSE; [illegible] Brueggeman, Chicago, Ill. App. filed Jan. 11, 1902. The fuse is contained in a plug adapted to be suspended in the course of the wire.

[illegible] WIRELESS SIGNALING SYSTEM; G. W. Pickard, Boston, Mass. App. filed June [illegible], 1901. In a wireless signaling system, a plurality of oscillating circuits of different natural periods and a radiating conductor common to all the circuits and operating simultaneously, and a frequency determining element for each of the circuits.

711,181. METHOD OF TRANSMITTING INTELLIGENCE; H. Shoemaker, Philadelphia, Pa. App. filed Jan. 11, 1902. A method of generating the energy in wireless telegraphy, at low pressure and low frequency and transforming it to energy of high pressure and high frequency.

711,182. SIGNALING SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed Sept. 5, 1902. The arriving current in a wireless system influences the magnetism existing in a magnetic mass, causing it to be moved to control local circuits.

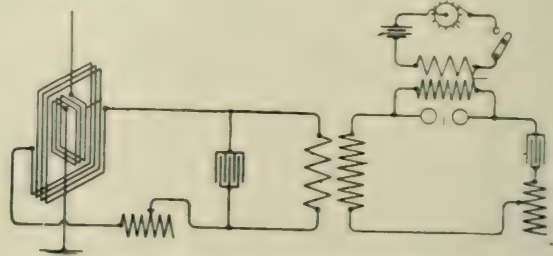
711,183. WIRELESS SIGNALING SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed Sept. 13, 1902. A system wherein an element of a signal is represented by a train of waves of energy, such trains succeeding each other at a predetermined and uniform rate.

711,184. WIRELESS SIGNALING SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed Sept. 16, 1902. An electrodynamometer is employed as a wave responsive device.

711,202. ELECTRIC SIGNALING SYSTEM; F. K. Fassett, St. Louis, Mo. App. filed June 13, 1898. Details of an up and down switch for elevators.

711,243. INCANDESCENT LAMP SOCKET; W. A. Church, Binghamton, N. Y. App. filed Jan. 10, 1902. Details.

711,246. ELECTRIC SWITCH; C. J. Doran, Jersey City, N. J. App. filed Jan. 11, 1902. Details.



711,184.—Wireless Signaling System.

711,256. INSULATED JOINT FOR TRACK CIRCUITS; S. P. McGouch, Newark, N. J. App. filed Jan. 13, 1902. Details.

711,266. WIRELESS SIGNALING SYSTEM; H. Shoemaker, Philadelphia. Pa. App. filed Sept. 13, 1902. A wave responsive device and a number of parallel circuits controlled thereby, each selective of a predetermined message.

711,276. APPARATUS FOR RECTIFYING ELECTRIC CURRENTS; G. B. Batten, Dulwich, England. App. filed June 29, 1901. Details.

711,286. TROLLEY; E. W. Clark, Columbus, Ga. App. filed April 9, 1902. The harp is hinged to the pole and latched in such a manner that when the wheel leaves the wire, the harp is caused to swing downward out of operative position.

711,292. ELECTRIC RAILWAY OR TRAMWAY; G. F. Cornwallis-West, London, England. App. filed May 23, 1902. A paving block of devitrified glass forming a section of the conduit.

711,300. ELECTROMAGNETIC TRANSMISSION GEAR; H. A. Earle, Manchester, England. App. filed Jan. 16, 1902. Consists of two members fixed on the ends of two shafts in alignment, one being a shell of iron traversed by copper rods, the other being an electro-magnet running inside of said shell.

711,319. OBJECT OF REFRACTORY MATERIAL AND METHOD OF MANUFACTURING SAME; C. B. Jacobs, East Orange, N. J. App. filed Dec. 26, 1900. Material containing an excess of silica is fused in an electric furnace to volatilize the excess of silica and leave a product harder and tougher than the original material.

711,375. PROCESS OF PURIFYING SUGAR JUICE BY MEANS OF ELECTRODIALYSIS; A. Baudry, Kiew, Russia. App. filed Feb. 28, 1899. Sulphurous acid added to the juice is caused to combine, when a current flows through the cell, with the hydrogen liberated at the cathode, to form hyposulphurous acid, which exerts a clarifying action on the juice.

711,386. MEANS FOR SIGNALING TO OR COMMUNICATING WITH SHIPS.; L. Daft and A. Williams, Wimbledon, England. App. filed June 10, 1902. Details.

711,414.—Underground Electrical Conductor.

[illegible] INSULATED RAIL JOINT OR CONNECTION; J. H. Allen, East Orange, N. J. App. filed March 7, 1902. Details.

711,414. UNDERGROUND ELECTRIC CONDUCTOR; C. [illegible], Lyons, France. App. filed June 11, 1902. To diminish excessive rises of voltage by sudden variations of conditions in a conductor, the conductor is covered by a conducting tube, which is insulated from it throughout its length, and the two conductors connected at one end through a suitable resistance.

711,421. APPARATUS FOR ELECTRICALLY LIGHTING RAILWAY TRAINS; A. B. Gill, London, England. App. filed Aug. 25, 1902. Details.

[illegible] TROLLEY RETRIEVER; A. W. Knutson, Galesburg, Ill. App. filed June [illegible], 1902. Spring drums controlled by a pawl and ratchet arrangement.

711,444. SIGNALING SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed Jan. 11, 1902. Apparatus for transforming the tension and frequency of the transmitting current in wireless systems.

[illegible] ART OF TRANSMITTING INTELLIGENCE; H. Shoemaker, Philadelphia, Pa. App. filed Sept. 16, 1902. The method patent corresponding to apparatus described in No. 711,184.

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CONTENTS.

EUROPE AND AMERICA.

One of the most able and interesting treatments in late years of the industrial changes of the time and the commercial relations between Europe and America is that found in Mr. Andrew Carnegie's recent address as rector of St. Andrew's University, Edinburgh. In many respects, it is but an amplified and more forcible exposition of views already advanced by the great steelmaker, and summed up in his recent "Empire of Business." But some new points are brought out, and new suggestions made; perhaps the most startling of which is that the Kaiser should consolidate Europe industrially and put himself at the head of the "combine." It is rather hard to imagine such a performance, but probably it would be even more difficult to carry out. Moreover, the object proposed by Mr. Carnegie is that implied in his title, "Europe versus America," and there lurks the main fallacy of his remarkable address, for the peace, prosperity, comfort and happiness of the world depend upon Europe *and* America. There need be no "versus" about it. In fact, there cannot be. No one country can do all the business, for if it did, the other countries would have no purchasing power left. There is a popular coon song: "If you don't have no money, you needn't come around," and that applies to international affairs as well. You cannot carry on trade with a people who have neither cash nor products left.

A pertinent point made by Mr. Carnegie is the importance of magnitude or quantity, in cheapness of production. This is, of course, an old and obvious idea, but he associates with it the corollary that it gives control of the home market and a grip on the foreign one. But, if on the other hand, the foreign market is highly protected, and if, in addition, automatic machinery that unskilled labor can play with, is introduced elsewhere, ability for colossal output may go for little. It is not to be denied that the tendencies of the time are against small markets, minor nationalities, "dead languages," eccentric forms; and equally in favor of concentration, combination, consolidation. But so far as we can see, the centrifugal forces still remain operative in ways that may be obscure but are none the less pronounced. If all the world looked alike, made and wore the same clothes, ate the same foods, used the same speech, thought along the same lines, voted the same ticket, and was just America, it would be about the dullest, most dismal and altogether insipid universe imaginable, to be escaped from at the first opportunity. But, happily, there will remain great differences among mankind, with resulting varieties of production and varieties of wants; and export trade and import trade will both flourish, while the traveler will ever be greeted by something new and strange to please him when he goes abroad.

TECHNICAL EDUCATION IN GREAT BRITAIN.

That technical education has been in a woeful state in Great Britain has been apparent not only to observers from other countries but also to the more enlightened Britisher. This situation appears to be partly, and perhaps largely, due to an unwillingness to depart from the methods of training which prevailed when all the world acknowledged the manufacturing supremacy of the British Isles, and when her engineers had world-wide reputation. During this period the engineer was almost necessarily a man of practical antecedents, for then engineering was little systematized and largely a matter of precedent, its advances being due to extraordinary ability on the part of a few rather than to any direct influence of scientific teaching. Since then, however, conditions have greatly changed. The

wide gulf which formerly separated science from engineering has been bridged. Engineering advance is no longer dependent on the intuition of great minds but proceeds apace with scientific discovery which, receiving form in the laboratory, passes quickly to the shop. The transition was duly recognized in this and some of the continental countries. Courses of technical education are now included in the curricula of almost all the important American schools, and specific technical schools are scattered about the country. As a consequence, at the present day the entire younger generation of engineers are men who have been specifically trained to meet the new condition.

At the present time the situation above referred to appears to be receiving serious attention in Great Britain, and particularly in the provincial manufacturing centers. We recently referred to the excellent electrochemical course organized at Owens College, Manchester, and the municipality of that city has just established a municipal school for higher technical education. In an address at the inauguration of this latter school, Premier Balfour went to the heart of the question when he said that the traditions of the great British manufacturing establishments are that the place in which to learn is not the lecture room, but the shop; not at the feet of skilled professors, but actually among the artisans who are carrying on an industry. While acknowledging that there may be a great deal of truth in this, the Premier said he felt that they would drive the truth too far, and that however sound the instinct might be that lay at the bottom of it, they were working it too hard at the present time, and if they really did mean to turn the brains, muscles, enterprise and the inventive ability of their countrymen to its best purpose, it was necessary to place among the directors of industry those who had not merely practical knowledge. They must give them, in addition, that complete scientific training which has become the basis of the whole industrial fabric. "True theory and true practice," he said, "can never be divorced without loss to both, and the ideal for which they had to strive was not that of simply imitating the process of those who went before, but imitating their energy—their anxiety to take the best the world had to give—the world both of practice and theory, in the changed and changing conditions of our time." This opinion by one whose views command attention not only as the utterance of an exalted official personage, but as the expression of a brilliant mind, should have no little influence in advancing the cause of technical education in Great Britain.

Starting Resistances.

An interesting paper on this subject by Mr. A. E. Gott has recently been published in the journal of the British Institution of Electrical Engineers, although it was read before the Newcastle Local Section in January last. The importance and value of a starting resistance for a direct-current motor increase rapidly with the size and capacity of the latter. A very small motor needs no starting resistance at all; while a large motor cannot be started at full pressure without one. Not only must a starting resistance be used, but it must also be graded carefully, with reference to the nature of its duties, in order to start its accompanying motor smoothly. It is not at all uncommon to find a large motor which accelerates very irregularly by reason of defective grading in the successive steps of its starting resistance. The paper referred to discusses the proper design of such resistances in order to obtain the best conditions for starting. The rules are capable of very simple algebraical expression, based upon Ohm's law, with the assumption of complete establishment of the c. e. m. f. in the armature at each step, before the next resistance step is cut out. But the numerical computation of the results for any particular case may be quite lengthy.

The use of water rheostats for starting is extending, and the difficulties they usually present are the introduction of too little resistance at the start, and too much resistance left in near the end, whereby there is apt to be an initial jerk of the armature at first start, and a final acceleration jerk when the water-starting rheostat is removed. It is shown how these difficulties may in large measure be removed by suitably shaping the vessel and electrodes of the water rheostat and by the judicious use of enamel as an insulating coating upon parts of the rheostat walls. The great advantage of a water rheostat is its power of absorbing energy without exceeding the temperature of boiling water. So long as there is enough water left to boil away, the energy is absorbed in gasification. A resistance grid of metal may get red hot by overwork, and may disintegrate, whereas a water rheostat can only boil away so long as water is supplied to it.

Studies of Illumination

The Institute papers of Messrs. Matthews, Sharp and Burnett show that the important subject of illumination is beginning to receive something like a proper amount of attention from engineers. The first-mentioned paper is of great practical interest in presenting a useful, even if somewhat complicated apparatus for obtaining directly mean spherical candle-power. This quantity while manifestly affording the only rational basis of comparison between lights, has heretofore been so inconvenient to determine that it has generally been regarded as of only theoretical interest, while really it is of unique practical importance; for measurement of mean spherical candle-power provides the only standard of comparison which cannot be evaded. So long as incandescent lamps are rated on any other plan, they will be given characteristics such as to exaggerate their efficiency in the conventional scheme of measurement. One cannot, however, increase the mean spherical rating without increasing the luminous flux to a corresponding degree, and consequently the energy supplied to the lamp. Professor Matthews' form of integrating photometer ought to do good service in simplifying the generally troublesome measurement, and so bring mean spherical candle-power within the range of the practical tests to be applied to lamps in commercial work. Its value obviously depends on the accurate determination and integrity of the mirror constants, since the process of integration is merely the physical summation at the photometer disc of light radiated in various zones. Whether the apparatus in practice can be kept in reliable working order is a thing that only experience can prove.

To tell the truth, the ordinary complication of the method is here transferred to the apparatus, and outside a standardizing laboratory it impresses us as a device to be used with extreme caution. We should much like to see the results of a test of fifty lamps or so first measured by any of the usual methods and then by the use of this integrating photometer in the hands of a careful man, not previously familiar with its use. For such an apparatus to realize anything like its full value in the art, it must be such that it can be worked with rapidity and precision in the hands of any man capable of good work on an ordinary photometer, and when used at infrequent intervals. If the mirror adjustments have to be frequently altered and are likely to be easily affected by the conditions of ordinary use and disuse, so that an elaborate overhauling is necessary whenever a fresh lot of lamps has to be tested, the general usefulness of the device will be greatly reduced. Our mind is no means clear on this point, and the paper is not over and above reassuring in its description of the adjustments to be made. However, time and experience will answer for this matter, and we trust that the new apparatus, which is based on scientific principles and is highly ingenious, will come through the tests in a satisfactory manner. But unless it is of so reliable a character that one can walk into his photometer room take the cover off the integrator, get out his standards, turn on the current and get to work sampling lamps in a very short time, it will fail of doing

the thing for which it is most needed. If it proves reliable and simple of application, we hope it will form the basis of a general commercial application of the mean spherical candle-power criterion in the rating of incandescent lamps. Such a rating should have been applied long ere this, and would have been save for the trouble involved in making the measurements as a commercial operation. Once applied it would treat with grim justice filaments of every section and shape.

Mr. Burnett's paper is of more theoretical than practical interest, but it does admirable work in pointing out some urgent problems which the advance in the art has brought forward for solution. In particular the author dwells on the need of better and more facile means for measuring illumination at any desired point instead of determining it in terms of a luminous intensity and a dubious coefficient of diffusion. The instruments he suggests ought to be useful in many instances, as in fact any portable and compact form of daylight photometer is bound to be. A trained observer can even do capital work with a standard candle in one hand and a Bunsen screen in the other. After all, however, it must be admitted that even if illumination could be accurately measured at any given point, it would still fail of defining the quantity which is really significant. One must never for a moment forget the physiological factor in illumination, and if the only specification were a demand for a certain minimum number of luces or a certain average number thereof, one would still have the possibility of very good or very bad results. The eye automatically steps itself down in the presence of a bright light, and hence the intrinsic brightness of the radiant must never be forgotten. The "visual usefulness" of illumination depends not only on the luces available at a given point, but inversely upon the brilliancy of the source from which the luminous flux proceeds. It makes a deal of difference whether the eye in the presence of this illumination is able to work at f 5 or at f 20, and this difference depends not on volition but upon the intrinsic brilliancy of the source. Hence, every instrument which works with a shielded eye is at a serious disadvantage in fixing the real working value of the illumination. This phase of the matter has as yet been very little investigated, and in interior illumination at least it is of the first order of importance. However, every bit of work on practical illumination is a real help, and the more lines of experiment opened the better. The paper by Dr. Sharp serves an excellent end by showing that with intelligent care photometric measurements can be made with an accuracy entirely sufficient for any commercial purpose.

Relative Rating of Engines and Generators.

The relative capacity of a generator and its engine has always been a fruitful topic for discussion, but generally with relation to the point of maximum efficiency. Thus, in railway and variable-load work especially, it has been maintained that the engine should be of somewhat larger rating than the generator, for the reason that the latter will bear a temporary overload and the engine will not. The general practice, however, has been to provide that the most economical load for the engine shall coincide with the rated maximum load of the generator, and to care for temporary overloads by increasing the point of cut-off of the engine, enabling the generators to be greatly overloaded without slowing down the engine. On the other hand, the proposition has been advanced that the engine should be made sufficiently small that in case of heavy overload due to short-circuit, it will slow down. While this idea has not been accepted in practice, it is by no means certain that it is not worth considering in some cases.

Practically, in the majority of cases it would not be advisable in applying this plan to reduce the size of engine units below what they are now proportionately to the units they drive. The main consideration is so to limit the point of maximum cut-off of the engine that it will slow down in case of a heavy overload on the generator. In other words, the engine would in such a case be put on practically the same basis as a water wheel, which exerts its maximum torque at rated full load; consequently, a station thus equipped with engines and generating units would behave very much like a water-power station. It might be said that a slowing down of the generators in case of an overload of this kind would throw them out of step with synchronous motors and converters in circuit, and that it would be better to have them hold up their speed under overload to the point where the automatic circuit opening device would act. In this connection something can be learned from the practice of many water-power plants operating long-distance transmission lines in the far west. In some of these plants, where much depends on the continuity of supply, fuses and automatic circuit-breaking devices of all kinds have in many cases been discarded, except at the distributing end. This is true of many of the more important plants, and others which have not adopted this practice are operating very much under their maximum load or have circuit-breakers or fuses which will stand so much more than the ordinary load before acting that there is practically no danger of their opening accidentally. Where generators and transmission lines are operating without any automatic circuit-opening devices, it might be thought that there would be great danger, in case of a short-circuit on the line, of damage to the generator by overload before the attendants could open the circuit. But it is held that this is in favor of a system in which the prime mover will slow down in case of overload. In the event of a continued short-circuit on a transmission line from a water-power station, the wheels driving the generators immediately slow down and the lower voltage limits the current which can flow through the short circuit to a comparatively small amount for a short time. Further than this, the generators used on this work usually have sufficiently high armature reaction to prevent an excessive current upon short-circuit.

The claim of interest for this practice is that it involves more reliable and continuous operation than can be secured if the speed were held up under a short-circuit with automatic circuit breakers or fuses to protect the generators, which fuses or circuit breakers while accomplishing the object of protecting the generators, are liable to open unexpectedly at times of heavy load and so interfere seriously with the service. There is also the difficulty of opening such short-circuits without risk of injury to the high-tension, circuit-breaking apparatus. Short-circuits on a long-distance, high-voltage, transmission line are almost sure to occur at some time, and in the absence of fuses or circuit breakers, it is often the case that they will be burned off immediately, so that the service will not be seriously interfered with. If, on the other hand, they are not immediately burned off, the switchboard attendants can open the low-tension switches, which will allow the arc between the high-tension wires to go out; then upon reclosing the switches the service is at once continued without the delay incident to closing a lot of automatic devices. It is claimed that this can sometimes be done so quickly that motors and other apparatus on the line may be kept in service without stopping. In any event, the time required to get over any trouble caused by short-circuit is less than if fuses and circuit breakers are to be replaced after a general opening of all these devices. It is admitted that there are places where the practice of running without these safety devices would not be advisable, because of the great amount of power involved, but it is maintained that there are many places where it should seriously be considered when designing an engine-driven plant; and that in the case of direct-current apparatus the argument in favor of the system has even more force, because the armature reaction tending to reduce the current on short-circuit is less than in the case of alternators.

Sudden Death of Prof. Sidney H. Short.

Word reached this country last week, by cable to the daily press, of the sudden death of Prof. Sidney H. Short, the well-known electrical inventor and street railway engineer, and technical director for the leading English firm of Dick, Kerr & Co. It appears that Prof. Short was about to proceed to this country on a trip, but was taken ill and was treated for appendicitis, dying under the operation.

Prof. Short was born in Columbus, Ohio, in 1857, and was, therefore, only 45 years old. He graduated from the Ohio State University in 1880. While in college he invented and patented a long-distance telephone transmitter and an improved arc lamp. He was appointed professor of physics and chemistry in Denver University, and while in that city built, in 1885, his first electric railway, which was a conduit line. It was illustrated and described in these pages. It operated on the series system. The first car was called the "Joseph Henry." In 1887 he returned to Columbus and built a 2½-mile electric railway in that city. He built another line in St. Louis in 1888, and in 1899 removed to Cleveland, where he organized the Short Electric Railway Company, which soon took a prominent place as a manufacturer of electric railway apparatus. After the absorption of this company by the General Electric Company, a proposition was made to him to engage in his chosen field by the Walker Manufacturing Company, which up to that time had been a large manufacturer of cable machinery. He became its vice-president and electrical engineer,

THE LATE PROF. S. H. SHORT.

Walker motors and generators were soon placed upon the market, and achieved a high reputation for excellence of design and construction. While connected with this company Professor Short paid special attention to the problems of heavy electric railroading, and developed an 80-hp motor for electric railway work, which was adopted on the Brooklyn Elevated Railway, and a 150-hp motor, which was put in service on the Metropolitan West Side Elevated Railway, of Chicago. He also developed a pneumatic system of multiple-unit control.

In 1898 the control of the Walker Company was absorbed by the Westinghouse interests, and early in 1899 Professor Short sailed for London, becoming technical director of the English Electric Manufacturing Company, a corporation organized by British capitalists, under the leadership of Dick, Kerr & Co. Very large works were erected by the concern, at Preston, England, and the work of manufacture was commenced. The success of the enterprise was immediate from the start, and orders were received not only from many of the large tramway companies in Great Britain, but also from British colonies in the East and from a number of continental countries. Professor Short's record in England as an electrical inventor and manufacturer was not below that made by him in America. In spite of his residence abroad, he never gave up his American citizenship, and with his wife made several trips to this country, the last one being on the occasion of the convention of the American Street Railway Association in New York, in 1901, where he renewed his acquaintance with many of his former friends.

Prof. Short was an extremely agreeable companion, and had a very wide circle of friends. He leaves a wife, three sons and one daughter. His eldest son is now taking the engineering course at Cornell University. The deceased was a member of the American Institute of Electrical Engineers, and was an active contributor to the transactions of engineering societies and to the columns of the technical press.

Submarine Boat Tests.

It is announced from Washington that much interest is displayed by the officers of the navy in the coming official tests of the new Holland electric submarine boats "Moccasin" and "Adder," which will be held this coming month. Peconic Bay, Long Island Sound, probably will be selected as the ground, and the course will be off Shelter Island, where the boats will be tuned up for the occasion. Exceptional care has been taken by the officers in charge to make these tests as comprehensive and as rigorous as is fair to the contractors. The tests will be for endurance, speed ,stability, dirigibility, torpedo discharge and general performance.

Rear Admiral George W. Melville, chief of the Bureau of Steam Engineering, who is the most pronounced opponent of the diving type of submarine boat, has called the attention of officers of the navy to what they may expect, if the tests prove sucessful, and has sounded a note of warning in an article, in which he says:

"If the boat has any military or strategic value we should change our policy of ship construction, for nothing could justify the building of so many battleships if the submarine boats possess even a portion of the advantages that their advocates claim. From the time that the Senate and House naval committees look with favor upon these boats, there will be a decreased construction of battleships, and the action of Congress in striking out of the naval appropriation bill of 1901, all authorization for battleships and cruisers can certainly, in part, be traced to the belief that the submarine possesses many of the qualities claimed by its advocates."

Rear Admiral Hichborn, who was many years chief of the Bureau of Construction, in discussing the subject last week, said: "The smaller countries of the world are greatly interested in the question of submarine torpedo boats. You can easily see what their success means to nations like Portugal, Brazil, Venezuela, Norway, Mexico, Chile and many other countries with seaports which they are anxious to protect, but without the necessary means to either equip a suitable navy or erect and maintain extensive land fortifications. The cost of a modern battleship or armored cruiser of the first class is about $6,000,000. That would construct almost 40 submarine boats, so that for the equivalent of one great fighting machine almost any country in the world, and especially the smaller ones, could secure enough submarine boats to defend its harbors.

"I consider a thorough blockade of a harbor defended by such boats a practical impossibility, for the most intrepid commander would not maintain his fleet in the mouth of a harbor at night exposed to their attacks, but would draw off to sea, thus enabling the defenders to get out or their friends to slip in. The new boats are the first to be constructed under the direct supervision and inspection of officers of the navy and under contract with the United States Government. Many improvements have been made over the Holland in the new boats. I confidently expect them to demonstrate the value of submarine boats and make their construction a permanent part of the naval programme."

Underground Road for Berlin.

A plan has been laid before the Berlin Municipal Council for an underground electric railroad from the extreme north of Berlin to the Hallesches Gates, ending at the suburb of Schoenberg, a distance of seven miles. Four years will be required for the construction of the road, and its cost is estimated at $14,000,000, to be covered by a loan. It is reported that the underground and other municipal undertakings will render a $50,000,000 loan necessary.

Train Wireless Telegraphy for Italy.

It has been decided to establish Marconi wireless telegraphy apparatus at all stations, and on all passenger trains on Italian railroads. King Victor Emmanuel, of his own initiative, has appointed Signor Marconi a Chevalier of the Order of Industrial Merit.

Some Features of the Valtellina Three-Phase Railway.

By Cesare Pio.

THE Valtellina three-phase railway, which was condemned in advance by those opposed to alternating-current traction, is now regularly operating both a freight and passenger service with the most gratifying success, and the Società della Rete Adriatica, which owns the Valtellina Railway, is contemplating extending the same equipment to the Lecco-Milan branch. The writer is of the opinion that had the line not been handicapped by physical conditions, there would have been no delay in the operation of the road. As it was, the Ganz Company had not only to work out the matter of 3,000 volts at the trolley, but also encountered a number of unusual difficulties, such as a great number of tunnels located along the line, the smoke of the steam trains, which were operated during the whole time of the experiment, etc.

The two branches, Colico-Chiavenna and Colico-Sondrio, have been running since the 4th of September without the slightest hitch, and the running of freight trains and passenger trains seems to be just as simple as in the case of a 500-volt street car. The overhead network itself is not as intricate as that of some ordinary trolley lines. The greater danger involved to motormen handling controllers is avoided, as they cannot touch the live parts of the same until the trolley arch is lowered. All this has been secured through an ingenious system of interlocking devices, which have been work- satisfactorily so far. Only one accident, resulting in the burning of the left arm of a motorman, happened during the whole year of experiments and test. This man, not observing the rules, forced the controller door open, and came in contact with the 3,000-volt connection.

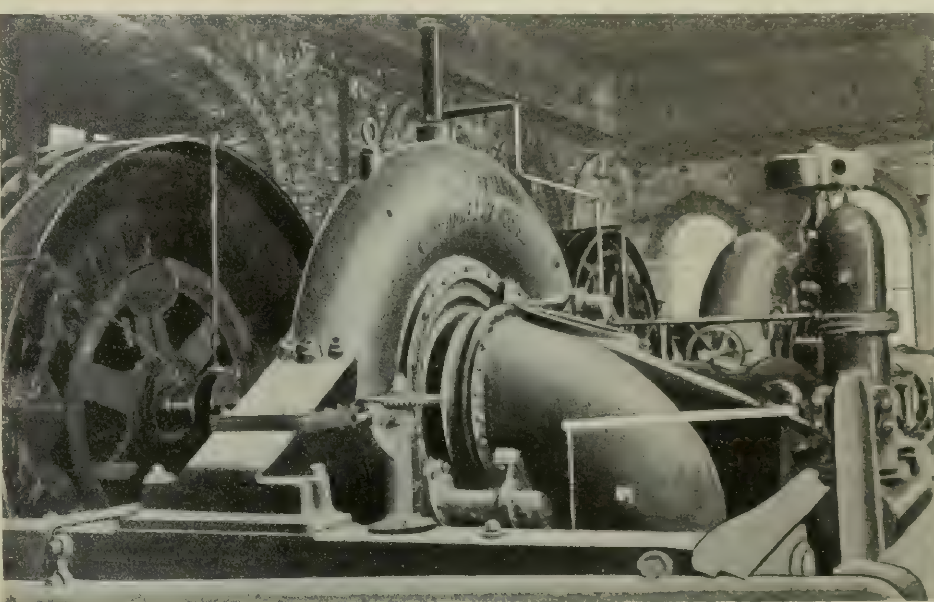


FIG. 1.—ALTERNATOR DIRECT-CONNECTED TO TURBINE.

For the operation of the road, water power from the Adda River was utilized.

The new stone canal and power house at Morbegno (between Colico and Sondrio) are designed to utilize still further the flow of the river. At present 6,000 hp are available. The canal was cut through the rocks of the mountains, and in several places is a tunnel. In the original project of the railway company, the whole canal was designed as a tunnel. The latter would have required more time for the construction, but, on the other hand, it would have been good policy, as the materials constituting the mountain are very soft and apt to fill the canal and interfere with the flowing of water. The water is carried to the head stock at a height of 90 feet above the power station; the amount of water is 25 cubic meters per second, so that the power available at the turbine axle is 7,500 hp, assuming an efficiency of 75 per cent. of the turbines. The turbines are of the Ganz type, direct connected to Schuckert three-phase alternators of the revolving-field type. Their stationary armatures give directly 21,000 volts. The armature coils project outside the cast-iron rings so that fine ventilation is assured. The exciters are mounted on the alternator shaft, and on the same shaft is also fixed a safety device of the centrifugal type, which, in case the turbine should attain a speed above 175 revolutions, inserts a very high resistance in the exciter's field The sets are actually too long for the size of the power station.

A mistake made, perhaps in designing the power station, was that of installing only two steel tubes for the turbine head stock. Each head stock should consist of two tubes, so that in case of accident to one the other will remain in service.

All the electrical equipment of the Morbegno power station was made by the Schuckert Company, including the whole switching work. The switching system includes six panels and a large-sized room on the back of the board. The panels can carry only low-tension apparatus, and the levers by which alternators are switched into parallel. The room at the back contains the high-tension switches, the lightning arresters, the transformers for the instruments and also two sets of bare copper bus-bars. No oil switches are used. The type adopted is the open type of the Schuckert Company, with the addition of copper horns of the well-known type of Siemens & Halske lightning arrester. These switches are located at the height of 12 feet, and are operated by means of ordinary ropes, so that there is no chance of injury to a person.

To American engineers, the large room required by continental high-tension switchboards is striking. In fact, the main difference between American and European practice in this work is that Americans want little room and much installation, and Europeans seem willing to sacrifice economy of the room in the back of the board, owing to the difficulty and expense of getting high insulation in limited space. It is a fact that the absolute absence of oil, rubber, fiber, wood, etc., renders the Morbegno switchwork entirely fireproof, which feature is absent from any American boards filled on the back with all kinds of insulating stuff. The main transmission line consists of only three wires, which is regretable, as in case of accident there is no reserve line.

Naturally, the main difficulties were encountered in equipping the overhead network. Besides the ordinary trouble of keeping a high degree of insulation, trouble from the smoke deposited by the locomotives on the insulators was encountered. But where the difficulties met were greatest was in the tunnels. The track had been laid out originally for slow steam trains, and with the increased speed of electric trains, it was necessary to add to the inclination of the roadbed to compensate for the effects of the greater centrifugal force. The new inclination of the roadbed caused the trolley arches to touch the walls of the tunnel at places, especially in the curves. This inconvenience has been obviated by changes of the trolley line and substituting a longitudinal suspension for the transverse suspension of the trolley wires. The transverse suspension proved too rigid, the trolley arches often jumping off and breaking when passing under the suspension points. The last branch of Lecco Colico is now ready for operation, it not having been started September 4, owing to lack of trained motormen.

The transformer substations are located along the line, and contain Ganz transformers of 450-kw, a motor for running the ventilators for cooling the transformers, a lightning arrester and switching apparatus of the above-mentioned type

The poles supporting the trolley wires are of wood, which indicates that originally the line was intended as a simple experiment. In five years these poles have to be replaced by iron or steel poles. The poles carry also the primary line. The suspension of the trolley wire is made without soldering, and it may be noted that there is not much complication of wires. Two peculiar features of the line are the double insulation and the elastic suspension of the trolley wires. Where the primary line crosses the trolley wires, a special arrangement has been devised to avoid accidents, being such that in case of a communication between a primary and secondary circuit, the fuses blow in the secondary substation. The cars are well equipped, and were entirely built at the Ganz works. Lately, there has been added to the trolley arch a little dash pot, so that in lifting up and lowering down with compressed air, inconveniences due to

the kinetic force are avoided. A cooling device has also been added to the water resistances of the controlling apparatus.

Worthy of special attention and study is the collecting device of the trolley. It consists of two cylindrical rollers terminating in two little conical surfaces, designed to work especially in the switching points. The rollers are of phosphor bronze, and are fitted with ball bearings of a diameter somewhat larger than is used for ordinary bicycle bearings. It is important to note that these bearings do not carry current at all. The current is conveyed by means

FIG. 2.—LONGITUDINAL SECTION OF TUNNEL AND DRAFT TUBE.

of small carbon contacts. The two rollers are insulated from each other with wood.

The locomotives for freight service have a tractive effort of 10,000 lbs., and run at the speed of 18 miles per hour. The motor cars run at two different speeds, 18 and 36 miles per hour.

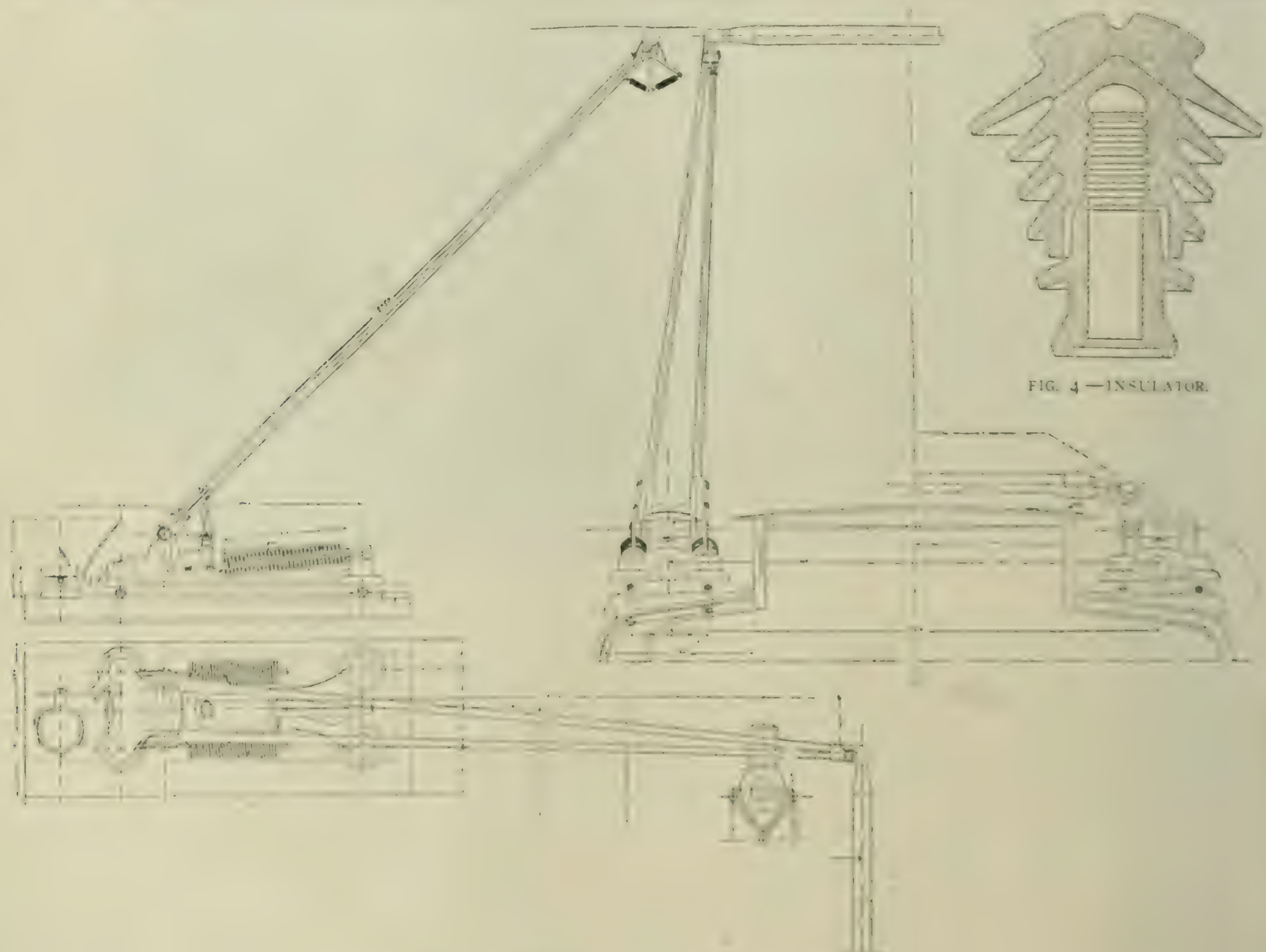


FIG. 3.—ELEVATIONS AND PLAN OF TROLLEY.

FIG. 4.—INSULATOR.

In the motorman's cab the following apparatus are installed: An automatic circuit breaker for the primary current, with the necessary fuses and the reversing device; a controller for starting and changing the speed; a valve for the compressed air, working the Westinghouse brake, and for lifting or lowering the trolley; a switch for the compressor motor; a voltmeter; an ammeter, and an air gauge. The cars are electrically lighted, heated and ventilated with current at 120 volts, derived from a small step-down transformer installed in the car. At present the Ganz Company is lighting all the railway stations of the line by utilizing primary current from Morbegno, after lowering its voltage with convenient transformers. Tests were made with 15 cycles, but they gave bad results, the flickering of the lamps being too noticeable.

Now that the work is finished, great honor is due to the Rete Adriatica for its bold initiative in the enterprise, and to the skill of the Ganz Company for the excellent solution of difficulties offered in a problem which could have resulted in a loss of 6,000,000 francs in case of failure. On the other hand, the Italian government, instead of encouraging and facilitating an enterprise destined to so greatly extend electric traction in Italy, put all manner of difficulties and trouble in the way, which indicates how unfortunate the situation would be should the government take over, as has been proposed, all Italian railways.

Wireless Telegraphy in War.

A dispatch from London says: At the naval manœuvres in the Mediterranean, the Channel and Mediterranean squadrons comprised the largest fighting force ever concentrated in one sea. The most interesting feature was the blockade of a collection of battleships, cruisers and torpedo craft in the Gulf of Argostoli by two forces more than twice its strength. The blockaded fleet, which was commanded by Prince Louis of Battenburg, made its escape without molestation, to the surprise of everybody. A correspondent who witnessed the manœuvres writes that the wireless telegraph system broke down completely in the face of the enemy, who deliberately and continuously sent confusing messages. In its present state it is absolutely useless for war purposes.

Work in the Philippines.

The Philippine commission has passed a bill providing for the construction, at Manila, of a standard-gauge electric railway. Maps and specifications will be exhibited in Manila and in Washington at the Bureau of Insular Affairs. The bids will be opened at Manila on March 5.

20,000-Volt Three-Phase Plant in France.

By P. Letheule.

HIGH-VOLTAGE transmissions are rare in France and though many projects have been proposed, they will probably await the commercial success of the plant forming the subject of this article. This plant is situated in the Department of Aude, in the extreme southeast of France, of which Carcassonne and Narbonne are the principal cities. The generating station is situated in the Corbières, at the mouth of Saint Georges, near Quillan. The total head of water is about 330 feet. The dam is in the river Aude, about 35 miles from its source in the mountains.

The dam at Saint Georges is a solid masonry structure. A canal having a total length of 18,000 feet extends underground for some 13,000 feet, and is open for the remaining 5,000 feet. The open portion is built of cement supported by wood in a very similar manner to the construction used for the Simplon tunnel generating station. The size of the underground part of the conduit is 6½ x 6½ feet. The incline is 7 feet per mile. In the open part of the canal this incline is increased to 10 feet, and the section reduced proportionately.

The canal brings water to a forebay from which lead two iron conduits of 3 feet 3 inches diameter to the generating station. These conduits are supported every 10 feet of their length by masonry, on which they can slide, and an expansion joint is provided every 650 feet. In a length of 650 feet the loss of head is 3½ feet.

The generating station is built over the iron conduits bringing the water to the turbines, and consists of a rectangular building of one floor, sufficient for eight groups of machinery, of which four are now installed and in service. At the end of the building is erected a platform, supporting the low-tension and transformer panels. In an extension of the building at the back is erected a high-tension switchboard and transformer room.

The generators deliver three-phase alternating current, at 2,900 volts, 50 cycles, to the low-tension panels in the generating room, and thence to the secondary low-tension side of the step-up transformers, the high-tension side of which delivers 20,000 volts.

The turbines are rated at 800 hp at 300 r. p. m. The wheels are of the Pelton type and were built by the Ateliers de Construction de Vevey. They are regulated either by hand or by an automatic regulator of the mechanical type. The distributor to the turbine offers four openings, which can be more or less regulated by a cylindrical valve controlled either by hand or by an automatic hydraulic regulator. The hydraulic regulator uses water under pressure from the conduits, which is previously cleaned by being passed through a filter. This regulator works perfectly, a sudden difference in load of 50 per cent., not affecting the speed above 4 per cent., and 100 per cent. variation, affecting the speed less than 10 per cent. It might be feared that the sudden difference in pressure would be dangerous to the conduits or the connections, but a regulator has been installed for preventing such a disastrous effect; it simply opens an outlet valve and discharges the water in case the pressure gets too high. The conduits conducting the water under pressure are also protected by tubes connecting with the open air at some distance above the station.

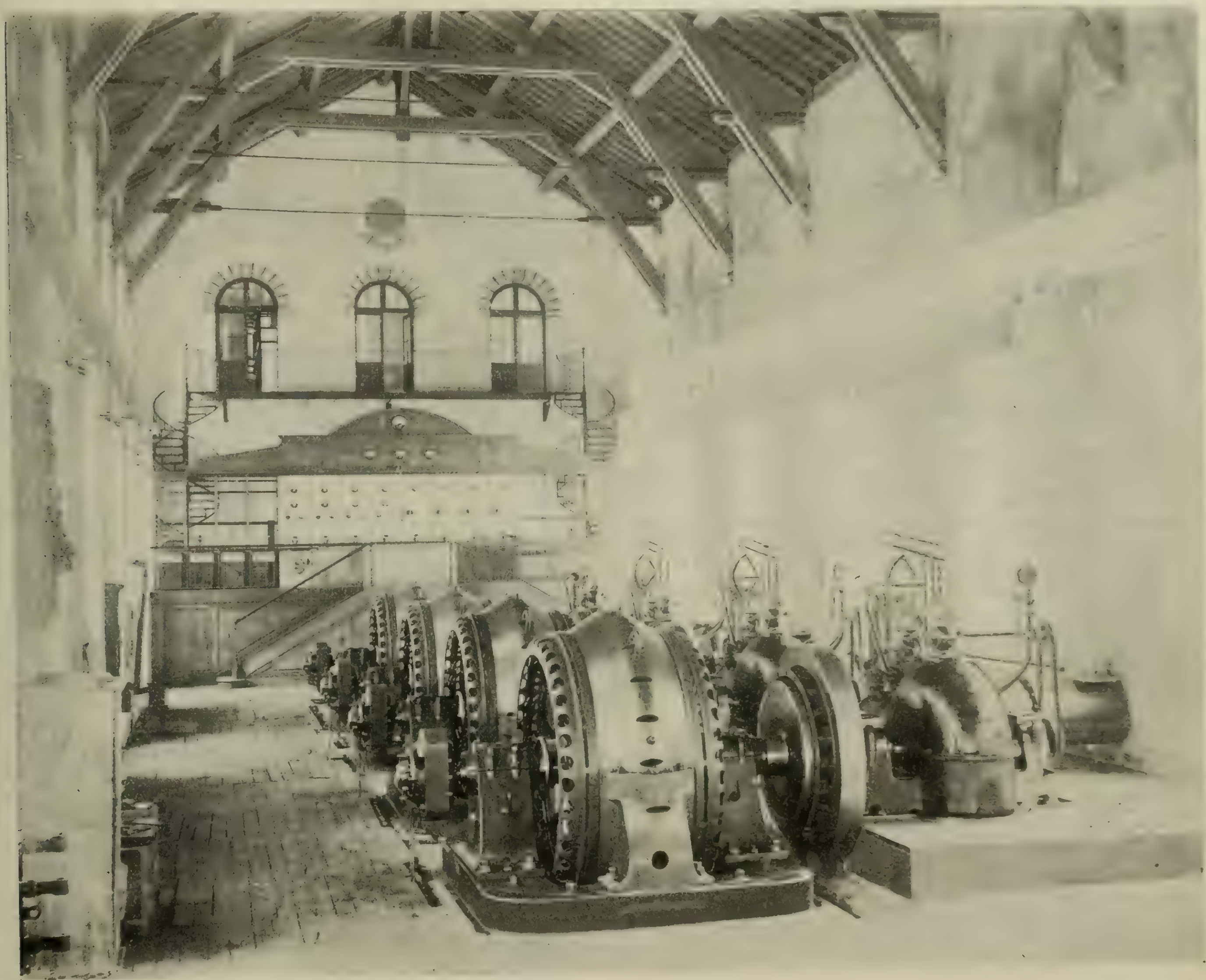


Fig. 1.—Interior of Generating Station.

The efficiency of the turbines reaches 77 per cent. at full load. Their axis is 11½ feet above the level of the water on the lower side, but the corresponding power is not entirely lost, an exhaust tube being designed for admitting air and water, giving a kind of relative vacuum, and allowing a certain amount of the power to be regained.

The generators are Alioth three-phase machines. Their rating

is 700 kw for a power factor of 100 per cent. or 540 kw for an 80 per cent. power factor. They operate at 50 cycles and 300 r. p. m., and generate 2,900 volts. The revolving part is entirely of iron with no windings. The fixed windings are star connected. The exciter is run on the end of the shaft, as in most German and Swiss installations. The exciting voltage is 50 to 60 volts, and the exciting

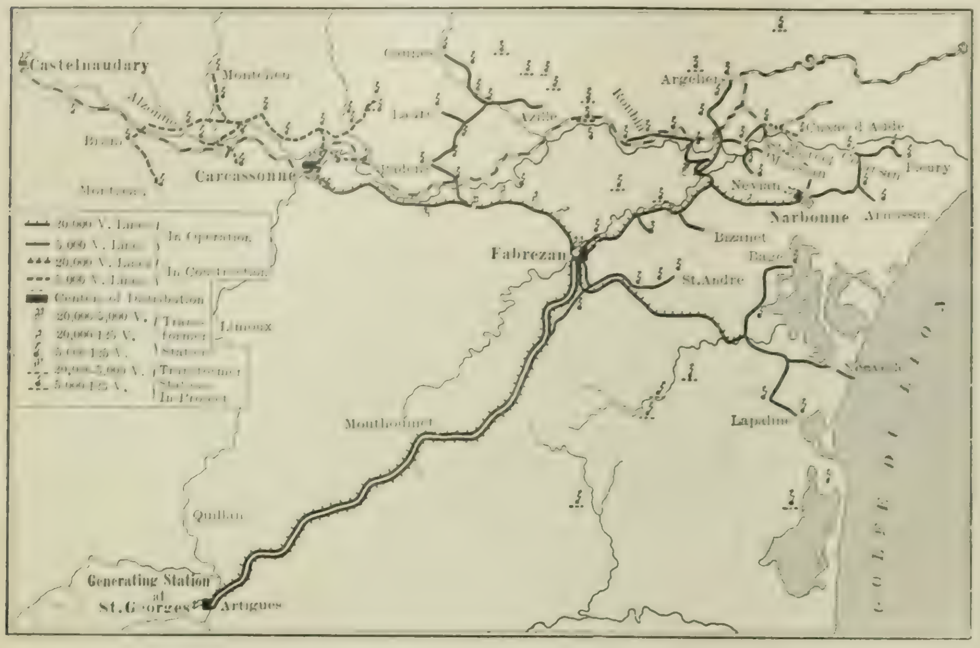


FIG. 2.—MAP OF TRANSMISSION SYSTEM.

current 25 amperes for full load, which gives .25 per cent. excitation loss. The efficiency at full load is 93 per cent. The drop in voltage is 5 per cent. for non-inductive load, and 16 per cent. for inductive load, 80 per cent. power factor. The weight of each machine is 35 tons, 12 tons of which are accounted for by the revolving part.

The cables from the machine to the low-tension switchboard in the gallery are provided with silver fuses. These cables are supported on porcelain insulators, and are provided with highly insulated connections.

The connections of the generating panels allow the machine to be run in parallel on one set of bus-bars, to which the low-tension secondaries of the step-up transformers can be connected. The voltage regulation of the alternators running in parallel is by hand, the field rheostats being mechanically coupled together and controlled by one single handle.

The high-tension step-up transformers which are between the high and low-tension switchboards consist of single-phase transformers, star-connected in the way well-known in the United States, but which is quite exceptional with continental constructors. In spite of the high voltage, the transformers are not cooled with water or oil; the windings are simply exposed to the air, though it is proposed to employ mechanical air ventilation if necessary.

The high-tension side of the transformers is controlled by switches placed on the high-tension switchboard, above the transformer room. The peculiar feature of these is the pneumatic or compressed air control from a distance, enabling the circuit to be opened or closed from the generating room by a man at the low-tension switchboard. There is a compressed air reservoir giving 90 lbs. pressure per square inch, which compressor is run by a low-voltage, three-phase induction motor.

Reference to the accompanying map will show the extent of distributing network, which seems at first sight disproportionate to the amount of power distributed, which is only some 1,600 kw, though intended in the near future to reach a total of 3,600 kw. This is far from being a great amount of power, but France is not a country possessed of great sources of hydraulic power as are the United States and a few countries in Europe, such as Switzerland, Sweden or even Italy and Germany.

The total length of lines reaches 240 miles, and will be extended to 360 miles. The distance from generating station to distributing center is 42 miles, and the main high-tension feeders distributing power from this center to the main transformer stations are from 18 to 24 miles long, so that the total distance from the central station to distributing points attains about 80 miles.

Three-phase transmission was selected, the choice being due to the power being required for public and private lighting and for small and large motors in many branches of industry. The long distance and the unusually large numbers of centers of distribution led to the adoption of alternating current, due to its great facility of transformation to various voltages. The presence of motors on the network of lines led to the use of polyphase current, the simplest and best form of which was deemed to be three-phase. The use of current for lighting led to the adoption of a frequency of 50 cycles.

All the hydraulic plant was designed and built for an output of 3,600 kw, but as only half this power was contemplated at first, the electrical plant is laid down for the latter output, further units to be added as required. Although this output is not very considerable, the tension of the line is quite high, 20,000 volts having been chosen. This pressure is not too high, as will be seen from the calculations given further, the diameter of the copper wire being 7.5 mm. The promoters, however, considered it advisable that the pressure should not be increased beyond 20,000 volts, by reason of the large number of small transformers and motors utilizing the power

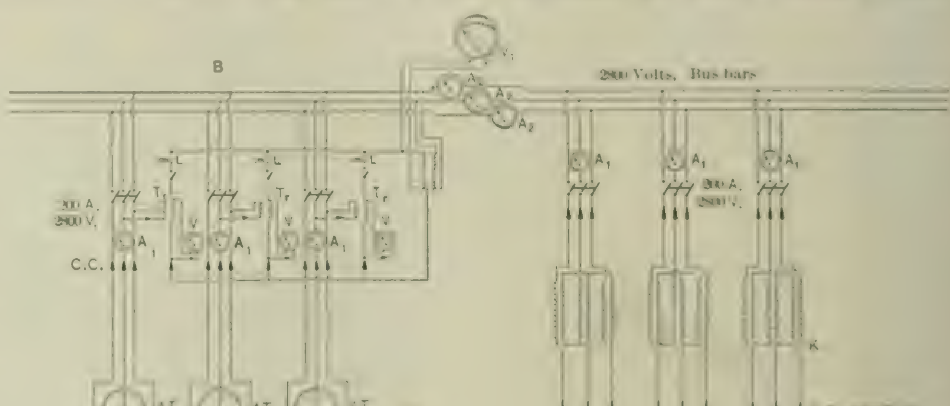


FIG. 3.—DIAGRAM OF CONNECTIONS OF HIGH AND LOW-TENSION LINES.

along the whole extent of the line, and also of the greater expense and difficulty of maintenance and inspection. A few special transformers have lately been installed, at the request of customers, for a power output as low as 3,500 watts, the construction of which for 20,000 volts entails special care and high cost. The low-tension

winding is placed directly on the core and inside a porcelain sleeve with large projecting ribs, around which the 20,000-volt primary is wound.

High tension is not used for the whole of the distributing lines running to the numerous small towns and villages where light and power is distributed. The voltage used here is 150 to 300 volts; an intermediate voltage of 5,000 is also used, stepping down to 125 volts for local distribution.

The 5,000-volt distribution has no special interest, but the 20,000-volt transmission line deserves more than passing notice.

The 20,000-volt transmission line of 80 miles is divided into sections. The first 42 miles of line running from the generating station to the main distributing center has been calculated for a loss of 20 per cent. in the transmissicn of 1,620-kw inductive load at 80 per cent. power factor. The resistance is determined from the following formula:

$$324{,}000 = 3RI^2,$$

R being the resistance of the cable, and I the current. The current amounts to 54 amperes, and thus the resistance of one conductor is 36.06 ohms; allowing for impurity of copper and a temperature of 15° C., the section adopted was 38 mm²; that is, a diameter of 7.5 millimeters for the conductor.

The drop in volts due to resistance is represented by the formula, $E' = \sqrt{(E - RI\sqrt{3})^2 + (RI\sqrt{3}\,tg\phi)^2}$. From this we find the drop to be 3,240 volts, and the volts at the generating station 20,240. It follows from the above that the weight of the copper reaches 75 tons, in spite of the high percentage of loss in the feeder.

The voltage at the central distributing point is in consequence regulated between 17,000 and 17,200 volts, according to indications received at the generating station from the receiving or distributing point. The stations are connected by telephone, and it has become quite feasible through experience acquired to regulate the voltage at the generating station by watching the total-output ammeter.

As to impedance, the distance between wires being 2 feet, we arrive by Blondel's formula, subtracting the mutual inductance from self-

FIG. 4.—ARMORED CEMENT WATER CONDUIT.

inductance of the two wires, at a value of inductance of 1.7 millihenrys per mile; so that the resistance factor, which is the ratio of reactance to ohmic resistance, is about 0.641 for the frequency of 50 cycles. This inductance increases the drop in volts by $\sqrt{1 + 2\,(p - p^2)\,(\cos\phi + m\sin\phi - 1) + p^2 m^2}$, p representing the relative loss of tension and m the reactance factor. Three per cent. has, therefore, to be added to the voltage of the generating station, to compensate for this impedance drop.

The effect of capacity can be approximated by assuming a condenser placed at a certain point in the line, the charging current of which will be about 46 amperes at 20,000 volts. Experience does

FIG. 5.—POWER HOUSE AND DRAFT TUBES.

not check these figures, as the ammeter shows 10.2 amperes as charging current with a tension of 17,600 volts at the generating station at no load. This changing current is equivalent to about 300 apparent kw-amperes; that is, half the rating of one generator. The current, however, leads so much that it is sufficient to allow 6 amperes exciting current to obtain the normal voltage at the terminals of the machine, instead of 12 amperes required when running. Experience has verified that the charging current is proportional to the pressure and to the frequency. It has been remarked also that the generating station voltage being 17,600 volts for no-load on the line, the rise due to capacity reaching 700 volts, the voltage at the end of the 42-mile feeder amounts to 18,300 volts.

There are three branch lines running from the main distributing center to the three main distributing stations; by adding one of these lines to the length of the main feeder, thereby increasing the length from 42 to 60 miles, we decrease the charging current from 72 to 38 amperes. By including another 25-mile branch line from the distributing point, no modification of this figure is obtained.

The following table gives the value of charge current obtained when the line was tapped at different successive points along its length, as mentioned on the top of the columns:

	St. Louis.	*Talairan.*	*Babrezan.*	*Ornaison.*	*Narbonne.*
Length in miles.......	7	37	42	50	60
Charging current.....	0	68	72	52	38

These results can be deduced from theoretical calculations though the exact laws of distributed capacity are rather complex. Moreover, the capacity has proved to be of no importance under load, and even with the sudden interruption, due to the blowing of a fuse, the rise in tension has never been dangerous. The maximum observed has been 32,000 volts. No resonance effects have been experienced, in spite of the presence of a third harmonic of a very considerable relative value in the curve of the alternators.

The feeder is made of three cables of 38 mm.², separated at a distance of 2 feet. They are supported by wooden poles, 32 feet high, placed 130 feet apart. The poles were treated by soaking them in kerosene. The insulators are of French design, and are provided with triple petticoats, as shown in Fig. 7. The insulators used have been tested to 40,000 volts. The defective insulators could easily be detected at night, owing to certain luminous effects which were never shown by good insulators.

The insulators have worked satisfactorily, and only a few defective insulators have had to be replaced. They have been covered with snow which reached to the tops of the poles, but no accident has arisen. Galvanometer readings showed an insulation of 500,000 volts between the three conductors and the ground. Rainy or overcast weather reduces this to 100,000 volts.

A telephone line is supported by the same poles, 7 feet below the power line. The telephone lines are crossed every 10 poles, so as to compensate for effects of inductance. The working of the telephone is satisfactory as long as the insulation of the line is good, the inductive effects being negligible.

The chief engineer of the line supervises the line and has three assistants under his charge. The first 42 miles of the line is inspected by seven men, under the supervision of the chief of the line, and the branch lines of 20,000 volts are similarly inspected. Short-circuits have been occasioned by trees and by various birds. In case of a short circuit, the tension rises as high as 35,000 volts, but the lightning arresters always protect the line in these cases.

Though the low-tension lines present no special interest, the transformer stations are worthy of notice. The main transformer station is situated in the center of distribution, Fabrezan, from which all tensions are regulated. All transformer stations stepping down from 20,000 to 5,000 volts are protected at the entrance of the line by lightning arresters of the "horn" type, with resistance and inductive coils.

The switchboard is entirely made of iron, and only the low-tension panels at the generating station are composed in any part of marble. The instruments, ammeters, voltmeters, etc., are insulated from the iron switchboard by means of porcelain insulators. The connections are all made of copper, non-insulated, and supported by insulators identical to those used on the line.

The three branch lines running from the central distributing point gives rise to a supplementary loss of power of about 5 per cent. They feed a certain number of distributing points along their course, and are mostly designed for feeding three terminal points at which the tension is stepped-down from 17,000 to 5,500 volts, fed into the secondary network. These distributing points use transformers of 100 kw, protected by lightning arresters of the "horn" type.

The up-keep of the secondary network is much less difficult than that of the primary lines. A great number of secondary posts are distributed on the system, stepping-down the voltage from 5,000 to 125 volts, for supplying motors and lamps.

Motors constitute about half the load of the station. Most of these are small induction motors, wound for 250 volts, with self-contained resistances. They are started by means of the resistances, which are cut out by a bronze contact operated by means of a rod inside the shaft of the motor. Some induction motors, however, have to be started under considerable load, and their starting resistances attain large dimensions; they, therefore, constitute a separate part distinct from the motor, and their final short-circuiting is by means of carbon brushes with rings mounted on the motor shaft.

Some of the motors, it is to be remarked, have an arrangement for automatically bringing into circuit the starting resistance of the in-

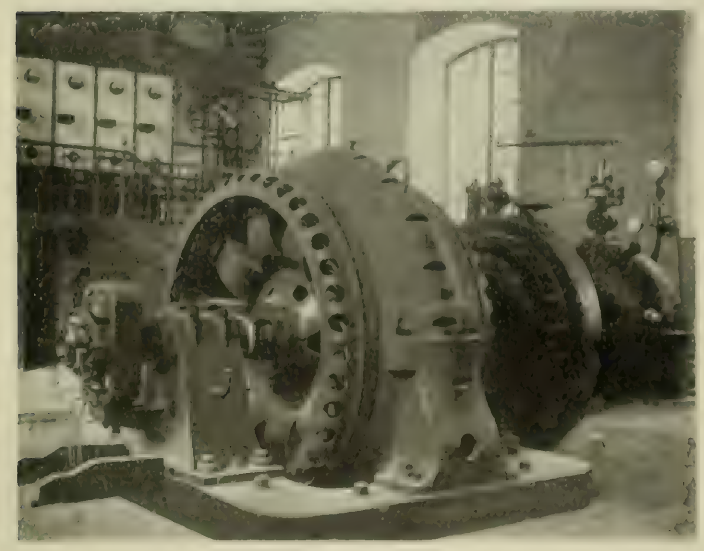


FIG. 6.—ALTERNATORS AT GENERATING STATION

duction motors in case of sudden interruption, and thus avoiding the restarting of these motors without resistance.

Only two synchronous motors have up to now been in operation, one at Carcassonne and another at Narbonne, for distributing direct current to the old Edison systems of these cities. These motors, which are rated at 150 kw each, are direct-coupled to dynamos running at 430 r. p. m. The motors are wound for 500 volts, and are fed from the secondaries of transformers of 200 kw each.

The motors are started from the direct-current side, and it has been observed that the synchronization of the first group causes a rise of voltage as high as 25,000 volts, with no load on the line. When

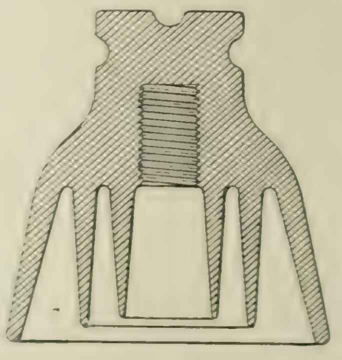


FIG. 7.—LINE INSULATOR.

the motor is put on the line previously loaded, no difference in voltage can be observed.

In case of short-circuits on the line, the motors sometimes drop out of step, and the switchboard attendant then generally lightens the load by decreasing the excitation of the continuous-current generators. It often happens that when the short-circuit ceases, the motor can be loaded again, thus avoiding the dropping out of step of the group. Synchronous motors are used in these two stations, because it was intended to employ them to regulate by raising the voltage of the line by over-excitation, but up to the present this has not been done.

The price for current has not yet been rendered definite. Municipal lighting is granted free of charge to the Communes in exchange for certain rights secured by the company. Every 1,000 inhabitants are entitled to 25 16-cp lamps. Domestic lighting is by contract

Interurban Work on the Oley Valley Railway.

The Oley Valley Railway may be considered as typical of the interurban electric roads now being built in many localities throughout the country. This road, running out from Reading Pa., is one of the lines owned by the United Power and Transportation Company. The power house at Reading contains a variety of generating apparatus which has been installed at various times to meet the growing demand of the city for power. The power for the electric road is furnished by two 400-kw and one 800-kw generator, direct connected to vertical engines, furnishing direct current at 550 volts

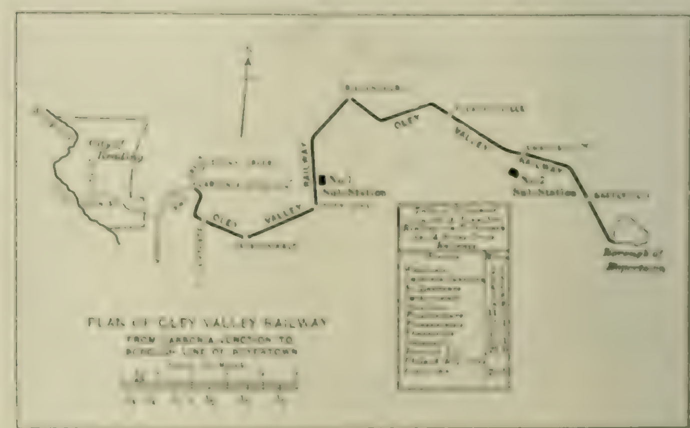


FIG. 1.—MAP OF OLEY VALLEY RAILWAY.

The cars of the Oley Valley road operate over one of the city lines for 3¾ miles, as far as Carsonia Park This section is supplied with current by a 500,000 circ. mil copper feeder, running direct from the 550-volt bus-bars. The trolley wires are broken at this point, and the remaining 18¾ miles of the road are operated by the sub-

station system. However, there is an independent 4/0 feeder running from the 550-volt bus-bars, extending the entire length of the line. This feeder furnishes current for starting the rotaries, and, in case of accident to the alternating-current transmission, the whole road can be operated from the main power house.

FIG. 2.—ROUTE OF ELECTRIC RAILWAY SYSTEM BETWEEN PHILADELPHIA AND READING.

In the Reading power house are two 400-kw rotaries, running inverted. The current from the positive bus-bar passes successively through circuit breaker, ammeter, starting rheostat and main switch to the commutator of the rotary, returning through a negative switch mounted on a separate equalizer stand to the negative bus-bar. By this arrangement no negative leads are brought to the rotary switchboard, and the danger of short-circuits on this board is thereby minimized.

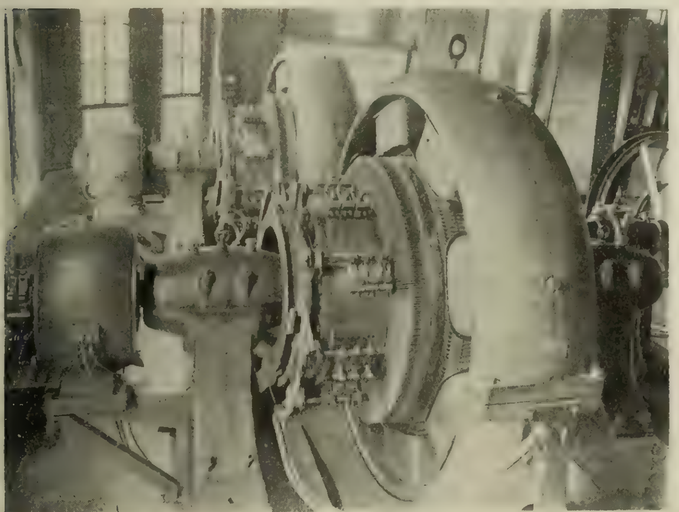


FIG. 3.—ROTARY CONVERTER SUPPLYING ALTERNATING CURRENT, READING STATION.

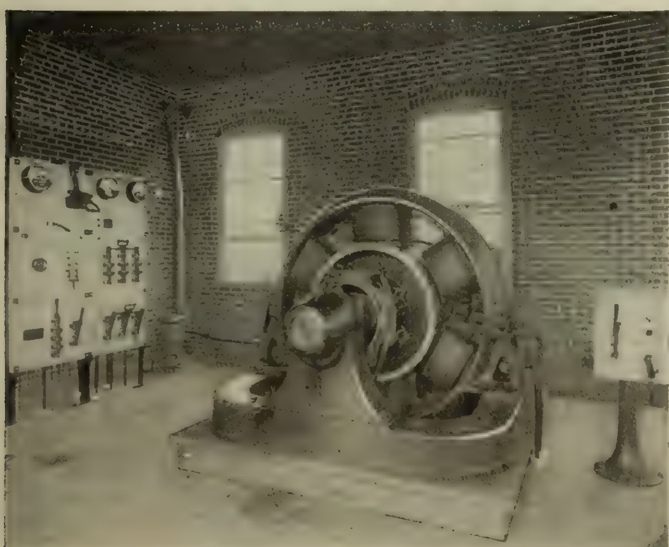


FIG. 4.—ROTARY CONVERTER AND SWITCHBOARD.

Each rotary is separately excited by a small exciter mounted on its main shaft, operating at 120 volts. From the alternating-current side of the rotary the current passes through low-tension switches and instruments mounted on the low-tension board. Leads runs from this panel to three 280-kw oil-filled, water-cooled transformers, which are placed in a separate room. From the high-tension, 16,000-volt side leads run to the high-tension switchboard, which is equipped with compression ball fuses and emergency switches. In the transformer room there is also a bank of lightning arrester and choke coils.

From the power house, the high-tension current is conveyed through one mile of three-phase, lead-covered cable to the outskirts of the town, where there is a junction box containing a second lightning arrester equipment. Beyond this point the transmission line consists of three No. 4 hard-drawn copper wires, supported on porcelain insulators carried on cross-arms upon the same poles as the 550-volt transmission.

FIG. 5.—TRANSFORMERS IN SUBSTATION.

The first substation is situated at Oley Line, nine miles from the power house, and the other at Shanesville, 18 miles from the power house. Each station consists of a transformer room and the rotary room proper. In the transformer room are three 100-kw oil-filled, water-cooled transformers, as well as a lightning arrester equipment and a high-tension switchboard. Water is circulated through the transformers by a small pump belted to the rotary, the source of water being a small stream in the vicinity. In the rotary room is a 300-kw rotary converter, with the necessary low-tension switchboard for controlling the rotary and feeding the trolley circuit.

The transformers in the Reading power house are designed for stepping-up to 16,000 volts. The substation transformers are wound for 15,000 volts on the high-tension side, and 300 volts on the low-tension side. As the loss on the line is considerably less than 1,000 volts, the rotary converters therefore supply current to the trolley wires at a voltage slightly above 550. The Stanley Electric Manufacturing Company supplied the rotaries, transformers, lightning arresters, etc., referred to above

Commercial Telegraphers.

A general convention of representatives of all unions of commercial telegraphers met at Pittsburg on October 26, for the purpose of forming a national telegraphers' union.

The Rowland Rapid Telegraph System—III.

(Concluded.)

It has been attempted, in the preceding description to give only a bare outline of the features of this invention. Much more might be said in regard to the many ingenious devices used and the new mechanical and electrical features employed. The apparatus is, throughout full of beautiful physical principles and most ingenious electrical and mechanical devices. One very important feature of

FIG. 9.—KEYBOARD.

the apparatus is the natural way in which it divides itself into distinct units, so that if one unit becomes deranged it may be immediately replaced by another, without stopping the operation of the rest of the apparatus. Thus, considering one end of the line only, there are four keyboards, all exactly alike, which may be replaced singly by others by merely breaking eleven wires joined together by a multiple connector. There are four-page printers which can also be operated, singly or together, and be immediately replaced by others in a like manner with the keyboards. There are four similar banks of eleven polarized relays each. If anything deranges one of these banks, only that printer to which it belongs is affected.

This being the case, it is thought that a clearer idea of the appearance of the apparatus as actually constructed will be obtained by showing a picture of one of each of these units rather than by giving a single view of the entire outfit as installed at one end of the line. Thus, Fig. 9 is a photograph of a keyboard; Fig. 10 shows a page printer; Fig. 11 a synchronizer, the receiving commutator and letter finder. A specimen of the printing is shown in Fig. 13. It will be noted that the operator has spaced and lined and paragraphed the

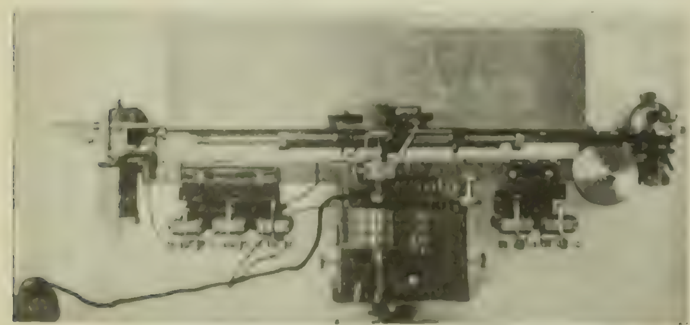


FIG. 10.—PAGE PRINTER.

printing in the same manner as would be done on a Remington typewriter.

LATER IMPROVEMENTS.

The mechanical operation of the page printer has been improved, and the keyboards have been entirely redesigned since the foregoing was written. The main distinction between the old and the new keyboards is that the new keyboard makes combinations electrically. The page printer performs the same functions as the one described, but more perfectly, and functions of minor importance have been added, such as the rapid feeding out of a telegraphic blank, in less than three seconds. The former description assumed that the alternating waves on the line were divided up into five groups: *A, B, C, D, X*, fifty-two waves being used for the purposes of printing with four printers, signalling and finding the letter. Fifty-six waves are now divided into four groups; eleven of the waves in each of the four groups are used for the printing, one wave in one of the groups is used for finding the letter, and three waves, one taken from each

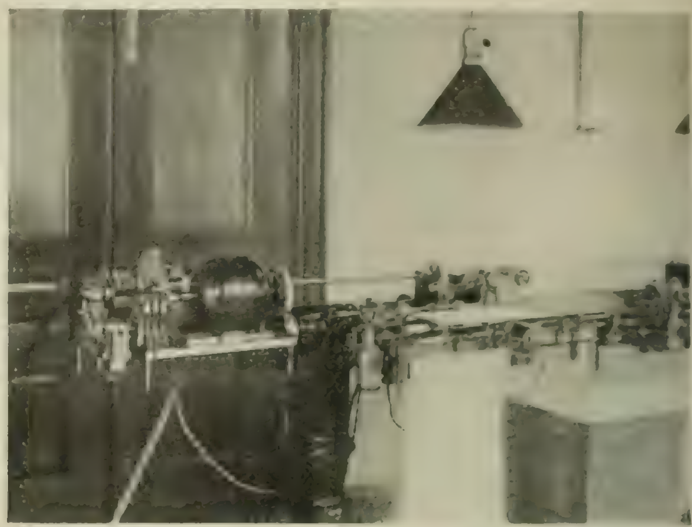


FIG. 11.—SYNCHRONIZER, RECEIVING COMMUTATOR AND LETTER FINDER.

of the remaining three groups, are reserved for purposes of signalling. The signalling can be accomplished in a variety of ways. Morse instruments, one at each end of the line, can be worked duplexed at a slow speed. It is preferable, however, to place at each end of the line, in addition to the four-page printers, a small tape printer, which print simultaneously at the rate of fifteen words a minute each. While the eight printers of the duplex system are in operation, for the transmission of telegrams, the two stations can correspond with each other regarding the business of the offices, or for the purpose of correcting errors. The system, therefore, may be called, with propriety, a "Decaplex" system.

The new machines have the additional important feature that all

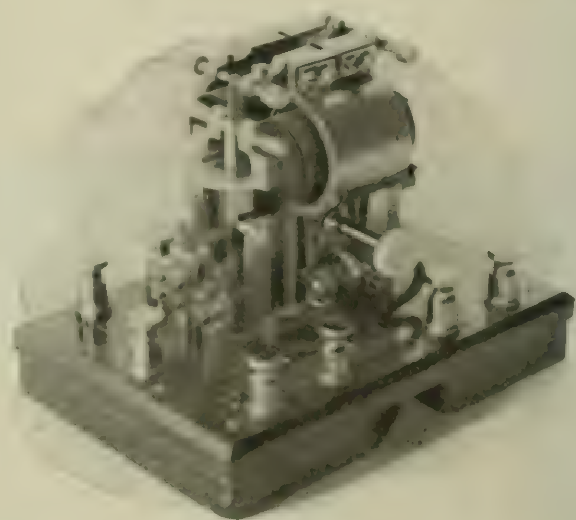


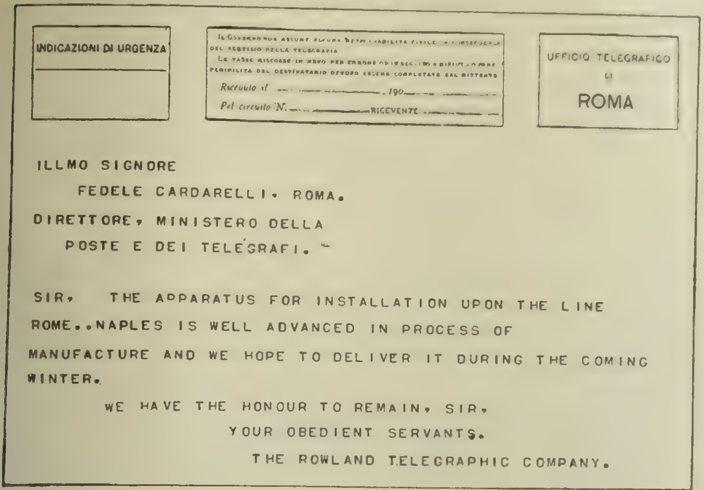
FIG. 12.—MAIN LINE RELAY.

the messages transmitted are simultaneously recorded at the sending station. The recording at the sending station is done on a tape in printed characters. The tape passes directly over the keyboard and before the eyes of the keyboard operator. (The illustrations represent the tape-recorder raised to the level of the eyes of the operator but in the latest form developed it passes directly over the keyboard.) This home-recording of the messages is accomplished without loss of speed in the eight regular transmitters and without additional complication in the keyboards.

A feature of the apparatus, as now constructed, is the manner in

which it is subdivided into interchangeable units. Each printer, keyboard, bank of relays, transmitter, and the main-line relay constitute an independent unit, which, in case of a failure or a breakdown, can be replaced by another like unit. As such an interchange can be effected instantly, neither the apparatus as a whole, nor any portion of it, is put out of operation more than a moment by the mechanical failure of any of its parts.

The system is kept in electrical adjustment, as far as the main line is concerned, much more easily than are other telegraphic systems.


INDICAZIONI DI URGENZA

Ricevuto il .... 190....

Pel circuito N. .... RICEVENTE ....

UFFICIO TELEGRAFICO DI ROMA

ILLMO SIGNORE
FEDELE CARDARELLI. ROMA.
DIRETTORE, MINISTERO DELLA
POSTE E DEI TELEGRAFI. -

SIR, THE APPARATUS FOR INSTALLATION UPON THE LINE ROME..NAPLES IS WELL ADVANCED IN PROCESS OF MANUFACTURE AND WE HOPE TO DELIVER IT DURING THE COMING WINTER.

WE HAVE THE HONOUR TO REMAIN, SIR,
YOUR OBEDIENT SERVANTS.
THE ROWLAND TELEGRAPHIC COMPANY.

FIG. 13.—SPECIMEN OF PRINTING.

The duplex line is thrown out of balance only by a considerable change in the insulation resistance of the line. Actual trial has shown that a 300-mile line can be connected to earth at its middle point, through only 2,000 ohms' resistance, without upsetting the duplex adjustment sufficiently to spoil the printing.

In view of its maintenance in electrical adjustment and its interchangeable units, the system may be kept operative under conditions which would upset any other than the Morse system operated simplex.

The octoplex system can transmit to greater distances without relaying than other multiplex systems hitherto known. It has been successfully operated under government tests over lines of 550 miles, and it is anticipated that it will work perfectly, without relaying, between New York and Chicago. Methods have, however, been devised by Professor Rowland for automatically relaying the messages.

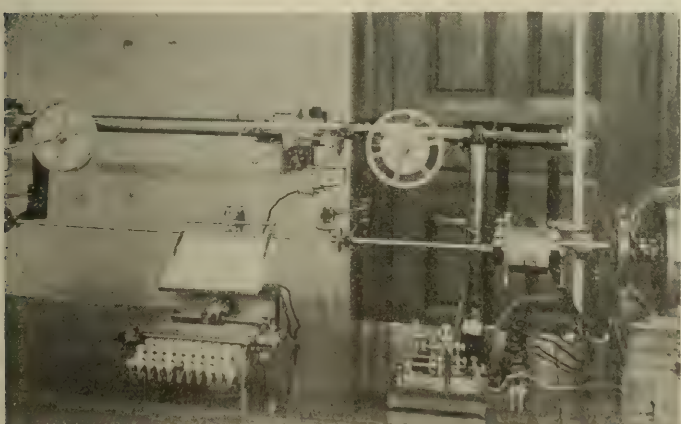


FIG. 14.—KEYBOARD, HOME RECORDER, TRANSMITTER (MAIN LINE), RECEIVING COMMUTATOR.

The instrument shown in Fig. 18 is used with the present octoplex as an additional auxiliary unit for executive correspondence over the line, without interference with the regular work of the octoplex transmitter. It, therefore, renders the capacity of the "octoplex" outfit decaplex. This represents the latest modification of the apparatus; it is the basic unit of the system, and includes a transmitter, a page-printer, a tape-home-recorder and its own synchronizer. All the combinations and the differentiations of the system will be effected by different arrangements of these basic units. There will be other units for the purpose of effecting line operation. In a telegraph operating room supplied with a number of these single-outfit units, it will be possible to move the machines about at will, in order to give a greater or smaller multiplex capacity to any telegraph line, according to the exigencies of the moment.

The system has advantages in the operation of lines subject to line disturbances. As the alternating current is employed, condensers may be used in series with the main-line relays; no amount

FIG. 15.—OCTOPLEX SINGLE POST, SHOWING GENERATOR TO RIGHT.

of direct current on the line, resulting from leakage to trolley lines, etc., can produce a harmful disturbance.

METHODS OF LINE OPERATION.

Aside from the operation of the system between two main terminal stations, most of the applications which involve the division of its octoplex capacity of transmission amongst stations separated by a considerable distance require the use of some sort of automatic relaying device. An automatic relay for the Rowland system is constructed in one of several different ways; for general use, the following method is considered the best, on account of its flexibility. The general idea may be expressed in a few words:

At a relaying station, the incoming signals are received on a bank of eleven selecting relays, in the same manner as at a terminal station. These relays, instead of operating an automatic printing device, have their eleven contacts connected to a sending commutator, in the same manner as the contacts of a keyboard; they operate the usual transmitter which transmits the proper modifications to an alternating current impressed upon the local line by a dynamo at the relaying station. This dynamo is run in synchronism with the dynamo at the originating terminal, or with the dynamo at the main central of the system.

FIG. 16.—COMPLETE OCTOPLEX SENDING AND RECEIVING POST.

Diagrams, with a brief statement of the operation in each case, are here shown, to illustrate various applications of the Rowland system. It is not deemed necessary, in the present article, to enter

into the technical details of these systems of operation; but it may be remarked that only such are presented as have been experimentally proved as operative, or used in the operation of actual lines.

In regard to all of these methods, some general remarks, which apply to all, may be made. In all cases, the octoplex capacity may be distributed in any convenient manner; that is, in place of having eight operators, at a speed of 40 words per minute each, the number of operators may be doubled and the speed of each halved; or any number of operators may be had, with the limitation that the aggregate speed of the apparatus shall not exceed that of the eight operators at 40 words. In cases where branch lines radiate from a central, these lines may be 300 miles long or longer. Or, in case of slightly different apparatus, placed at the terminal of the branch, these branches may have any length up to the maximum of the system. Way station lines may have any length up to 300 miles.

FIG. 17.—RECEIVER.

In Fig. 19 are shown two centrals, 1 and 2, connected by a trunk line. Passing out from each central is a branch containing a number of stations in series. At 1 and 2 there is an automatic repeater, comprising:

Dynamo and motor.
Two sending commutators.
Two receiving commutators.
Three main line relays.
Three transmitters.
Two banks of selecting relays.

FIG. 18.—SINGLE-OUTFIT UNIT.

At the way stations A, B, C, etc., is a simple or multiple outfit, as the case might be, comprising:

Synchronizer.
One sending commutator.
One receiving commutator.
One to four banks of selecting relays.
One transmitter.
One main line relay.
One to four keyboards.
One to four home recorders.
One to four printers.

Communication may be established so that one station, A, corresponds with another, A_1, another station, B, to a station, B_1, or, by additions to the apparatus, more complicated and general methods of communication may be established, if such should be desirable.

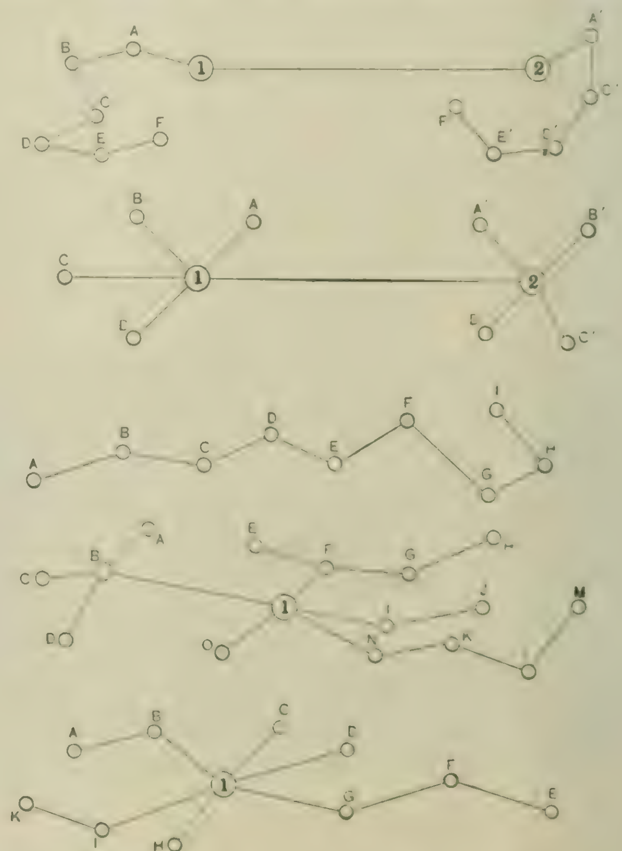
Fig. 20 shows two centrals, 1 and 2, connected by a trunk line, and, at each central, a number of radiating termini. At each central is an automatic repeater. At each branch terminal, A, B, etc., is a single or a multiple outfit, as desired. As in Fig. 14, correspondence between particular stations, such as A and A_1 can be established, or, by additions to the apparatus, any station may be made to communicate with any other, at will.

In Fig. 21 is shown a way station line. A number of stations are connected in series. At A is the apparatus:

Dynamo and motor.
One sending commutator.
One receiving commutator.
One to four keyboards.
One to four home recorders.
One to four printers.
One to four banks of selecting relays.
One transmitter.
One main-line relay.

At B, C, etc., are single or multiple outfits. Here independent communication may be had between A and any other station or stations, to the extent of four, each station having a rate of 40 words a minute. These messages may be all received at A, or all sent from A, or A may receive part and send part up to a total of four.

In Fig. 22 is shown a distributing system. Here the apparatus at the various points is substantially the same as given at various corresponding points of the systems previously described. In this system, a keyboard, operated at 1, will simultaneously operate automatic



FIGS. 19 TO 23.—VARIOUS LINE OPERATIONS.

printing devices at all the points of the system.

In Fig. 23 is shown another distributing system, which has the addition of transmitting devices at all the substations. The operator of a keyboard at any point of the system transmits the same matter simultaneously to all other points of the system. Any number of operators distributed among the various stations in any manner may be operating at the same time, up to the total capacity, in this case 160 words per minute.

Underground Work for Telephone Exchanges—IX.

By ARTHUR V. ABBOTT, C. E.

COST OF CONDUITS.

THE cost of a conduit system will be directly proportional to its length, and depends on, but will not be exactly proportional to, the number of ducts. This is almost self-evident, for slight consideration shows that certain of the items of expense are independent of the number of cable spaces, others are partially dependent thereon, while the remainder vary directly with the number of ducts installed. Thus, the cost of manholes will be the same whether few or many ducts are placed; engineering expense, the cost of lighting, watching, protecting and cleaning the street will be the same irrespective of the size of the subway. For necessary working room a certain width of trench must be opened, and if the required number of ducts does not need a wider trench the cost of excavation and paving will be constant. When, however, a greater number of ducts is to be placed, a wider trench than is essential for working room must be excavated, and then the cost of excavation and paving will become partially proportional to the number of ducts. Finally, the expense of the duct material, the cost of labor of laying and that of the surrounding concrete encasement will depend exactly upon the number of ducts.

The fundamental items of cost entering into the expense of conduit construction are ten in number:

1. Duct material. 2. Cement. 3. Sand. 4. Broken stone. 5. Brick. 6. Wrought iron. 7. Cast iron. 8. Lumber. 9. Paving materials. 10. Labor. (a) Skilled labor. (b) Unskilled labor.

TABLE NO. 1.

Cost of Manholes in Dollars.

a. Brick with brick roof.

Item.	Amount.	Rate. Min.	Rate. Ave.	Rate. Max.	Min. Amt.	Per cent.	Ave. Amt.	Per cent.	Max. Amt.	Per cent.
Excavation	375 cu. ft.	.02	.03	.04	7.50	12.6	11.25	11.8	15.00	11.2
Concrete	.7 yards	5.00	7.00	9.00	3.50	5.9	4.90	5.3	6.00	4.4
Brick	2200	12.00	15.00	18.00	26.40	44.5	33.00	35.3	39.60	29.4
Cover	1	5.00	10.00	15.00	5.00	8.4	10.00	10.6	15.00	11.2
Iron	500 lbs.	.015	.03	.05	7.50	12.6	15.00	16.1	25.00	18.6
Repaving	6 yards	.75	2.00	4.00	4.50	7.6	12.00	12.8	24.00	17.8
Cleaning	10 loads	.50	.75	1.00	5.00	8.4	7.50	8.1	10.00	7.4
Totals					59.40	100	93.65	100	134.60	100

b. Brick with concrete roof.

Item.	Amount.	Rate. Min.	Rate. Ave.	Rate. Max.	Min. Amt.	Per cent.	Ave. Amt.	Per cent.	Max. Amt.	Per cent.
Excavation	375 cu. ft.	.02	.03	.04	7.50	14.8	11.25	14.4	15.00	13.8
Concrete	1.9 yards	5.00	7.00	9.00	9.50	18.7	13.30	17.0	17.10	15.7
Brick	1600	12.00	15.00	18.00	19.20	37.8	24.00	30.9	28.80	25.7
Cover	1	5.00	10.00	15.00	5.00	9.0	10.00	12.8	15.00	13.8
Repaving	6 yards	.75	2.00	4.00	4.50	8.9	12.00	15.4	24.00	21.9
Cleaning	10 loads	.50	.75	1.00	5.00	9.9	7.50	9.5	10.00	9.1
Totals					50.70	100	78.05	100	109.90	100

c. Concrete manhole.

Item.	Amount.	Rate. Min.	Rate. Ave.	Rate. Max.	Min. Amt.	Per cent.	Ave. Amt.	Per cent.	Max. Amt.	Per cent.
Excavation	375 cu. ft.	.02	.03	.04	7.50	16.8	11.25	15.5	15.00	14.3
Concrete	4.5 yards	5.00	7.00	9.00	22.50	50.5	31.50	43.6	40.50	38.8
Cover	1	5.00	10.00	15.00	5.00	11.2	10.00	13.9	15.00	14.4
Repaving	6 yards	75.	2.00	4.00	4.50	10.2	12.00	16.6	24.00	23.0
Cleaning	10 loads	.50	.75	1.00	5.00	11.3	7.50	10.4	10.00	9.5
Totals					44.50	100	72.25	100	104.50	100

These fundamental units will vary with different localities and times. For ease in calculation it is convenient to express these fundamental costs in certain derived units, and to assign to each such a range of variation as is likely to cover probable change within reasonable place and time limits. The derived units are:

1. Duct material. 2. Pavement per square yard. 3. Street excavation per cubic foot, including the removal of paving, the refillment of the excavation after the ducts are laid, and the temporary replacement of the paving. 4. Concrete deposited in place. 5. Labor of placing duct material. 6. Engineering expenses. 7. Manholes. 8. Removal of obstacles.

Of all these derived units, the cost of manholes is least dependent on the number of cable spaces, the cost of this item varying only with the total cost of each manhole and the distances apart that they are set. Table No. 1 gives the itemized cost of various types of manholes. For each item three prices are given: One a minimum price, estimated as that required under the most favorable circumstances; second, an average price, that which is likely to obtain under usual conditions; and, third, a maximum price, or that likely to be required under the more severe requirements of congested city construction, and where work has to be prosecuted at least partially out of working hours to avoid too great interruption to traffic. For each price a parallel column to that showing the cost of the various items is given, in which the percentage that each item bears to the total cost is calculated. Therefore, with any change in the unit prices, it is easy to estimate the effect that this change will have upon the total cost.

TABLE NO. 2.

Cost of Sewer Connections in Dollars.

Item.	Amount	Rate. Min.	Rate. Ave.	Rate. Max.	Min. Amt.	Per cent.	Ave. Amt.	Per cent.	Max. Amt.	Per cent.
Excavation	225 cu. ft.	.02	.03	.04	4.50	35.1	6.75	26.0	9.00	21.1
Repaving	5 yards	.75	2.00	4.00	3.75	29.2	10.00	38.8	20.00	47.0
Trap	1	1.00	2.50	4.00	1.00	7.6	2.50	19.6	4.00	9.3
4 in. pipe	16 ft.	.04	.07	.10	.64	5.0	1.12	4.4	1.60	3.6
Cleaning	2 loads	.50	.75	1.00	1.00	7.6	1.50	5.8	2.00	4.7
Permit	1	2.00	4.00	6.00	2.00	15.5	4.00	15.4	6.0	14.0
Totals					12.89	100	25.87	100	42.60	100

Whenever practicable, a sewer connection to each manhole is desirable to provide exit for street drainage. Such sewer connections are essential in all cases where manholes are equipped with ventilating covers, otherwise the manholes will assuredly fill during every storm. Cases will arise when, either due to the absence of sewers, or to their relative grade with reference to the manhole bottom, a connection of this kind is impracticable; and so the cost of sewer connections has been estimated separately, and is shown in Table No. 2. This table is prepared in a similar manner, a minimum, average and maximum price being shown, and the percentage of each item to the total calculated.

Manholes will occur at intervals of from 250 to 500 feet, consequently the constant cost per conduit foot for this item is obtained by dividing the various manhole costs by the ristances between them. In Table No. 3 manhole cost per conduit foot for each of the various styles of manholes given in Table No. 1 for a minimum, average and maximum price is calculated for distances from 250 to 500 feet, varying by 50 feet. In this table the cost of sewer connections per foot of street is included, calculated in a similar manner. For example, assume concrete manholes spaced 300 feet apart, with average cost price. The cost per foot of conduit for manholes will be 24.2 cents, the cost of sewer connections 8.6 cents; a total of 32.8 cents.

Engineering expense is difficult to estimate, as this item will depend chiefly upon the care and thoroughness with which the conduit is laid. The calculation of this item is best obtained as a "factor of experience," namely, such an amount as extended practice in building large systems of conduit has in the past shown to be adequate for the purpose. Upon this basis, engineering expense will vary from a minimum of 5 cents per conduit foot to a maximum of 12 cents, depending chiefly upon the difficulty of the work.

The cost of the removal of obstacles is another item impracticable to estimate *a priori* with any degree of certainty, as it is impossible

to foresee, and usually impracticable to ascertain, even with the greatest care, the impediments to be encountered beneath street surfaces. Here also a resort to experience is necessary to ascertain the amount required for this purpose. The cost of the removal of obstacles falls into the category of semi-variables, for it is evident that a large subway will require a greater expense for this purpose than a small one. But this expense is by no means directly propor-

TABLE NO. 3.

Constant Cost per Conduit Foot for Manholes in Dollars.

		Distance between manholes in feet.				
		250	300	350	400	500
Brick Manhole with Brick Roof	Min.	.238	.196	.170	.148	.118
	Ave.	.372	.310	.248	.236	.186
	Max.	.536	.427	.384	.335	.268
Brick Manhole with Concrete Roof	Min.	.203	.169	.145	.127	.102
	Ave.	.300	.260	.223	.195	..156
	Max.	.440	.363	.314	.272	.218
Concrete Manhole	Min.	176	.148	.127	.111	.089
	Ave.	.278	.242	.209	.180	.144
	Max.	.416	.347	.298	.260	.208
Sewer Connection	Min.	.051	.043	.038	.032	.025
	Ave.	.104	.086	.074	.064	.051
	Max.	.170	.142	.121	.105	.084

tional to the number of ducts installed. Experience indicates that this expense will vary for small subways from 10 cents to 62 cents per foot of conduit; for medium sized ones from 12 cents to $1.10, and for large conduits from 15 cents to $1.25.

The cost of paving is partially dependent upon the number of ducts. It is impracticable for workmen to perform their avocations in a trench less than 18 inches wide, and, therefore, a strip of pavement of this width must be opened irrespective of the number of ducts to be installed. Experience shows that in such a trench it is possible to install three ducts horizontally, and the same number vertically. Consequently in an 18-inch trench the advisable maximum number of conduits is 9; so the cost of paving will be constant for any number of ducts from one to nine. To place more than three ducts horizontally requires the trench to be opened three or four inches wider, which will require a corresponding amount of repaving. Therefore, for from 9 to 16 ducts the cost of repaving is again constant. Similarly, the amount of repaving per foot of conduit will increase by three or four inches for each additional duct placed horizontally, while the number of ducts will increase in proportion to the square of this number.

The cost of repaving will further vary with the kind of paving. In Table No. 4, the usual kinds of pavement encountered, the minimum, average and maximum prices per square yard, and cost per conduit foot are given.

Allowing a disturbance of paving for six inches on each side of the trench, the cost per lineal foot for small conduits will vary from 2.3 to 26.3 cents; for medium sized ones from 4.6 to 29.2 cents, and for large conduits from 6.9 to 35.0 cents.

Similarly the cost of excavation is only partially dependent upon the number of ducts. The necessary width of trench to give working room, and depth to clear gas and water service pipe, will accomodate nine ducts, and so the cost of excavation is constant for this number. For from 9 to 16 ducts four inches additional width and depth must be provided, and for each additional layer of cable spaces horizontally and vertically four inches additional excavation in width and depth must be provided. Experience shows that 3 feet 6 inches is a minimum permissible depth for the bottom of subway construction, and that the cost of street excavation will vary from two to four cents per cubic foot of material excavated, including the removal of the pavement, the refillment of the trench and the replacement of temporary paving. The cost of excavation will, therefore, stand as in Table No. 5.

TABLE NO. 4.

Cost of Paving per Square Yard and per Foot of Conduit in Dollars.

Kind of Paving.	Min. Price per Sq. Yard.	Cost per Conduit Foot. Ducts from 1 to 9	10 to 16	17 to 25	Ave. Price per Sq. Yard.	Cost per Conduit Foot. Ducts from 1 to 9	10 to 16	17 to 25	Max. Price per Sq. Yard.	Cost per Conduit Foot. Ducts from 1 to 9	10 to 16	17 to 25
Quantity per conduit foot............		.0925 sq. yd.	.105 sq. yd.	.117 sq. yd.		.0925 sq. yd.	.105 sq. yd.	.117 sq. yd.		.0925 sq. yd.	.105 sq. yd.	.117 sq. yd.
Asphalt	1.75	.163	.183	.205	2.00	.185	.210	.234	3.00	.276	.315	.350
Asphalt block	2.25	.208	.218	263	2.50	.231	.262	.292	3.00	.276	.315	.350
Granite block	1.50	.138	.157	.176	1.75	.163	.172	.205	2.50	.231	.262	293
Cedar block	.60	.056	.063	.070	.75	.069	.079	.088	1.00	.092	.105	.117
Brick	1.25	.115	.131	.146	1.50	.138	.157	.176	2.50	.231	.262	.293
Telford	.80	.074	.084	.093	1.00	.092	.105	.117	1.25	.116	.132	.146
Macadam	.25	.023	.026	.029	.50	.046	.052	.058	.75	.069	.079	.088

Table No. 6 will summarize these constant items: conduits of from one to nine ducts, ten to sixteen ducts, and seventeen to twenty-five ducts, giving the minimum, average and maximum prices of all, together with the percentage that each bears to the total. This table shows that conduits containing nine ducts or less will cost from 32.4 cents to $1.60 per lineal foot for street work; those containing 10 to 16 ducts, from 41 cents to $1.87, and those containing from 17 to 25 ducts, from 52 cents to $2.34. If to these prices the cost per foot of street for manholes be added, as given in Table No. 3, it is easy to calculate the total cost per foot of conduit exclusive of duct material for any desired subway. For example, assume a subway of nine ducts, with brick manholes set 350 feet apart, at average prices the manhole cost is 22.3 cents, sewer connections 7.4 cents, other items (from Table No. 5) 67.25 cents; total cost per foot of street, exclusive of duct material and laying the same, 96.95 cents.

The cheapest form of duct material is hollow brick, depending upon distance from factory and freight rates, the price f. o. b. cars will vary from 1.6 cents to 3 cents per duct foot; adding expense of inspection, hauling, cleaning, breakage, etc., 2 to 5 cents per duct foot will be the cost delivered along side the trench. Multiple duct material stands next, costing from 3 to 5 cents f. o. b. cars, or from 3.5 to 6.5 cents per foot on the trench. Cement-lined pipe and cement pipe will cost from 4 to 8 cents on the street, and creosoted wood from 4 to 6 cents.

The cost of placing duct material in the trench varies considerably with the kind employed. Hollow brick has been classed by trades unions as brick masonry, owing to the use of a trowel in laying; for this reason, and from the large number of pieces that must be handled, the expense of placing single-duct material is greater than that of either the multiple duct, cement-lined pipe or cement pipe. The cost of placing hollow brick, including the necessary mortar, may

TABLE NO. 5.

Cost of Street Excavation per Conduit Foot in Dollars

	Minimum	Average	Maximum
	.02 per cu. ft.	.03 per cu. ft.	.04 per cu. ft
1 to 9 ducts	.105	.1575	.210
10 to 16 ducts	.160	.240	.320
17 to 25 ducts	225	.3375	.450

be taken from ½ to 1½ cents per duct foot. The cost of placing multiple duct material will vary from .1 cent to 1 cent, depending on the size of the pieces and the difficulties of the trench. Cement-lined pipe and cement pipe cost less to place than hollow brick and more than multiple ducts, varying from .25 cents to 1 cent per duct.

Cars and Cabs in Vienna.

The cabmen in Vienna are feeling the competition of electric cars, and have decided to send a petition to the burgomaster and the Municipal Government demanding indemnity for their unremunerative licenses at $600 each; or, should this plan fail, they will themselves pay the said sum for each license now in operation, provided no more be issued. They prefer the first alternative, for, with the $600 and the money derived from the sale of their carriages and horses, the men hope to set up in some other business. There are 1,000 two-horse public open carriages in Vienna. and their owners have for many years monopolized all first-class traffic and have even controlled the number of licenses annually issued.

District Central Station Plant in England.

As we have from time to time noticed in these columns, a central-station development which promises to take large proportions, is the supply of a large number of towns from a single generating station. Recently we described two such plants in New Jersey, one of which supplies no less than 35 towns, the majority having previously had local central stations. In view of the interest which exists in this subject, we give below a description of an English example of this system of electrical supply, the plant of which has recently been completed. In this case there is an additional interest from the fact that the distribution throughout the entire district is by underground cables. The accompanying map shows the area of distribution, though at present only the shaded portions are served. The district is quite a small one, the radius only being about seven miles, but this was considered to be the maximum over which underground distribution would be economical, in view of the cheapness of coal at the point of generation, the plant being situated in the heart of the "Black Country," thus approaching the ideal of a generating station at the pit's mouth.

The power station is situated on the Birmingham canal, and a branch railway line also runs alongside of it. The coal and ashes are handled by a Hunt conveying plant, having a capacity to deal with from 400 to 500 tons of slack per day, the bunker capacity being

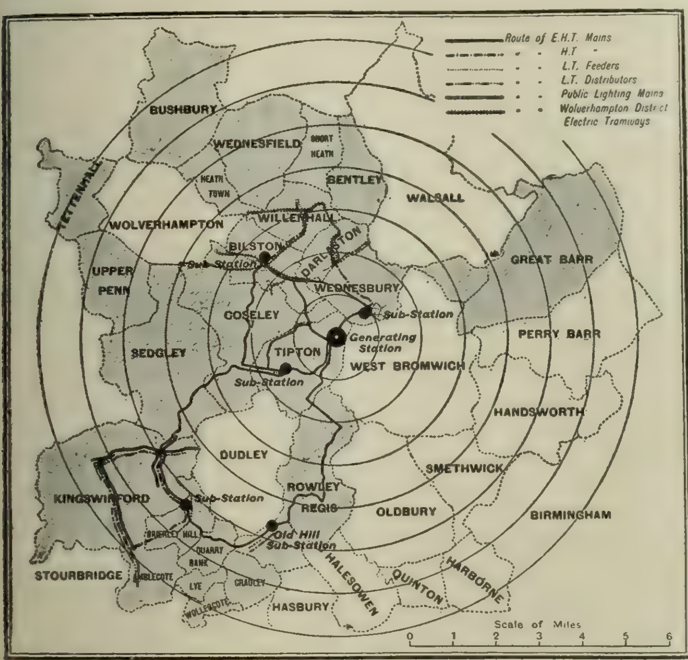


FIG. 1.—MAP OF DISTRICT.

900 tons. In the boiler house there are eight Babcock & Wilcox boilers, arranged in pairs, each having a capacity of 12,000 pounds of water evaporated per hour and at from 212° F. The boilers are fitted with chain grate stokers and superheaters.

So far the engine room contains only two 800-kw alternators and one 1,500-kw alternator. There is space for two more sets of the larger size without prolonging the engine room, and there is sufficient land unoccupied to lengthen the engine room to three or four times its present size at least. The alternators generate two-phase currents directly, at 7,500 volts. All three are of Messrs. Ferranti's make, the two smaller ones being driven by Ferranti engines, and the larger one by a Yates and Thom engine. One of the smaller sets is seen in Fig. 3, and a drawing of the 800-kw alternator in Fig. 4. Both engines are of the vertical cross-compound type. The Ferranti engines run at 166 r. p. m., and the Yates and Thom engine run at 90 revolutions.

The dynamos differ but slightly in general design from Messrs. Ferranti's well-known moving magnet single-phase type. Their armatures are tunnel wound, the windings being cotton-covered and placed in micanite tubes. The magnets have cast-steel pole pieces, and the magnet coils are wound with insulated copper strip on edge. The windings of the two phases on the alternators are kept quite independent. A frequency of 50 ~ per sec. has been adopted. Each unit is capable of working continuously at 25 per cent. overload, with a power factor of 0.8. The flywheel consists of a central boss of cast steel shrunk upon the crank shaft. The rim of the wheel is of cast iron, and is in one piece. The spokes which connect the rim to the central boss are mild steel bolts screwed into the central boss.

The method of building up is as follows: The wheel is adjusted to come concentric with the shaft, the bolts being screwed up as tight as is possible by means of clamps on the center portion of the

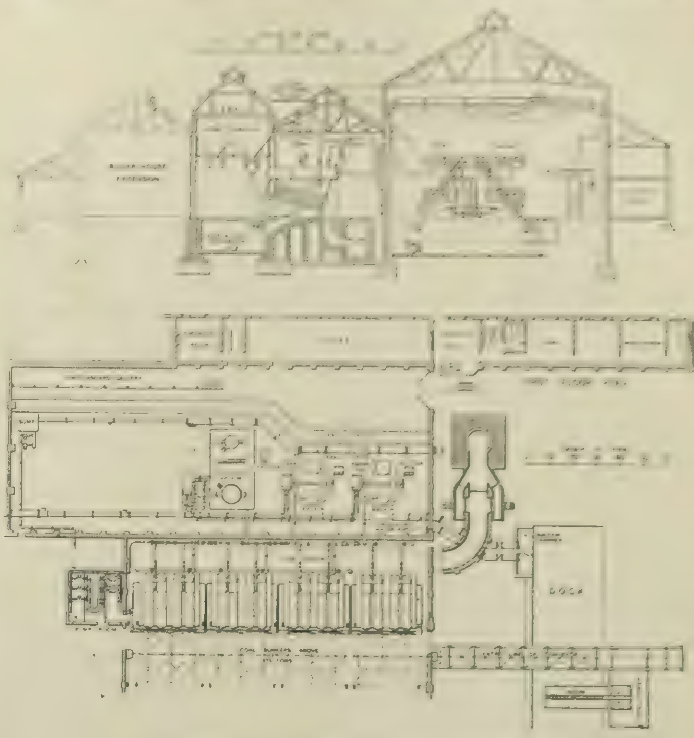


FIG. 2.—SECTION AND PLAN OF GENERATING STATION.

bolts. The bolts are then heated so as to elongate them, afterwards screwed up whilst hot, and on cooling put a compressive stress in the rim of the flywheel. The wheel rim is then machined true, and the field magnets are bolted in position upon it. In the case of the 800-kw machines, the peripheral speed of the rim of the flywheel is

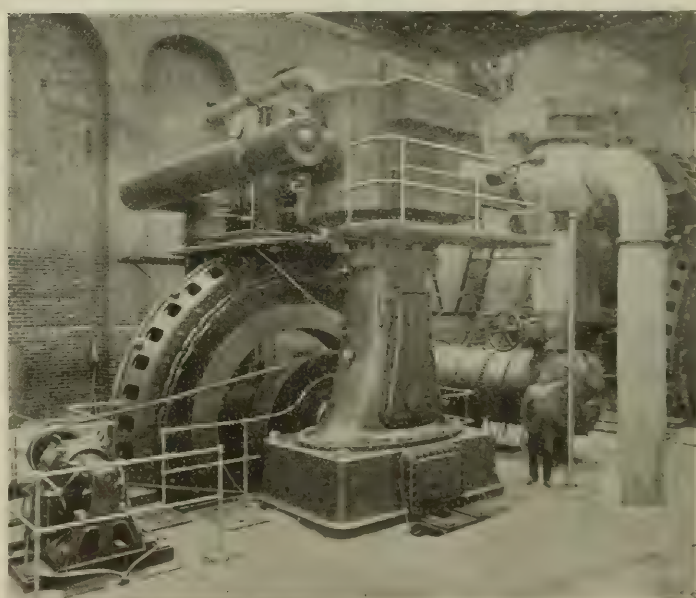


FIG. 3.—ONE OF THE 800-KW GENERATING SETS.

5,800 feet per minute, and the peripheral speed of the outer face of the magnet is 6,800 feet per minute. The stress in the cast iron, due to the centrifugal strain put upon it by both the field magnets and its own centrifugal force amounts in the weakest section to one ton per square inch, assuming that no benefit is to be obtained from the initial compressive stress explained above. The stress on each bolt arm is only 3½ tons per square inch on the weakest section, to resist a centrifugal force of both rim and field magnets.

The 1,500-kw alternator is built on similar lines to the 800-kw, as

far as is shown in Figs. 3 and 4, but as in this instance both the engine and flywheel are supplied by Messrs. Yates and Thom, the construction of the wheel is different.

On the two smaller sets, the exciters and the circulating and air pumps of the surface condensers are rope-driven from a pulley on the main shaft. The exciters are 100-volt, 60-ampere machines. Ropes from the same pulley on the shaft pass underneath the engine room floor, over a jockey pulley, which drives the centrifugal circulating pump, to the pulley of an Edwards air pump. The larger set does not drive its air and circulating pumps, these being separately-driven by two-phase motors.

An independent surface condenser of 20,000 square feet cooling

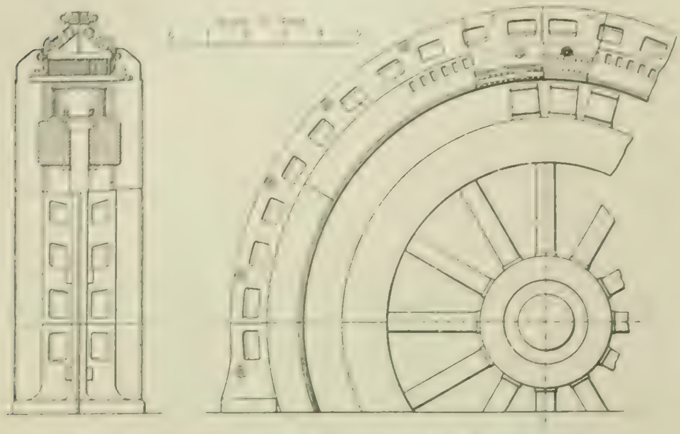


FIG. 4.—800-KW., 7,500-VOLT, TWO-PHASE ALTERNATOR.

surface is placed behind each engine on stools standing on the engine-room floor. The circulating water will be taken from the canal basin, and, as the canal company object to hot water being let into the canal, a cooling tower will be erected. There is a crane spanning the engine room, worked by three two-phase motors, and rated at 25 tons. Running the whole length beneath the engine room is a tunnel for cable, with openings to the machines and switchboard.

One of the most interesting part of the plant at the power house is the switchboard. The switch gear, which has been supplied by Messrs. Ferranti, includes oil-break switches of entirely new design, and a modification of the Ferranti oil-break fuse, both of which are here employed for the first time. Figs. 4 and 5 show in detail the construction of the switch and fuse.

The switches are on the divided-break system. The main contact outside the oil container breaks circuit first, and the final break is in shunt with this, and takes place at the seven blades within the oil vessel, each of the blades, together with the corresponding clip con-

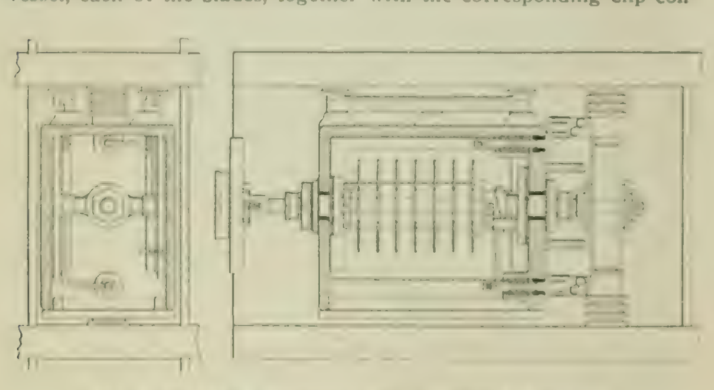


FIG. 5.—EXTRA HIGH-PRESSURE OIL-BREAK SWITCH.

tact fixed to the interior of the vessel, constituting as it were a double-break switch, so that the spark is divided among 14 breaks in series, and all under oil. In switching off, the handle as it is turned to break the main contacts, winds up a spring, which releases suddenly, and rotates the ambroin sleeve carrying the contact blades. In switching on, there is a synchronizing contact at half-cock, but the break does not pass through this intermediate stage. The box containing the oil and the shunt blades is of porcelain and is quite covered in, and the main break, being at the back of this, and, therefore, at the end of the compartment of the switchboard containing the switch, is also quite inaccessible until the whole piece of apparatus is withdrawn, and contact is thus broken. To facilitate removal, the complete switch is provided with runners. The framework of the board is divided up into compartments similarly to the ordinary Ferranti board, and the two lugs protruding from the bottom of the oil container make contact with clips just as in the Ferranti oil-break fuse for high pressures. Contact with the synchronizing bar is made at the bottom in a more or less similar manner, and, as seen in the illustrations, the fixed contacts are part of the main body of the switchboard. It would appear that some difficulty might be anticipated in the accurate fitting of this contact, but so far everything has worked well, the only detail which has given trouble being the helical spring on the contact spindle, which appears apt to break. This can, however, only be a matter of the temper of the steel, and is, doubtless, already remedied. The switch illustrated has a maximum capacity of 1,000 kw, but switches of this type are intended for alternating-current pressure between 7,000 and 15,000 volts.

The fuses are a modification of the Ferranti oil type. In this case there are a number of breaks—four—in parallel, the fuse-wire in each case being bridged over the top of each pair of the upright porcelain tubes. The main body of the apparatus is made up of a porcelain holder, provided with a handle at the front for removing or replacing the fuse. Into this holder a gunmetal fitting is cemented, containing the necessary contacts for operating the fuse. A spindle, fitted with revolving drums, is placed in this casting, each drum having a clockwork spring fixed to it. A flexible copper conductor is also fastened to the drum at one end, and the other is provided with a suitable coupling, to which the fuse-wire is soldered. The porcelain tubes are clamped into the upper portion of the gunmetal castings by a suitable gland, the bottom of the tube being fitted with an iron plate having a slot cut in it for the passage of the flexible conductor. An insulating field rises between the sets of glands in order to prevent the passage of an arc across the nuts themselves, as these form part of the high-tension circuit

When made up in position the porcelain tubes just touch one another at the top, and across these joints the fuse wires are stretched and soldered to the ends of the flexible copper strips. Drawn out to their full extent these strips wind up these springs in the barrel on the spindle, and as soon as the fuse melts each strip is quickly pulled down into the oil, with which both the tubes and porcelain box are filled, and an arc is prevented. A lid extending the whole length of the fuse box covers up the fuse wires themselves, and also prevents splashing of the oil when the fuse blows. Each fuse is made up complete with jaws at the back for making connection to spring clips in the fuse panel itself, so that by these means the fuse may be readily withdrawn for examination or replacement. Where it is required to replace the fuse while in operation a short-circuiting device in the shape of a plug can be fitted above the fuse itself

The contacts at the back of the fuse are enclosed in separate insulating compartments, which entirely prevent the possibility of any

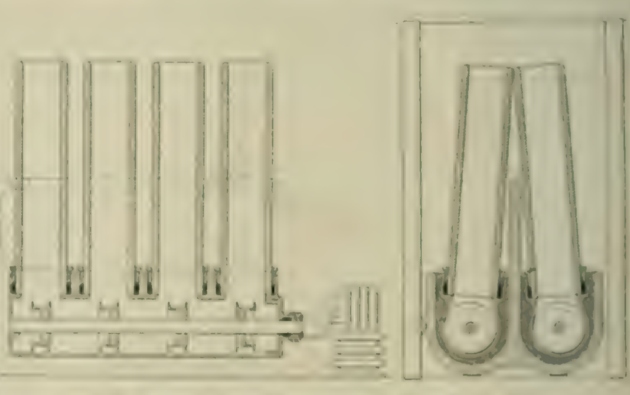


FIG. 6.—EXTRA HIGH-PRESSURE OIL-BREAK FUSE.

arc passing between the contact jaws themselves. In every case the apparatus is so constructed that it is impossible to receive a shock, even though an attendant may stumble against the board, as all high-tension portions are fitted at the back of the fuse, and in the case of the gland nuts the porcelain holder effectively prevents the possibility of accident from contact. The fuses have proved themselves quite efficient, and with them also the only trouble experienced at the Midland works has been due to the breakage of some of the springs of the fuses first sent out.

The two phases are quite independent on each dynamo, and a pair of lead-covered concentric cables leads up from each machine to the switchboard, rising vertically from below. The feeder cables are two-phase cables, however, with two cores and a common return

concentric with the lead covering. These are also led up to the board, and just below the gallery there is a common earthed bus-bar, to which all the outers are connected. The cables end in small terminal boxes just below this bar, their outers as well as their lead sheathing being connected to the boxes, and short copper links connect the boxes to the outer bus-bar. This is visible in Fig. 7. The switchboard is thus single-pole, the cables rising in the usual manner through the fuses, switches and ammeters. The two high-tension switches forming each pair are mechanically connected by a link, as seen in Fig. 7, and are worked by the same lever; and the same type of switch, fuse and ammeter is used for connecting the feeder to the bus-bar as for connecting the generator to the bus-bar.

The bus-bars rest on insulators on the top slate, and are completely covered in. The standard designs for this board allow of one to three bars being fitted, but in the case under consideration only two are required. Each bar is separated from its neighbor by ambroin division plates, and these are so arranged that it is impossible for any arc to start between the bars. An isolated plug of the expansion type is employed for connecting the panel below to the bus-bar, so that at any time by withdrawing this plug each two-phase panel can be completely cut off from the bars for cleaning purposes, for inspection or for repair. Standing on the top slate in front of the bus-

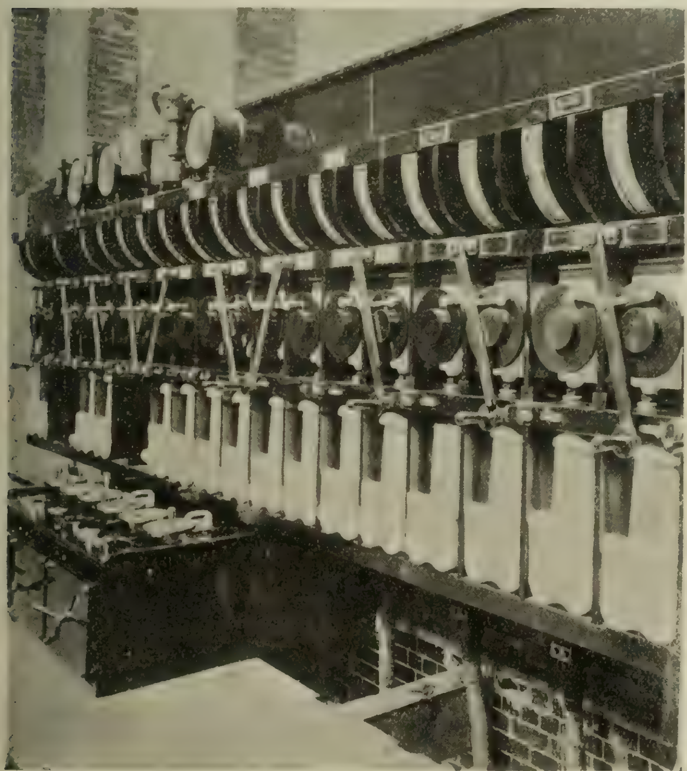


FIG. 7.—EXTRA HIGH-PRESSURE SWITCHBOARD.

bar chamber are the voltmeter and synchronizers, the latter being protected by oil-break fuses, and the former by the water resistance cut-outs already alluded to. By the removal of the water resistance cut-outs or the fuses, the voltmeters and synchronizer can be removed from their terminals without fear of shock.

At present the "mains charger," which is to prevent the momentary rise in high pressure which a sudden switch-on would occasion, is not in position, and it is necessary to run up on the mains. The importance of this matter will be realized when it is mentioned that the capacity between each inner conductor and the other two conductors is 0.25 microfarad per mile in the largest cable, the longest feeder of this size is nearly eight miles in length, and the working pressure is 7,500 volts. The mains charger is simply a water resistance in series with the cable, the plates dipping into the water being gradually lowered until the pressure on the feeder is the same as that on the generator. The synchronizing contact of the feeder switches, which is, of course, not required for synchronizing, is employed for this purpose, the cable being connected up through the water resistance when the switch is in this position.

There are two switchboards in addition to the main board above described, one the meter board and the other the works switchboard for distributing the current used for light and power on the works.

The area to be covered by the Midland scheme and the position of the existing mains and substations are indicated in the map, Fig. 1. Cables of the type shown in section, in Fig. 8, are employed, which represents the largest size. Its two inner conductors are each 0.14 square inch in section, and the common return, which is composed of flat strip, has a sectional area of 0.2 square inch. The

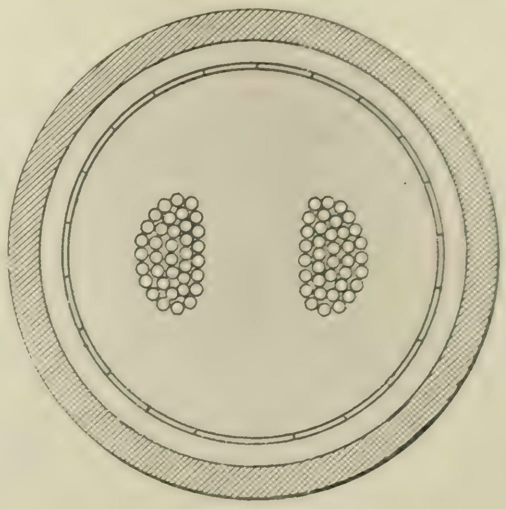


FIG. 8.—SECTION OF CABLE, FULL SIZE.

capacities are as follows: Between the two inner conductors, 0.14 microfarad per mile; between the two inner conductors when one is connected to the outer conductor, 0.25 microfarad per mile; between the two inner conductors connected together and the outer, 0.38 microfarad per mile; and, finally, between the outer conductor and lead sheathing, 3.8 microfarad per mile. The cable is insulated with paper, and is not armored, but outside the lead covering there is a serving of jute impregnated with preservative compound. It is laid at a depth of about 3 feet in earthenware troughs, filled "solid" with pitch and covered with bricks. The troughs (Fig. 9) are of U-

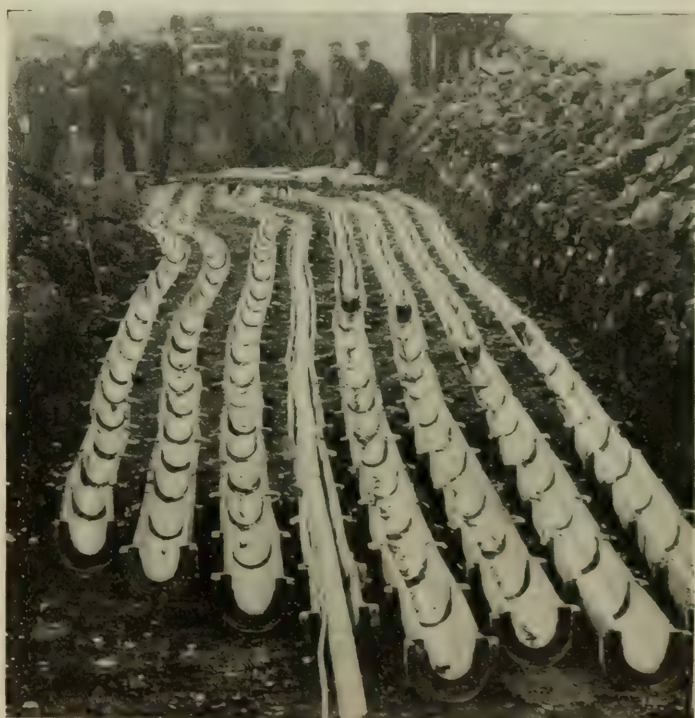


FIG. 9.—CABLE TRENCHES.

section, with spigot and socket joints, and the cable rests on separate bridge pieces.

Subsidences, due to the mining operations in the district, are things to be guarded against, and in places where trouble from this cause might have been expected, a different mode of main laying has been adopted. Lengths of cast-iron piping are used, whose ends are merely butted together, and these are held in place by 2-foot sleeves passed over the ends of the pipe and packed with yarn. In addition

to this increase in flexibility, "loop pits" are provided every 200 yards, in which about 6 feet of slack cable is left, this being passed over rollers so that it is taken up automatically without undue strain in case of a subsidence occurring. One of these "loop pits" is shown in Fig. 10.

The high-pressure and low-pressure cable is lead-covered concentric, and is laid in the same way as the extra high-pressure cable. Double service boxes of the usual pattern, with compound glands, are employed.

Distribution takes place in three ways: Directly from the substation at 200 volts, two-phase; from street transformers, fed at 2,700 volts from the substations, and delivering at 200 volts two-phase to the consumers' networks; and (from the Bilston substation only) at 500 volts continuous current for tramways, through rotary converters.

The general arrangement of the Bilston substation is apparent from Fig. 11. It is seen that the floor is occupied by the stationary transformers and the rotary converters, a rail dividing these two portions, and that the various switchboards (with the exception of the tramway switchboard, which is, so to speak, a lodger) are placed on two low galleries only just above the floor level, and running about half the length of the room by the transformers. Two extra high-pressure cables (both of 0.105 square inch section inner conductors) come in to the substation, and two (0.105 square inch and 0.07 square inch) go out again, the extra high-pressure cables being arranged more or less in a ring to feed the substations. All four cables are led to an extra high-pressure switchboard divided into two parts, and connecting the extra high-pressure mains to the 7,000 : 2,000 and 7,000 : 200 transformers, for the high-pressure and low-pressure distribution, respectively.

The apparatus installed on these boards is of the new Ferranti pattern, similar to that employed at the substation. The transformers which transform down for the rotary converters are not connected to this board directly, there being merely switches to connect the extra high-tension mains to the top of the rotary converter board, to which these transformers are connected. Rubber cables

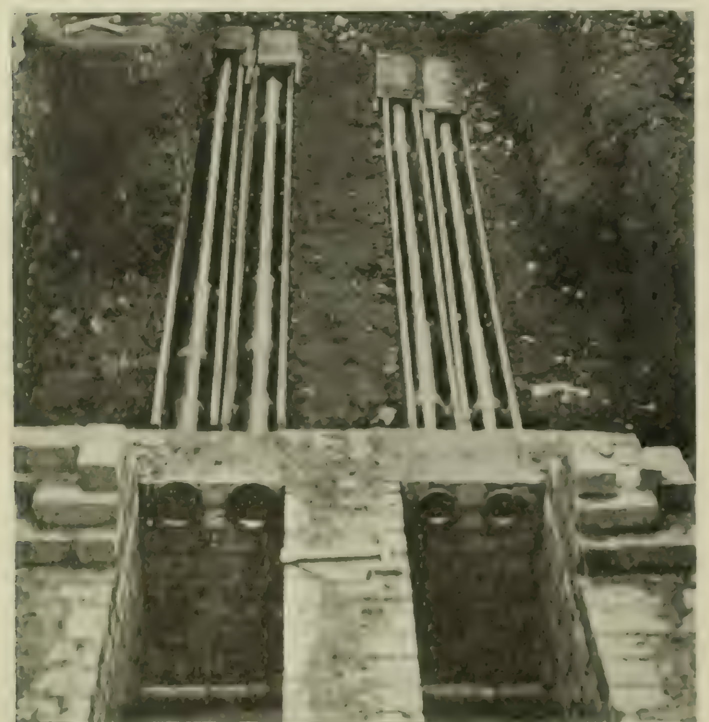


FIG. 10.—LOOP PIT.

on insulators connect these switches with the rotary converter board.

The 7,000 : 2,000-volt transformers, as all the other transformers, will be pairs of separate transformers, one transformer on each phase. From the secondaries of these, mains are led to the high-pressure board, whence feeders will run to Ferranti tank transformers, which will be used in the Willenhall district, the first portion of the company's area to be supplied at this pressure. A low-pressure, two-phase board receives current from two pairs of 50-kw and one pair of 25-kw transformers. One set of switches and fuses connect the transformers to the bus-bars, and the other set are between the feeders and the bus-bars; and in each case the switches of the two-phases are coupled together. Although the mains are two independent concentric cables for the two phases, and the transformers are also separate, both the outers are connected to a common bus-bar, and there are no fuses on these outers except on the consumers' premises. The two-multi-cellular voltmeters are connected one in each phase.

At the top of the converter board are four "time element" cut-outs which are also used as switches, for connecting the two pairs of

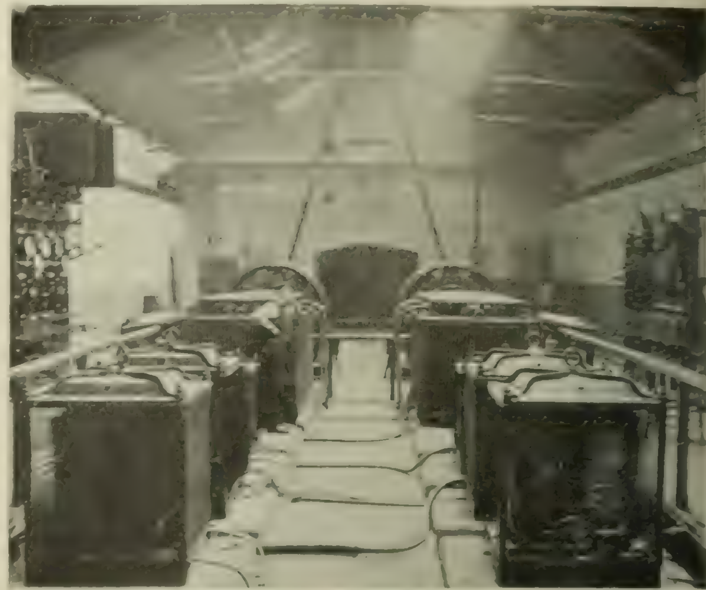


FIG. 11.—INTERIOR OF BILSTON SUBSTATION.

step-down transformers which feed the rotary converters to the 7,000-volt bus-bars of the adjacent extra high-tension switchboard. They are fitted with a time-element relay, which it is possible to adjust so that there is an interval of any time up to 10 seconds between the short-circuit and the cut-off. If the short-circuit or excess current is of shorter duration, the cut-out does not fall. Two pairs of 100-kw Westinghouse transformers are connected to these cut-outs, the connections being single-pole, as are all the extra high-pressure switching arrangements. The secondaries of these transformers are brought back to the board to the two pairs of switches in the bottom row but one, which connect them to the slip rings of the rotary transformers. At the bottom of the board are two throw-over switches to switch on induction motors placed on the shafts of the rotaries for starting them. When the switch is thrown over to one side, the induction motor is started through a resistance. The switch is then thrown right over to the other side, and the synchronizer switch is closed, and finally, when synchronism is reached, the transformer secondary switches are closed and the starting switch placed in its middle or no-contact position. Above the secondary switches are handwheels for adjusting the field excitation of the rotaries, and above these again are three ammeters for each rotary. Two of these in each case are connected to the secondaries of small transformers, whose primaries are in series with the slip rings; they, therefore, show the current flowing from each phase to the rotaries. The third ammeter is in the field circuit. These connections are seen in the upper part of Fig. 12, the lower part of which corresponds to the board, at which current is metered to the tramway circuits.

On the meter board there is a voltmeter and two ammeters to indicate the continuous current passing from each converter and its voltage. A time element cut-out is placed on each of the positives from the converters, and an instantaneous cut-out on the negatives. The four switches in connection with each converter enable it to be utilized as a shunt machine, or as a compound-wound machine, with an equalizing switch for paralleling. As agreed with the Wolverhampton Tramways Company, the current delivered to them is passed through three meters in series. A single meter might be liable to error; if there were two meters and they differed, it would be difficult to know which was the correct one; so three meters are used on the "odd-man-out" principle. Although not more than three meters are in circuit at a time, six are provided; one set of three reads from 0 to 400 amperes, and the other three from 0 up to 1,200 amperes. There are also two recording ammeters reading up to 400 and 1,200 amperes

o correspond with these, a recording voltmeter and a set of plugs or short-circuiting the meters and recorders which are not in use.

The rotary converters are rated at 250 kw each, and they run at 00 revolutions, the frequency being 50 cycles, as already stated. They re of the Westinghouse standard type, with a damping coil on each ole piece, and are compound-wound. Their continuous-current out-ut is 400 amperes, at from 500 to 550 volts. As will have been gathered from the description of the switchboards and the diagram f connections, the regulation of the continuous-current voltage does ot take place with the assistance of induction regulators or regu-ating turns on the secondaries of the transformers, but by a variation f the excitation. Altering the excitation varies the lag between the lternate-current voltage, and practically varies the transformation atio of the step-down transformers, which are specially built to have high inductance at light loads. A decrease in the strength of the ield increases the lag of the alternate current behind the pressure, nd the pressure is lowered owing to the increase in self-induction. Conversely an increase in the field increases the pressure, and in both ases the continuous-current voltage, of course, changes with the lternating voltage. As the converter fields are compound wound, his regulation is largely automatic, but there is provision to vary he resistance of the shunt-exciting circuit. Evidently it is not an-icipated that this will be called into requisition much, however, for he field rheostat is on the rotary converter board, where no volt-neter is provided, and the only voltmeter is on the meter board on he other side of the room. The total variation in pressure which

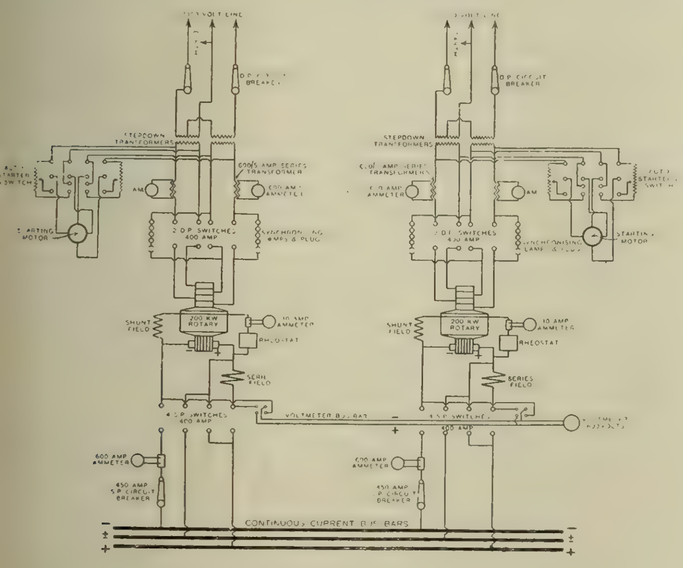


FIG. 12.—DIAGRAM OF CONNECTIONS OF ROTARY CONVERTER.

an be effected with the rotaries at the Bilston substation by varying he shunt excitation amounts to over 15 per cent.

From the meter board the current is led to the board of the Wol-erhampton tramway. This board has four feeder panels, with cut-uts, ammeters and single-pole switches, the usual negative booster onnections and the Board of Trade panel. A booster runs at 850 . p. m., and can deal with 260 amperes and produce a pressure of 9 volts as a maximum. There is space in the first-floor of the sub-tation for a battery, but none has been put in yet.

The Wolverhampton tramways is one of the offspring of the British Electric Traction Company. Its route, which was indi-ated in Fig. 1, is in all 10 miles in length, and is part single and part louble track. The current is all taken from the Bilston substation, nd is supplied to the line through the usual feeder pillars, placed t about one-half mile intervals. The line construction is chiefly with pan wire suspension from side poles, but there is a certain amount f single-bracket pole construction as well. In this connection, it is nteresting to remark that the Board of Trade has recently limited he length of bracket arms to 16 feet, so that span wires will now e used on new work instead of those top-heavy-looking poles with xtraordinarily long brackets, which are an eye-sore in some towns. On the Wolverhampton and district lines, the telephone wires are in ome parts overhead, being placed on the poles.

The three insulators on the right carry the telephone wires, which re supported by a clip fixed to the pole.

Following are the rates which has been fixed by the Midland Corporation. All the supply, except to the tramway company, is by two-phase alternating current, at 200-volts pressure. For lighting, the consumer can choose between a flat rate of 4½d. per kw-hour, or 6d. per kw-hour for the first 100 hours of maximum demand per quarter, plus 3d. for additional units. For power, the flat rate is 1½d. per kw-hour, with discounts to large consumers; and the "Wright" system tariff is 3d. per kw-hour up to 78 hours of maximum demand per quarter, and after that 0.825d. per kw-hour.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

ETHER FROM ACETYLENE.

A direct method for the synthesis of ether from acetylene, proposed by Joseph W. Harris, is of especial interest. While there are a variety of chemical methods for effecting this transformation, they are in general indirect, alcohol being formed as an intermediate product; it is quite possible that in Mr. Harris's method alcohol forms as an intermediate step of the reaction, but the synthesis is, for practical purposes, direct.

Acetylene is introduced into strong sulphuric acid solution in the cathode compartment of an electrolytic cell, the anode of which is enclosed in a porous cup; the gas reacts with the liberated hydrogen, yielding a mixture of ethylene ($C_2 H_4$) and ethane ($C_2 H_6$), the conditions of the reaction being such as to restrict as far as possible the production of the latter gas.

This ethylene, formed in strong sulphuric solution, passes at once into ether, the controlling feature of the reaction being the presence of relatively small percentages of water—not to exceed 35 per cent.—in the acid. At lower acid concentrations the formation of alcohol is noted. The reactions considered most probable by Mr. Harris are as follows:

1. $C_2 H_2 + H_2 = C_2 H_4$,
2. $C_2 H_4 + H_2 S O_4 = C_2 H_5 O S O_2 O H$,
3. $2C_2 H_5 OSO_2OH + H_2O = (C_2H_5)_2O + H_2SO_4$.

In other words (1) acetylene by union with hydrogen passes into ethylene; (2) ethylene unites with sulphuric acid to form ethyl-sulphuric acid; and (3) ethyl-sulphuric acid in the presence of water breaks up with formation of ether and regeneration of the acid electrolyte.

Inasmuch as certain of the known carbides and carbide mixtures react with water with formation of ethylene, it would be interesting to determine whether they would yield some ether by decomposition with strong sulphuric acid.

ELECTRICAL REDUCTION OF IRON ORES.

A known method for the reduction of iron ores consists in coating the fragments of a divided ore with a carbonaceous reducing agent, coking the carbonaceous matter in place, and thereafter reducing to sponge iron. This method, with the additional step of fusing the sponge by the passage through it, or through the molten iron, of an electric current, is now patented to Mr. Marcus Ruthenberg, of Philadelphia. As the apparatus is described, the electric current is passed between lateral terminals through a pool of molten metal in the bottom of the furnace, the developed heat serving to fuse the reduced iron in the zone immediately over the molten meal; the reduction of the iron ore and the coking of the carbonaceous coating, take place in successively higher zones of the furnace, the latter operation being conducted on a hearth over which the waste gases play.

It is scarcely yet born in upon inventors that the practicability of the reduction of iron ores by electrically-developed heat is doubtful at best; and that if success ever crowns the persistent efforts which are being made along this line it will come as a result of such careful study of the conditions for economical energy transformation as has been given to no converter of energy save only the electric lamp. A common conception of the electric furnace of the resistance type seems to be two electrodes and a short-circuit, the usual assumption being that electricity will turn with completeness and economy into heat, provided only it be brought within furnace walls.

October Meeting of the American Institute of Electrical Engineers.

Illumination and photometry were the subjects on the programme of the October meeting of the American Institute of Electrical Engineers, represented by three papers, as follows: "An Integrating Photometer for Glow Lamps and Sources of Like Intensity," by Prof. Charles P. Matthews; "Distributed Lighting," by Mr Douglass Burnett; and "The Commercial Accuracy of Photometrical Measurements," by Dr. Clayton H. Sharp.

By request of President Scott, Mr. T. C. Martin detailed the results secured in founding the John Fritz medal, in which the Institute had co-operated with the three other national engineering societies, Messrs. Calvin W. Rice, R. W. Pope, Wm. Maver, Jr., and Martin having represented the Institute on the general committee since its formation early in the year. The medal is to be awarded annually on the recommendation of a board, constituted of four members from each body, for achievement in the industrial arts and sciences. The Institute nominees for the board are the three latest past presidents, Messrs. Hering, Steinmetz and Kennelly, and the present president, Mr. Scott.

The John Fritz Banquet, which is to be held on Friday, October 31st, in the ballroom of the Waldorf-Astoria, will be an occasion of more than usual importance, as it is to signalize not only the eightieth birthday of Mr. John Fritz, of Bethlehem, Pa., the oldest steelmaster in the country, but the foundation by the four national engineering societies of the Fritz gold medal. Towards the foundation of this medal about $6,000 have been contributed by 484 members of the American Society of Civil Engineers, American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the American Institute of Electrical Engineers, as well as some of the most distinguished steelmakers and engineers in England, Germany, France, Belgium, Scotland, Austria, Wales and Luxembourg. The medal is a design of Mr. Victor D. Brenner, and at the dinner a large bronze reproduction of it is to be given to Mr. Fritz and the cast then broken. A number of interesting and novel features will be presented at the dinner, and the speakers include some of the most notable engineering authorities in the world. The venerable Abram S. Hewitt has promised to attend; Admiral Melville is to speak for the Navy, and Gen. Eugene Griffin for the Army. Each of the four engineering societies is to be represented by its president, and to be responded for by a leading official or past president. Prof. Elihu Thomson will respond for the Electricals. The list of 500 guests includes every name of importance in the engineering professions or the arts connected with steel production, and in distinction compares with that of the "Captains of Industry" at the famous breakfast given to Prince Henry. A number of congratulatory messages have been received from all parts of the world, attesting the universal interest in this first co-operative movement of the American engineering societies, and the foundation of a medal which compares with the celebrated Bessemer one, as a reward to inventive genius and industrial leadership. Out-of-town members of the Institute in the city last week on Institute business were: C. P. Matthews, Ralph D. Mershon, F. O. Blackwell, C. C. Chesney, P. M. Lincoln, Prof. H. J. Ryan, Harold W. Buck, J. S. Peck, Prof. E. B. Rosa, P. G. Gossler, F. A. C. Perrine, C. J. H. Woodbury.

The paper by Prof. Matthews, which will be reprinted in a following issue, described a type of photometer which may be used; 1. as a simple photometer for any unidirectional measurements, such as occur in standardizations, ratings and candle-power distributions; 2. as an integrating instrument for the direct determination of mean horizontal, mean spherical, mean hemispherical or mean zonular candle-power; and 3, as an integrating instrument for the direct determination of the spherical reduction factor—that is, the ratio of mean spherical to mean horizontal candle-power.

The instrument consists of 12 pairs of mirrors, arranged concentrically to the lamp to be tested, each pair of mirrors being capable of a certain amount of radial movement for purposes of initial adjustment, and the plane of the mirrors being rotatable in azimuth. With this arrangement the mean spherical candle-power may be determined with the ease and celerity of the ordinary photometric measurement.

The paper of Dr. Sharp discussed the accuracy of photometrical measurements, that is, whether they stand on equal or nearly equal footings with other electro-technical measurements. Photometrical measurements were divided into three general classes, corresponding to similar classes in electro-technical measurements in general. For these classes, different degrees of accuracy are to be expected. The first class includes those measurements in which the primary standard or unit of luminous intensity is used to calibrate secondary standards of the same. This is similar to the calibration of secondary standards of resistance from a mercury ohm, and like the latter, the results are involved in the uncertainty connected with the production of the primary standard.

The second class comprises the calibration of working secondary standards by reference to the original secondary standards. This is the class of work which can be carried out to the highest degree of accuracy. The third class includes commercial measurements of sources of light by reference to working secondary standards, and corresponds to ordinary electrical testing where direct reading instruments are used and no effort is made toward great refinement. Speed is an important factor in this kind of work

The paper then gives the results of tests made to determine the accuracy attainable in these three classes of work, full details and data of the tests being included in the paper.

In testing the accuracy of work of the first class, starting out, that is, from a primary standard, two Hefner amylacetate lamps and one Harcourt 10-cp pentane lamp were repeatedly compared with invariable incandescent lamp standards.

The mean difference between the lamps tested was but 1.2 per cent in a series of 14 measurements made on 10 different days. The mean deviation of the values uncorrected for humidity from the mean of all was 1.7 per cent. for both lamps, while the corrected values differed only 1.1 per cent. and 1.0 per cent. on the average. The greatest deviation of a single measurement from the mean of all was but 4.8 per cent., but this occurred when the indications of the lamp disagreed by 5.2 per cent., and in any practical case this measurement would have to be rejected. If the mean indication of the pair of lamps is taken as representing a measurement, the mean deviation was 1.0 per cent., and the maximum 2.5 per cent.

In the measurements coming under the second class—the copying of incandescent standards—ten lamps were tested. The greatest mean deviation from the mean for any lamp is 0.07 per cent. in voltage, which corresponds to about 0.05 cp. The final results may be taken as certainly correct within narrower limits than this value. The closeness with which photometrical measurements can be made under these conditions is such as to task the capabilities of the best direct reading voltmeter. The voltmeter actually used in making these was a Weston laboratory standard. Certainly, for commercial purposes, copies of photometric standards need not be made any more accurately than this table shows that it is possible to make them.

As showing what may be and is done in strictly commercial measurements, ten lamps were measured at marked volts on four different photometers by four different photometer teams, under strictly commercial conditions. Each photometer was turning out some 500 lamps a day, measured just as these ten were. Each value given represented a single photometer setting

The greatest deviation of a single measurement from the mean of the four was 2.5 per cent. The mean of the maximum deviations is but 0.4 per cent. It is particularly important to note that the results obtained by different operators on different photometers are in substantial agreement. The deviations of the candle-power of the individual lamps from 16 are to be ascribed to the fact that these lamps were marked to integral voltages.

When photometrical measurements are made on sources of light such as the electric arc, the limits of allowable error must be considerably extended The difficulties of arc-light photometry have often been ascribed to the difference in color which exists between the light of the arc and that of the comparison source This is undoubtedly a real and a serious difficulty, but it is not an unsurmountable one The great trouble in arc light photometry has been that photometrists have been trying to ascribe a constant value to a varying quantity, namely, the luminous intensity of the arc in a given direction Just as soon as a rational endeavor is made to measure some moderately constant luminous element of the arc such as its total luminous flux or its mean spherical intensity, good consistent results can be obtained, as the experiments of Professor Matthews have amply proved.

The conclusions of Dr. Sharp were as follows: 1. There are primary standards of luminous intensity, which, whatever may be their shortcomings from the point of view of the physicist, are sufficiently accurate for commercial purposes. 2. These standards can

be copied with as high a degree of accuracy as is desired. 3. Rapid photometrical measurements can be made with all the accuracy required for commercial purposes. 4. In the case in which photometrical measurements are in the worst repute, namely, in the photometry of the arc, the chief fault lies with the varying nature of the quantity which it is sought to measure rather than with available methods of measuring the same.

The paper by Mr. Burnet dealt with illumination at surfaces as contrasted with intensity of sources of light. It is shown to be possible in some measure to calculate the distribution of lighting along an illuminated surface, though the problem becomes further complicated when a second reflecting surface is introduced, and it may be at present considered impracticable to determine with any fair degree of accuracy the actual illumination in a room.

It seems, however, quite possible actually to measure this lighting effect. In several instances such curves of illumination have been plotted, but are usually based upon the assumption that there is no reflection or diffusion. In others, the mistake has been made of plotting the candle-power of the light incident upon the surface, with the result of exaggerating the apparent lighting effect. A fundamental law in this connection is that illumination from independent sources may be arithmetically added to determine resultant illumination. An error which has always been made is in connection with the plotting of the space intensity curves of incandescent arc, Nernst and other lamps. The impression they convey would much more nearly accord with what actually occurs if the curve showed—not the intensity of light in the various directions—but the lines along which the lighting is equal at any point. Such curves may be called "isophotals," and while they are of the same general shape as intensity curves, their dimensions are as the square root of the radii. The tendency of enclosing an arc, for instance, either in the interior gas globe, or more particularly in the outer diffusing globe, is to make such an isophotal curve approach more nearly a circle, which effect is further enhanced by the diffusion from a neighboring ceiling; thus tending towards the desired result of a flat curve, indicating uniform illumination.

Arc lamps for the lighting of country roads should be such as throw their lighting downward; whereas in the lighting of city streets, lined with buildings, such lamps should be used as will throw an amount of light on the walls for diffusion purposes as will not be objectionable to the occupants.

A number of photometers for determining the intensity of sources o flight have been devised, while few instruments, notably those of Weber and of Houston and Kennelly, for the measurement of illumination on a surface have been described; and in each of these the lighting was not measured directly, but was adjusted by means of screens or by means of the weakening of visual power, and then compared with a standard amount of illumination.

The Bunsen, the Lummer-Brodhun and other standard photometers operate with varying and indeterminate amounts of lighting on the surfaces to be compared; any one of them is in essence a luminometer rather than a photometer, since the candle-power is deduced by the application of the mathematical formula instead of measured or compared directly.

Mr. Burnett has devised an instrument arranged so as to expose a standard white surface to the ordinary lighting of a room, the amount of which is not varied. The position of a small incandescent lamp in reference to a similar and adjoining surface is, however, adjusted in order to secure within commercial limits an equal illumination, the position of this standard lamp being indicated on a graduated scale in terms not of distance but directly in terms of the number of luxes. Other observers have stated that the use of small incandescent lamps is quite permissible for such purposes for several hundred consecutive observations. The only precaution necessary in the use of such an instrument would be to shield the eyes from light other than that reflected from the two standard surfaces, and to shield each respectively from the other source of light.

It may be of interest at some future date to plot the space candle-power curves from a standard open arc without enclosing globe, the space candle-power curves of an enclosed lamp of the same watt consumption with the diffusing globes used in practice, the isophotals from the latter lamp, the theoretical illumination from the open arc along a horizontal surface without diffusion and the actual illumination curves from the lamp with the enclosing and diffusing globes in a room under normal operating conditions.

In addition to the case cited there have been but few instances where the amount of illumination on a surface has been measured or calculated, notable among which may be mentioned a test of the lighting of the streets of Paris.

Our methods of expressing illumination have been in terms of the number of standard lamps, such as those of 16-cp, 50 watts per hundred or thousand square feet of surface. Bell has expressed an opinion that 5-cp per square inch is a maximum for interior lighting; Cohn has given 10 meter candles as the hygienic minimum, and 50 meter candles as the value of daylight, and Wybauw has given 15 to 25 meter candles as necessary to fluent reading, or one meter candle for street lighting. Possibly practical requirements may hereafter be more clearly specified by the assistance of some such instrument as suggested in the paper.

Messrs. Scott, Nichols, Upton, Marks, Smith, Rosa, Ryan, Rice, Hammer, Stratton, Howell and Marshall took part in the discussion that followed the papers. Prof. Nichols said that the mean spherical candle-power should always be used to which to refer measurements, even if another unit is found convenient for some practical purposes. He spoke highly of the papers of Messrs. Burnett and Sharp as contributions to the study of illumination. He outlined the method he has employed in connection with room photometry; the floor is divided into squares of one meter, and a small white card placed in each division and the illumination thereon determined by means of a photometer. The same card is then placed on a movable stand, and the illumination explored at a distance of one meter above the floor, two meters, etc., the method thus being analogous to the exploration of a magnetic field. Prof. Nichols said that all of the newer sources of light are too bright for the eye, and that illumination considered as a fine art will consist in placing lamps so that the source of light will not be visible.

Mr. F. R. Upton dwelt upon the importance of illumination as opposed to the intensity of the source. He called attention to the fact that no inconsiderable amount of illumination in the vicinity of cities and towns well supplied with respect to exterior lighting is reflected from the clouds; this reflection under favorable circumstances being sufficient to light up buildings and the landscape considerably. Prof. Marks reviewed the work of committees of the American Institute of Electrical Engineers and National Electric Light Association, with respect to measurement of light. One committee of the former favored mean spherical candle-power, and another total flux expressed in terms of the lumen; and the committee of the National Electric Light Association reported strongly in favor of the mean spherical candle-power. He said that the total flux is an excellent term in which to express light. He thought that the fact that the Matthews' arrangement enabled the spherical reduction factor to be easily obtained was a strong recommendation for it, particularly in view of the fact that some large electric light companies now insist upon such factor being specified in the purchase of lamps. Mr. John W. Howell said that the Lamp Testing Bureau had tried the Matthews' instrument, and it worked out so well that the Bureau will use it for making spherical measurements. Mr. Marshall added that the Edison Lamp Works would use the Matthews' photometer, and Mr. F. B. Smith and Prof. Rosa also commended it. Mr. Calvin W. Rice considered that a better substandard should be used than the incandescent lamp. He said that in a written communication on the papers read, which Mr. A. J. Wurts asked him to submit, the room photometer referred to by Prof. Nichols is advocated. Mr. W. J. Hammer suggested the use of selenium cells in room photometry. Prof. Sharp expressed the opinion that the incandescent lamp is a satisfactory substandard if it is intelligently used.

Pittsburg Meeting of the A. I. E. E.

At a meeting of the local members of the American Institute of Electrical Engineers, of Pittsburg, held Monday evening, October 13th, a committee, consisting of P. M. Lincoln, Professor S. M. Kintner, Calvin W. Rice, J. S. Peck and F. B. Erwin, was appointed to call a second meeting, provide a progamme therefore, and to propose a plan for a permanent organization. The committee decided to accept the invitation of the Electric Club, an organization made up chiefly of engineering apprentices, to hold the next meeting in their hall in Wilkinsburg, on Thursday evening, November 6th. The members of the club were in turn invited to attend these meetings

and to take part in the [illegible] programme, it was decided to take up for discussion the general subject of illumination suggested by the papers taken up at the general October Institute meeting.

Professor Kintner, of the Western University of Pennsylvania, is to give a resumé of the papers presented at the general meeting, and Mr. Scott will give a summary of the New York discussion. Mr. Wurts will be asked to discuss the general topic of the evening—illumination. Although no definite arrangements have yet been made, it is expected to have talk also on the Nernst-Bremmer flame-arc lamp, and on the Cooper-Hewitt lamp, by gentlemen who are more or less familiar with these subjects. Acetylene lighting and indirect electric lighting will also receive a share of attention. It is also proposed to illustrate the remarks by exhibitions of the lamps themselves. A Nernst lamp, a Bremmer arc-lamp, a Cooper-Hewitt lamp, and an acetylene gas light will be exhibited in the hall during the evening. The stated communications will be restricted to not over ten minutes each, and the subject will then be thrown open to general discussion.

As to permanent organization, the committee will recommend that an executive committee of five, consisting of a chairman, a secretary and three other members, be elected at the meeting of November 6th, to take full charge of this local section, including the calling of meetings, the preparation of papers, etc.

Hot Water Heating From a Central Station.*

By E. H. McKnight

Owners of electric light plants have long desired to increase the earning capacities of their properties without appreciable additional expense. This has lead to an investigation of the utilization of exhaust steam as a means of heating buildings. Wherever this business has been added to an electric light plant it has proven its salvation, especially where competition has been keen and profits small.

The purpose of this paper is to give a general idea of the equipment and operation of such an enterprise.

Details of Construction.—Pumps and condensers, or heaters, an expansion tank and a catch-all constitute the equipment of the station. Large duplex pumps are used to circulate the water about the system. They are operated at a low pressure during moderate weather, but in extreme cold weather the pressure is increased.

An open tank of sufficient capacity is placed at an elevated position, and used as an expansion tank for the system. Any good condenser or open heater into which the exhaust steam from the engines is turned can be used. The condensation formed is conducted back to the boiler by means of a small automatic pump, furnishing a quantity of heated water free from impurities, the oil having been extracted by means of the catch-all. The water for the heating system is pumped under pressure into the condensers or heaters, and becomes heated, passing out of the condensers or heaters and continuing its travel about the circuit. The condenser should be of ample size to heat sufficient water to care for the amount of radiation installed. A continuous and uninterrupted service during the heating season is assured by having all station equipment in duplicate.

The Mains.—Upon leaving the station, from eight to twelve-inch pipe is used, this depending upon the capacity of the system; the size of same is reduced at intervals until the end of the line is reached. The two pipe system has many advantages, in my opinion, over a single-pipe system; one pipe being used for the supply, and the other for the return. With this arrangement water is brought directly into each building from the heating apparatus, not having passed through any other building.

The insulation of the mains is a matter which necessitates much care and attention. The material which has been found to be the most efficient and inexpensive consists of hemlock boxes, built with double air-tight compartments in which the mains are laid; the space remaining about the pipes being well filled with process shavings or mineral wool. The outside of the boxing is protected by a prepared building paper.

Where this kind of insulation has been used the loss of heat on the line amounts to not more than 15 to 20 degrees; that is to say, when water is sent out at 180 degrees, it will return to the plant at 160 degrees. Thus when this water is raised from 160 degrees to 180 degrees, it is ready to send out again. Care should also be taken in anchoring the mains and providing for expansion.

Cost of Operation.—The expense of operating the heating plant under ordinary conditions is not great, the principal expense being in the amount of live steam used to operate the circulating pumps, which at no time is any great amount, the total for the entire heating season being a comparatively small item. No extra labor is needed at the plant, since what little attention the heating plant may require can be given by the same force of men heretofore employed at the electric light plant.

In order to fully realize upon the investment at the earliest possible time, it is most desirable to secure the services of one who is thoroughly conversant with the details of the business and familiar with the method of figuring for the purpose of making contracts for the heating of every available building located upon the pipe line.

As soon as the capacity of the pipe line has been reached, this additional expense can be dispensed with.

Method of Figuring.—The rules used are the same as those given by the highest authorities on the subject of heating, and are the same as those which have been in general use for a number of years.

In determining the amount of heat a given building will consume, measurements are taken of the cubic contents of each room, it being assumed that the atmospher of a room changes once and must be reheated. The square feet of exposed glass surface is also measured, the loss of heat through one square foot of glass being 75 times as much as the heat consumed by one cubic foot of air. Next the square feet of exposed wall surface is taken, it being estimated that ten square feet of wall surface, in the average well-built house, will lose as much heat as one square foot of glass surface.

By this means we arrive at the total number of feet of radiating surface to heat a given building, allowing one square foot of radiating surface for every hundred feet of cubic contents or its equivalent. An erroneous impression has gone forth to the effect that the heat is charged for according to the number of feet of radiation used, whether this be much or little; but in reality the cost per year is governed by the amount of heat the building will consume, and is not based entirely upon the number of feet of radiation contained in it. It is a well-established fact that hot water as a heating medium is far superior to all other known methods of heating. Among the numerous advantages to be had from this particular method is the fact that during the fall and spring months when a moderate amount of heat is desired, this need can be supplied by circulating the water at a low degree of temperature.

The heat from such a system is supplied to the consumer 24 hours a day, and every day upon which heat is needed; the service being continuous and uninterrupted, it gives the consumer the least concern. A crowning feature of this system of heating is obtained by the use of heat regulators, one or more being placed in each building. This insures an even, regular temperature through the house at all times.

* A paper read at the Eighth Annual Meeting of the Ohio Electric Light Association.

New Telephone Patents.

The wave of prosperity must certainly have at last reached the telephone inventors, for instead of the one or two patents, per issue, bearing upon the subject of telephony, which was the general run a few months since; now a Patent Office issue containing four, five and even more telephone patents is no rare occurrence. Of course the number of patents issued, while of some general interest, carries little weight unless the patents themselves are valuable, but as a rule the large issue contain no more than the usual proportion of doubtful material. Of the patents issued this week, one is for a receiver, one for an antiseptic mouthpiece, one for a switchboard plug and two for a very novel type of inclosures for telephones; as to the value of which the reader is referred to the following descriptions:

The improvement in receivers, for which a patent has been granted to Willard M. Miner, consists in the replacing of the large sound opening in the middle of the cap by a number of very small openings. These small openings are small drillings, grouped near the center of the cap and sufficient in size and number to allow of the proper issuance of the sound waves from the air space in front of the diaphragm. The primary object of the invention is the prevention of injury to the diaphragm by any instrument in the hands of a maliciously-inclined or curious person, or from accidental injury from the prongs of the hook switch. The value of the invention is doubtful as far as protection from sharp instruments is concerned,

for a needle is sufficiently large, when properly applied, to ruin a diaphragm. On the other hand, as a protection from the hook switch, the new cap will undoubtedly be a success. As to the effect of the change from a single to a multiple opening upon transmission, some doubt arises. Mr. Miner states, "A very important function performed by the small perforations is their equalizing and refining effect upon sound waves, caused by the vibration of the diaphragm. While waves of ordinary amplitude pass through without encountering obstruction, those of greater amplitude, which would cause unpleasantly loud sounds in the ear, are impeded to a certain extent, so as to greatly lessen their unpleasant effects." The reason for this paradoxical action of the small holes is not quite evident at first sight, but if such action does actually occur, the future of the new receiver should be assured.

A good idea of the new antiseptic mouthpiece may be well obtained from Fig. 1, which shows a sectional view. The holder for the antiseptic consists of a metallic box, pierced at its center by a perforated, cloth-covered tube. This box also has an opening at one side for the admission of the antiseptic, and is normally closed by a screw. A metallic case is provided for the antiseptic, containing box so arranged that the ordinary transmitter mouthpiece may be screwed into the center of one of its faces, while the other carries a threaded projection which screws into the face of the transmitter.

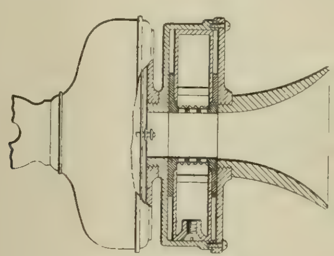


FIG. 1.—BROWN MOUTHPIECE FOR TRANSMITTERS.

By this means the porous tube of the box becomes a mere extension of the sound passage of the regular transmitter mouthpiece. The patent for this device is granted to Mr. Y. W. Brown, of Philadelphia.

Patent No. 711,556, issued to Henry P. Clausen, and assigned by him to the American Electric Telephone Company, claims one thing which is new, and one thing which is old. The former is an attachment to a switchboard plug, whereby the usual fibrous rubber protecting sleeve may be held in position without the use of screws. A small metallic stud carried on the end of a flat spring is so mounted upon the body of the plug that when the protecting sleeve is slipped into position, the stud is forced by the spring into an opening in the sleeve provided to receive it. To remove the sleeve from the plug, it is only necessary to press the stud through the sleeve against the pressure of the spring and then to slip the sleeve off the plug. The stud and spring are shown in Fig. 2. To any one who has struggled with the small screw usually employed to hold protecting sleeves in place, this part of the invention needs no recommendation. The second part of Mr. Clausen's invention claims novelty for the provision of an insulated collar about the body of the plug, in order

FIG. 2.—CLAUSEN SWITCHBOARD PLUG.

to insure that no contact shall occur between the body of the plug and the test ring of the jack, in those switchboard systems where an individual test circuit is provided. As all plugs for the so-called branch terminal switchboards of the American Bell Company for the last seven or eight years have been similarly equipped, the novelty is not apparent.

Fig. 3 shows two views of one of the inclosures for telephones, invented by A. Y. Parke, of Boston. This inclosure is constructed very much like an awning, and is shown at the right in the raised position. On desiring to use the telephone, the subscriber drops the awning over his head and shoulders, to screen himself and the telephone from extraneous sounds. A light is provided in the roof of the inclosure, as shown. This apparatus reminds one forcibly of the habits of the ostrich, in trying to shield his whole body by covering his head. Mr. Parke's second type of inclosure is built upon more liberal lines, consisting of a curtain mounted upon a flexible steel frame in such a manner that the user may readily draw the curtain completely around himself and the telephone, thus forming a small cloth booth. The top of this inclosure is a sheet

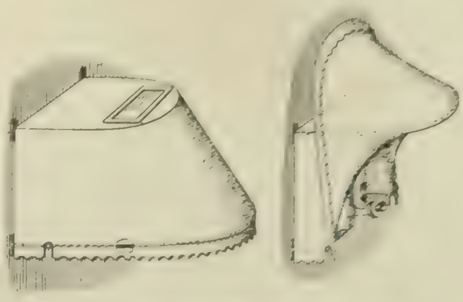


FIG. 3.—PARKE TELEPHONE ENCLOSURE.

of glass, while the bottom of the curtain extends nearly to the floor. After reflecting upon the rise of temperature in the ordinary telephone booth, with its fairly large enclosed volume during a call, the value of the above inclosure as accessories to a Turkish bath must at once suggest itself.

Right of Property in Quotations Sustained.

At Chicago, on October 28, an important principle of law was established when Judges Jenkins, Grosscup, Baker and Bunn, of the United States Court of Appeals, handed down an opinion to the effect that the Western Union Telegraph Company has a right of property in the news which it gathers, and that such right does not cease when the news is published on the tickers rented to its patrons. In laying down this new principle, the Court of Appeals affirms two decisions of the lower court, and forever enjoins the National Telegraph News Company, the Illinois Commission Company and other defendants from using the quotations in question.

The court says: "The business of appellee is that of a carrier of information. The gist of its service to the patron is that by such carriage the patron acquires knowledge of the matter communicated earlier than those not thus served. The ticker, with its printed tape, is an implement or means only to this commercial end, which the patron, or the patron's patron, may utilize to the end intended, but may not appropriate to some end not intended, especially if such appropriation result in injury to or total destruction of the service. In short, the law being clearly inadequate to that purpose, equity should see to it that the one who is served and the one who serves each gets what the engagement between them calls for, and that neither to the injury of the other, shall appropriate more.

"The immediate business of appellee, brought to our attention, may not arouse any great solicitude. It relates to the gathering and distributing of news, not looked on, perhaps, in all quarters as essential to the public welfare, but the questions raised are of much wider significance. These involve among others that modern enterprise—one of the distinctive achievements of our day—which, combining the genius and the accumulations of men with the forces of electricity, combs the earth surface each day for what the day has brought forth, that whatever befalls the sons of men shall come, almost instantaneously, into the consciousness of mankind. By such agencies as these the world is made to face itself unceasingly in the glass, and is put to those tests that bring increasing helpfulness and beauty into the heart of our race.

"Is service like this to be outlawed? Is the enterprise of the great news agencies or the independent enterprise of the great newspapers or the great telegraph and cable lines to be denied appeal to the courts against the inroads of the parasite, for no other reason than that the law fashioned hitherto to fit the relations of authors and the public, cannot be made to fit the relation of the public and this dissimilar class of servants? Are we to fail our plain duty for mere lack of precedent? We choose rather to make precedent—one from which is eliminated as immaterial the law grown up around authorship—and we see no better way to start this precedent upon a career than by affirming the order appealed from.

CURRENT NEWS AND NOTES.

THE MESSENGER BOY STAMP.—The messenger boys are to have official recognition by the Government. In a few weeks the delivery stamp will have a new design of a boy riding a wheel instead of the familiar messenger rushing with a letter in his hand. The size and shape of the stamp will be kept, but the design is regarded as much more characteristic and artistic. Instead of dark blue, the new stamp will be light blue or carmine.

WIRELESS TELEGRAPHY IN THE NAVY.—A telegram from Annapolis, Md., of October 23, says: Successful experiments were made to-day between the Naval Academy and the auxiliary cruiser "Prairie" with the Slaby-Arco system of wireless telegraph. Signals were exchanged between the "Prairie," 70 miles down the Potomac, and the station here. To-day's experiments are said to have given entire satisfaction to the naval experts conducting the tests. Representatives of the company assist in the experiments, which will be continued until the extreme limits of the system are determined.

HIGH LIVING.—On October 25, a company of half a hundred Philadelphians had the novel experience of eating luncheon at the top of a brick smokestack, 275 feet high. Only one of the guests declined to go up. He was a politician. The smokestack, which is one of the largest of its kind in this country, has just been built for the Southern Electric Light and Power Company, at Christian Street and Schuylkill. The inside diameter of the stack at the top is 18 feet. About five feet below the rim a platform was built, and on this a long table laden with good things to eat was placed. There was chicken salad, and there were sandwiches which had gone up in an unprecedented way, and coffee, and olives, and such things. "High balls" were also favored as an appropriate drink.

MILLIONS OF TRANSFERS.—Some interesting facts are noted about trolley transfers in New York: The Metropolitan Street Railway Company during the year of 1901 gave out 176,000,000 transfers, and this year, on account of the further extension of the transfer system, the company expects that the number will reach 200,000,000. The transfer system was inaugurated in 1884, and during the first year the company distributed 156,000 of the free tickets. Each year the number has increased, till it has reached the figures now recorded. Giving out this number of transfers has cost the company an enormous sum of money in printing and paper. Over 10,000 tons of paper were used for the transfers of last year, and as the dates are changed each day, the cost of printing was also very large.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION.—Mr. C. M. Goddard, the secretary, informs us that the annual meeting of the electrical committee of the Association will be held at the New York Board Rooms, 32 Nassau Street, on Tuesday, December 9th at 10 A. M., continuing two, and possibly three days. Members of the committee and others have been requested to forward any suggestions as to changes in the National Code, to his office, in Boston, not later than November 25th, when the communications will be put in type and distributed to members for consideration previous to the meeting. It is the custom at these meetings to first consider such matters as have been sent in in advance and are contained in the printed report, after which, if any time remains, those present may present suggestions from the floor.

SUSQUEHANNA POWER.—It is stated that the engineers who, in the interest of the Continental Trust Company, of Baltimore, have been investigating the possibility of using the Susquehanna River have reported favorably. Plans for the work have been completed, with the exception of certain details of hydraulic engineering. It is proposed to furnish light and power to Baltimore and many towns in the northern part of the State, between York and the river, and also Elkton, Wilmington, Del., and other points east of the river. The Continental Trust Company, which has an option on the purchase of the United Electric and Power Company, of Baltimore, until November 15, it is reported, will soon close the deal, involving nearly $1,000,000. A new company probably will be formed to take in this and other lighting and power companies as part of the Susquehanna power plan.

THE PACIFIC CABLE.—A special dispatch from Victoria, B. C., of October 20, says: Civil Engineer Dearlove, who superintended the laying of the Pacific cable from New Zealand to Fanning Island, has arrived here from London. He goes to Bamfield Creek, a landing station of the cable on Vancouver Island, where he will for 30 days subject the cable line to a severe test before accepting it from the Telegraph Construction and Maintenance Company. He expects from the perfection of the cable that a speed of 100 letters a minute will be attained. Dearlove transmitters, an invention of his own, will be used on the longest line in the world. It is expected the last section from Fanning to Suva will be completed by November 5, by Anglia. Mr. Dearlove does not believe that it is an assured fact, as stated, that the cable from Hawaii to this line is to be constructed. The matter is being considered.

TROLLEY AND LIGHTING CENSUS.—Director Merriam, of the permanent census office, has appointed 75 clerks to visit the large cities and work up the data on street railways and electric lighting. The importance of electric traction, power and lighting will be recognized by a special census volume giving all the statistics of electrical work, including the details of corporate interests, capitalization, rate of installation, and the per cent. of increase of traffic and lighting. Two special schedules, one for trolleys, etc., and one for electric lighting, have been prepared. Mr. T. C. Martin, who was the special expert agent for the government in the last census, for electrical manufacturing, has been appointed again, to assist the office in its present inquiry, which was ordered by Congress last March. Street railways were included in the census of 1890, but no report has ever been made on the growth of electric light and power companies.

THE NEW WHITE HOUSE at Washington will have practically no gas fixtures. Electricity will reign supreme. It has long been evident that the use of electricity in the type of chandeliers suitable for gas or oil lighting was an absurdity, when electricity only was to be employed. The change permits much more tasteful and effective methods. The so-called "sunburst," used in some of the rooms of the temporary office building, has been put into two or three of the rooms of the White House, but as a rule its lighting appliances are similar to the candelabra designs of the period of 1800, and have been worked out with special reference to the present methods of lighting. The results are reported to be exceedingly satisfactory. The telephone arrangements of the new building are as complete as modern appliances can make them. There is a private system for the rooms of the house, and through the switchboard a connection with the outside world, local and long-distance. It will be possible, from any room of the house, to talk with the gardener or the steward or the butler; heretofore it has been necessary to send a messenger. President Roosevelt is nothing if not up to date.

THE LONDON RAILWAY DEAL.—A special despatch from London states that the motion to recommit the bill granting a franchise to the Morgan group for the construction of the Piccadilly, City and Northeast London Railway was withdrawn on the night of October 29 in the House of Commons after an interesting debate. It was made clear, however, that the settlement of the House was overwhelmingly in favor of the Morgan scheme, and it was only because it involved a grave violation of ordinary parliamentary procedure that the proposed action was not taken. The result of the present situation is simply that the Morgan scheme is postponed for the one year necessary to regain its parliamentary status. There is little doubt that all the necessary powers will then be granted by Parliament. The debate evoked unprecedentedly plain speaking in the House, where the participants, while differing on other things, agreed that the Robinson and White interests, which promoted the West London scheme, obtained parliamentary sanction and then sold it behind the back of their agreement, and had been guilty of the most discreditable sharp practice. Mr. Thomas Ashton, who brought the business before the House, said he doubted if ever before such a dirty transaction had been done by parties who had come before Parliament. J. S. Morgan & Co., he added, had been the victims of a dishonorable transaction, and Parliament had been tricked.

PROGRESS IN CUBA.—A cable dispatch from Havana says: The Senate and House of Representatives has adjourned until the first Monday in November. The House voted a concession to the National Telephone Company for 50 years. The company will have the exclusive right to establish a telephone service in Cuba. The details of the concession will be discussed at the next session. The company is an American concern.

TECHNOLEXICON.—We have several times noted that the German Society of Engineers has undertaken the publication of a polyglot technical dictionary, and that it solicits the co-operation of engineers throughout the world to render the work of the highest possible value. Dr. Alfred Müller, 150 Nasau Street, New York, is authorized by the Society to arrange in this country for collaboration in the work, and application may be made to him for further information on the subject. Mr. Müller will supply collaborators with notes books especially arranged for their use.

WIRELESS FOR CABLE-SHIPS.—A cable dispatch from London, of October 21, says: The Eastern Telegraph Company has equipped its cable-ships with a new system of wireless telegraphy, designed by J. E. Maskelyne, Jr., for the company. He purposes to utilize the ships in an auxiliary telegraph service for inter-island communication or any other short stretches, where tides and rocks unduly shorten the life of a cable. Mr. Maskelyne's system makes use of a new form of coherer, dispensing with metal filings. He claims that the action is much more delicate and reliable.

THE LONDON TUBES.—As to the recent Yerkes victory, noted last week, a cable dispatch, of October 23, says: The contention made by counsel for Charles T. Yerkes before the House of Commons' Railroad Committee, on Tuesday, that the bill providing for the construction of a Piccadilly and City road must be withdrawn, as the Morgans' "tube" scheme had no legal status through having been presented to Parliament as part of the London United plan, which became non-existent that day through the withdrawal of its bill, was upheld by the committee to-day. The chairman, Sir Lewis McIver, announced that the committee was unable to proceed with the consideration of the bill. It is learned that the Morgans do not propose to abandon their underground projects. In spite of the decision of the committee, they will have a bill introduced in 1903, giving facilities similar to those of the scheme just quashed by the defection of the London United, control of which was purchased by Speyer Brothers, who are financing Charles T. Yerkes's plans. It is extremely doubtful, however, whether Parliament will grant the concessions desired.

AN ENGLISH POWER SCHEME.—A plan is on foot for supplying electricity and gas for Cheshire and North Staffordshire, with a proposed capital of £1,500,000. Three generating stations, each with engines of 2,000 hp, are to be built. The district covered is mapped out in the form of three circles. Within each circle a particular generating station will operate in the supply of electricity and power gas, but all will be connected. Two stations will be built in Cheshire and one in Staffordshire. Seven acres have been procured for a generating station within a mile of Frodsham. This station is near the railway, and on the banks of the canal. Thirteen acres will be obtained at Sutton, near Macclesfield, and the third site is one of 11½ acres at Stone. The Frodsham station will supply Runcorn, Chester, Sandbach, Nantwich, Tarporley, Middlewich, Winsford, Northwich, Knutsford, Altrincham, Sale, etc. The other stations in like manner will supply the towns and villages in the locality. It will be possible to supply trolleys with current, and it is not improbable that the projected Macclesfield to Warrington electric tramway will be supplied by the syndicate with the necessary power.

POWER AT THE SOO.—At Sault Ste Marie, Mich., on October 25, water was turned into the new power canal of the Consolidated Lake Superior Company, and Miss Helen Clergue, sister of Francis H. Clergue, organizer and general manager of the company, turned a jeweled switch that started the wheels in the big power house. Miss Clergue started the machinery and set the wheels in the power house whirling for the first time. The first current generated was used to run one of the company's new electric street cars. A civic and military parade marched through the streets during the morning, the parade exceeding anything ever seen in Upper Michigan. Over 10,000 men were in line. In the afternoon an industrial parade was given, which showed the different products of the Clergue institutions in the various stages from raw material to finished product. At night the three days' celebration ended with a banquet in the armory. The opening of the new water-power canal on the Michigan side of the St. Mary's River marks the completion of an engineering work of great magnitude, which has been in progress for four years, and which has been accomplished at a cost of about $4,000,000. A very full account appeared in these pages recently, with illustrations.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—This body continues its rapid growth, and Secretary Cahoon reports the following additions to the list of membership since the end of September. He also states that many companies are contributing liberally toward the fund for further tests of arc lamps: Evanston (Ill.) Electric Illuminating Company; Hoosick Falls (N. Y.) Electric Company; Crookston (Minn.) Water Works, Power and Light Company; Citizens' Electric Company, Eureka Springs, Ark.; Portsmouth (Ohio) Street Railway and Light Company; Meridian (Miss.) Light and Railway Company; Morrison County Electric Light, Heat and Power Company, Little Falls, Minn.; Westport (Conn.) Water and Electric Company; Zanesville (O.) Electric Light Company; Faraday Heat, Power and Light Company, Morton, Pa.; United Gas and Electric Company, Dover, N. H.; Monett (Mo.) Electric Light, Power and Ice Company; Branford (Conn.) Lighting and Water Company; Robert E. Strahorn, Sumpter, Ore.; Havre De Grace (Md.) Electric Company; Citizens' Electric Company, Eaton Rapids, Mich.; Taylorville (Ill.) Electric Company; The Washington (Pa.) Electric Light and Power Company; The Larimer Light and Power Company, Fort Collins, Colo.; Janesville (Wis.) Electric Company; Waynesburg (Pa.) Electric Light and Power Company; Antigo (Wis.) Electric Light Plant; Key West (Fla.) Electric Company; The Canadian Electric Light Company, Quebec, Ont.; Ashland (Ore.) Electric Light and Power Company; Big Fork Electric Power and Light Company, Kalispell, Mont.; Streator (Ill.) Gas and Light Company; Cheyenne (Wyo.) Light, Fuel and Power Company; North Shore Electric Company, Hoquiam, Wash.; Madison (Ind.) Lighting Company; Lewiston (Pa.) Electric Light Company; Dayton (Wash.) Electric Light and Power Company; The Electric Company, Connellsville, Pa.; Citizens' Electric Illuminating Company, Pittston, Pa.; Erie (Pa.) Company; Consolidated Gas and Electric Company, Batavia, N. Y.; Georgetown (S. C.) Electric Company; Pipestone (Minn.) Light, Heat and Power Company; Newport (N. H.) Electric Light Company; Pine Bluff (Ark.) Light and Water Company; Roanoke (Va.) Railway and Electric Company.

LETTER TO THE EDITORS.

Central Station Electrical Engineering.

To the Editors of Electrical World and Engineer:

Sirs.—The reports which frequently appear in your columns, of the proceedings of the minor electrical associations disclose a certain condition not at all, it appears to the writer, creditable to the business acumen of the owners and managers of the smaller central stations of this country. Judging from the experiences sometimes related at these meetings, or implied in the remarks of speakers, and the inquiries for technical information as to proposed changes or extensions of plants, it would appear that many of our central stations are presided over in a slip-shod manner from the engineering standpoint, and supposed improvements mostly made by blindly following what some one else has done, and with little or no regard to the specific conditions of a particular case. In other words, with this class the professional engineer has no standing, and electrical engineering seems to be regarded as a "frill." Doubtless in some cases the engineer's fee is the deciding factor, but we venture to say that in ninety-nine cases out of a hundred the cost of "investigation" by the non-technical owner or manager, and the mistakes inevitable in their selection and installation of plant would almost invariably many times cover such a fee.

It is said that a very large proportion of the central stations of this

country are non-paying ventures, and this is most probably attributable to the condition above noted. While the smaller stations could not afford to have on their staff a professed engineer, yet the rapid changes in the art and the engineering questions that frequently arise would appear to demand occasional expert advice; but too often in this respect the electrical plant is not differentiated from the case of a planing or flour mill. In recent years many hundreds of non-paying stations have been bought up by capitalists, and placed upon a profitable basis, the stations under their original ownership having languished through parsimony or ignorance in not securing engineering guidance—the profit that had been latent thus being realized only to be lost to the communities. If each central station were inspected once or twice a year by a consulting engineer, and changes or additions to plant only undertaken on his advice, we venture to say that the aggregate additional profit to the central station industry incident to such a system would many times cover the aggregate of engineers' fees.

Chicago, Ill. Chas. L. Bates.

DIGEST
OF
Current Electrical Literature.

Dynamos, Motors and Transformers.

Deri System of Compensated Direct-Current Machines.—Eichberg.—A very long and profusely illustrated paper read before the German Association of Electrical Engineers. On his compensated direct-current dynamos and motors, Deri uses no pole system with distinct poles, as in ordinary direct-current machines, but a distributed stator winding, like in the primary of an induction motor. Moreover, he has two different windings distributed over the stator, one is the real field exciting winding, while the other, called the compensation winding, is for the purpose of compensating for the armature field in order to insure perfect commutation. In a similar way as in a two-phase machine, the exciting and the compensating winding are placed on the stator; for the exciting winding one-third to at the most one-half the number of ampere turns of the compensation winding are required. The adjoining diagram represents a four-pole stator winding with 48 slots. The shunt winding

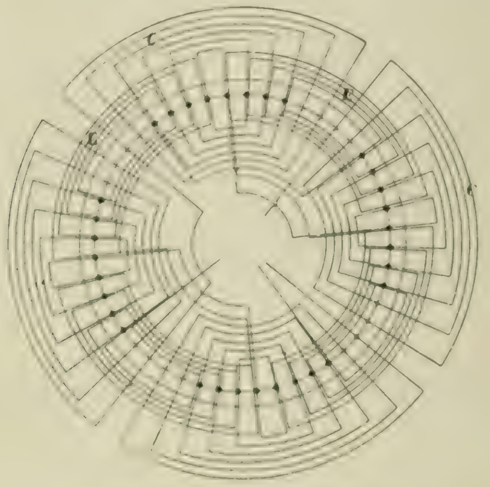


Diagram of Connections

(excitation winding) E comprises 8 slots in each pole field. The compensation winding, C, passes through all the slots in order to get as uniform a field as possible, due to the compensation winding and the armature winding. The essential point of Deri's compensation is that the number of ampere turns of the compensation winding is not equal to the number of ampere turns of the armature, but greater by a certain amount, so that the difference of compensation ampere turns and armature ampere turns produces a field which he calls the commutation field, and which is always proportional to the armature current, which also flows through the compensation winding, being in series with the armature. By a proper choice of number of turns of the compensation winding, it is always possible to get the proper commutation field once for all for any load or overload. If after the construction of the machine is finished, the compensation winding is found to have too many turns, it is easy to correct the error by shunting the compensation winding. A displacement of the brushes has the opposite effect when the machine is used as dynamo or as motor. When the exciting field is decreased in the generator it is increased in the motor, and when it it increased in the generator, it is decreased in the motor. The latter case would be fatal, as the motor would run up to a higher speed and take in more current, the field would further decrease, etc. By using a high saturation in the stator core, it is, however, possible to obtain a steady and safe operation not only at the theoretical neutral line, but also with a small displacement of the brushes. Many details are discussed, and results of tests of machines are given. Among other things he remarks that the complete compensation of the armature reaction and the removal of the difficulties of the commutation, enables one to make the air-gap as small as is allowed by mechanical considerations. Nor is it necessary to use the high induction in the rotor teeth and the high number of ampere windings of the magnets, required in machines of ordinary construction. In several machines which he has designed, and which have given very satisfactory results, he has decreased the ratio of magnet ampere windings to armature windings to one-third. The less amount of magnet copper wire and the uniform distribution of the compensation winding along the stator result in smaller outside dimensions.—*Elek. Zeit.*, September 11.

Commutators and Slip-Rings.—Hellmund.—An article in which he discusses the mechanical treatment of commutators and slip-rings. The principal point is generally to diminish the wear and tear as much as possible. To hold the energy loss, due to the Joulean heat, within proper limits, it is necessary that the resistance of the brushes should be small; against this requirement acts the fact that in machines with bad commutation a better commutation can be obtained by means of a high specific brush resistance. Finally the heating effect should remain within proper limits, so that the commutator insulation is not affected. He first discusses metal brushes, and gives the results of some tests, showing the influence of lubricating upon the brush resistance. The results show that the influence of lubricating may be quite different for different conditions of the sliding surface, and probably depends also on the material; moreover, lubricating does not reduce the resistance in any instance; it appears that under normal circumstances there is no increase of the ohmic losses, or, if there is any, it is balanced by the considerable decrease of the friction losses, so that in any case where a small brush resistance is wanted, no trouble may be feared from lubricating, although the layer of oil should not be too thick. In such machines, in which a higher brush resistance is wanted in the interest of good commutation, special lubricants are suitable; he obtained good results by using a lubricant, consisting mainly of paraffine and tallow. At present, of course, carbon brushes are generally used, where a high transition resistance is wanted. With carbon brushes no lubricants should be used. Although he found that the use of the lubricant of paraffine and tallow, mentioned above, sometimes decreases sparking, he thinks that the same results may be obtained by using a sort of carbon of higher specific resistance. In general the pressure with which the brushes are pressed against the commutator should be as small as possible, as Dettmar has shown that the increase of the friction losses with increased pressure overbalances the advantages of decreased ohmic loss. To press the brushes tightly on the commutator may be advantageous only in such cases in which the machine is exposed to strong vibrations with consequent danger of sparking, due to the vibrations.—*Elek. Zeit.*, September 11.

Reference.

Alternator Design.—Denham.—A paper, read before the Cape Town local section of the British Institute of Electrical Engineers,

in which he gives "some notes on alternator design." He discusses the general principles of the construction of alternators and emphasizes the superiority of polyphase over single-phase working. There is also a separate editorial on this subject.—Lond. *Elec.*, September 26.

POWER.

Cost of Electric Power Transmission.—ADAMS.—An article in which he discusses the three main factors concerned in the cost of electric power transmission, namely, the transformers, the pole line and the wire or conductors. The first cost of the transformers varies directly with the maximum rate of transmission, and is nearly independent of the voltage, the length of the transmission and the percentage of line loss. A pole line changes in first cost with the length of the transmission, but is nearly independent of the other factors. Line conductors, for a fixed maximum percentage of loss vary in first cost directly with the square of the length of the transmission and with the rate of the transmission; but their first cost decreases as the percentage of line loss increases and as the square of the voltage of transmission increases. Applications are made to numerical examples. The distance over which energy may be transmitted at a given rate, with a fixed percentage of loss and a constant weight of copper, increases directly with the voltage employed.—*Cassier's Mag.*, October.

Mine Hoist.—An illustrated description of an electrically-driven mine hoist, exhibited by Siemens & Halske at the Dusseldorf exhibition. It is designed to hoist 9,200 lbs. of coal at each lift, from a depth ultimately of 1,640 feet. A main shaft carries at its center the rope sheave and brake drum, at each side of which is located an electric motor of 1,400 maximum horse-power each. These motors may be connected in series or in parallel, and thus be worked at full or half speed, and in case of accident to one motor, work may be continued with the other. By various combinations (not described) of the storage battery and alterations of the field current, speeds of 2, 4, 5, 6, 8, 10, 12, 16 and 20 meters per second can be obtained without loss of energy, and practically any intermediate speed may be obtained with slight loss from the rheostats. Direct current of 500 volts is used.—*Am. Mach.*, October 9.

REFERENCES.

Electric Power.—SELBY-BIGGE.—The first parts of a paper, read before the Iron and Steel Institute at Dusseldorf, on the application of electric power in the iron and steel industries. He gives actual facts and figures from practice, on the saving obtained by the use of electric power, and a table of details concerning motors for various mechanical purposes.—Lond. *Elec. Rev.*, September 19, 26.

Control of Electric Motors in Factories.—WOODFIN.—An article discussing mechanical details of the construction of starting switches. Lond. *Elec. Rev.*, September 19.

Coupling of Machines.—EHNERT.—A brief illustrated article on the mechanical problems involved in the direct coupling of prime movers and dynamos.—*Zeit. f. Elek.*, September 28.

TRACTION.

Interurban Electric Railway Car Equipments.—POTTER.—An article in which he first points out the effect of curves on train resistance, and gives the speed at which cars can travel around curves with safety, which, he says, roughly in miles per hour is the square root of the radius of the curve in feet. Grades, provided the cars can coast at the bottom of the grade, do not materially affect the power consumption, but especially if trailers are hauled, they become of serious importance in determining the motor capacity, the gear ratio and the minimum weight on drivers. Under ordinary conditions of track, the coefficient of friction may be taken from 15 to 18 per cent. of the weight on drivers, and two miles per hour per second is a reasonable maximum for comfortable acceleration. The speed curve should be concaved at the beginning instead of being a straight line, to insure comfort to passengers, just as the braking curve is concave at the end. If the grades exceed 5 per cent., or if the acceleration exceeds 1¾ miles per hour per second, four motors will be found essential (with a four-axle car) for reliable service. Two motor equipments (for a four-axle car) will have a slightly higher efficiency, but four motors of the same total power rating will perform a faster schedule for the same temperature rise because the total radiating surface of four motors is greater. The writer recommends a truck-wheel base, for high-speed work, of 7 feet rather than the more common standard of 6 feet, as this will provide room for 200-hp motors, large axles and an ample bolster, and special attention should be given to the method of wiring and installation of motors to see that no danger of fire results. The cables should preferably be carried in a non-inflammable conduit of asbestos compound rather than in metal ducts, as the former will not maintain an arc. All parts of the flooring of the car near the motor should be of asbestos compound. The writer then discusses the subject of fuses, car switches and the trolley wheel, which latter has shown a surprising capacity for high-speed work. A single trolley wheel can be depended upon to carry 200 amperes at 60 miles per hour, 400 amperes at 30 miles per hour, and 800 amperes at 10 miles per hour. For heavy high-speed service the third-rail is more desirable than the trolley.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Detroit.—An article on overhead construction and electric power distribution in Detroit. On the Flint division an inverted rotary of 250 kw is installed in the direct-current power station. Current is transmitted at 15,000 volts over two circuits of aluminum wire as far as 48 km. The rotaries in the substations on this division are started as direct-current motors from the trolley line, and when run to as high a speed as possible are thrown into the three-phase circuit. The other lines are fed by direct-current and boosters. The city system is supplied from two stations adjoining each other, and a diagram shows the method of connecting the bus-bars together. The switchboard of these two stations have three sets of bus-bars, allowing three different voltages, viz., 625, 575 and 550. Full details are given also of the circuit breakers, feeders, etc.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Track Maintenance.—An illustrated article on track construction and maintenance in Detroit. The cost of maintenance on interurban track falls between $7.50 per mile per month in winter and $12 in summer. All of the rail is 60 to 70 lbs. T, and the joints seem to be in very good condition. Some trouble has been experienced with rails 60 feet in length from drawing apart on grades, but in other respects they are considered more desirable than shorter rails. Illustrations also show an electric shoveler, for shoveling gravel on construction work; it was made in the shops of the company, and saves the wages of six men. Another illustration is of a semaphore signal, for switches, which shows "clear" only when the switch is entirely closed. At the steam railroad crossings, interlocking signals and derailing switches are used. Details are given concerning the track construction.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

REFERENCES.

Motor Power and Rolling Stock at Detroit.—FARMER.—A description in detail of the stations of the traction company of Detroit, of which there are six. The two largest are adjoining each other, and their bus-bars can be connected. The heaviest interurban car of the company weighs about 33 tons, loaded. All express and freight matter is carried on special cars. The construction of the rolling stock is described in detail. The interurban cars are usually heated with hot water, and the city cars by hot air or electric heaters. The illustrated trolley wheels, used in the city, are self-oiling, Views are also shown of a machine for rewinding old field coil wires. When the field coil becomes defective, the insulation is burned off in the fire and then the machine illustrated rewinds it. In the latest machine, instead of burning off the insulation, it is cut off by the machine which is fitted with a pulley with a corrugated steel face.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Surface Contact Systems.—LORDEREAU; DOTTER.—Replies to critical remarks made by Paul in a recent article.—*L'Ind. Elec.*, September 25.

Berlin.—PERKINS.—An illustrated article on the latest developments of the Berlin elevated and underground railway.—*Elec. Rev.*, October 11.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

German Central Station.—A description of the new station of Erlangen. The three-wire system with 440 volts between the outers is used. The capacity of the station is at present 420 hp. The dynamos are driven by gas engines. There is a storage battery of 272 cells, giving 648 amp.-hours if discharged in three hours. The results of the tests of the gas engines are given.—*Zeit. f. Elek.*, September 14.

REFERENCE.

Single-Phase Plant.—An illustrated article on the single-phase pumping plant of the Hammersmith Vestry, England, where a single-

phase traveling crane is also installed.—Lond. *Elec. Rev.*, September 26.

ELECTRO-PHYSICS AND MAGNETISM.

Sparking Distances in Oils.—JONA.—An account of tests of a large number of various oils with respect to their "dielectric strength." The charges were derived from an alternating-current transformer yielding voltage as high as 160,000. The oils differ greatly in their insulating powers, but the curves indicating the relation between voltage and maximum sparking distance all tend to become straight lines at voltages higher than 80,000. Natural olive oil shows the lowest insulating power. Benzol and fused paraffin are at the other extreme, and of these, benzol shows only a very slight increase of sparking distance for the higher voltages. It begins at 44 cm., and rises to only 47 cm. at a voltage of 160,000. The sparking distances in air show a very much greater increase with voltage than those in any liquid, but they also tend to a straight curve at the higher voltages. All dessiccated oils show a smaller change of sparking distances with voltage than the corresponding oils do in their ordinary state. Toluol, xylol and solution of colophony in xylol have nearly the same insulating power as benzol, but the modern vaseline oils used for transformers closely approach them. Benzol is, in any case, too dangerous on account of its inflammability.—*Atti. Ass. Elet. It.*, No. 4, 1902; abstracted in Lond. *Elec.*, October 10.

Electric Spark Gaps.—LECHER.—A description of a set of experiments, in which he electrified the whole secondary of an induction coil from an influence machine, and then worked it as usual. He found that the brushes usually seen on the positive electrode of an induction coil, when no spark can pass, are enormously increased when the whole is positively electrified, whereas they disappear when the electrification is negative. The results are probably due to the fact that the charge of the influence machine eliminates from the air of the spark-gap one or the other kind of electrons.—*Ann. d. Phys.*, No. 10, 1902; abstracted in Lond. *Elec.*, October 10.

Luminosity and the Kinetic Theory.—BUTLER-BURKE.—An abstract of a British Association paper on "luminosity and the kinetic theory," in which he points out that the phenomena of luminosity are accompanied by or dependent upon the formation of large molecular aggregates, which act as centers of intense molecular force; and that the luminosity results from the bombardment of these by the free corpuscles in the luminous body, which in virtue of these powerful centers of force acquire a great velocity under their attraction and produce collisions of considerable violence.—Lond. *Elec.*, September 26.

Luminescence of Wires in a Vacuum.—BORGMANN.—An account of experiments with two wires in a vacuum tube, mounted parallel to the axis and connected to an induction coil. A narrow strip of tin-foil was stuck along the tube outside. He describes the various phenomena produced by connecting one or both of the wires with the induction coil and exhausting to various degrees of vacuum. When both wires are connected with the positive pole, with a spark gap in parallel with the coil, and the strip of tin-foil not earthed, both wires show portions of luminous lenses at right angles to the axis of the tube; at smaller pressures, the lenses are changed into cylindrical sheaths of violet light surrounding the wires. When both wires are connected to the negative pole, and the tin-foil is earthed, two luminous surfaces appear between the tin-foil and each wire, while at lower pressures there are longitudinal sheaths of light interrupted by dark rings.—*Phys. Zeit.*, September 15; abstracted in Lond. *Elec.*, October 10.

Longitudinal Magnetization of Nickel.—WILLIAMS.—An account of an experimental investigation of the fact that the length of a nickel wire is diminished, while its electrical resistance is increased by longitudinal magnetization. When these effects are represented in curves showing the change of length, or resistance, as a function of the magnetizing field, it is found that the two curves bear a very striking resemblance to each other. He has continued the investigations of the relation between these two effects, the results being given in tables and diagrams.—*Phil. Mag.*, October.

Elasticity and Magnetism.—HONDA, SHIMIZU, AND KUSAKABE.—An account of an experimental investigation of the change of the modulus of elasticity of ferromagnetic substances, by magnetization. It has been generally admitted that the effect is small, and former experimenters found that magnetization increases slightly the modulus of elasticity in iron and nickel, and that the change increases with the magnetizing force. They have experimented with soft iron, steel, wolfram steel, nickel and cobalt. The results are given in tables and diagrams. The results obtained for iron, steel and nickel are far greater than those given by former experimenters. The modulus of elasticity of nickel decreases in weak fields.—*Phil. Mag.*, October.

REFERENCE.

Vacuum Tube Discharge.—SKINNER.—An account of a theoretical and experimental investigation of the conditions controlling the drop of potential at the electrodes in vacuum-tube discharge. He discusses the variation of the anode drop with the potential gradient in the positive column, the anti-cathode effects, the effect of tin-foil coating on the tube surrounding the cathode, the effect of a magnetic field on the electric drop, and the effect of a magnetic field on the anode drop.—*Phil. Mag.*, October.

ELECTRO-CHEMISTRY AND BATTERIES.

Lead Refining.—ULKE.—An article on the Betts electrolytic process of refining lead bullion, which is said to have a low working cost and a high efficiency, and which is worked at a plant of about 10 tons daily capacity. The process is based on the solubility of lead in an acid solution of lead fluosilicate, from which very pure lead is said to be deposited with impure anodes at a very low cost. The fall in potential between tanks is only 0.2 volt. A current density of 14 amperes has given the most satisfactory results. According to the inventor, each ton of lead refined, including casting of anodes, requires the burning of 210 lbs. of fuel. The silver slimes obtained, averaging about 8,000 ozs. of gold and silver per ton, are now treated at the Seattle Smelting and Refining Works.—*Eng. & Mining Jour.*, October 11.

Chlorates.—J. B. C. KERSHAW.—A second article on the electrolytic manufacture of chlorates. He discusses the Corbin cell and the Franchot & Gibbs cell, and makes some remarks on the efficiency of the various processes. He gives an estimate of the cost of chlorate of potash, made in a 3,000-hp hydroelectric plant, producing 1,600 metric tons of chlorate; the cost per pound of chlorate is 4.7 cents. He gives a summary of numerous laboratory investigations bearing on the theory of chlorate cell and various practical results which have been obtained. Foerster and Mueller state that the best efficiency is obtained when an electrolyte is used containing sodium chromate and free hydrochloric acid, in conjunction with a spongy platinum electrode. Under these conditions two-thirds of the chloride present in the cell can be converted into chlorate with a current efficiency averaging over 94 per cent.—*Elec. Rev.*, October 11.

Trilbelhorn Storage Battery.—An illustrated description of this lead cell, made in Switzerland. It is said to be used in factories, hotels and central stations. Its characteristic feature is the arrangement of the cells, which are in the form of conical leaden dishes, one above the other. The upper side of each dish is positive, the lower negative. The active material is keyed in peculiarly formed furrows on both sides of the dishes. The charging voltage increases to 2.75, and the discharge voltage decreases to 1.85 at slow discharge, and to 1.72 at fast discharge. The amp.-hour efficiency is in the average 90 to 92 per cent., the watt-hour efficiency 68 to 70 per cent.—*Elek. Neu. Anz.*, October 1.

REFERENCES.

Free Ions.—OLSEN.—An account of an experimental investigation into the existence of free ions in aqueous solutions of electrolytes. His experiments are based on the following considerations: It is believed that an electrostatic charge attracts and repels the unlike and like charged ions, respectively; and as it is the ions which, in giving up their charge, produce a current, then if these ions can be guided by an electrostatic charge, we should get a current with electrodes indifferent to the solution, and be able to detect it with a sufficiently delicate galvanometer.—*Am. Jour. Sc.*, October.

Copper Refining.—DUJOUR.—An illustrated popular article on copper refining.—*La Nature*, September 20.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Alternating-Current Voltage Selector.—HEINKE.—An illustrated description of an instrument, which is to be used for calibrating alternating-current instruments and for alternating-current tests of any kind, in which an easy variation of the voltage is desirable. The instrument is essentially a transformer, which, however, has not two, but a large number of windings of suitably selected number of turns and cross sections; they are connected like the resistances in a resistance box, which are varied by putting in or taking out plugs; in the

present case the voltage can be varied in sufficiently small steps and in an economic way. This is especially suitable for calibrating ammeters or other apparatus with large currents and low voltage.—*Elek. Zeit.*, October 2.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Light Telephony.—RUHMER.—An illustrated account of some recent experiments with "light telephony." He has succeeded in getting good communication over a distance of 7 km (4¼ miles). As has been noticed before in the Digest, the principle is as follows: at the transmitting end the sounds spoken into microphone generate variations of the current, which are superposed on the direct current from a storage battery, feeding an arc lamp. This gives the phenomenon of the sparking arc, and the light intensity of the arc lamp follows the vibrations. The vibrating light rays are made parallel by a parabolic searchlight reflector, and transmitted to the receiving station, where they fall upon a reflector in the optical axis of which there is a cylindrical selenium cell; this cell is connected in series with a battery and two telephones. If the selenium cell is sensitive enough the transmitted sounds are reproduced. It is necessary to use such a current at the transmitting station for feeding the arc lamp, that the illumination of the selenium cell is at the point of its maximum sensitiveness. He uses 4 to 5 amperes for transmission over 1 to 2 km, 8 to 10 amperes for 3 to 4 km and 12 to 16 amperes for 5 to 7 km; the greater the distance, the more light is needed at the transmitting station, in order to keep the illumination of the selenium cell at the most favorable point. He finds that the relatively short wave lengths of the spectrum are the most active in the phenomenon of the "sparking light." The construction of the selenium cell is the principal point, and he promises a description of his cells in the near future. He says his cells are at least as good as the one used by Simon, which has a resistance of 533,000 ohms, and is reduced to 26,000 ohms with an illumination of 400 lux. In the author's cell, thin layers are used. After having been illuminated, the original resistance, which corresponds to darkness, is reproduced within a few minutes. His experiments were made on the Wannsee, and are said to have given very satisfactory results. He thinks light telephony has a practical future for use in the army and navy.—*Elek. Zeit.*, September 25.

MISCELLANEOUS.

Physiological Effects of Röntgen Rays.—OUDIN.—A full account of the pathology and treatment of the skin disease radio-dermatitis, which is the consequence of excessive exposure of the skin to Röntgen or Becquerel rays. It is a painful and troublesome malady, which may last for 18 months, and is difficult to cure. As regards treatment, nothing has yet been found capable of stopping the development of the disease. The electric effluvium and red light appear to accelerate the course of heating, and it is supposed that red light would, to a certain extent, counteract the effects of Röntgen rays, as they somewhat resemble the effects of ultra-violet light. Besides this acute radio-dermatitis, which is practically confined to overexposed patients, there is a "chronic radio-dermatitis," which attacks the operators and affects more especially the fingers. He uses fencing gloves, containing a padding of very fine brass wire, to protect his hands.—*Arch. d' Elec. Med.*, September; abstracted in Lond. *Elec.*, October 10.

New Books.

DIE GLEICHSTROMMASCHINE. Theorie, Konstruktion, Berechnung, Untersuchung und Arbeitsweise Derselben. By E. Arnold. Berlin: Julius Springer. 555 pages, 421 illustrations. Price, 16 marks.

This work is in character a classic, and constitutes by far the most thorough and able discussion of the modern direct-current dynamo that the reviewer has seen. With characteristic painstaking, the author reduces every feature of dynamo theory to its simplest aspect and considers each feature first alone and then in its relation to other features. In contrast to the frequently-encountered method of requiring the reader to supply missing links in an exposition, Prof. Arnold's explanations are in many instances, perhaps, unnecessarily exhaustive, but in every instance complete and lucid. In common with other technical writers, however, he goes to the trouble of filling many pages with rudimentary material that is superfluous to anyone capable of understanding the main parts of the book.

The first engineering information reached by the reader is on the theory of armature windings, which is treated very elaborately. Following this is a discussion of potential equalizing cross-connections for multipolar armatures, which is given the same elaborate treatment.

Chapter VI is devoted to potential differences between neighboring armature coils side by side and between adjacent commutator segments, with various types of winding; Chapter VII, to ring windings with parallel series and mixed connections; Chapter VIII, to drum armatures with similar windings; Chapter IX, to the disc winding and the Desroziers and Fritsche disc armatures; Chapter X, to open-circuit armatures; Chapter XI (which might as well have been omitted), to the three types of field winding series, shunt and compound; Chapter XII, also superfluous, to a elementary comparison of the dynamo and motor; Chapter XIII is a short description of different types of field magnets.

Chapter XIV, on the calculation of the magnetization curve of a dynamo, is more academic than practical. The treatment of the problem is beautiful, but it is doubtful if any designer outside of Germany ever goes through the appalling task of calculating air-gap excitation with allowances for flux paths into the slot edges of armature teeth and the plane end surface of the core. Field magnet leakage also forms part of the problem, and receives the same exhaustive treatment that is accorded air-gap excitation.

Chapters XV to XXI constitute the most valuable portion of the book, and contain a superb analysis of armature reaction, commutation, air-gap flux distribution, magnet pole construction, and the relations of all these factors to each other. It is impracticable to do justice in a book review to these chapters; they are simply a masterpiece. Chapter XXI concludes with a discussion of the compensating windings of Sayers, Fischer-Hinnen, Ryan and others. The remaining chapters are devoted to Characteristic Curves; Copper, Iron, Commutator and Mechanical Losses; the heating of field magnet coils and armatures, and their radiating surfaces.

ELECTRIC INCANDESCENT LIGHTING. By Edwin J. Houston, Ph. D., and A. E. Kennelly, Sc. D. Second Edition, Enlarged. New York: Electrical World and Engineer. 508 pages, 161 illustrations. Price, $1.00.

Four chapters have been added to the second edition of this work, in which are considered 240-volt lamps, Nernst lamps, the vacuum tube lighting, photometry of incandescent lamps, and incandescent lighting for railroad trains. The chapter on the Nernst lamp gives the theory of that lamp, and the Cooper-Hewitt lamp is described in the chapter on vacuum tube lighting. In the chapter on the photometry of the incandescent lamp, the principles are explained and brief directions for testing given.

NATURLEHRE. By Dr. Alois Lanner. Wien: Jos. Roth'schen Verlagsbuchhandlung. 377 pages, 377 illustrations.

This modern work on physics is intended for use by the upper classes in the gymnasia in Germany, and follows more or less closely the lines laid down in the recommendations of the German Imperial Bureau of Education about two years ago. As at that part of their course the students have not yet taken up the calculus or gone far into trigonometry, the former is not used at all in the book, although the latter is briefly mentioned under "Astronomy." Algebra is liberally used where necessary and vectors are handled on an early page, but as a whole there is little of a mathematical character to be waded through.

Somewhat unusual from the viewpoint in this country is the inclusion of chapters on chemistry and "Cosmic Physics." The former is of a length of 30 pages, mostly closely printed, and its extremely simple character and the descriptions of the more important properties of the elements that it contains make it of undoubted value.

Even organic chemistry receives some mention, and while this is necessarily of the most elementary character it can by no means be considered out of place. Under "Cosmic Physics" are included astronomy, physical geography and meteorology, the former being particularly well handled under the circumstances.

The electrical section is thoroughly modernized, the Röntgen and Becquerel rays, wireless telegraphy and multiphase transmission of energy all finding place. We note a curious lapse in the chapter on electrical measuring apparatus in that while instruments of the solenoid, hot wire and dynamometer types are named, there is no mention of the D'Arsonval type that is now in almost universal use

for direct-current measurements in this country as well as abroad.

No specific forms of apparatus for the demonstration of physical actions and laws are given, all illustrations of this kind being elementary and often only diagrammatic. This is in many respects a good feature, as it avoids the confusion that often arises in the students' minds when the book apparatus and that of the lecture-room are of different appearance. The number of the illustrations is, however, great, in order that some idea of the devices may be had, even if, as is often the case, there is no apparatus of the type required in the lecture-room's collection.

BOOKS RECEIVED.

MATERIALS OF MACHINES. By Albert W. Smith. New York: John Wiley & Sons. 142 pages, 17 illustrations. Price, $1.00.

ELEMENTE DER ELEKTROTECHNIK. By Moriz Kohn. Leipzig und Wien: Franz Deuticke. 108 pages, 121 illustrations. Price, 2.50 marks.

MECHANICS-PROBLEMS. By Frank B. Sanborn. New York: Engineering News Publishing Company. 155 pages, 60 illustrations. Price, $1.50.

DIE WECHSELSTROMTECHNIK. Herausgegeben von E. Arnold. Berlin: Verlag von Julius Springer. 425 pages, 263 illustrations. Price, 12 marks.

ALTERNATING-CURRENT MACHINES. By Samuel Sheldon, Ph. D., and Hobart Mason, B. S. New York: D. Van Nostrand Company. 259 pages, 184 illustrations. Price, $2.50.

AUFGABEN AUS DER ELEKTROTECHNIK NEBST DERED LOSUNGEN. By Dr. Phil. E. Müllendorff. Berlin W: Verlag von Georg Siemens. 113 pages, 14 illustrations. Price, 2.50 marks.

DAS SELEN UND SEINE BEDEUTUNG FUR DIE ELEKTROTECHNIK. By Ernst Ruhmer. Berlin: Verlag der Administration der Fachzeitschrift Der Mechaniker. 57 pages, 49 illustrations. Price, 2.40 marks.

A GRAPHIC METHOD FOR SOLVING CERTAIN QUESTIONS IN ARITHMETIC OR ALGEBRRA. By George L. Vose. Second Edition. New York: D. Van Nostrand Company. 62 pages, 29 illustrations. Price, 50 cents.

THE ELECTRIC TELEPHONE. By Edwin J. Houston, Ph. D., and A. E. Kennelly, Sc. D. Second Edition, Enlarged. New York: Electrical World and Engineer. 453 pages, 152 illustrations. Price, $1.00.

GALVANIC BATTERIES, THEIR THEORY, CONSTRUCTION AND USE. Comprising Primary, Single and Double-Fluid Cells, Secondary and Gas Batteries. By S. R. Bottone. London: Whittaker & Co. 376 pages, 144 illustrations. Price, 5 shillings.

THE ELECTRO-PLATING AND ELECTRO-REFINING OF METALS. Being a New Edition of Alexander Watt's "Electro-Deposition." Revised and Largely Rewritten. By Arnold Philip. New York: D. Van Nostrand Company. 680 pages, 160 illustrations, 14 tables. Price, $4.50.

Electrical Testing Laboratory.

The Lamp Testing Bureau is a company incorporated under the laws of the State of New York, with headquarters at No. 14 Jay Street, New York City. This location, near the Hudson River, Broadway and Duane Street, is conveniently situated for the visits of electrical men in the down town neighborhood. The company also operates a testing station at Harrison, New Jersey.

The original purpose of the bureau was the testing of incandescent lamps supplied by the Edison Lamp Works, at Harrison, to the Association of Edison Illuminating Companies, under specifications as to quality and life. The bureau had, therefore, originally but one testing laboratory at Harrison, with a photometer room and a lamp-life testing department. Since that time the company has inspected upwards of 25,000,000 of incandescent lamps, and has measured the candle power and life history of over 125,000 sample lamps.

The success attending the operation of the bureau has caused the company to extend its field of operation beyond the Association of Edison Illuminating Companies, and to come before the general public for the testing not only of incandescent lamps, but of electrical apparatus, cables, supplies and electrical machinery generally.

The laboratory of the company is on the 6th, 7th and 8th floors of the building at No. 14 Jay Street. Each floor measures 90 feet x 23 feet. On the 8th floor are the offices, and also a general electrical laboratory, equipped with the requisite portable instruments as well as instruments and apparatus of precision. Among the latter may be mentioned an accurately-adjusted Wheatstone bridge of the Anthony pattern, wound with manganin wire; a Thomson double bridge by Wolff, of Berlin, for the measurement of low resistances and of the conductivity of specimens of wire; potentiometers by Leeds & Company, of Philadelphia, and by Wolff, with a complete outfit of standard cells and with the requisite chemicals and apparatus for the preparation of standard cells; a complete set of maganin resistances by Wolff, running from 0.0001 ohm to 100,000 ohms, which are used as standards of resistance, and, in connection with the potentiometer, for the accurate measurement of direct currents up to 2,000 amperes; the platinum dishes and sensitive balance required to make standardizations by the silver voltameter. For alternating-current measurements, besides a very complete set of portable and semi-portable voltmeters, ammeters and wattmeters, there is a Rowland electro-dynamometer, with shunt box, by which a great variety of A. C. work can be done, including much of which is entirely outside of the range of the ordinary instruments. Standard condensers, keys, secohmmeters, et cetera, are at hand for cable testing, determining coefficients of induction, capacity, etc. Alternating-current instruments are checked or standardized by reference to standardized direct-current instruments, using reactanceless transfer instruments. The standard photometer, which is equipped for making all kinds of photometric measurements, is also on this floor. The accessory apparatus for correcting measurements made with the Hefner amylacetate lamp and the 10-cp pentane-lamp, taking account of atmospheric conditions, is also at hand.

On the 7th floor are 300 cells of accumulator, arranged in several batteries, and used for testing purposes. On this floor are also a small converter, which can be driven by storage battery current to furnish alternating current for making instrument checks, and vibration-free meter boards, with the necessary arrangement for making accurate tests, and complete laboratory investigations on recording electricity supply meters, using current from storage batteries. There is also suitable space for testing heavier apparatus.

On the 6th floor are the motor-dynamo, which supplies current to lamps on life test, working photometers for life-test measurements, and the racks on which lamps on life test are set up to burn. These racks are at present capable of holding and supplying 1,100 incandescent lamps. The various pressures required are supplied to these lamps from a special sectional transformer, the e. m. f. of which is controlled by an attendant constantly on duty. Any integral voltage can be steadily maintained between 100 and 150 volts. The finer adjustments of voltage on individual lamps are made by placing suitable resistances in series with them.

The routine of incandescent lamp testing as usually practiced by the bureau is as follows:

When lamps are purchased from a manufacturer in large quantities, under the supervision of the bureau, an inspector is sent by the bureau to the lamp factory, and the lamps are there examined for physical defects. A number of sample lamps are selected at random from each barrel, and these lamps are tested in respect to accuracy of rating, their candle-power and watts per candle being measured. From each accepted barrel of lamps, the sample lamp is selected which most nearly represents the average qualities of the group. The test lamps thus selected are sent to the bureau in Jay Street, New York, are carefully photometered and are set up to burn at exactly their proper respective pressures on the life-testing rack. Their performance is carefully noted at the specified constant voltage from day to day, frequent photometer measurements being made to ascertain their behavior as to candle-power at different periods of life. As soon as a lamp falls to 80 per cent. of its normal candle-power, its life test is ended. The blackening of the bulb, the discoloration of the filament, the maintenance of the vacuum and other characteristic phenomena are all recorded, so that the reports of the bureau upon the lamps shipped by the factory are not only much more complete and much more nearly accurate than those which the manufacturer or purchaser could attempt to make himself, but by reason of the system and routine, the cost of testing is much less than that which the purchasers could individually effect.

The experience of the past seven years has shown the great commercial value of these systematic tests to manufacturers and purchasers of lamps. The charge for lamp testing of this character is based upon the nature of the test. A manufacturer or purchaser sending only a few lamps is charged considerably more per lamp

tested than if a large number of lamps is included in the test. Where the tests are made for the joint interest of the manufacturer and purchaser, it has been the custom in the past for the cost of the bureau's test to be divided between them. In all cases a full report is made to the party sending the lamps for test, and the party is allowed access at any time during the progress of the test to the lamps tested, as well as to the records and tests of the bureau upon those lamps; but information on such tests is strictly withheld from all other parties, and no manufacturer can have access to the test of any lamps save his own, without the mutual consent of the parties interested. When a party sends to the bureau lamps purchased in the open market, the lamps are designated by definite numbers, and the party is notified of the results pertaining to the lamps having those numbers, so as to prevent unauthorized statements being made under the apparent authority of the bureau, in regard to the quality of lamps made by the various competing manufacturers.

The facilities of the bureau are now placed at the service of the general public, and it is prepared to receive for test any kind of electrical apparatus. It is believed that the special facilities which are at hand for promptly making reliable and authoritative tests and checks of voltmeters, ammeters, wattmeters and recording meters, will be of especial convenience to the public. This general testing work will not conflict in any way with the work projected by the National Bureau of Standards, in Washington, since that institution will probably require to issue fundamental standards, and standards of reference of a higher grade of accuracy than that ordinarily needed in commercial work. On the contrary, it is expected that the work which the Lamp Testing Bureau intends to perform for the electrical public will aid and supplement the standardizing work of the Government Bureau, at Washington.

The Lamp Testing Bureau will also undertake the commercial testing of motors, dynamos and other electrical machinery of moderate size. If the machinery or apparatus is of such a character that it cannot well be transported to the laboratory for test, the bureau is prepared to send competent experts to the required locality to make the test needed. Such tests of apparatus, subterranean cables and machinery in general can be made promptly on demand.

The sale of incandescent lamps standardized for candle-power, ampere or watt consumption and of standard cells will be made a special feature, and certificates will be issued by the bureau upon all instruments sent to it for testing or calibration.

The president of the company is Mr. J. W. Lieb, Jr., associate general manager of The New York Edison Company. Mr. Wilson S. Howell, who has been identified with many electric lighting companies, is the manager of the company. The bureau testing officer is Dr. Clayton H. Sharp, a graduate of Hamilton College, New York, and of Cornell University. Dr. Sharp has also studied in the University of Leipsic, where he undertook special work in physics. He was for a number of years instructor in physics and applied electricity at Cornell University. With Dr. Sharp is associated a corps of competent assistants.

Dr. A. E. Kennelly, of Harvard University, is associated with the bureau in the capacity of consulting engineer, the company having arranged to avail itself of Dr. Kennelly's services in connection with any special work which the bureau may desire to undertake.

Small Alternating-Current Motors.

In no branch of electrical design have more obstacles been encountered than in that dealing with alternating-current motors, and the greatest difficulties have been with respect to small motors for high-frequency circuits. In the latter case, aside from the matter of starting torque and electrical efficiency *per se*, a low power factor has had to be dealt with. The General Electric Company announces that it has succeeded in developing a line of single-phase motors for a frequency as high as 125 cycles, in which both of the above-mentioned defects have been overcome. That is, they start under full load with only a moderate current and operate at practically 100 per cent. power factor at all loads.

These results are secured by the use of a condenser, which, however, is not employed in shunt to the motor, but energized by a tertiary motor circuit which is induced by the motor armature. In consequence, the motor does not require a sine wave of e. m. f. usually required when using condensers, but operates equally satisfactorily and with practically 100 per cent. power factor on any wave shape of e. m. f., that is, any kind of alternating-current generator. The condenser and its compensator are permanently connected to the motor and involve no additional operation in starting. The motor is started in the same way and with the same ease as any polyphase induction motor.

The construction of these motors is similar in all cases, and in the self-starting motors for single-phase circuits condenser-compensators are used for producing starting torque and eliminating wattless lagging current.

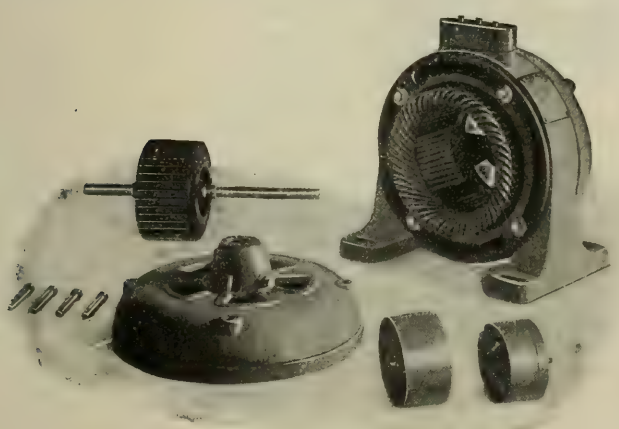


FIG. 1.—½-HP, 125-CYCLE MOTOR.

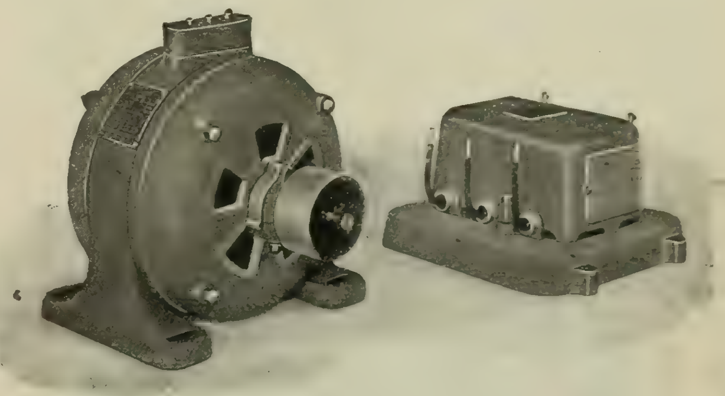


FIG. 2.—2-HP, 125-CYCLE MOTOR WITH CONDENSER COMPENSATOR.

The construction does not differ materially from that of three-phase motors. The field winding is of the three-phase type, but is differently proportioned in the single-phase motor than in the motor for three-phase circuits. The condenser produces a current in the windings across which it is connected, which acts as exciting current of the motor, so that the motor takes only the energy current from the supply circuit, and at practically 100 per cent. power factor, and thereby consumes current only proportional to its load.

Since condensers of given capacity can be made much more compactly for high than for low voltage, motors wound for low voltage are provided with transformers, or compensators which raise the voltage of the current supplied to the condenser. The use of the condenser results in a single-phase motor with all the good characteristics of the standard three-phase motor, and fully as satisfactory, but superior thereto in its power factor, that is, by the absence of lagging currents.

The frame is arranged so as to protect the windings and moving parts. The field winding is composed of form-wound coils inserted in the laminated field. The armature winding consists of bare copper bars in the smaller motors, but in the larger sizes an insulated winding is used. The ¼ and ½-hp motors are provided with centrifugal clutch pulleys, which enable the armatures to reach speed before the load is applied. This clutch consists of a split ring which is expanded by means of a centrifugal weight so as to engage the inner surface of the pulley when the proper speed has been reached. The larger motors are provided with a starting switch and electrical connections, which limit the current at starting, and at the same time

able the motor to develop strong starting torque in the same way as customary with polyphase motors.

The bearings are lubricated automatically, and the reservoir requires only occasional examination to see that the oil is kept at the proper level. The motors may be adapted to wall or ceiling suspension by simply turning the bearings 90 or 180 degrees, in order to keep the oil ports in an upright position. The bearings may be turned without removing the armature. Slots are provided in the feet of the motor, to provide for adjusting the belt.

While the condenser compensators are thoroughly reliable, they should be handled with some care and not placed in a room having an excessively high temperature. The compensator is in principle simply a transformer that raises the voltage of the current taken by the condenser, and thus reduces the required condenser capacity. The compensator is used with motors wound for less than 250 volts.

A Residence Telephone.

One of the most neatly designed and compactly constructed long-distance central energy wall telephones for public exchange use or hotel systems is the residence set recently put on the market by the International Telephone Manufacturing Company, of Chicago. Fig. 1 shows the instrument complete as used for public exchange service. The cabinet-work, or case, is neatly designed and properly proportioned to receive the necessary apparatus, with ample working space between the various parts. The condenser is mounted in the base of the cabinet-work, in which it is readily placed from the back.

The long-distance transmitter is mounted on a small nickel-plated cast-brass base, to which it is hinged with a strong knuckle joint, so it may be moved up and down. The transmitter is held in position by a hard brass binding bolt and nut. A stop is provided inside of the socket joint to prevent turning the transmitter either up or down against the woodwork. The base is mounted against the cover of

FIG. 1.—TELEPHONE COMPLETE.

the case, and is firmly held in position by three heavy binding screws passing through the cover from the rear.

Both sides of the circuit of the International transmitter are taken direct from the front and back electrode by insulated cords passing through the joint and base into the box, and terminate directly on the induction coil, as will be seen in Fig. 2. The induction coil is mounted on the back in the lower end of the case. The cord terminals and wire clips are mounted on a special terminal strip, placed directly on the induction coil. The receiver cord passes into the case from the bottom and is terminated directly at the terminal clips on the coil. The line wires enter the case from the rear and are terminated inside on a pair of clips mounted on the bottom in the case, convenient for making the connections.

The rear of the back-board is provided with a slot so that the wire may be brought from the top or from the bottom of the instrument.

The gongs are mounted on the top of the case upon adjustable bell stands. The bell hammer is provided with a net, nickel-plated guard. The ringers are mounted at the top in the rear of the case and are fastened with heavy machine-binding screws passing through

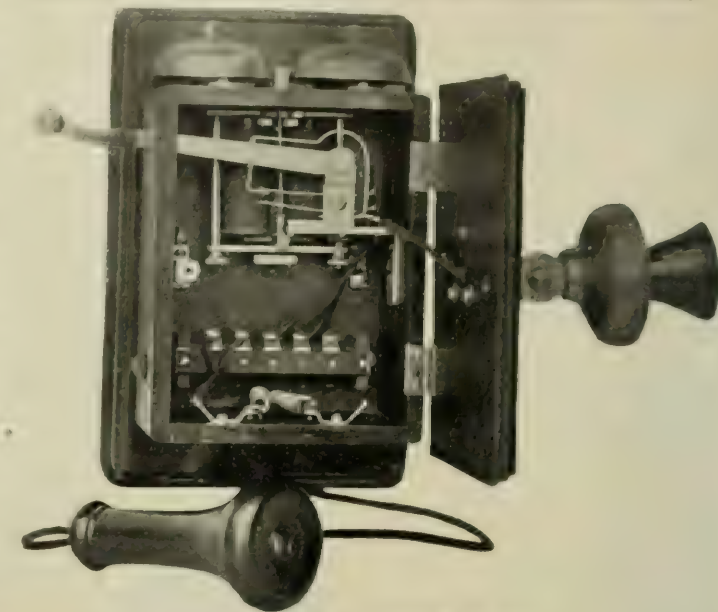


FIG. 2.—VIEW OF INTERIOR OF BOX.

from the top and screwed into the metal of the ringer. The ringer is provided with a convenient thumb-screw adjustment, so that it may be readily adjusted at one of the posts. The bell hammer pin is provided with a thread setting, into which it is screwed, so that it may be lengthened or shortened to correspond with the thickness of its mountings, so that th eringer may be adjusted to strike the gongs at the point that will secure the clearest and loudest tone.

The switch hook is mounted in front of the ringer, upon a firm metal bracket, securely clamped at the side of the case by two heavy binding screws passing through the case from the outside, threading into the metal. The switch hook is a neatly proportioned, heavy brass casting, nickel-plated and highly polished.

The switch base is a firm brass standard, in which is mounted the rubber block binding the contact springs. The spring insulating block is firmly clamped by a brass plate, held in position by a binding screw through the block, and screwing into the metal standard in the rear. The binding plate is insulated from the springs by a sheet of heavy mica.

The switch-restoring spring is a heavy German silver spring, six inches in length, passing through the rear over the switch hook and standard, and mounted in such a manner that there are no scraping or rubbing parts excepting at the contact points, which form a sliding connection. The hook passes through a wide slot in the restoring spring, from which it is insulated by a small rubber bushing at the bottom of the hook, perfectly insulating the hook from any part of the circuit.

The door of the case is provided with a screw lock, securely set into the wood-work. On the side of the case, directly under the switch-hook, is mounted a small rubber bottom, at a proper distance from the hook to prevent the receiver from marring the cabinet or from breaking the shell when hanging up the receiver.

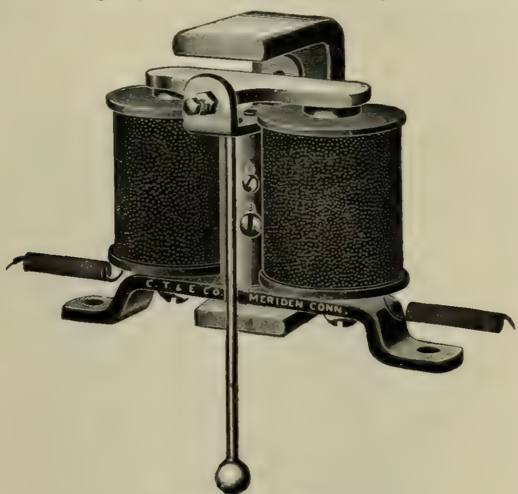
The receiver is of the double-pole, horeshoe-magnet type. The magnet and magnet coils are adjustably set into a substantial metal head, and the diaphragm is clamped to the head by a metal ring, making all working parts self-contained. All metal parts are completely enclosed in a hard rubber shell and cap. The receiver cord is of the ordinary length, and has a green silk braid covering and terminates inside of the shell at clips, which connect direct with the wires from the magnet coils. The workmanship is of the very highest grade in every detail. There being no metal parts exposed that form a part of the circuit at any time. This instrument is especially adapted for residence use.

Machine-Tool Builders.

A convention of the National Machine Tool Builders' Association was held at the Hollenden Hotel, Cleveland, Ohio, recently. The association is a comparatively new organization, having held its first meetings at Niagara Falls and New York City, in June and August of this year. Twenty-seven companies were represented, and about 40 delegates were present. The objects of the association are to facilitate and extend acquaintance among the different manufacturers of machine tools. The following officers were elected: Joseph Flather, Nashua, N. H., president; Wm. Lodge, Cincinnati, and W. P. Davis, Rochester, vice-presidents; P. E. Montanus, Springfield, Ohio, secretary; Enoch Earle, Worcester, Mass., treasurer.

A Ringer for Telephone Work.

An improved form of ringer for telephone work has been put on the market by the Connecticut Telephone and Electric Company, Meriden, Conn., the principal object in view is to lessen the amount of adjusting by simply using a beveled screw. The frame of the ringer is made of soft sheet-iron, bent into form. On the center of this is mounted a barrel or supporting post, into which fits the plunger carrying the armature. There are two screws in the barrel. One is simply a set screw which prevents any possibility of the shifting of the plunger. Another is the adjustment screw, which draws the armature near the pole of the magnet, and is screwed out or unscrewed to throw them away from the poles of the magnet. With this arrangement it is possible to adjust the ringer with a pocket knife or a screwdriver. After being adjusted, there is absolutely no chance for varia-



TELEPHONE RINGER.

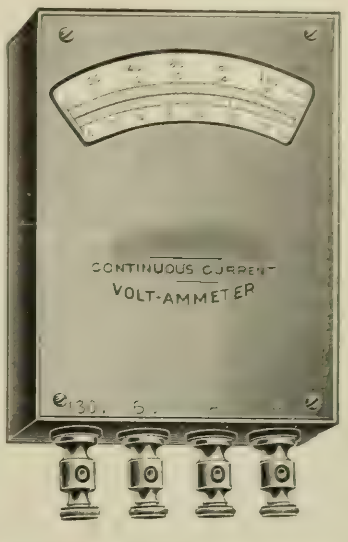
tion, and the change can be accomplished in the fractional part of a minute. The magnet cores on these ringers are made up of the very best grade of imported Norway iron, and the cores are wound with silk-insulated wire. The armatures are made of a high grade of Norway stock, carefully annealed and polished; then the armature is blued and coated with gun barrel lacquer, which prevents any possibility of its rusting, even if wet with salt water. It is made up and carried in stock, wound to 80, 1,000 and 1,600 ohms' resistance, and can be made up for any resistance desired.

Combined Ammeter and Double Voltmeter.

The accompanying cut represents a volt-ammeter which combines three instruments in one, and yet is small enough to be carried in the pocket though large enough for practical use. The instrument is furnished in various ranges and combinations. The particular instrument illustrated contains voltmeters reading from 0 to 6½ volts in tenth-volt scale divisions; from 0 to 130 volts in two-volt divisions, readable in single volts, as half divisions can be easily estimated; and an ammeter reading 0 to 15 amperes.

This combination gives the instrument a wide range of usefulness, and makes it specially adapted where portability and compactness are desirable. It is thus particularly useful to the electric light or telephone inspector or to any one having the care of electric light or battery circuits for testing the circuits and detecting and locating trouble.

The usefulness of this combination is apparent when it is noted that one and the same instrument will measure the pressure of storage and primary batteries either singly or in small groups, as well as higher pressures up to that of an incandescent electric light circuit, besides measuring amperes. It can thus be used for a large number of tests and measurements, such as measuring the current consump-



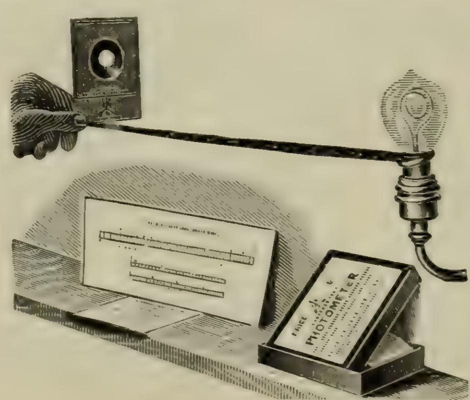
COMBINED AMMETER AND VOLTMETER.

tion and pressure of arc and incandescent lamps, testing dry batteries to ascertain when new ones are of full strength and when to renew old ones. The instrument is made by Louis M. Pignolet, 78 Cortlandt Street, New York.

The instruments are twice the size of the cut, and are for continuous current measurements only. They are made in the same manner as a large one, except the parts are smaller and are of the permanent magnet type, with magnets of special imported steel carefully aged to insure permanency.

Incandescent Lamp Photometer.

The pocket photometer, shown herewith, made by Everett, Edgesumbe & Co., Charterhouse Square, London, consists essentially of a modified form of Leeson disc photometer; this type possesses several marked advantages over the well-known Bunsen grease spot, particularly when lights of a somewhat different color have to be compared, as, for example, in the measurement of high and low efficiency incandescent lamps. Two lamp holders are provided, attached to an adaptor, so that connection can be made to any electric light



PHOTOMETER.

fitting. In order to use the photometer, a divided scale, provided with a ring at each end that can be slipped over the lamp holders, has only to be put in place and stretched tight. Having obtained a point of balance in the ordinary way, the required candle power is readily found without any calculation whatever by means of an ingeniously devised direct-reading logarithmic scale.

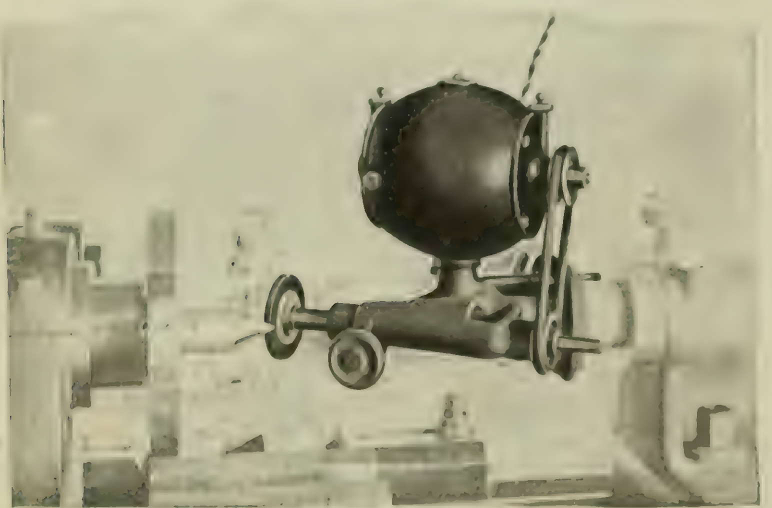
Two great difficulties which have to be surmounted in incandescent lamp photometry are: First, to obtain a handy and reliable

tandard, and, secondly, to regulate the voltage. With the photometer shown, no attempt is made to keep the voltage constant, but specially standardized lamp is employed, forming part of the outfit. It has been repeatedly shown that the relation between the light emitted by an incandescent lamp bears a perfectly definite relation to the pressure at its terminals. As both the standard and the lamp under test are run off the same supply, any increase or decrease of voltage will affect both lamps equally, and the point of balance will remain unaltered. The method has the further advantage that the candle-power so found is, no matter how much the supply voltage may vary, the candle-power which the lamp would give at the standard voltage; which is, of course, what is required. It is clearly best in practice not to use the standard lamp throughout a series of tests, but to standardize another lamp from it, and to use this as a sub-standard.

It is claimed that with this set no specially-arranged dark room is necessary, as any moderately screened position is all that is required; or by hanging a few yards of black cloth over the photometer, a photometric chamber can be readily improvised. When it is impossible for any reason to obtain a fair absence of light, a simple correction factor can be determined once for all, as explained in the directions which accompany the instrument by interchanging the standard and test lamps, and obtaining a second point of balance. This will, however, be seldom found necessary. The direct-reading scale already alluded to can be used to obtain the efficiency of the lamp in watts per candle-power, from the candle-power and measured current. The operation is perfectly dead-beat, so that the readings can be taken with the utmost rapidity. It should be mentioned that the same instrument can be used for direct or alternating current, as required. In this case also, fluctuations of voltage will have but little effect on the result, and unless extreme accuracy is required, no voltmeter need be employed.

Electrically-Driven Center Grinder.

The accompanying illustration shows a new style of electrically-driven center grinder, manufactured by L. S. Heald & Son, Barre, Mass. The particular feature of this machine is the clamping on the tail spindle of the lathe to get the correct angle. The main frame is made with a V-shaped groove in it, and a clamping yoke which will receive any size of spindle up to 2½ or 3 inches in diameter. In this way the correct angle is given to the center without regard to whether the tail stock is set either for turning tapers or not. The grinding spindle runs in a sleeve to protect the bearings from grit and to give added stiffness to the spindle when extended. This sleeve has teeth cut in the under side in which a pinion runs which connects with a small hand wheel, shown in the center of the cut. This is used for feeding the grinding wheel across the work, and makes a very smooth working machine.



ELECTRICALLY-DRIVEN GRINDER

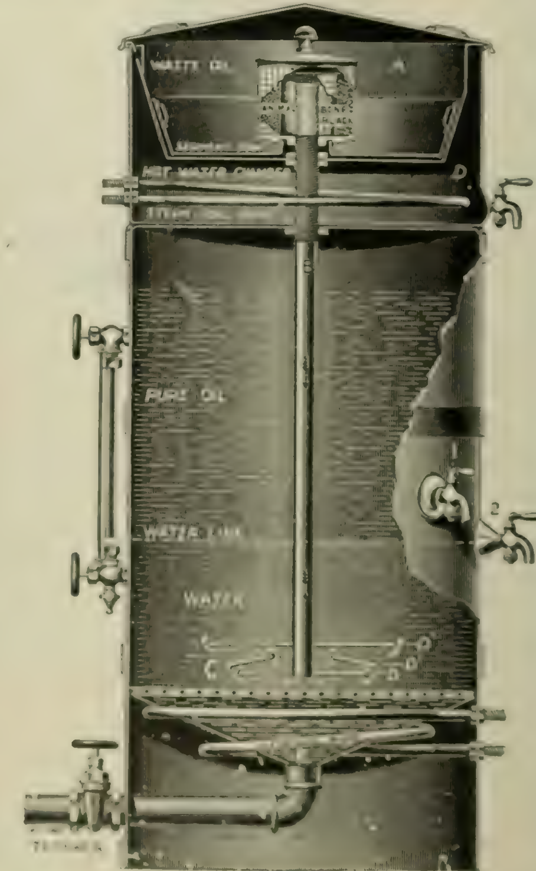
The style of machine shown grinds at a fixed angle of 60 degrees, but machines are also made in larger size which will grind angles varying between 55 degrees to 75 degrees, inclusive. The firm builds these machines in three different styles—hand driven, friction driven by means of a friction roll running on the belt cone of the lathe, and electrically-driven. In the electrically-driven machine the mounting of the motor above the grinding spindle is commended because it gives a chance for end play of the armature shaft and also an opportunity of running the motor at its most efficient speed, as well as the grinding wheel.

The American Oil Filter.

A new oil filter which has just been placed upon the market by the Burt Manufacturing Company, of Akron, Ohio, is shown in the accompanying illustration. It has been especially devised for the filtering of very heavy grades of oil which cannot be successfully cleaned in an ordinary filter because of the liability to clog. It is stated that such oils are readily purified by this filter.

The pan for receiving the waste oil is surrounded by a hot-water chamber, through which passes a steam coil pipe. When this chamber has been filled with warm water, and the lower part of the filter has also been filled with warm water until it flows from faucet 2, the filter is ready for operation, the proper steam connections, of course, having been previously made. The cleansing of the oil is then accomplished as follows:

Through the filtering material in the cylinder the oil makes its way into tube *B* and down upon the filter plate, *D*, where the pressure of the oil above overcomes the resistance offered by the weight of the water, and the oil spreads out in a very thin film, becoming thinner and thinner as it travels from the center to the circumference of the plate. Every particle of the oil is thus exposed to the action of the water. This process is repeated as the oil flows upon plates *D1* and *D2*. The separation of all foreign matter from the oil is thus completely effected and the remaining impurities then settle by force of gravity to the bottom of chamber *I* and are drained off by opening the valve. The pure oil is drawn from faucet 1.



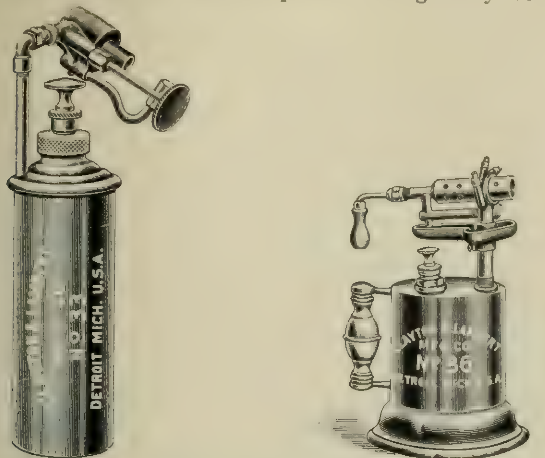
OIL FILTER

Any kind of filtering material may be used, or none at all, and the filtering material may be removed without interrupting the oil service. The method of cleaning the filter is very simple, requiring only that the cylinder at the top be unscrewed, the filtering substance removed and the sediment pan lifted out and emptied of the accumulated material. As the dirt collects at the top in this filter, the operation of cleaning is greatly facilitated.

Torches.

We illustrate herewith two styles of torches manufactured by the Clayton & Lambert Manufacturing Company, Detroit, Mich. The torch shown in Fig. 1 is recommended for work on inside wiring, removing putty from sash, light brazing, etc. It is light in construction, can be carried in the pocket, and is always ready for use. The tank is supplied with a pump so that air pressure can be applied, making a blue blast-flame, which, while small and running to a fine point, is intensely hot. The burner hangs on a swivel, so that the flame can be thrown in any direction.

The torch shown in Fig. 2 is designed for the use of mechanics who desire a powerful burner capable of doing heavy work out of

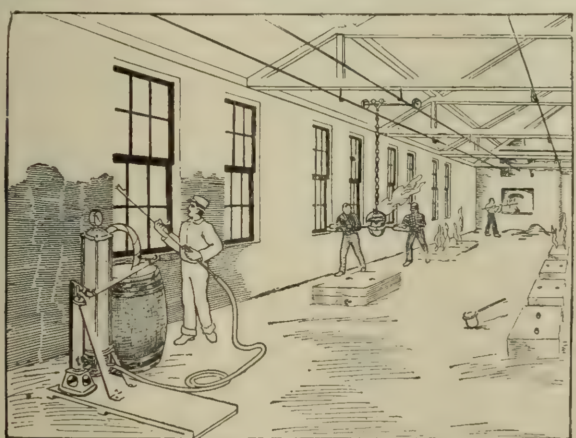


FIGS. 1 AND 2.—TORCHES.

doors in cold or windy weather. The generator has ample power and will produce a clear blue, intensely hot flame. The torch is economical in the use of gasoline and is made extra strong with heavy fittings. The brass air pump screws into the tank, and is submerged in gasoline which aids in keeping it cool.

Painting Machine.

Since more or less painting is necessary in all electrical shops and works, the machine described and illustrated herewith will be of interest. It is designed to cover surfaces of buildings and other structures of any kind with paint or other preservative coating. The principle of operation is the compressing of air and liquid into a receptacle, the compressed air discharging the liquid through a hose and nozzle in the form of a fine misty spray. By means of an air pump, a pressure of 40 lbs. may be obtained in the receptacle in two or three minutes, which is increased by pumping into it the liquid or paint to 150 lbs. The coating is laid evenly, uniformly and neatly,



PAINTING MACHINE.

and by means of an extension rod, overhead construction, high walls and ceilings may be easily painted without the construction of scaffolding. It is stated that the liquid permeates every crevice and joint thoroughly, and that one man can cover from 20,000 to 25,000 square feet of surface per day, against 1,000 square feet, which is the average day's work by the old brush method of painting. This machine is manufactured by F. E. Hook, Hudson, Mich.

Combination Rip and Cross-Cut Saw and Attachments.

The illustrations herewith show a combination self-feed rip and cross-cut saw and moulding and scroll sawing attachments for same. This machine is operated by foot and hand power, or can be run by motor power. They are used extensively by carpenters, cabinet makers, etc., and by their particular construction they are adapted to the requirements of electrical workers for making boxes and finishing the wood work of electrical apparatus, etc.

The saw has a strong and rigid iron frame, cold rolled steel shafts, with hand-scraped babbitt metal-lined boxes, adjustable to take up the wear. The combination wood and iron table top is 28 inches wide by 36 inches long; the middle portion (10 x 36) is of iron, planed perfectly true. The table is hinged at the back and can be adjusted up or down by a hand-screw in front for rabbetting, grooving, dadoing, etc. The self-feed ripping device is self-adjusting for all thicknesses of wood, is positive in its action, power being transmited by gears. The self-feed has three changes of speed. This device is easily detached, leaving the table free for cross-cutting, etc. The extension rolls increase the length of the table to seven feet,

FIG. 1.—MOULDING ATTACHMENT.

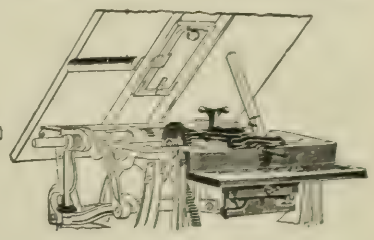


FIG. 2.—BORING ATTACHMENT.

making it valuable for cutting long stuff; they can be instantly folded down out of the way when not in use. It is provided with two hand powers, both arranged to allow the operator a natural, upright and easy position. The hand power (for one or two cranks), at the rear of the machine, leaves an entirely free table for cross-cutting (any length), dadoing, etc. The foot power has a powerful walking motion. Power is transmitted entirely by automatic machine-cut gears and chain belts, doing away with slip or lost motion, and running smoothly. It is claimed that with this machine one man can easily rip soft wood up to 3½ inches thick, and hard wood to 2 inches, doing the work of four men with common hand saws, and that it is equally valuable for cross-cutting, mitering, etc.

The boring attachment can be adjusted to the machine as quickly as changing a saw. It has an adjustable sliding table and stop to gauge the depth of hole. The scroll saw attachment can be quickly placed in position on the machine, making a strong and serviceable scroll saw, with large capacity. It will cut up to three inches thick

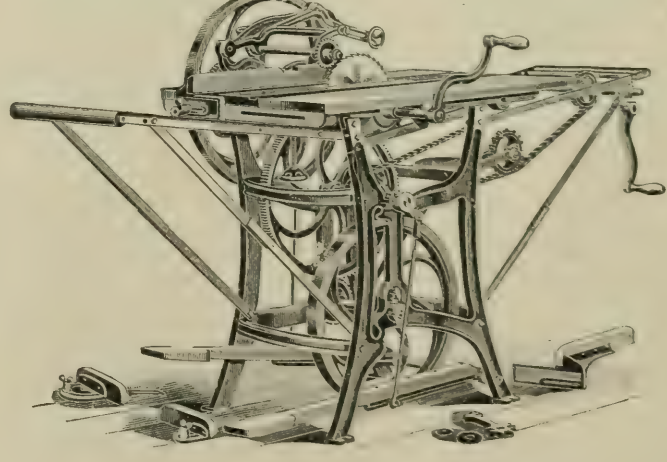


FIG. 3.—COMBINATION SELF-FEED AND CROSS-CUT SAW.

and swing 24 inches. It has adjustable saw clamps, the wooden arms being mounted on pivot rocker plates. The moulding attachment is designed for edge moulding, beading, etc., on either straight, curved or irregular work. The spindle has a vertical adjustment for different thicknesses of work, and is made to rotate in either direction to suit the grain of the wood. The machine with its attachments is made by the Seneca Falls Mfg. Company, Seneca Falls, N. Y.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 6 per cent. for all dates. It was offered with some freedom, but the rates were unattractive to borrowers in many instances. The stock market was dull, and speculative activity decreased greatly in spite of the easing of money as a result of the government bond purchases; the ending of the coal strike also failed to stimulate the market. Little interest was shown in the industrials, although the United States Steel stocks seemed to have a fair amount of support in the early transactions. There was some buying of Amalgamated Copper, said to be for inside interests. All of the traction and electric stocks shared in the general weakness of the market, and trading in them was comparatively small. Brooklyn Rapid Transit closed at 63, a net loss of 1¼ points, and Metropolitan Street Railway 104, a net loss of 1½ points. The lowest and highest quotations of these stocks, respectively, were 62⅜, 64¾ and 138¾, 142¼. General Electric dropped to 185¼, the highest point reached being 189, 187 being the closing quotation, a net loss of 1½ points. Westinghouse, common and preferred, were exceptions, common closing at 220, a net gain of 3 points, and preferred at the same figure, being a net gain of 5 points. Western Union closed at 91¾, which was practically the lowest figure of the week, representing a net loss of ¾ point. Other closing quotations were American District Telegraph 37, a net decline of 3 points, and Commercial Cable 180, a net gain of 5 points. In Boston there was a quieter tone in the market, with an easier tendency. American Telephone and Telegraph closed 3 points down in price, while General Electric closed 3 points higher. Following are the closing quotations at New York on October 28:

NEW YORK.

	Oct. 21.	Oct. 28.		Oct. 21.	Oct. 28.
American Tel. & Cable	92	90	General Electric	187	185
American Tel. & Tel.	164½	163	Hudson River Tel.	—	107
American Dist. Tel.	39⅝	39¼	Metropolitan St. Ry.	139¾	139½
Brooklyn Rapid Transit	63	62½	N. E. Elec. Veh. Trns.	⅜	—
Commercial Cable	—		N. Y. & N. J. Tel.	162	—
Electric Boat	28*	18½	N. Y. E. V. T. Co.	13¼	12
Electric Boat pfd.	45*	37	Tel. & Tel. Co. Am.	—	—
Electric Lead Reduc'n.	3⅝	3⅝	Western Union Tel.	91¼	91
Electric Vehicle	5	4½	Westinghouse Company	210	213
Electric Vehicle pfd.	13	11	Westinghouse Co. pfd.	—	213

BOSTON.

	Oct. 21.	Oct. 28.		Oct. 21.	Oct. 28.
American Tel. & Tel.	165	164½	Western Tel. & Tel. pfd.	100½	99
Cumberland Telephone	—	—	Mexican Telephone	2¼	2⅛
Edison Elec. Illum.	—	270	New Eng. Telephone	139	138¼
General Electric	—	185½	Westinghouse	210	213
Western Tel. & Tel.	—	28½	Westinghouse pfd.	—	213

PHILADELPHIA.

	Oct. 21.	Oct. 28.		Oct. 21.	Oct. 28.
American Railways	—	—	Phila. Traction	98½	97⅞
Elec. Storage Battery	—	85	Phila. Electric	8⅝	8⅝
Elec. Storage Bat'y pfd.	—	—	Pa. Elec. Vehicle	1	—
Elec. Co. of America	9½	9⅝	Pa. Elec. Vehicle pfd.	—	—

CHICAGO.

	Oct. 21.	Oct. 28.		Oct. 21.	Oct. 28.
Central Union Tel.	—	—	National Carbon pfd.	99½	100½
Chicago Edison	—	—	Northwest Elev. com.	—	—
Chicago City Ry.	212	212	Union Traction	17¼	17¾
Chicago Tel. Co.	—	—	Union Traction pfd.	50	47
National Carbon	30	30½*			

* Asked.

AMERICAN UNION ELECTRIC CO. IN RECEIVER'S HANDS.—The American Union Electric Company, of 15 Cortlandt Street, New York, was placed, Tuesday, in the hands of a receiver, at the instance of F. C. Hollins, of the financial house of F. C. Hollins & Co., 11 Wall Street, New York. The company was organized only last summer, with an authorized capital of $7,000,000, for the purpose of acquiring the business of several railway equipment and electrical concerns. It took over the Morris Electric Company, the Union Railway Power and Electrical Company, the Falcon Electric Manufacturing Company, the Electric Motor Specialty Company, the Fountain Manufacturing Company, the Federal Manufacturing and Specialty Company, the Refrigerator Machine Company, and the Metropolitan Switchboard Company, carrying with it the Murphy patents. The company has operated an extensive plant at Ampere, N. J., for the manufacture of rail bonds, trolley wheels, fare registers, trucks and sweepers, headlights, cars trimmings and electrical devices. At the former factory of the Metropolitan Switchboard Company, located in West Twenty-ninth Street, New York, switchboards and special panel-board work were manufactured by the American Company. The management of the company was, until lately, in the hands of Elmer P. Morris, S. Marsh Young, E. P. Ewing and J. Fountain. It is said that the breakdown of this consolidation will give a definite quietus to some other like projects that have been afloat in the atmosphere of Wall Street.

DEAL IN DETROIT LIGHTING.—The North American Company is understood to have purchased control of the Detroit Electric Light Company for $4,000,000, which, however, is to be paid in installments. The first of these is to be turned over this week, and will be $2,400,000, or 60 per cent. The purchase price was subscribed by a syndicate composed of several large banking houses. It is the intention of the North American Company to build a new power house to supply Detroit with light and power. The acquisition of this company is therefore expected to result in great benefits to the North American Company, which controls similar companies in Milwaukee, St. Louis, Cincinnati and other Western cities. These transactions are declared to be mainly responsible for the continued strength of North American stock, which, although it has not paid any dividends, has been selling above 120 for some months. There has been a report on the Street that the company would soon declare a dividend, but this is denied by persons familiar with the property. It is not denied, however, that dividend payments may be begun next year.

DIVIDENDS.—The directors of the Westinghouse Electric and Manufacturing Company have declared a quarterly dividend of 1¾ per cent., payable November 15. The Hudson River Telephone Company has declared the regular quarterly dividend of 1½ per cent., payable November 1. Twin City Rapid Transit directors have declared a quarterly dividend of 1¼ per cent. on the common stock, payable November 15. Chicago Edison directors have declared the regular quarterly dividend of 2 per cent, payable November 1. Books close October 24 and reopen November 1.. It is officially reported that the company is doing a splendid fall business. Allis-Chalmers directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock. The directors of the Nassau Electric Company have declared a dividend of 4 per cent. per annum on the preferred stock, payable November 15 to stock of record November 6. The American District Telegraph Company, of New York, has declared a semi-annual dividend of 1 per cent., payable November 15. Books close November 5 and reopen November 17.

CONSOLIDATION IN ST. LOUIS.—A deed of trust for $10,000,000 was filed in the recorder's office at St. Louis recently by the Union Electric Light and Power Company. This is a step in the consolidation of the Imperial, the Citizens' and the City Lighting Companies, details of which have already been given. The mortgage secures the $10,000,000 issue of bonds that is to be made to take care of the underlying bonds of the three component companies, and also give the new corporation a working capital to enable it to extend its facilities and widen the field of its service and operation. The new bonds will run for 35 years, and will be handled by the Mississippi Valley Trust Company's bonds department.

CONSOLIDATION OF LIGHTING INTERESTS.—It is stated that negotiations are under way to consolidate a large number of gas and electric lighting companies now operating as independent concerns and at present controlled by a group of prominent Western capitalists and Frank Tilford and Henry R. Wilson and their associates in the East. It is probable that an operating company will be formed to acquire ownership of these plants. The most important properties affected by this contemplated consolidation are the New York and Queens Electric Light and Power Company, the Newtown and Flushing Gas Company, and the Williamsport (Pa.) Gas Company.

MACON, GA., CONSOLIDATION.—The merger of the Macon Light and Railway Company and the Macon Consolidated Street Railway Company has been consummated. The officers are: T. J. Garling, Macon, president; W. W. Mackall, Savannah, vice-president; J. H. Hentze, Macon, secretary; E. L. Douglass, Savannah, treasurer. The merger involves a capitalization of $1,000,000, of which $70,000 stock has been issued, the rest remaining in the treasury. The board authorized an expenditure of $164,000 for new equipment.

THOMSON EUROPEAN WELDING.—The affairs of the Thomson European Electric Welding Company are now being wound up pursuant to a decree of dissolution issued by the supreme court of the State of Maine. There will be a final dividend, payable to stockholders from the assets of the company. A dividend of 2 per cent. from the assets of the company has already been declared.

A SOUTHERN TELEPHONE DEAL.—The People's Independent Telephone Company, of Paducah, Ky., has bought the Alexander system, comprising 150 miles and 1,200 subscribers in adjoining counties, for $50,000.

Commercial Intelligence.

THE WEEK IN TRADE.—The reports received by the mercantile agencies indicate that favorable features dominate the trade and industrial situations. Some reduction in the demand for Fall and winter goods is noted, but business on next spring's account tends rather to expand, and a similar tendency is noted in retail business, particularly at the East, where the fear of a coal famine has been removed by the actual resumption of work. In agricultural lines, favorable features are found, and at the South good weather prevails, which is favorable to the cotton crop. The railway earnings continue to show gains over last year's exceptional returns. A deficiency of motive power, no less than a shortage of car capacity, is noted at many widely separated centers, particularly in Pennsylvania and the Central West and in the Pacific Northwest. This condition, however, is largely a reflection of excessive prosperity rather than of any depressing element. Manufacturers of machinery expect to run double time to keep up with the business offered. In the iron trade, the heavier forms of finished material remain very strong. Structural iron and steel plate for ship building purposes hold strong. A cut in the price of wire and nails has already had the effect of encouraging consumption. The demand for building materials continues active, and in the lumber regions strength is the main feature. In the metal market, copper recovered in price through the announcement of the settlement of the coal strike, and between 15,000,000 and 20,000,000 pounds were sold for delivery during the next three months, at prices ranging from 11.60 cents to 11.80 cents. In the meantime, prices reached 12 cents for all grades. The closing quotations are: Lake, 12 cents nominally; electrolytic, 11.62½ cents to 11.87½ cents; casting stock 11.62½ to 11.82½ cents. The number of business failures for the week ending October 23, as reported by *Bradstreet's*, aggregated 194, as against 203 the previous week, and 223 the corresponding week last year.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended October 4: Antwerp—30 pkgs. material, $2,215. Argentine Republic—15 pkgs. material, $887; 85 pkgs. machinery, $4,441. Brazil—76 pkgs. material, $9,216; 87 pkgs. machinery, $3,400. Berlin—1 pkg. machinery, $35. Bremen—4 pkgs. material, $150. Birkenhead—35 pkgs. machinery, $14,276. Budapest—3 pkgs. material, $95. British West Indies—30 pkgs. material, $680. British East Indies—16 pkgs. material, $888; 8 pkgs. machinery, $1,225. Copenhagen—1 pkg. machinery, $30. Chili—3 pkgs. material, $500. Cuba—3 pkgs. machinery, $1,000; 48 pkgs. material, $1,404. Central America—12 pkgs. material, $297; 1 pkg. machinery, $50. Glasgow—15 pkgs. material, $867. Havre—15 pkgs. material, $217; 7 pkgs. machinery, $435. Hamburg—1 pkg. machinery, $60; 37 pkgs. material, $2,020. Ipswich—5 pkgs. material, $2,737. Kiel—6 pkgs. material, $244. Liverpool—236 pkgs. machinery, $20,258; 66 pkgs. material, $2,938. London—19 pkgs. machinery, $973; 58 pkgs. material, $3,033. Mexico—121 pkgs. material, $4,470; 6 pkgs. machinery, $487. Manchester—1 pkg. material, $158. Newcastle—2 pkgs. machinery, $200. Nova Scotia—48 pkgs. material, $1,946. Portsmouth—6 pkgs. material, $510. Rotterdam—2 pkgs. material, $100. Riga—5 pkgs. material, $100. Southampton—58 pkgs. material, $1,061. U. S. Colombia—7 pkgs. material, $295. Venezuela—56 pkgs. material, $5,122. The following are the exports of electrical materials from the port of New York for the week ending October 18. Antwerp—13 pkgs. machinery, $925. British East Indies—15 pkgs. material, $2,529; 17 pkgs. machinery, $1,444. British West Indies—18 pkgs. material, $295. Barcelona—37 pkgs. material, $1,000. British Australia—41 pkgs. material, $1,998. Cuba—266 pkgs. material, $950. Chili—1 pkg. material, $90. China—3 pkgs. material, $85. Equador—1 pkg. material, $33. Glasgow—4 pkgs. material, $138. Genoa—2 pkgs. material, $37. Hamburg—18 pkgs. material, $462; 7 pkgs. machinery, $476. Havre—1 pkg. machinery, $100. Ipswich—4 pkgs. machinery, $150. Japan—135 pkgs. material, $12,736. Liverpool—188 pkgs. machinery, $12,207; 6 pkgs. material, $200. London—1 pkg. machinery, $1,165. Liberia—1 pkg. machinery, $55. Madrid—1 pkg. material, $783. Manchester—200 pkgs. machinery, $21,136. Milan—2 pkgs. material, $222. Naples—4 pkgs. material, $100. Nova Scotia—18 pkgs. material, $2,236. Philippine Islands—212 pkgs. material, $34,394. Siam—64 pkgs. material, $3,864. Southampton—30 pkgs. material, $619. Venezuela—6 pkgs. material, $254; 1 pkg. machinery, $50.

SOME HEINE CONTRACTS.—The Heine Safety Boiler Company, of St. Louis, Mo., local offices 11 Broadway, is about to make shipment of two 300-hp units for the plant of the Great Boulder Gold Mining Company, of Great Boulder, West Australia, which is to be electrically equipped. The Auburn Interurban Railroad Company has placed a contract with the Heine people for five 300-hp boilers for its new plant. The generators will be of Westinghouse build, three 350-kw machines having been ordered. The engines, three of 500-hp each, will be of Corliss type. They will be turned out by the Westinghouse Machine Company. The Philadelphia and Lehigh Valley Traction Company's new plant, at Allentown, Pa., is to be installed with 2,464 hp of Heine boilers in 414-hp units. The Colonial Construction Company, of Syracuse, N. Y., has let contracts for the equipment of a 2,000-hp cement plant, to be erected by the Hudson Cement Company at Hudson, N. Y. All the machinery is to be operated by electricity. There are to be four 500-hp Heine boilers. The engines will be of Murray type. Keystone generators are to be installed. The Danbury and Bethel Gas and Electric Company, of Danbury, Conn., has requisitioned for a 500-hp Heine boiler. Herbert A. Wagner is consulting engineer for the Danbury company. The Keystone Improvement Company has placed a contract for four 275-hp Heine boilers, to be installed in an extension of the Lehigh Traction Company's plant, at Hazelton, Pa. Brown, Fitchburg, Mass., engines will be also installed. L. B. Stillwell is acting as consulting expert in the matter. An extension of the Edgewater, N. J., plant of the New Jersey and Hudson River Railway and Ferry Company, will mean the installation of two 500-hp Heine boilers. Ford, Bacon & Davis are the engineers. The Virginia Railroad Company has requisitioned for a 300-hp boiler unit, to be installed in the Atlantic City plant of the West Jersey and Seashore Railroad Company, and 1,000 hp of Heine boilers in three units are to be furnished the Taunton Municipal Electric Light Company, of Taunton, Mass.

ELECTRICAL EQUIPMENT FOR BIG WESTERN PLANT.—The Standard Motive Power Company, Consolidated Exchange Building, New York, are to build a $1,000,000 plant at Canal Dover, Ohio. The initial capacity of the plant will be 1,000 hp, which will be eventually increased to 3,000 hp. Four 150-kw turbines are to be furnished by the De Laval Steam Turbine Company. The boilers—4 units of 250-hp each— will be built by the Stirling Company, of Chicago. The machine-shop equipment will consist of over 200 tools, which, it is estimated, will represent an expenditure of over a quarter of a million dollars. Mr. George L. Fowler has drawn up the specifications for the company.

TO PURCHASE EQUIPMENT FOR TOKIO PLANT.—The plant of the Tokio Electric Light and Power Company is to be extended, principally for the purpose of furnishing energy to operate the electric traction system, to be constructed by the Tokio Street Railway Company, to which some reference has already been made. The present equipment has a capacity of 4,000 hp. It is to be increased by 1,200 hp. Mr. Y. Nogami, chief engineer of the first-named company, is expected to arrive in New York next week.

ROCHESTER AND BUFFALO POWER HOUSE EQUIPMENT.—The principal contracts for the equipment to be installed in the Canandaigua power station of the Rochester and Buffalo Street Railway Company have been decided upon. Thayer & Company, incorporated, of 39-41 Cortlandt Street, New York, have secured a contract for 2,000 hp of Cahall boilers. The engines will be of Williams type. The generators are to be of Westinghouse manufacture.

THE OTIS ELEVATOR COMPANY has recently received the contract for the elevator and dumb-waiter equipment of the new Astor Hotel, Long Acre Square, Forty-fourth to Forty-fifth Streets, New York. The plant consists of seven electric passenger elevators, two electric servants' elevators, eleven electric dumb-waiters, and three electric sidewalk lifts. Messrs Clinton & Russel are the architects, and John Downey the general contractor.

SANTO DOMINGO ELECTRIC ROAD.—An electric railway is to be constructed from a point on the line of the Pacific Railway to Alajuela and Heredia, terminating in the Province of Santo Domingo. Mr. Emilio Joubert, a special purchasing agent of the Santo Domingo Government, is now in the United States with a view to placing contracts. He may be found at the Export Club of America, 82-88 Wall Street, New York.

POWER HOUSE EQUIPMENT FOR JAPAN.—The plant of the Kioto Electric Traction Company, of Kioto, Japan, is to be equipped with two 500-hp boilers, manufactured by the Heine Safety Boiler Company, of St. Louis, Mo., whose New York offices are under the management of Mr. Paul H. Brangs. The engines will be furnished by McIntosh, Seymour & Company. The generators are to be of General Electric build.

CONTRACTS PENDING FOR PORTUGUESE ELECTRIC ROAD.—The Anglo-African house of Wernher, Beit & Company, which concern financed the City of Mexico and the City of Lisbon electric traction systems, both built with American equipment, will shortly let contracts for the construction of additional lines in the Portuguese capital. The London offices of the firm are in Bishopsgate Street, London, E. C.

MONTEREY ELECTRIC TRACTION.—Some further importtant details are to hand regarding the projected electric traction system to be constructed in the city of Monterey, Mexico, to which some reference was made in our issue of October 18. Since that date Sperry, Jones & Company, of Baltimore, Md., which concern is financing the enterprise, has purchased the Ferrocarriles de Monterey y Topo-Chico, a horse road 15 miles long, known as the Slayden system, of which Mr. S. W. Slayden, of 50 Broadway, is the president. The new electric lines will be about 30 miles in length. The enterprise will entail an expenditure of about $1,500,000. Everything in the way of power-house equipment, cars, trucks, motors, etc., will be purchased in the United States. First and second class passengers will be carried. The large double-truck cars will be divided by a partition. One compartment will be for the accommodation of passengers paying first class fares, and the other for second. Freight will be carried on specially constructed flat trucks. Sixty and 70-pound rails are to be used. The capacity of the power house will be 1,500 hp. Mr. R. B. Sperry, the senior member of Sperry, Jones & Company, accompanied by Mr. A. W. McLimont, the general manager of the new undertaking, will return to the United States this week, and will immediately place contracts for equipment, etc. It was reported this week that the General Electric Company, the Westinghouse interests, and the Stanley Electric Manufacturing Company were after the contract. It is expected that 20 miles of the road will be in operation within 12 months.

THE WHITE MOUNTAIN PAPER COMPANY has placed contracts for a substantial part of initial capacity of its new plant Practically everything will be operated by electricity. In the first instance the capacity will be about 12,000 hp, to be considerably added to in the near future, it being expected that some $7,000,000 will be expended before the plant is finally completed. The electrical apparatus will be furnished by the Westinghouse Electric and Manufacturing Company. There are to be three 1,000-kw, 440-volt, 94 r. p. m. revolving-field engine-type alternators; one 300-kw, 440-volt, 100 r. p. m. revolving-field engine-type alternator, complete with exciters, and 5,500 hp in induction motors, varying from 5 hp to 400 hp each. Ten motors of 300-hp each will be direct connected to a constant speed line of paper machines. The engines will be built by the Hooven, Owens & Rentschler Company. There will be three 1,500-hp cross-compound engines for driving the Westinghouse generators. One 450-hp cross-compound engine is for lighting purposes. Two 1,200-hp engines and one 750-hp capacity will be direct connected to shafting for power transmission throughout the plant. Ten single-cylinder engines, representing an aggregate of 3,350 hp, are to be used for operating the paper machines. These engines will be capable of showing a wide range of speed, and will be built so as to permit of the change of speed in the paper machinery being controlled from them. The boilers to be installed in the plant will be of Babcock & Wilcox build.

EQUIPMENT FOR ANOTHER JAPANESE ROAD.—Contracts are now being placed for equipment in connection with the conversion to electric motive power of part of the steam railroad between Iidamachi and Hachioji, suburbs of Tokio, Japan. In the first instance, 4½ miles of road will be changed to electric traction. The contract for the boilers has been taken by the Stirling Company, of Chicago, Ill. There will be three units of 250-hp each. This contract was secured through the Japanese house of Okura & Company, which concern has a New York office located in the Bowling Green Building. The generators and engines will be supplied by the Siemens & Halske Company, of Berlin. The contract for the car trucks and motor equipments are understood in local Japanese trade circles not to have been placed yet. The initial equipment of the road will be 50 cars. The American electrical engineering and contracting firm of Bagnall & Hilles, of Yokohama, is reported to have received a contract for various material for the new road and the Japanese house of Mitsin & Company, 445 Broome Street, New York, has also been allotted a contract. The new system will be known as the Okubo Electric Railway.

EQUIPMENT CONTRACTS FOR MEXICAN POWER PLANT.—The Guanajuato Power and Electric Company, in which Chas. A. Coffin, president of the General Electric Company; John Hays Hammond, the mining expert, and other men prominent in electrical and mining circles are interested, has just let some contracts for the equipment of the power plant to be built on the River Duero, near the city of Zamora, in the State of Guanajuato, Mexico, to furnish power 110 miles to Guanajuato. The initial capacity of the plant will be about 5,000 hp. The General Electric Company has secured a contract for two generators of 1,500 kw each. The Pelton Water Wheel Company has been awarded a contract for two 2,300-hp wheels. The contract for the pipe line, which calls for 3,300 feet of 57-inch, 63-inch and 69-inch steel rivetted pipe, has been allotted to Jos. T. Ryerson & Son, incorporated, of Chicago, Ill. The capacity of the plant will be considerably increased in the near future.

"AXLE LIGHT" IN EUROPE AND JAPAN.—The Consolidated Railway Electric Lighting and Equipment Company, 100 Broadway, New York, have advices from the British firm of Vickers Son & Maxim, that some important contracts have lately been taken for the installation of the "Axle Light" system of electric lighting on British railroads, and also on the trains of some of the principal continental European roads. The equipments are being manufactured at a special plant, located in Birmingham, by the Vickers people. A contract has been secured through the Japanese house of Mitsin & Company, of 445-447 Broome Street, New York, for several equipments for the Kuishuit railway, Japan. Among recent domestic contracts received is one from the Southern Pacific Railroad Company, for the new trains which are to run from Chicago to San Francisco, via El Paso. The cars on these trains will also be equipped with several fans, to be operated by the "axle light" system.

MEXICAN POWER TRANSMISSION PLANT.—Plans have been perfected by Harold J. Rossi, of the city of Mexico, Mex., for the construction and operation of a large electric power transmission plant, to be located on the hacienda of his uncle, Archbishop Gillow, situated near the town of San Martin, Texmelucan, State of Puebla, Mexico. It is proposed to utilize the power derived from a large waterfall to generate 500-hp of electrical energy, which will be transmitted ten miles to the town above mentioned, where more than 450 hp has already been contracted for by cotton mills and other manufacturing concerns. Later on a greater amount of power will be generated for transmission to Tlaxcala and the haciendas between San Martin and Puebla. Mr. Rossi will be in personal charge of this plant and enterprise.

OIL FILTER ORDERS.—The Atlas Portland Cement Company, of Northampton, Pa., has recently placed an order with the Burt Manufacturing Company, of Akron, Ohio, making 16 of these filters in use in its different plants. Other recent orders reported from the Burt Company were from the following concerns: The Allis-Chalmers Company, Swift & Company, American Sheet Steel Company, West Virginia Pulp and Paper Company, American Locomotive Company, Savannah Electric Company, and Armour & Company.

BALL ENGINE ORDERS.—The National Tube Works have recently placed in operation at their Middletown, Pa., plant two 450-hp engines, direct connected to Westinghouse generators. The Ball Engine Company, Erie, Pa., furnished the engines. The Pennsylvania Railroad Company, West Jersey and Seashore Line, Atlantic City, N. J., has recently installed an outfit consisting of two 150-hp cross-compound engines, built by the Ball Engine Company, direct connected to Westinghouse alternators. The generators run in parallel, and the engines are equipped with synchronizing devices.

THE YORK STREET RAILWAY COMPANY, York, Pa., has decided to expend about $25,000 in needed improvements on its lines. All of the principal streets which the line traverses will be double tracked. The rails and turn outs are made at Steelton and are of the latest and heaviest pattern, 55 feet in length, and weigh about 1,500 pounds each. The turn-outs and crossings are proportionately as heavy. The trackage is being laid under the superintendency of traction track foreman, Klinedinst. It is being laid upon a concrete base of quite a depth. This part of the work is in charge of the Vulcanite Paving Company, of Philadelphia.

MONTAUK FIRE DETECTING WIRE ORDERS.—The Montauk Fire Detecting Wire Company, 100 Broadway, has recently secured a contract through E. H. Kirkby, of 147 Elizabeth Street, Melbourne, Australia, for the installation of its system in Her Majesty's Theatre there. Among domestic orders lately secured is one calling for several thousand feet of wire for the Ashland House, Fourth Avenue and Twenty-fourth Street, New York. The Jenney Construction Company, of 563 Fifth Avenue, New York, is sending in several orders for wire, to be installed in private residences.

DETROIT AND THE SOO.—Mr. Francis H. Clergue, of the Canadian Soo, while in Detroit recently is said to have announced that plans had already been perfected for supplying Detroit with electricity direct from the big power plant he has just completed at the Falls of Sault Ste. Marie. The plan is to convey the current by means of cables carried on towers, 60 feet high. It is proposed to furnish Detroit with 20,000 hp at first, increasing the amount later to 200,000 hp. Transforming stations along the route will supply smaller cities.

ENGINES FOR HOKKAIDO, JAPAN.—McIntosh, Seymour & Company, of Auburn, N. Y., and the Havemeyer Building, New York City, has just made shipment of two 400-hp horizontal cross-compound engines to Japan, for installation in the plant of the Hokkaido Colliery and Railway Company. The contract was secured through H. Becker & Company, whose offices are in the Curtis Building, 35 South William Street, New York. The generators will be made by Siemens & Halske, Berlin, Germany.

NEW LUNKENHEIMER FACTORY.—At Cincinnati last week the fine new factory of the Lunkenheimer Company was opened with great eclat, and in the presence of large crowds of merchants, city officials, employees, etc. ELECTRICAL WORLD AND ENGINEER was represented by J. M. Wakeman and Western Manager J. V. S. Church. The company itself, represented by Mr. and Mrs. Carl Lunkenheimer, treasurer; Mr. Edmund R. Lunken, president; Mr. Samuel L. Moyer, engineer, and Mr. D. T. Williams, vice-president provided refreshments, music and an excellent vaudeville. The conspicuous event of the evening was the presentation to the firm by the employees of a very handsome American flag, which was gracefully acknowledged by Mr. Lunken. The factory contains 150,000 square feet, and will give ample room to no fewer than 700 hands. It is of the latest steel construction. The general distribution of power throughout the building is quite modern; the source of energy is a 300-hp engine, which drives a 240-kw, three-phase, 220-volt, General Electric, alternating-current dynamo. The current is led out from a switchboard to the different parts of the building, where suitable motors are provided to drive the various lines of shafting. These motors are of the induction type. The power from the motors to the shafts is transmitted through what is known as the Renold silent-chain gear, which permits of a very compact arangement of motors, shafts, countershafts; runs without any noise whatever, is positively frictionless, and it also dispenses with the use of leather belts. The whole power transmission scheme in this building is the most modern of any manufacturing concern in the West. In the engine room, besides the engine driving the dynamo, there is also a large cross-compound, two-stage Laidlaw-Dunn-Gordon air compressor, which supplies compressed air throughout the shops and foundries, where it is used for driving different pneumatic tools and other similar appliances. The engine room, when finished, will be one of the handsomest in the country; the floor will be mosaic tiling, and all the fittings about the room will be of the latest type. Bell telephones connect all departments to a central exchange, which connects with the city lines, thus affording immediate communication from any point in the factory. The illumination is furnished by what is known as the Nernst lamp, made by the Nernst Lamp Company, of Pittsburg. Owing to the arrangement of the lamp, the distribution of the light is absolutely even and without shadows. The lamps are so disposed that sufficient illumination is secured without providing each operator with an individual light. In order to avoid any misunderstanding as to the nature of the products manufactured, we would state that the line of goods made in these shops consists of valves of all kinds for engines, boilers—in fact, all kinds of gas, steam, air, water, etc.; whistles, gauges, injectors, lubricators, oiling devices, oil and grease cups and engine, and boiler appliances generally. The business was founded in 1862 by the late Frederick Lunkenheimer, and, from a very small beginning, has grown to the large proportions shown by the present establishment. The company's products are sold at branch stores throughout the world, and are looked upon by engineers as possessing the very highest quality. The company is now erecting another large building, which will be occupied by the general offices and engineering force, and this will be ready for occupancy about the first of the year.

THE RHODE ISLAND AND SUBURBAN RAILWAY COMPANY is making extensive additions to its power station on Eddy Street, Providence, R. I. The plant now building was originally designed for a rated capacity of 7,500 hp, but recently the company decided to augment its power equipment and contracted with Westinghouse, Church, Kerr & Co. for a new Westinghouse vertical cross-compound Corliss engine, designed for a maximum capacity of 6,600 hp. The cylinder dimensions of the engine are 42 and 86 inches diameter, with a stroke of 60 inches. The engine will be approximately 35 feet in height, and will be direct connected to a 2,500-kw Westinghouse, 600-volt, direct-current railway generator, mounted between the main bearings together with a flywheel 24 feet in diameter, and weighing 125 tons. In encouragement of the proposed legislation upon smoke prevention, the Rhode Island and Suburban Railway Company also contracted with Westinghouse, Church, Kerr & Co. for a complete equipment of mechanical draft and Roney mechanical stokers for the 5,400-hp boilers which the new station will contain. Provision for the greatly increased boiler capacity will be made by the addition of a second story to the boiler house for the accommodation of the upper deck batteries.

THE STUART-HOWLAND COMPANY announces in a circular letter to the trade that owing to the rapid growth of its business it has been compelled for the third time in 18 months to materially increase its quarters in Boston. The latest addition includes the entire premises until recently occupied by Pettingell-Andrews Company. This will give it about 30,000 square feet of floor space, with a frontage on Denvonshire Street and Winthrop Square of about 240 feet, and when remodeled according to its plans will make a store and offices the equal if not the superior of any electrical supply store in the United States. It had much outgrown its quarters, and the added space was badly needed. Its stock is one of the largest, carefully assorted, and includes practically everything electrical. The location is in the heart of the busiest business section of Boston, within three minutes' walk of the South Terminal Station, and convenient to the car lines from the North Station, as well as from all suburban points. The Stuart-Howland Company started in business less than three years ago, and its growth, which has been phenomenal, proves what can be done by a thoroughly up-to-date business policy. Its business is now one of the largest of the kind in the country.

USE OF ELECTRIC VEHICLES BY ELECTRIC LIGHT COMPANY.—Two years ago the rapidly increasing business of the Hartford Electric Light Company was drawing so heavily upon the energies of the executive department that the appointment of an assistant to the general manager was thought necessary. While looking about for the right man, President Dunham conceived the idea that use of an automobile might help matters, and, as an experiment, he purchased one of the Electric Vehicle Company's runabouts. It was found that the machine greatly increased the scope of personal inspection of the company's work going on in different parts of the city, and the appointment of the assistant was indefinitely postponed. President Dunham says that the vehicle, which is still in commission, paid for itself in eight months. More recently the company has purchased an additional runabout for the foreman of line construction, an electric delivery wagon and a large electric emergency wagon for general utility and "trouble business." Mr. Dunham states that these vehicles have proved very profitable and have saved the company approximately a third of its labor.

WESTINGHOUSE, CHURCH, KERR & CO. report extensive sales of Roney mechanical stokers for the past month. Among the orders are the following: Carnegie Steel Company, Homestead works—12 duplex stokers, to replace another make; fifth order follows a large order given one year ago; total 15,000 hp. Lackawanna Steel Company, Buffalo—16 duplex stokers; fourth order—14,000 hp. Juniata Steel and Iron Company, Greencastle, Ind.—10 duplex stokers. Continental Tobacco Company, St. Louis, Mo.—4 duplex and one quadruplex stokers. Atlanta Rolling Mill and Tin Plate Company, Atlanta, Ind.—8 duplex stokers. Woodward & Lothrop, Washington, D. C.—6 duplex stokers. Merchants' Heating and Light Company, Indianapolis, Ind.—5 duplex stokers. Duplex and quadruplex stokers are also to be installed in J. L. Mott Iron Works, Trenton, N. J.; American Locomotive Works, Schenectady, N. Y., fourth order; Pennsylvania Railroad, Altoona, Pa., tenth order; United States Lighting and Power Company, Washington, D. C.; National Tube Company, Pittsburg, Pa., sixth order; Pressed Steel Car Company, Pittsburg, Pa., sixth order.

TROLLEY FOR MONTEREY, MEXICO.—Extensive trolley lines, with first and second class fares, is the project planned for the City of Monterey, Mexico, by Baltimore capital, represented by Sperry, Jones & Co., bankers, of Baltimore, Md. The city is a live, industrial town, with 80,000 inhabitants. This will be the first application of electricity to street-car service in Monterey. There is now a mule-car line, which this syndicate has purchased, together with concession, granted to local capitalists. There will be six different lines, aggregating 30 miles, and so constructed as to meet at the center of the city.

M. B. FOSTER ELECTRIC COMPANY has opened offices in the Fuller Building, at Broadway and Twenty-third Street, New York City. It proposes to do a general electrical contracting business, inclusive of wiring and the installation of plants. The company numbers Messrs. Freund and Cordnan, who have been engaged in the business for the past 15 years. Mr. M. B. Foster is a graduate of the Massachusetts Institute of Technology, and has been in the contracting business for a year and a half. Mr. A. C. Foster, another partner, was previously a hotel manager.

ILLINOIS ELECTRIC VEHICLE TRANSPORTATION COMPANY.—The Illinois Electric Vehicle Transportation Company is inviting bids until November 8, on 77 electric vehicles of various styles manufactured by the Electric Vehicle Company, of Hartford, Conn., all of which are equipped with chloride storage batteries. The operating equipment is also to be sold. Messrs. Samuel Insull, E. B. Russel and James E. Hays are trustees for the dissolution of the Illinois Electric Vehicle Transportation Company, Chicago.

VICTOR TURBINES FOR FOREIGN COUNTRIES.—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, have, through their New York offices, received a contract from the Strong & Trowbridge Company, an Australasian concern, 22-24 State Street, New York, for several 30-inch Victor turbines, to be shipped to Auckland, New Zealand. An order for five carloads of turbines has also been received from the English house of Rose & Knowles, Santos, Brazil.

General News.

THE TELEPHONE.

LITTLE ROCK, ARK.—The Cabot and Lonoke Telephone Company has filed its articles of incorporation with the Secretary of State. The capital stock is $1,500. It is proposed to erect and operate a telephone line from Lonoke to Little Rock via Cabot. George Rule, Jr., is president and treasurer; R. G. Stovall, vice-president; W. A. Thompson, secretary.

DENVER, COL.—The Local Telephone Company has been incorporated in this city by S. L. Clough, W. H. Hake, C. M. Brady and others. The company proposes to operate lines in Denver and throughout the State of Colorado.

DENVER, COL.—City Attorney Sheafer, of Denver, has prepared an adverse report on the proposition of the Colorado Telephone Company to furnish the city with 18 telephones without charge, increasing the number as the population increases provided the city signs a contract not to use any other telephones or to enter into contractal relations for the use of other telephones with any other company.

FOWLER, ILL.—The Fowler Central Telephone Company has been incorporated by C. C. Haxel, L. E. Schriver, and H. Schroeder. The capital stock is $2,500.

STEWARDSON, ILL.—The Stewardson Telephone Company has been incorporated with a capital of $2,500. Incorporators: T. P. Mantz, D. M. Duddleston and William Frede.

MT. AUBURN, ILL.—The Mt. Auburn telephone exchange has been sold to Walter McKaig. The switchboard at Blue Mound was included in the purchase and will be removed to Mt. Auburn, while a larger one will be secured for Blue Mound.

JACKSONVILLE, ILL.—Representatives of twenty-three telephone companies, covering the independent field in Western Illinois, met here recently and arranged for the organization of an Illinois Telephone Traffic Association, to handle the interchange of telephone traffic and promote the interest of the independent companies.

NASHVILLE, ILL.—The Southern Union Telephone Company has completed the construction of its line in the west end of this county and its system is now complete. The district embraces the towns of Venedy, Venedy Station, Lively Grove, Stone Church, Oakdale and Coulterville. This part of the county has long been in want of means for communicating with the county seat and the outside world.

PIKE'S PEAK, IND.—The Pike's Peak Telephone Company has been incorporated to build a system in Brown, Bartholomew and Jackson Counties. The capital stock is $2,000.

SEYMOUR, IND.—The Seymour Home Telephone Company has been incorporated, the initial capital stock being placed at $15,000. The company will operate a telephone system within the city of Seymour and throughout Jackson and adjacent counties. The incorporators are E. D. L. Barber, John C. Montieth, Claude Hymer, J. H. Peters and S. A. Barnes.

EVANSVILLE, IND.—The recent action of the Cumberland Telephone Company in advertising for bids for the construction of a new exchange building is a puzzle to the city officials. The Cumberland company is under orders of the city council to remove its poles, wires and other property from the streets and alleys of the city by the middle of November. But in the face of orders to get out, the advertisement for bids for a new exchange building comes as a surprise and wakes up the slumbering telephone question. Mayor Covert is indignant at the action of the company and other city officials have expressed themselves against the company's position and in favor of municipal ownership. The telephone situation here is greatly strained, and the crisis seems to be near at hand.

WHITTEMORE, IA.—The Whittemore Telephone & Lighting Company has been incorporated here.

ELLIOTT, IA.—At the general election on Nov. 4 the question of granting a franchise by the town of Elliott to the Elliott Central Mutual Telephone Association will be voted on.

DES MOINES, IA.—The Mutual Telephone Company's managers are figuring with makers of telephone supplies on a new 6,000 connection switchboard which it proposes to install in its Des Moines plant next season and will require that it be delivered ready to set up with 4,000 connections. The board is being ordered in contemplation of the extension of the service into the country.

REDWOOD FALLS, MINN.—The Redwood County Rural Telephone Company is about to extend its lines from Wabasso to Morgan, a distance of twenty miles, with a central office at the latter point, and some forty instruments.

ST. JOSEPH, MO.—The Central States Telephone, Telegraph and Construction Company has been organized here with a capital stock of $100,000. Toll lines will be built all over Missouri, Kansas, Iowa and Nebraska. Connections will be made with the Citizens' company, of this city, the independent companies at Atchison and Leavenworth, and the Home Company, of Kansas City. The principal stockholders are W. F. Rankin, of Tarkio, and S. M. Baker, of Atchison. Over twelve thousand telephones will be connected by these toll lines.

GOWANDA, N. Y.—The Gowanda Telephone Company has been incorporated, capital $25,000. Directors: E. C. Fisher, J. M. Congdon and R. E. Congdon, Gowanda.

ELIZABETH CITY, N. C.—The Norfolk and Carolina Telegraph & Telephone Company, of Elizabeth City, has been chartered with a capital of $50,000. C. R. Johnson, of Portsmouth, Va., is the principal stockholder. M. L. Guirkin, of Elizabeth City, is also interested.

PORTSMOUTH, OHIO.—The Portsmouth Telephone Company is installing a new switchboard and will spend $20,000 in extensions next spring.

BOWLING GREEN, OHIO.—The Weston-Grand Rapids Telephone Company is receiving material for new lines and a new switchboard at Grand Rapids. Other improvements are to be made.

MARION, OHIO.—By paying $1 per year additional subscribers of the Bell Company at Caledonia will be given service to Marion without toll charges. The plan is being favorably received.

ELMORE, OHIO.—The New Ottawa County Telephone Company has been incorporated, with a capital stock of $150,000. The incorporators are E. D. Harkness, J. G. Steinkamp, George W. Luckey, Homer Metzger and Taylor Fuller.

MARSHALLVILLE, OHIO.—The Marshallville Telephone Company has been incorporated, with a capital stock of $1,000, by William Beidler, D. W. Kaufman, C. W. Biddle, H. H. Bachman, L. Hinderer, Jacob Ault, John Weiner, Edson Stinson and Benjamin Ault.

TOLEDO, OHIO.—The Toledo Home Telephone Company now has 5,000 telephones in operation. Of these 4,600 are independent telephones and 400 sub-telephones connected with private branch exchanges. About 300 telephones have been placed in operation in East Toledo.

TORONTO, OHIO.—The East Springfield Telephone Company has purchased from the Phœnix Telephone Company its exchange at Richwood, including franchise and toll lines to Wintersville. The Wintersville line is now being built and other improvements will be made.

URBANA, OHIO.—The United Telephone Company, of Bellefontaine, has sold a portion of its lines in Champaign County to Murray E. Weymer, of Rosewood. Mr. Weymer owns other lines in the county and the various properties are to be improved and consolidated into a new company, which will be of considerable importance.

HARRISBURG, PA.—The Summit Park Electric Company, of Bethel township, Allegheny County, has been incorporated; capital, $1,000.

LANCASTER, PA.—The Enterprise Telephone and Telegraph Company has been organized at New Holland with a capital of $25,000. It will build a line from New Holland to Reading especially for the use of farmers. The officers are: President, W. M. Stauffer, New Holland; treasurer, E. H. Burkholder, Summersville.

NEWBERRY, S. C.—The Southern Bell Telephone Company has applied for a franchise to put in an exchange at Newberry.

YANKTON, S. D.—At a recent meeting of the Business Men's Club a resolution was adopted to let the contract for an independent telephone system for the city of Yankton to the Messrs. Crumb, of Chicago, for the sum of $13,000, that being the smallest of several bids submitted.

EL PASO, TEX.—The Southern Independent Telephone Company of El Paso has been incorporated; capital stock, $500,000. The incorporators are Annie McElroy Britt, Lorain Miller, J. B. Badger and B. S. Sprague.

SALT LAKE CITY, UTAH.—Two reports were presented to the city council of Butte, Mont., in regard to the franchise asked for by the Rocky Mountain Telephone Company. A majority and a minority report will be presented later on. The company's franchise will expire in about two years more. There is likely to be a hard fight over the matter before the telephone people secure a franchise without paying a large sum for it.

SALT LAKE CITY, UTAH.—Superintendent A. J. Vance, of the Rocky Mountain Bell Telephone Company, has received a set of plans for the new exchange building to be erected in Cheyenne, Wyo., this fall. The advertisement for bids for the construction of the building will be published immediately. The structure will be 25x75 feet, and will be the only fire-proof building in Wyoming. Everything will be of stone, brick, steel, tiling and other non-inflammable material, with no woodwork whatever in its construction. The building is arranged to accommodate a much larger telephone exchange than now exists in Cheyenne.

RICHMOND, VA.—The Richmond, Va., Telephone Company has been granted the right to string a number of wires and cables overhead in order to connect with its new exchange. The arrangement is, however, temporary.

CAMERON, W. VA.—The Augusta Telephone Company has applied to the Town Council of this place for a franchise.

WHEELING, W. VA.—The Bell Company at Wheeling is rearranging its exchange system, giving the entire city direct connection with one central station. Subscribers at Bridgeport, Martin's Ferry and other towns in that vicinity are to be given the same service.

ELECTRIC LIGHT AND POWER.

FLAGSTAFF, ARIZ.—The Grand Cañon Electric Power Company proposes to build a new power plant on Right Angle Creek, a branch of the Colorado River. Surveys for the work are now under way. Mr. Julius Aubineau is president of the company and Mr. D. Babbitt secretary and treasurer.

SAN FRANCISCO, CALIF.—The Standard Electric Company is now supplying electric power for the San Francisco Gas and Electric Company, although in a limited quantity. The distance of transmission is about 145 miles from the Electra power station in Amador County.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company is building a branch from its main electric transmission line at Elmira to Vacaville, Calif. New transformers now being installed at the Vacaville Water & Light Company's sub-station will reduce the high tension current for distribution. E. D. N. Lehe is the manager of the distributing company.

SAN FRANCISCO, CALIF.—It is reported that electric pumping for irrigating rice fields in Texas and Louisiana will be carried on in an extensive way. The Southern Pacific Railroad Company is said to be behind the project. Harvesting machinery and rice mills will also be operated by electric power. The plant will be installed on a 10,000-acre rice plantation in Harris County, Texas.

SAN FRANCISCO, CALIF.—The Richmond Light and Water Company, Richmond, Calif., recently closed a contract with the Bay Counties Power Company for power from its transmission lines. Transformers aggregating 300-kw in capacity have been ordered from the General Electric Company. Richmond is the Santa Fe terminus on San Francisco Bay, with 3,000 inhabitants.

SAN BERNARDINO, CALIF.—The Hellman-Huntington syndicate of Los Angeles has just closed a deal for the purchase of the famous Bear Valley flume, which was built years ago at an enormous expense for the purpose of conveying water from the Bear valley dam on the north side of the San Bernardino mountains, to the orange groves about Redlands and Highlands. It is announced that the syndicate has already selected a site in Santa Anna canyon, 500 feet below the flume, for a power plant and that the flume will be used in connection with this plant.

SAN FRANCISCO, CALIF.—The Golden State Power Company which was recently incorporated in San Francisco, with a capital stock of $10,000,000, has located water rights along the Feather River. It is proposed to develop electric power at various points in Plumas and Butte Counties in California. The first plant is to be installed at Yankee Hill, 186 miles from San Francisco. C. L. Morrill, whose name heads the directorate, has been carrying on preliminary engineering work for five months past, working along the river from Big Bend to Big Meadows. It is proposed to have the first installation completed within two years with a probable capacity of transmitting 60,000 horse-power to San Francisco. The plant farthest away from that city will be 220 miles distant. Frank H. Powers, of San Francisco, represents Eastern investors and H. P. Hussey is connected with the enterprise.

DENVER, COL.—Machine shops, run entirely by electricity, are to be constructed at some points between Denver and Littletown by the George J. Leyner Engineering Works Company. Three electrical 20-ton cranes will be installed. All the larger machines will be run by individual electric motors, and the smaller machines and tools in groups.

EDWARDSVILLE, ILL.—At the last meeting of the City Council, the four bids for a franchise submitted by the Edwardsville Electric Light Company were rejected. The feeling between members of the Council and the electric light company is so intense at present that it is not probable they can get together on a compromise proposition, and in consequence the city will be in darkness after the time of the expiration of the company's present franchise unless the efforts of citizens in the interest of an amicable settlement are successful. The Mayor and a majority of the members of the Council favor municipal ownership.

NOBLESVILLE, IND.—Thomas Griffin and others have purchased the Cromer mill dam north of this city and will at once construct an electric lighting and power plant using water power to generate the electrical energy, which is to be brought to this and other cities.

INDIANAPOLIS, IND.—Lower rates for commercial lighting is the result of the invasion of the downtown districts by the Merchants' Heat and Light Company. The maximum charge permitted by this company is 10 cents per kw-hour. The Indianapolis Light and Power Company charges 12½ but is making contracts at 7½ where the new company competes with it.

AUGUSTA, ME.—The Union River Light & Power Company has been incorporated for the purpose of developing the water power of the Union river and its tributaries, with $1,000,000 capital. The officers are, president, A. Wendal Jackson, of New York City; treasurer, I. L. Halman, Boston, Mass.

PRINCESS ANNE, MD.—The Princess Anne & Deal's Island Light, Power & Railroad Company proposes to construct an electric railway and furnish light, heat and power. It will erect a plant. Mr. H. P. Dashiell is president.

NANTUCKET, MASS.—Mr. J. A. W. Cawley, of Stoneham, Mass., has purchased the Nantucket Gas Light Company and the Nantucket Electric Company and will erect here a new electric plant of about 200 horse-power. Mr. Cawley has entire control of the lighting system.

HELENA, MONT.—The power house of the Helena Light and Power Company was destroyed by fire on Oct. 20: loss, $100,000. It will probably be two weeks before service is resumed by the company.

MIAMISBURG, OHIO.—The Miamisburg Electric Light Company is installing a new arc light machine and will make other improvements to its system.

FINDLAY, OHIO.—The Adams Bros. Bridge Company is completing the installation of an electrical power plant and will operate all machinery by individual motors.

GALLIPOLIS, OHIO.—Risenbach & Maxon, of Coshocton, Ohio, have closed a deal for the purchase of the Gallipolis lighting plant owned by the Clendinen Light Company. The price paid is said to have been $12,500.

FOSTORIA, OHIO.—Prominent citizens are agitating the question of installing a municipal lighting plant in connection with the city water works. At present the city pays $90 per light which is claimed to be too high. The present contract will expire next year.

MIAMISBURG, OHIO.—The Mitchell Wheel Company, which was recently incorporated here, has purchased a site on which it will erect a large plant. It is probable that this plant will be operated by electric power, an independent motor being applied to each machine. Mr. N. J. Catrow is president and Mr. Lee Mitchell, secretary and general manager.

COLUMBUS, OHIO.—J. D. Karns and J. Barber are working in the interests of the Citizen's Heating & Lighting Company which is desirous of securing a franchise to operate its utilities in the southern and western portions of Columbus. The company offers to furnish lighting current at 15 cents per kw-hour and power current for 7½ cents per kw-hour. Discounts ranging from 10 to 30 per cent. are to be allowed on bills paid before the 15th of each month.

SPARTANSBURG, S. C.—J. E. Duval, of Spartansburg, has been awarded a contract to install an electric plant in the Bessemer City, N. C., cotton mill.

BENNETTSVILLE, S. C.—The town council of Bennettsville has provided for a municipal electric lighting plant, the action being taken over the protest of Mayor C. S. McCall.

WACO, TEX.—The Colorado Power and Manufacturing Company, of Waco, has been incorporated; capital stock $12,000. Incorporators: W. W. Seley, R. H. Chatham and S. F. Harrill, of McLennan County, and Rod Oliver, of Dallas.

THE ELECTRIC RAILWAY.

DANIELSON, CONN.—Contracts for extending the Providence and Danielson Electric Street Railway to East Killingly and Elmville have been awarded and construction begun. The Worcester & Connecticut Eastern Railway has practically completed a trolley line between Wauregan and Central Village, and the road will be opened early in November. Work is in progress on the line from Central Village to Moosup, and the entire road from Danielson to Moosup will probably be open for public travel by Jan. 1.

AUGUSTA, GA.—President Jackson, of the Augusta electric railway interests, will probably take up the matter of extending the lines to a number of nearby towns in the near future.

INDIANAPOLIS, IND.—The Huntington and Winona Traction Company, of South Whiley, has filed articles of association. The capital stock is $10,000 which will be increased later on. The directors of the company are George Lee, E. B. Bowers, C. R. Banks, M. W. Webster and E. L. Eberhart.

SEYMOUR, IND.—At a meeting of representative men from Jackson, Bartholomew, Washington and Orange Counties and promoters of the electric railway from Columbus through Seymour and Brownstown to French Lick, a committee was appointed to draft articles of incorporation and also to secure stock subscriptions. The right of way has been obtained through all the counties.

LOUISVILLE, KY.—Articles of incorporation have been filed by a new company which proposes to convert the Louisville, Harods Creek and Westport Railroad into an electric line. The company has $35,000 capital stock, fully paid in, and the officers are Lajon Allen, president; Owen Tyler and Bethel Beach, vice-presidents; W. N. Cox, secretary-treasurer. The work of reconstructing the line is to start at once.

JOPLIN, MO.—The Southwest Missouri electric railway is to be extended from Joplin to Carl Junction, Mo., ten miles north.

ALBANY, N. Y.—The Cross Country Railroad Company, of Brooklyn, with a capital of $250,000, has been incorporated. It proposes to operate a fifteen-mile electric surface railroad with terminii at College Point and Willetts Point. The following are named as the directors: J. F. McClean, A. A. Halsey and Theodore Bernard, all of Brooklyn.

ALBANY, N. Y.—The Brockport, Niagara and Rochester Railway Company, of Brockport, Monroe County, has been incorporated, with a capital of $500,000, to construct and operate an electric railway forty-four miles long from Rochester to Medina. The corporators are Frederick Beck, of Brockport; William Shields, of Waterville; S. J. Spencer, J. L. Bock and Stephen J. O'Gorman, of Buffalo; John Helling, of Rochester; Samuel W. Smith, of Holley, and G. L. Smith, of Glade Run, Penn.

SARATOGA, N. Y.—It was supposed that the strike of the Hudson Valley Railway Company had been settled, but complications have arisen which remove that event as far away as ever and the situation has again assumed a threatening attitude. The strikers at first desired arbitration, but twice rejected propositions to have all questions in dispute settled by a board of arbitrators. It is stated that the company has about decided to close up the road for the fall and winter, running only a sufficient number of cars to maintain its charter.

TOLEDO, OHIO.—The Toledo & Indiana Railway has increased its capital stock from $1,000,000 to $2,500,000.

CLEVELAND, OHIO.—The Lake Shore Electric Railway Company will erect a new sub-station at Vermillion.

CINCINNATI, OHIO.—The Cincinnati Traction Company is planning to build a belt line touching Norwood, East Norwood, Winton Place and Bond Hill.

CINCINNATI, OHIO.—The Ohio Valley Traction Company is making active preparations to commence the building of a line from Covington to Louisville, Ky.

URBANA, OHIO.—The Urbana, Bellefontaine & Northern Railway Company has filed a mortgage for $500,000 given to the Continental Trust Company, of New York. Construction work is being pushed on this line.

COLUMBUS, OHIO.—Plans have been completed for the new power house to be erected near Columbus by the Scioto Valley Traction Company. Contracts will be closed in the near future for the electrical equipment.

LIMA, OHIO.—It is announced that the Western Ohio Railway will commence work of grading this fall on the section from Lima to Findlay. When this is completed there will be a through line from Cincinnati to Toledo.

COLUMBUS. OHIO.—It is stated that the Appleyard syndicate is planning another interurban road out of Columbus to extend up Alum Creek Valley to Central College, Galena and Sunbury. A route into the city will also be secured, it is said.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Railway will increase its capital stock from $750,000 to $1,500,000. Extensive improvements will be made to the system, and the line from Dayton to Springfield will be double tracked.

STEUBENVILLE, OHIO.—The Steubenville, Mingo & Ohio Valley Railway which has been acquired by the Wheeling Traction Company is to be improved and extended. A large power house will be built at Brilliant. A generating unit has been ordered.

CLEVELAND, OHIO.—It is reported that the Pomeroy-Mandelbaum syndicate is preparing for a merger of the Cleveland & Southern Railway with the Cleveland, Elyria & Western Railway. From an operating standpoint the two roads are at present identical.

SPRINGFIELD, OHIO.—Boston capitalists have agreed to take the $2,225,000 bond issue of the Springfield & Washington Traction Company which proposes to build from Springfield to Washington C. H. George H. Frye, of Springfield, is the chief promoter.

RIPLEY, OHIO.—The Columbus & Ohio River Railway has been organized by G. Bambach, E. E. Galbreath, A. White and others of Ripley and Cincinnati, to build a combined steam and electric road from Aberdeen down the Ohio River to Ripley, thence northerly to Georgetown, Hillsboro and Columbus. It is the plan to operate electric cars, freight trains to be steam hauled.

CINCINNATI, OHIO.—The Norwood, Oakley, Madisonville & Red Bank Traction Company has been organized, with $100,000 capital stock, by David Davis, Captain Peter Eichels, L. M. Strafer, B. W. Harrison and A. E. Carr. The road will run from Norwood to Red Bank, connecting with the Cincinnati & Norwood and the Rapid Transit Railway at Oakley and the East End line at Red Bank.

ZANESVILLE, OHIO.—The organization of the Zanesville Street Railway & Electric Light Company has been effected by the parties who purchased the street railway and lighting plants from a Boston syndicate. The new officers are F. A. Durban, Zanesville, president; H. M. Byllesby, Chicago, vice-president; W. D. Breed, Cincinnati, treasurer; W. A. Gibbs, Zanesville, secretary and general manager. The property will be improved and extended.

CLEVELAND, OHIO.—An electric sleeping car service between Cleveland and Detroit will soon be established by the Lake Shore electric railway. The company has awarded the contract for the building of several sleepers to the Kuhlman Car Company of this city, and when they are completed a fast night service will be started. It is thought that the run can be made in about ten hours so that one can take a sleeper here at 9 p. m. and be in Detroit at 7 o'clock the next morning. The cars are to be of the same class as up-to-date Pullmans.

CLEVELAND, OHIO.—The Cleveland syndicate which financed the Toledo & Western Railway and the Cleveland, Painesville & Ashtabula Railway has taken up the financing of another enterprise, forming a new link in the chain of lines paralleling the ake Shore & Michigan Southern Railway from Buffalo to Chicago. Both the roads above mentioned are on this route while the new road which will be known as the Buffalo, Dunkirk & Western Railway, will close up another important gap. The chief promoters are Hon. Luther Allen, J. E. Latimer and J. W. Holcomb. The line will extend from Westfield to Buffalo, a distance of fifty miles. The road will cost about $2,000,000.

READING, PA.—The Electric Equipment Company, of this city, has secured 51 per cent of the stock of the Elmira & Waverly Railroad Company, New York, and is making preparations to equip the road. The remainder of the stock is held by capitalists in Elmira, N. Y. The New York street railway commissioners have heretofore refused the necessary permission to proceed with the line because of alleged insufficient capital.

MEMPHIS, TENN.—The Gulf Shore Electric Railway Company has been incorporated to build a 20-mile electric railway between Henderson's Point, on Bay St. Louis, to Point Cadet, near Biloxi, Miss.

SALT LAKE CITY, UTAH.—From reliable sources it is learned that the Pacific Electric Railway Company will at once build its line to Whittier, Calif.

SALT LAKE CITY, UTAH.—Steps have been taken to secure a branch of the Salt Lake & Suburban Railway connecting with the company's lines at Sixteenth South Street and extending to Mill Creek canyon.

RICHMOND, VA.—The Richmond and Petersburg electric railway has been bought by the Virginia Passenger and Power Company, of Richmond, and the latter will take formal possession about the middle of November.

NEW INDUSTRIAL COMPANIES.

THE MERCHANTS' ELECTRIC COMPANY has been incorporated at Wilmington, Del., with a capital stock of $150,000.

THE ELECTRICAL REFLECTOR COMPANY, of New York; capital $10,000, has been incorporated. Directors: W. A. Schiffer, E. A. Kerbs and C. S. Gans, New York.

THE CHAMPION TROLLEY-HARP COMPANY, of Philadelphia, has been incorporated under the laws of Delaware to manufacture an improved trolley harp. The capital stock is $130,000.

THE EICKEMEYER ELECTRIC PUMPING COMPANY has been incorporated at Jersey City, N. J.; capital stock $50,000. Incorporators: Carl Eickemeyer, John F. Avery, S. R. Bullock.

THE CLARK AUTOMATIC TELEPHONE COMPANY, of Providence, R. I., it is stated, will organize a sub-company, with Sioux City, Ia., as headquarters, to do business in Iowa and Nebraska.

THE ARCHER & PANCOAST COMPANY, New York (gas and electric light fixtures), has been incorporated, capital $10,000. Directors: J. H. Selmes and W. E. Curtis, New York; C. P. Davis, Hartford, Conn.

THE PENNSYLVANIA EQUIPMENT COMPANY, Camden, N. J., has been incorporated to manufacture electric equipments, etc.; capital $25,000. Incorporators: Benj. Beerwald, Benj. L. Cates and Aaron A. McCray.

THE ELECTRIC CONSTRUCTION & MACHINE COMPANY has been organized at Moline, Ill., with a capital stock of $25,000. Messrs. Thomas H. Burtchaell and Herman Schmidt, of Moline, are prominent among the incorporators.

THE AMERICAN DEVICE MANUFACTURING COMPANY, of New York, has been incorporated to manufacture railway and electric supplies; capital $100,000. Directors: Nelson Stafford, Brooklyn; A. N. Stafford, East Orange, N. J., and Edgar Beekman, New York.

THE UNITED STATES ELECTRIC COMPANY, of Jersey City, has been incorporated to manufacture electrical devices; capital, $25,000. Incorporators: George C. Wilfore, New Brighton, S. I.; Henry McDonough, Montclair, and Clarence Kelsey, Jersey City.

THE PROTECTIVE THIRD RAIL ELECTRIC BLOCK AND SIGNAL COMPANY, of New York, has been incorporated at Albany with a capital stock of $500,000. The directors are Frederick Brotherhood, A. M. Lowry, Henry Lehman, H. F. Clinton and Dennis A. Kennelly, all of New York City.

THE AMERICAN MOTOR CARRIAGE COMPANY, Cleveland, Ohio, has been incorporated under the Delaware laws with a capital stock of $500,000. The incorporators are Frank H. Ginn, Albert E. Green and J. M. Garfield. The company will manufacture gasoline and electric automobiles. It will erect a large factory in Cleveland.

THE J. & M. MANUFACTURING COMPANY has been incorporated at Augusta, Me., for the purpose of manufacturing and dealing in engines, storage batteries and electric appliances; capital stock $1,000,000, of which $15,000 is paid in: president, Fletcher W. Jewell, Boston, Mass.; treasurer, William F. Miller, Boston, Mass.

LEGAL.

LEGALITY OF INFORMATION BY TELEPHONE.—The Supreme Court of Iowa recently decided that when a judge notifies an attorney over a telephone line that he has decided a case a certain way, the attorney has a right to rely on the telephone having accurately transmitted the information.

EDISON LAMP SOCKETS.—An injunction has been issued against J. F. Buchanan, of Philadelphia, in a suit filed by the General Electric Company on the Tournier patent, No. 559,232, April 28, 1896, the particular infringement being the sale of certain Edison lamp sockets manufactured by the New England Electric Manufacturing Company, of Boston, Mass.

COLUMBIA TELEPHONE MFG. CO.—J. F. Furman has filed a petition in the U. S. District Court declaring bankrupt the Columbia Telephone Manufacturing Company, of Ottawa, Ohio, and asking for the appointment of a receiver. The Security Trust Company, of Toledo, was appointed. Following this step, an injunction was secured restraining the sheriff from disposing of the company's plant and goods. It is believed the company will be reorganized.

SUBWAYS PART OF EQUIPMENT.—According to Justice O'Gorman of the N. Y. Supreme Court, the rapid transit subway contractors must pay for the electric ducts that are being installed in the side walls of the Rapid Transit tunnel. John B. McDonald applied to the court for a writ of mandamus compelling Controller Grout to pay $400,000 already expended on the ducts. If the ruling stands, the city will save $1,200,000, the cost of the ducts. Mr. McDonald contended that the ducts or tubes were part of the construction of the tunnel. The Controller refused to pay the voucher for $400,000 on the ground that the ducts were part of the underground road's equipment. The $400,000 has been expended prior to July 1 of this year. The Board of Rapid Transit Commissioners decided by a formal vote that the city ought to pay the $1,200,000. Justice O'Gorman says: "This action of the Rapid Transit Board cannot be upheld. While acting within the authorty delegated to them, their actions will not be interfered with, but where it is claimed that they have gone beyond the scope of their authority, their conduct will be reviewed by the courts. Concededly, under the statute, the commissioners have no right or power to designate as work of construction what the Legislature has declared to be equipment." "Equipment" is defined in the decision as including all such things as motors, cars, power houses, ways, wires, and conduits—"all the devices used in the transmission of power."

PERSONAL.

MR. CHARLES A. CHAPMAN, consulting engineer, is changing his address and will be hereafter at 1040-1042 No. 204 Dearborn Street, Chicago.

DR. A. E. KENNELLY has just returned to New York from a successful cable laying expedition in Mexican waters, and has proceeded to Harvard University to take up his duties as professor of electrical engineering.

MISS LEILA MORSE, grand-daughter of Prof. Morse, sang last week at the dedication of the Kaiserin Augusta Institute, in Berlin, and was called up and complimented by the Empress, who mentioned having heard her at a school concert a few years ago.

DR. F. A. C. PERRINE, president of the Stanley Electric Mfg. Company, and Mr. Ray D. Lillibridge, were guests of the Michigan Lake Superior Power Company at the celebration of the opening of the 60,000-hp canal and power house at Sault Ste. Marie, October 25.

MAJOR FLOOD-PAGE, of the Marconi Wireless Telegraph interests in England, is to be one of the representatives of the London Chamber of Commerce at the opening of the new home of the New York Chamber of Commerce next month. He is now in New York City.

PROFESSOR MORGAN BROOKS, the head of the Electrical Engineering Department of the University of Illinois, Urbana, and a party of seniors, consisting of Edward T. Buell, L. Dolkart, J. F. Duffy, M. D. French, R. W. Gaston and F. W. Rose, last week made an inspection tour of things electrical in and about Chicago.

MRS. LESLIE CARTER, in going about the country, has found great inconvenience in the various dressing rooms at the theatres where she performs,

and has consequently had built a portable dressing room. One essential feature of it is a little electric heater. Mrs. Carter says that the room is a great saving of wear and worry.

MR. JOHN F. KELLY, of the Stanley Electric Mfg. Company, and family, have just returned from a long trip abroad.

MR. THEODORE BERAN, of the General Electric Company's headquarter's staff in New York City, is home again from Europe.

MR. D. M. STEWARD, the veteran lava insulator manufacturer, of Chattanooga, Tenn., is now in New York City to introduce a new form of cleansing material.

MESSRS. DAVIES AND EVANS, engineers of the Pwllbach Colliery Company, of Swansea, South Wales, are now in the United States studying electrical machinery, etc., which it is proposed will be installed very shortly in their plant.

COL. ALEXANDER GORDON, chairman of the Board of Directors of the Niles-Bement-Pond Company, who is also largely interested in the German Niles Tool Works, of Berlin, arrived from Europe this week on the Kaiser Wilhelm der Grosse.

COL. W. A. ROEBLING, after suffering for thirty years as the direct result of caisson fever, contracted during the building of the piers of the Brooklyn Bridge, submitted to an operation in the Roosevelt Hospital last week, which is thought will restore him to physical comfort unknown during this long period. He is going along very nicely.

MR. A. W. McLIMONT, formerly president of the Federal Electric Company, 141 Broadway, New York, has been appointed general manager of the newly formed Monterey Electric Railway Company, which is to build and operate an electric traction system in the city of Monterey, Mexico. Mr. McLimont will have charge of the construction and management of the road.

MR. W. C. WHITNEY, who has been spending the past five weeks at his lodge in Yorkshire, England, returned on Sunday last on the White Star liner Celtic. The party that sailed with him on September 5 included his son, Harry Payne Whitney, Mr. and Mrs. H. B. Duryea, H. Yale Dolan and Mrs. Thomas Hastings, all of whom returned with Mr. Whitney, except Harry Payne Whitney, who arrived recently on the Oceanic.

MR. C. O. POOLE, who recently resigned his position as electrical engineer with the Standard Electric Company in San Francisco and went East, has been appointed manager of the Stanley Electric Manufacturing Company's agency in Denver. Mr. Poole had much to do with the successful completion of the Standard transmission system which is now in commercial operation as far as San Francisco. He was for some years in a responsible position with the San Francisco Gas & Electric Company.

MR. J. C. BELDEN, formerly sales manager for the Kellogg Switchboard and Supply Company, of Chicago, and previously purchasing agent, has left the company and gone into business for himself under the style of the Belden Mfg. Co., at 118 Michigan Street, Chicago. He began with the Kellogg interests when they started at Highland Park and had been with them ever since. A specialty with the new concern is magnet wire. Mr. Belden has Mr. Albert Bentler with him as superintendent.

MR. E. ZORRILLA, general manager of the Spanish-American Light and Power Company, Consolidated, of Havana, Cuba, of which concern Mr. T. J. Hayward, of Bartlett, Hayward & Co., of Baltimore, Md., and 100 Broadway, New York, is the president, is now on a short visit to the United States. As already mentioned in the ELECTRICAL WORLD AND ENGINEER, the company's operations are to be considerably extended and a quantity of new equipment will be required. Mr. Zorrilla may be found downtown at the company's offices, 100 Broadway.

MR. E. H. BEACHAM, of New York, recently connected with Messrs. Sanderson and Porter in the construction of the new street railway and electric lighting plant for the Peekskill Lighting and Railroad Company, has accepted an engineering position with the Levering & Garrigues Company, of New York, engineers and contractors for bridges, buildings and general structural iron work. Mr. Beacham secured his early training in the shops of the Thomson-Houston Company at Lynn, Mass., and for twelve years past has been engaged in construction work in both the street railway and electric lighting fields.

MR. THOS. E. MITTEN.—Advices from Milwaukee say: It is reported here that Thomas E. Mitten, who was for several years General Superintendent of the Milwaukee Street Railway system, and who is now general manager of the International Traction Company, of Buffalo, N. Y., is considering a proposition which may place him at the head of the Metropolitan Railway Company, of New York. The New York position would place Mr. Mitten under President Vreeland, who, it is said, is contemplating a European tour to cover a period of two years. Mr. Mitten to be in charge of affairs during Mr. Vreeland's absence. Before coming to Milwaukee Mr. Mitten was connected with the Denver system.

MR. EMILIO DYSTERUD, chief engineer of the Compania de Luz Electrica y Firaza Mortriz de Monterey (the Monterey Electric Light and Power Company), of Monterey, Mexico, has been in the United States for several weeks past studying electrical machinery, with a view to determining as to equipment which it is intended to further install in the company's plant, as such may be extended shortly from 800 hp to 2,000 hp. He left New York Wednesday for Niagara, Buffalo, Toronto, Pittsburg, Cincinnati, St. Louis, Chicago and Austin, Tex., from which place he will return direct to Monterey, arriving in that Mexican city about November 12. It is anticipated that very shortly after his return some substantial contracts for machinery, etc., will be placed here.

MR. W. K. PALMER, consulting engineer, 401 New York Life Building, Kansas City, Mo., has been retained as consulting engineer for the American Carbolite Company, which has recently been organized for the purpose of building a plant at Constantine, Mich., for the manufacture of calcium carbide by a new process. Mr. Palmer and assistants are now in Chicago engaged in designing the electrical furnaces and special machinery required in the plant, and preparing plans for the arrangement of the equipment and for the steel building. The plant embodies many novel features—electrical, mechanical and structural—because of the unusual character of the process. Electrical power will be employed throughout the works.

NEW YORK ELECTRICAL SOCIETY.—At the regular meeting on October 22, the following members were elected: A. H. Ackerman, N. Y. Edison Co., 53 Duane Street, N. Y.; Frank F. Thompson, J. G. White & Co., 29 Broadway, N. Y.; Orosco C. Woolson, 118 Havemeyer Building, N. Y.; E. W. Hazazer, 8 Dover Street, N. Y.; C. R. Newman, Pasaic, N. J.; John H. Dale, 22 Thames Street, N. Y.; Charles H. Sinnett, 463 West Street, N. Y.; Olin Beecher Greene, 93 Liberty Street, N. Y.; A. F. Stanley, 170 Broadway, N. Y.; Geo. L. Patterson, 93 Liberty Street, N. Y.; Brice A. Frey, Signal Office, Governor's Island, N. Y.; Berry Riphael, Astor Court Building, 18 West 34th Street, N. Y.; Gustave A. Brackly, 874 Broadway, N. Y.; John L. Streever, 85 Borden Ave., Long Island City, N. Y.; R. Halliday Nexsen, 302 St. James Place, Brooklyn, N. Y.; Geo. Greenwood, Apartado 91 Jalapa V, Mexico; Henry A. Sheuplein, 497 Lexington Avenue, N. Y.; G. T. Luckett, 506 West 151st St., N. Y.; Severn D. Sprong, 818 Marcy Avenue, Brooklyn, N. Y.; William T. Dempsey, 1273 Bushwick Ave., Brooklyn, N. Y.; F. Moreton Jack, 1330 Bushwick Ave., Brooklyn, N. Y.; E. A. Harley, 80th Street and East End Ave, N. Y.

Trade Notes.

THE NATIONAL ELECTRIC LAMP COMPANY will build a plant at Warren, Ohio, and will employ 500 hands.

THE STANDARD ELECTRIC MANUFACTURING COMPANY, of Niles, Ohio, has increased its capital stock from $30,000 to $75,000.

S. E. I. COMPANY, J. W. Eager, manager, has moved from 219 Walton Street to the Hall & McChesney Building, corner South Franklin and Jefferson Streets, Syracuse, N. Y.

THE ELECTRIC MOTOR & EQUIPMENT COMPANY, of 13 Beaver Street, Newark, N. J., has secured the contract for the electrical equipment of the new city hall in Newark, the price being $59,200.

THE CENTRAL ELECTRIC COMPANY, of Chicago, wishes to call attention to Columbia lamps. Any buyer of incandescent lamps will be sent, upon request, an attractive pamphlet entitled "That Question of Light."

THE NATIONAL-ACME MFG. COMPANY, of Cleveland, Ohio, maker of the Acme automatic tools, screw slotters, etc., reports the opening of its New England office at 45 Oliver Street, Boston, in charge of Mr. M. M. Brunner.

THE *TELEPHONE MAGAZINE* has passed into the control of the Trade Press Company, of Chicago. This company publishes the *Produce News*, the *Dry Goods Reporter* and the *Investor*. C. E. Kammeyer will still be connected with the paper.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out circulars illustrating and describing its three styles of Newgard combined waterproof globe and receptacle. It claims for it that it is the only thing that "will make a brewery or wet job, dry."

NOTICE OF REMOVAL.—The offices of Messrs. F. S. Pearson, L. J. Hirt, W. P. Plummer, H. L. Cooper and R. D. Mershon, as well as of the Brazilian, Mexican and West Indian interests they represent, will hereafter be at the Columbia Building, 29 Broadway, New York.

REMOVAL.—The Pettingell-Andrews Company, Boston, Mass., announces the removal to its new building at the corner of Pearl Street and Atlantic Avenue, which location is in Boston's electrical center. The company has in its new quarters a large and excellently equipped supply house.

DIAMOND CHEMICAL WORKS, of 58 South Clinton Street, Chicago, who manufacture the Stubenrausch "Diamond" commutator compound, report being very busy filling orders. They have a large demand for their product. Their works have just been removed to 547 School Street, where they have better facilities for manufacturing than formerly.

THE WHEELER REFLECTOR COMPANY, of Boston, will remove, about November 1st, to 156 Pearl Street. It was forced to make this move as in its present quarters it was unable to fill the large orders which have been pouring in upon it. With largely increased room and new and improved machinery which it will install, it will be enabled to supply the demand for its fixtures and shades promptly.

UP-TO-DATE READING.—One of the most authoritative and at the same time one of the most interesting narratives of the "Volcanic Eruptions in the West Indies," is contained in the report made by scientists sent out by the Royal Society to investigate the phenomena, which is published in *The*

AKRON BULLETINS.—The Akron Electric Manufacturing Company, Akron, Ohio, has issued three well printed and handsomely illustrated bulletins, the subjects being respectively "Direct-Current Motors and Generators," "Direct-Current Engine-Tube Generators," and "Invertable Type Open and Enclosed Generators and Motors." The latter bulletin is accompanied by a handsome illuminated engraving on a card of a machine of the enclosed type. The same company has also issued a reprint from the Proceedings of the Engineering Society of Western Pennsylvania, of an article by Mr. F. B. Duncan on "Electrical Equipment in Modern Machine Shop Practice." This contains some valuable data on the power required to run various kinds of tools.

CORRESPONDENCE INSTRUCTION SCANDAL.—It is reported from Scranton that a fake correspondence school there has been choked off by the action of the Government, the postal authorities causing the arrest of four of the managers for fraudulent use of the mails. They had garnered $90,000 in two years from about 6,000 patrons, under specious offers of cheap or free tuition, with all kinds of "chromos" thrown in, but had no real instructors and used stereotyped corrections of instruction papers. Such excellent institutions as the International Correspondence Schools of Scranton are to be congratulated on being freed from the dishonest competition of a concern of this character, whose object in locating at that place is obvious.

Living Age for September 27. The distinguished explorer, Dr. Sven Hedin, has written for the *Geographical Journal* an account of his last three years' exploration in Central Asia. It will be found in *The Living Age* of the same date.

EUGENE MUNSELL & CO., who are pioneers in everything connected with the mica business, have recently begun the manufacture of a mica chimney, for incandescent gas burners, which is superior in many respects to anything heretofore offered in that line. It is known as "Warren's Folding Interlocking Mica Chimney," and application has been made for a patent on its unique and yet simple style of construction. The chimney is packed and sold flat, like a sheet of paper, and it can be formed into a cylinder as easily as a sheet of paper can be rolled up, the edges interlocking, as implied by the name. This makes it possible to clean the chimney, when necessary, easily and thoroughly, which cannot be done with the ordinary mica chimney. It furthermore, by its peculiar construction, transmits 10 per cent more light than any other mica chimney and casts no shadow. In addition to these good selling points, there is the further advatage to the dealer that the shipping weight of these chimneys is one-fifth less than that of others, and that they take up but little space on shelf or in store room—a whole gross occupying less space than two dozen of the old-fashioned chimneys. A descriptive price list will be sent upon application.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 21, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

711,465. TANK; H. Bradshaw, Chicago, Ill. App. filed June 13, 1902. The tank is constructed to recieve cells of battery and to be sunk in the earth.

711,481. STORAGE BATTERY PLATE; N. T. Daboll, New London, Conn. App. filed Feb. 19, 1902. The plate consists of wire gauze coated witn finely divided carbon and this coated with white lead.

711,488. SUPPORTING AND LIFTING MECHANISM FOR SECONDARY BATTERY PLATES. App. filed Feb. 24, 1902. The frame comprises a two-part beam having a bent rod and two transverse beams having hooks arranged for ready engagement with the two-part frame.

711,520. ELECTRIC MOTOR FOR VEHICLES; H. G. Osburn, Hoboken, N. J. App. filed May 6, 1901. The armature is carried by the hub and the field magnet by the vehicle frame.

711,532. INCANDESCENT ELECTRIC LAMP; J. J. Rooney, Scarsdale, N. Y. App. filed Nov. 14, 1901. A multi-filament lamp having a base adapted for an ordinary socket.

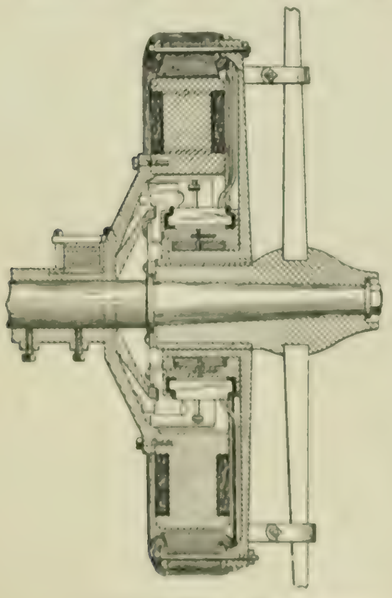
711,537. STORAGE BATTERY; F. Sedgwick, Chicago, Ill. App. filed Aug. 2, 1902. The electrode is composed of film-like layers of lead foil, each having small closely arranged perforations sufficiently numerous and minute to produce in the assembled whole a cellular mass capable of capillary action.

711,543. FUSE BOX; J. C. Stewart and W. Horn, Newark, Ohio. App. filed April 28, 1902. Details.

711,545. ART OF BLASTING; G. Thompson, Elizabeth, N. J. App. filed May 28, 1902. An electric furnace is introduced into the blasting hole and a current passed until the excessive heat disrupts the rock.

711,556. TELEPHONE SWITCHBOARD PLUG; H. P. Clausen, Chicago, Ill. App. filed April 13, 1901. (See Current News and Notes.)

711,567. CARBON HOLDER FOR ELECTRIC ARC LAMPS; J. A. Heany, Philadelphia, Pa. App. filed March 12, 1902. A spring socket formed of a strip of metal bent into clyindrical shape with a space between its edges and a tongue formed at one end to receive a post for electrical connection.



711,520.—Electric Motor for Vehicles.

711,545.—Art of Blasting.

711,588. INCLOSURE FOR TELEPHONES; A. J. Parke, Boston, Mass. App. filed May 23, 1901. (See Current News and Notes.)

711,589. INCLOSURE FOR TELEPHONES; A. J. Parke, Boston, Mass. App. filed July 13, 1901. (See Current News and Notes.)

711,610. SHOW CASE BRACKET; G. C. Wright, Cleveland, Ohio. App. filed May 10, 1902. An adjustable bracket to hold an electric light.

711,614. GAS BATTERY; O. Britzke, St. Petersburg, Russia. App. filed Jan. 17, 1901. A cell of refractory material having metal plates on opposite sides and a plate saturated with an electrolyte and dividing the space between the two plates into two passages and means for circulating hot gases through the passages.

711,615. MOUTHPIECE FOR TELEPHONE-TRANSMITTERS OR SPEAKING TUBES; J. W. Brown, Philadelphia, Pa. App. filed Jan. 9, 1902. (See Current News and Notes.)

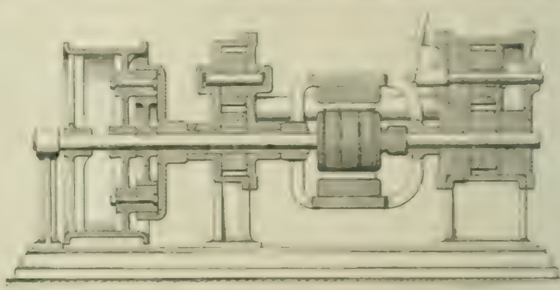
711,624. CANDLE HOLDER; M. Hammerstein, Berlin, Germany. App. filed Oct. 25, 1901. The holder contains a battery and is provided with a cover which carries an electric lamp which is thrown into view and into circuit when the cover is raised.

711,629. INSULATOR; C. Hobart, Philadelphia, Pa. App. filed March 6, 1902. A knob having a groove at the side to receive the wire and a wedge to hold it in place.

711,640. TELEPHONE-RECEIVER; W. M. Miner, Plainfield, N. J. App. filed March 7, 1901. (See Current News and Notes.)

711,649. SECONDARY ELECTRIC CLOCK; J. J. Stockall, Sr., London, Eng. App. filed Feb. 26, 1901. Details.

711,663. MECHANICAL MOVEMENT; F. E. Herdman, Winnetka, Ill. App filed April 14, 1902. A rotating armature and field, a hydraulic apparatus connected between them and means to vary the speed of the hydraulic apparatus to vary the proportionate speed of the motor elements without altering the speed of the motor.



711,663.—Mechanical Movement.

711,667. MEANS FOR REGULATING ELECTRIC MOTORS; R. Lundell, New York, N. Y. App. filed May 10, 1902. A controller for changing the strength and character of the field magnet of the motor in such a manner that the field strength is practically independent of the armature for the slower current, but highly responsive to variations in the armature current for the higher speeds.

711,710. STORAGE BATTERY; D. E. Wiseman, Chicago, Ill. App. filed March 12, 1901. A ribbon of lead having pockets therein is bent back and forth to form the plate.

711,743. TELAUTOMOTOR; H. Shoemaker, Philadelphia, Pa. App. filed April 12, 1901. A wireless telegraph arrangement is used to control the mechanism of a marine torpedo.

711,790. AUTOMATIC ELECTRIC CIRCUIT CONTROLLER; J. Sachs, Hartford, Conn. App. filed Oct. 5, 1900. A series of fuses are arranged to be cut out in succession as and when a given number of lamps in circuit is exceeded.

711,827 ELECTRIC HEATER FOR DENTAL PURPOSES; J. Cook and J. M. Pumerville, Michigan City, Ind. App. filed July 15, 1901. The heater is used for drying a current of air which is to be directed into the cavities of teeth.

711,867. PORTABLE ELECTRICALLY ILLUMINATED SIGN; H. S. Kemp, Richmond, Va. App. filed Feb. 25, 1902. A street car sign which can be readily changed without deranging the circuits.

711,868. ILLUMINATED SIGN; H. S. Kemp, Richmond, Va. App. filed Feb. 25, 1902. A modification of the preceding patent.

711,873. ELECTRIC COMMUTATOR; W. Loewen, Breslau, Germany. App. filed March 22, 1902. A mercury switch consisting of a closed vessel on the hour glass plan.

711,893. ELECTRIC SIGNALLING APPARATUS; A. F. Hauss, Baltimore, Md. App. filed Jan. 30, 1902. A circuit closing and opening device is arranged to automatically open the circuit after the transmitting mechanism is operated, to avoid waste of battery and accidental change of the signal.

711,917. STORAGE BATTERY PLATE; E. H. Winkes, Buffalo, N. Y. App. filed April 25, 1902. A long sheet of lead folded back and forth to present numerous corrugations, each of which is cut through for a portion of its width and provided with spacing bosses to separate the folds.

711,921. FUSE; F. B. Cook, Chicago, Ill. App. filed July 29, 1896. An insulating tube containing a fuse and suspended and supported across two conductors.

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NEW YORK, SATURDAY, NOVEMBER 8, 1902.

CONTENTS.

THE FRITZ MEDAL.

The manner in which the four national engineering societies have co-operated, with notable success, to endow and celebrate the foundation of the John Fritz Medal, is of the best augury for further federal work for the best interests of the professions represented. The prompt participation of members of the American Institute of Electrical Engineers in both the medal fund and the birthday banquet, has been to us a matter of great satisfaction, while we know that it has also been regarded with pleased surprise by the members of other societies with which Mr. John Fritz has been in closer relation. It is natural that in alliances of this kind there should be some jealousies, rivalries for precedence among the bodies, and possibly a little suspicion of the other fellow's altruism. But all these are but symptoms of devotion to one's own worthy cause, and we believe that when such enthusiasts do get together and learn to trust and work with each other the result aimed at is reached all the more quickly. After all is said and done, the work of such bodies will always be accomplished by a few devoted, single-minded men, but it surely strengthens their hands and their resolution, to find in kindred societies, men of like sentiments and impulses with themselves, with practically the same lofty, disinterested ends in view.

This Fritz medal, so worthily bestowed, ought to be regarded as a bond and pledge of work in other directions. We might mention one, namely, the securing of a commodious engineering building in this city, to accommodate the headquarters of the various societies of an engineering and scientific character, and to house also the engineers' Club, which has long been the hearth and social rallying point of all such institutions. There need be no surrendering of autonomy by any society; there need be nothing eleemosynary about the plan; but it does seem to us that this is a cause which should appeal for financial support to the superabundant wealth placed by the skill and labor of engineers in generous hands. The American Institute of Electrical Engineers is very badly in need of a home for itself and its matchless select library, and we sometimes wonder there is not a rush of electrical millionaires to fill the want and to cover themselves with praise and glory. We have despaired long time of the joint engineering building, but make bold to say that the man who meets these pressing necessities will do more for the arts and sciences than if he added another to the already redundant colleges and universities.

MORE WIRELESS PUZZLES.

A report last week chronicles the troubles experienced in the use of wireless telegraphy during the recent British naval manœuvres in the Mediterranean. We can hardly score it as a failure of wireless telegraphy, technically considered, since the chief source of woe was that the transmission worked so well as to hopelessly mix up the messages of friend and foe. Wholesale interference with messages is almost as serious and fully as annoying as inability to send any messages at all. The attacking squadrons are reported as totally unable to make effective use of their wireless outfits by reason of the persistence of the defense in sending confusing messages. We know not what was the substance of these, but the senders of them would have been more than human if they had been unremittingly polite,

Fancy the wrath of an admiral commanding, at having miscellaneous objurgations and selected personalities hurled at him out of ionized space! His case would be little better than that of Lieutenant General Bangs, immortalized in Kipling's verse, with the added sorrow of being unable to locate the offender against official dignity. For the last year or two we have been hearing much of so-called syntonized systems, but in spite of the number of times the problem has been solved in the newspapers, the net result has evidently not made its début in the British navy. We fear this branch of electricity "is still in its infancy" so far as military operations are concerned. And unless we are very short of memory, the wireless system attempted during our own combined military and naval manœuvres left several things—including messages—to be desired. It is quite certain that wireless telegraphy is capable of doing important work in the world, but just now there seems to be great need of investigating its limitations and getting a line on its practical field of usefulness. This matter of mutual interference is a serious one, and it cannot lightly be put aside by invoking a syntonized system unless said system is demonstrably effective. And even granting a perfected syntonized system, it still remains to insure its operation in face of persistent and skillful attempts at interruption. Could not Marconi beat his own game, especially now that he is said to be sending not merely single letters but full-length messages across the Atlantic?

The Valtellina Railway.

A short time since we noted the formal opening of this most interesting line, and last week were enabled to present to our readers some important details of the installation to which we desire to make further reference. Perhaps the most striking feature of the transmission system from which the railway derives its power is the fact that the generators are wound to give 21,000 volts directly from their stationary armatures. This, if we mistake not, is the highest generator voltage yet attempted on a commercial scale. In this country little more than half this pressure measures the capacity of most of the high-voltage generators. Yet there seems to be no good reason why 12,000 or 15,000 volts should be the limit thus reached. Experience has already shown that stationary armatures are easy to insulate, and with the experience that has been gained in the construction of transformers, a 20,000-volt generator should present no serious difficulties. From the present outlook, the upper limit of line voltage is receding into indeterminate distance, and it would be nothing surprising if the present usual line voltages were doubled in the next decade. When one goes in for high voltage he might as well be hanged for an old sheep as a lamb.

Another point not generally taken into account in considering this Valtellina line is the great additional difficulty introduced by having to work over a line originally planned for steam locomotives, without any cessation of the steam service during the period of construction and experimentation. This is a very different proposition from starting out in a fresh field, and the successful result is, therefore, doubly worthy of commendation. Of course, such a system as this cannot be regarded as a finality in traction by alternating-current motors, for there are still difficulties to be overcome and there is much yet to be learned in the operation of alternating motors for railway purposes. But in some form or other the high-voltage working conductor is the key to the situation, and every experiment, be it success or failure, adds to the common stock of knowledge. Ganz & Co. deserve the greatest credit for their persistence in the face of many discouraging conditions, not the least trying of which was the attitude of the Italian government.

Engineering.

Professor John Perry's opening address to Section G of the British Association is a very amusing and interesting discourse. It is amusing for its combativeness of existing methods and institutions. It is interesting for the breadth and candor of its views. As Herbert Spencer long ago pointed out, ornament precedes utility in the history of all superfluous acquisitions. Ornamentation took the lead over usefulness in the early development of apparel, liberal arts and education. Although utility now occupies the first consideration in all these directions, yet the evidences of the reign of adornment are clearly visible. In general education, undue prominence in ornamental studies evidence a survival of the unfit. There is something intensely grotesque in a busy practical age like ours spending a large part of several of the best years of a boy's educational life in teaching him Latin and Greek, languages which he will never attempt to speak, and which he will probably never read in later years. The educational value of Latin and Greek are unquestionable, but it is no greater than that of French and German. The beauty and the importance, in history, or in literature, of Latin and Greek are undoubted. But the study of these subjects should continue to be the devotion of the few, not the burden of the many. From a modern curriculum ancient things should be removed. In another way this spirit of conservatism is carried even to greater grotesqueness in our navy through the official policy which requires that those who are to man the mastless aggregations of machinery constituting the modern war vessel, shall be trained on sailing vessels. The selection of the trireme instead would have been but a short step to a reductio ad absurdum.

Professor Perry takes up the cudgels in favor of a utilitarian method of educating utilitarians, and of engineering methods of teaching engineering students. He condemns the existing school system of Great Britain in terse and fearless language. He is probably right. The average school, not only in England but also in every civilized country, attempts to carry education over too many subjects to give adequate development in the essentials for commencing an engineering course. The result is apt to be that the first year of a collegiate course in a technical college is spent by the student in acquiring familiarity with those principles which should have been completely within his grasp on entering college. Nevertheless, the tendency is always towards improvement. Latin and Greek are now relegated more and more to innocuous desuetude. The average school is every year tending to eliminate from its courses what is unnecessary, and to teach what is practically useful. Professor Perry's millennium in technical education is certainly remote, but its dawn is here. His labors to advance the epoch are timely and in some measure, we trust, effectual.

Integrating Photometers.

The paper of Prof. C. P. Matthews, read at the last meeting of the American Institute of Electrical Engineers, and reprinted elsewhere in this issue, calls renewed attention to the desirability of measuring the mean spherical candle-power of an incandescent lamp, or what is virtually equivalent thereto, the total flux of light it emits. The customary method of comparing luminous sources wholly on the basis of mean horizontal candle-power is as faulty as would be the plan of comparing the sizes of casks by exclusive reference to their girth at the middle, and entirely ignoring their relative heights. In the past the difficulty of measuring the spherical candle-power of incandescent lamps has been largely responsible for the sole reliance on horizontal candle-power. Moreover, lamps having similar geometrical forms of globe and filament are known to give a total flux of light approximately in porportion to the mean horizontal candle-power. Variations in the shape and arrangement of the filament are,

however, likely to bring about variations in the luminous distribution, such that if operated at the same mean horizontal candle-power per watt, one type of lamp will be worked harder, and be shortened in life, relatively to the more favored type.

The apparatus described by Professor Matthews promises to give one more practical means of measuring the total flux emission of an incandescent lamp at a single observation, and its practical success will remove the excuse that it is not possible to make the measurement. There are now at least three types of photometer constructed by which mean spherical candle-power may be measured at a single observation. In practice it is only necessary to determine the mean factor of reduction from horizontal to spherical for a limited number of lamps of the same structural type, and for most purposes this factor of reduction can be applied to the horizontal candle-power of all lamps of this type; so that in the observation of lamps in commercial photometry the mean horizontal candle-power, as usual, needs only to be measured, the reduction to spherical being computed when so desired by the use of the reduction factor for that particular structural type of lamp. Prof. Matthews's paper is a valuable one from various standpoints of photometry.

The paper read by Dr. C. H. Sharp at the same meeting goes to show that under practical conditions of photometric measurement, incandescent lamps can be compared for horizontal candle-power within a mean deviation of about half one per cent.; while secondary standard lamps can be compared within much smaller limits of deviation, by taking more care with the measurements. The photometer accuracy under such conditions narrows down to a range which is scarcely greater than that of standard voltmeter accuracy. Such a degree of accuracy in photometric measurements is, however, only possible in lamps which have the same color. When the lamps, or luminous sources, compared differ considerably in color, the probable error of the observation increases for one and the same observer, while it increases still more rapidly with reference to a group of different observers. This is why a primary standard of light in the form of an incandescent lamp constructed under rigid and reproducible conditions would be so valuable if it could be made reliable. Up to the present, however, the limits of variation in the light-emissions of incandescent lamps, manufactured as nearly as possible under the same conditions, appear too great to promise success in devising a standard incandescent lamp as a definitely reproducible luminous source.

Power in Manufactures.

One of the most interesting of the reports issued by the U. S. Census Office, coming naturally at the close of the statistics on manufacturing, as a "round up" of the data developed, is the Bulletin No. 247, devoted to the power employed in manufactures, metal working machinery and motive power appliances. This report has been compiled and arranged by Messrs. E. H. Sanborn and T. C. Martin, both of whom were employed on other parts of the inquiry into manufacturing, etc., conducted under the able and vigilant direction of Mr. S. N. D. North, the chief statistician. The amount of data and material developed is indeed surprisingly large, and some idea of the extent of the ground covered may be learned from the fact that no fewer than 512,254 establishments came under consideration. Perhaps the extent to which hand power is still resorted to, evidencing the opportunity for small electric motors, may also be gauged from the singular fact that of these half million establishments only 169,409 reported power. In other words, in only 33 per cent. of the "shops" in the United States does it pay to instal ordinary mechanical power, or a gain of about 5 per cent. in ten years. While in this age of combination and trusts we have thus at once a significant demonstration of the prevalence and preponderance of hand power in scattered, individual shops and factories, the old argument for electric power comes back with renewed and irresistible cogency, for if ever such establishments are to be aided by other than mere brute, human energies, electricity is the means for relieving them. No other agency can begin to compare with it for ease, simplicity, flexibility and economy in the cheap distribution of small power to innumerable minor concerns.

Steam continues, of course, to be the great primary power, and has risen rapidly, being as the report shows not less than 8,742,416 horse-power in 1900 out of a total of 11,300,081 horse-power. This is 77.4 per cent., whereas in 1890 it was only 51.8 per cent. Water power, on the other hand, has gone off, for although it has risen in bulk from 1,255,206 horse-power to 1,727,258, the percentage of the total in 1900 was only 15.3, as compared with 21.1 in 1890. But while this may be true as to manufacturing, it is hardly a true test of the relative position of water power development, unless it should prove that in lighting and railway work, steam has also shot ahead. There is a general impression that in electrical work generally, and in power transmission, water power has been able to redress the balance a bit. Some of the hydro-electric plants, as at Niagara, Massena, Sault Ste. Marie, etc., have been on a huge scale, but then again equally huge, and possibly more numerous, have been such steam plants as those of the New York Edison Company, on the East River, and those of the Metropolitan and Manhattan Elevated systems. There is little question, however, even taking these figures of manufacture, that water power would relatively have fallen off much more had it not been for electrical transmission, such as is seen in New England and the South, to factories of all kinds.

Not being a prime mover, it goes without saying that every time an electrical transmission is put in, the figures of steam or hydraulic generating plant are to that extent increased, offsetting the figures of the motors utilizing the current. This will, to some degree, explain the curiously disappointing figures of electric power, for it appears that electric power owned and rented for manufacturing work is only about 4 per cent. of the total, the figures being 311,016 hp owned, in 16,923 motors; and 183,682 hp rented. But what a magnificent margin to work on this leaves! Even as it is, it shows a gain of 1897 per cent. over the figures of 1890, when the electric motor had not fairly come in. It is encouraging to think of the field yet to be exploited. Moreover, the happy fact emerges, supporting theory, that while electric power rented is 183,682 hp, all other power rented is only 137,369 hp. It is obviously so easy to run wires and hire current; but it is not very feasible in most cases to extend shafting and steam piping from one establishment to another. In the early days of the motor, it was proposed to rent out the motors as a means of introducing them, and the practice gained considerable vogue; but as the above statistics show, people now buy and own their motors, and the companies are not burdened with an investment it would have been extremely difficult to maintain free from enormous risk of detriment and depreciation. What this would have meant may be inferred from the statement that in 1900-1 the New York Edison Company reported 50,634 hp of motors connected to its circuits, or 30 times as much as in 1890. At $75 per horse-power, this would imply an investment by the company of nearly four millions in machinery that it would have had to watch with inspectors over widely scattered territory. And, obviously, the plan of selling motors outright has not checked their adoption, in view of such phenomenal increases.

John Fritz Medal Foundation and Celebration.

The name of John Fritz, the great American ironmaster and mechanical engineer has long been associated with brilliant successes, and the foundation of the medal in his honor as well as the birthday dinner to celebrate it are certainly worthy to be called great successes also. The various stages in the affair have been noted in these pages, but may fittingly be recapitulated here. Last spring, at the call of Mr. S. T. Wellman, of Cleveland, a number of engineers and manufacturers met in this city to discuss the question of a suitable celebration of Mr. Fritz's eightieth birthday, the outcome of these meetings being the appointment of the following general committee:

President, S. T. Wellman, Wellman-Seaver Engineering Company, Cleveland, Ohio; treasurer, John Thomson, New York; secretary, C. Kirchhoff, editor *The Iron Age*, New York; S. W. Baldwin, Pennsylvania Steel Company, New York; N. H. Heft, New York, New Haven and Hartford Railroad, New Haven, Conn; R. W. Hunt, Chicago, Ill.; F. R. Hutton, secretary American Society of Mechanical Engineers, New York; C. Warren Hunt, secretary American Society of Civil Engineers, New York; J. C. Kafer, president The Engineers' Club, New York; T. C. Martin, editor the ELECTRICAL WORLD AND ENGINEER, New York; E. E. Olcott, president American Institute Mining Engineers, New York; R. W. Pope, secretary American Institute of Electrical Engineers, 26 Cortlandt Street, New York; H. G. Prout, editor the *Railroad Gazette*, New York; E. G. Spilsbury, New York; Jesse M. Smith, New York; Ambrose Swasey, Cleveland, Ohio; Oliver Williams, Catasauqua, Pa.; Calvin W. Rice, New York; Wm. Maver, Jr., New York.

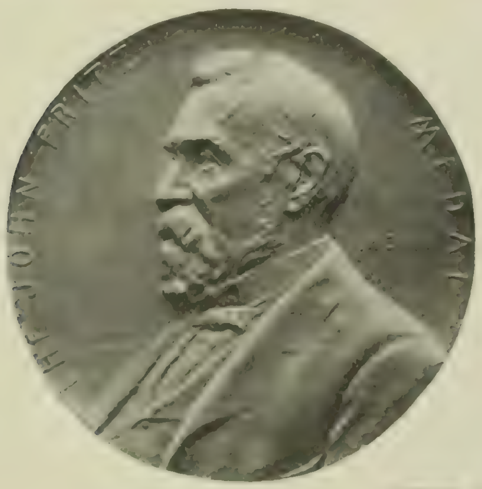
The organization was effected by the appointment of four subcommittees, as follows: Medal Committee—C. Warren Hunt, chairman; F. R. Hutton, R. W. Pope, C. Kirchhoff. Finance Committee—John Thomson, chairman; Ambrose Swasey, Jesse M. Smith, E. E. Olcott. Dinner Committee—T. C. Martin, chairman; J. C. Kafer, H. G. Prout, E. G. Spilsbury. Invitation Committee—S. W. Baldwin, chairman; N. H. Heft, R. W. Hunt, Oliver Williams.

Various rules were adopted to govern the foundation of a John Fritz medal, the design of which was happily entrusted to Mr. Victor D. Brenner, a well-known medailleur.

Towards this medal the sum of about $6,000 was contributed by some 484 persons, including these from the electrical ranks: B. J. Arnold, E. G. Acheson, C. Batchelor, A. E. Brown, C. L. Buckingham, F. H. Ball, J. Barre, N. F. Brady, A. N. Brady, W E. Baker, C. A. Coffin, G. H. Day, J. M. Dodge, G S. Dunn, C. H. Davis, R. N. Dyer, T. A. Edison, W. L. R. Emmet, H. Eames, Eugene Griffin, N. H. Heft, G. A. Hamilton, F. B. Herzog, C. T. Hutchinson, F. V. Henshaw, J. D. Hawks, C. E. Hewitt, D. L. Hough, W. J. Johnston, W. C. Kerr, N. S. Keith, R. T. Lozier, J. W. Lieb, Jr., R. D. Lillibridge, J. Markle, T. C. Martin, W. McFarland, J. H. McGraw, F. A. C. Perrine, C. G. Roebling, F. W. Roebling, Calvin W. Rice, A. F. Sever, Elihu Thomson, N. Tesla, G. Westinghouse, Jr., B. H. Warren, J. Wetzler, W. H. Wallace, H. H. Westinghouse. There are some curious omissions from this list of those who might be expected to share in this movement, but the responses were so prompt, the lists were closed at a very early stage. Most of those named above were also participants in the banquet at the Waldorf-Astoria on October 31, which is said by competent observers to have been the finest gathering of engineers and leaders in the great metal industries ever seen in this country. The representatives named for the American Institute of Electrical Engineers on the medal council are the present president and the three latest past presidents, viz., Messrs. Scott, Hering, Steinmetz and Kennelly. Each president as he becomes a past president joins this body, succeeding the oldest past president on it.

The banquet was held in the ballroom of the Waldorf-Astoria, was a brilliant affair, being attended by 535 guests, of whom 125 were ladies, seated in the boxes, where light refreshments were served them. There were various features of novelty and suggestiveness. Over the banquet table was a fine electric sign, furnished by the Elblight Company, which flashed into light exactly as Mr. Fritz took his place under it. It read: "John Fritz, 1822-1902." Each end of the table were fine large models of blast furnaces, etc., loaned by the Stevens Institute of Technology, one of them, an open hearth, being realistically lit by red incandescent lamps to give the glow. On the table were tracks and hot metal cars, etc. The menu was made up in the form of embossed tin-plate, showing on the front cover a blast furnace in operation, and held together by real bolts as well as by ribbon attached to a small oxidized copy of the obverse of the medal. The sorbet was served in imitation sections of steel rail, little boxes with removable cover being fitted into the head. The ice creams were brought in in procession, headed by large candy models of the Westinghouse units at the Manhattan elevated plant; the "Oregon" battleship, a modern steel bridge, a big rifled gun, the famous new "Flatiron" building, etc., to exemplify the creations of the modern iron and steel industry.

Col. H. G. Prout presided most admirably as toastmaster. Among the speakers were Brig.-Gen. Eugene Griffin, U. S. A., for the Army, and Prof. Elihu Thomson, for the American Institute of Electrical Engineers, whose president, Mr. C. F. Scott, also sat at the speakers' table. The proceedings included the presentation by Mr. John Thomson to Mr. Fritz of a magnificent album containing the record of the medal fund and the autographs of all the contributors, and of a large bronze replica of the medal, the only one to be made, the casts being broken there and then. During the evening, also, Mr. John C. Kafer presented a superb hammered silver loving cup to Mr. Fritz, in the name of Mr. Irving M. Scott, the builder of the "Oregon." In addition to the excellent speeches, there were read a number of special congratulatory cablegrams from Andrew Carnegie and C. M. Schwab, and from leading ironmasters and engineers in England, Wales, Scotland, Belgium, France, Germany, Austria and Japan.



OBVERSE AND REVERSE—JOHN FRITZ MEDAL.

The medal shown above is 2½ in plane diameter, less 1/39 inch. Its thickness may be ⅛ inch, and it is to be struck in pure gold, 1,000 fine. The bronze cast given to Mr. Fritz is 7 inches in diameter. In bringing up the Fritz medal, it will require about six pressures of 250 to 300 tons each time.

As already noted in these columns the medal is to be awarded not oftener than once a year for achievement in the industrial arts and sciences. The four national engineering societies are each asked to name four representatives to constitute a medal Board of Award, and should any society fail in this, the others are to proceed to action. The medal is not limited to any part of the world, but is open to both sexes and every nationality. It is the first American medal that can compare for importance with the Bessemer.

The Opening of the Water Works Power Plant at Sault Ste. Marie, Michigan.

At noon, October 25, occurred the formal opening of the water-power plant of the Michigan Lake Superior Power Company at Sault Ste Marie, Michigan. The event is an important one, not only to the citizens of that locality, but to the electrical industry in general, because it marks the beginning of operation of the second largest water power electric plant in this country. Many of the more important features of the hydraulic installation at this place were described in these columns September 27, 1902, so that but a brief mention of these need be made here.

It is notable that both of America's greatest water power electric generating stations (Niagara and the Soo) should derive power from the waters of our great lakes, and the two falls where water power is available, formerly given consideration in a practical way mainly because of the obstructions they offered to navigation, are now proving valuable assets in the wealth of the country through the water power developments made possible by their presence. Of the two falls, Niagara and the Soo, the former was naturally the first to attract sufficient favorable attention from capital to ensure their utilization. The result at Niagara has been the magnificent electric generating stations with which every electrical engineer is somewhat familiar. The rapids of the St. Mary's River being further from a market for power, with less available power and in a sparsely populated portion of the country, has been left for later development, but now that this development has taken place, it ranks in size among the leading power stations of the country, through not being as much of a pioneer plant in an engineering way as was the Niagara plant when installed, it lacks some of the engineering interest that accompanied some of the early Niagara work.

The Niagara plant was built with a large immediate market in view in the City of Buffalo, and also with the promise, which has since been realized, that a number of large industries requiring cheap electric power would cluster about Niagara. The Soo plant, on the other hand, has been built mainly on the faith that the future will bring to that point a market for the power which is now available, and that the existence of cheap power at that point will attract enough power consuming industries to utilize eventually the capacity of the plant.

The Michigan Lake Superior Power Company is but one of a group of corporations carrying on operations at the Soo, under the control of the Consolidated Lake Superior Company, which is under the general management of F. H. Clergue, a man of great enterprise and organizing ability. All of the various subsidiary companies except the Michigan Lake Superior Power Company are working on the Canadian side. There is a Canadian Soo water power, an electro-chemical company, a paper pulp mill, a machine shop, a blast furnace, a rolling mill, a railroad under construction to Hudson Bay, an iron mine, a ferro-nickel mine, a sawmill and numerous other incidental industries, operated under one syndicate. A history of how these enterprises came to be started one after the other by a sort of evolution of one from another makes an interesting story, but is aside from the purpose of this article.

Fig. 1.—General View of the Power House.

No extravagant language is needed to convey to an engineer's mind the magnitude of this water power undertaking when, together with the accompanying photographs, the following figures are appreciated:

Length of canal from Lake Superior to power house on Ste. Marie River	[illegible] ft.
Width of canal in solid rock	200 ft.
Depth of water in canal (average)	23 ft.
Length dam and power house	[illegible]
Number of generating units provided for	[illegible]
Size of units	[illegible]
Head of water	17 to [illegible] ft.

Details of the hydraulic work can be found in the recent issue above referred to, together with a map showing the route of the canal

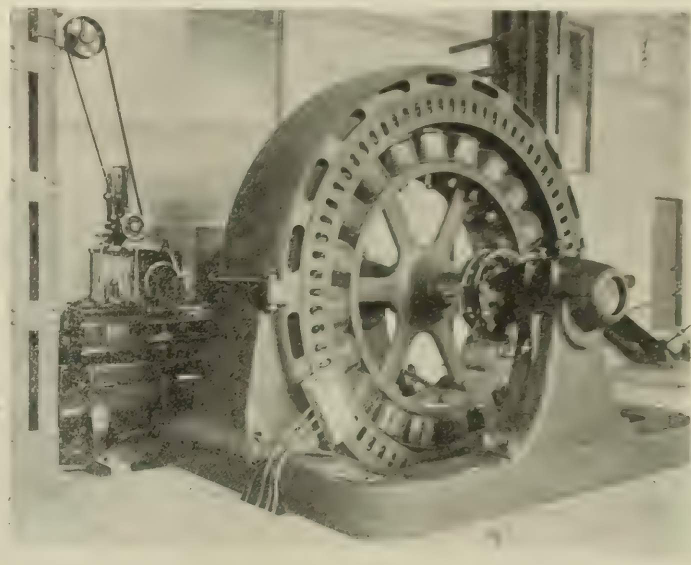


FIG. 2.—400-KW, THREE-PHASE, 2,400-VOLT, 30-CYCLE, 180 R. P. M., GENERATOR.

through the town. A right of way 400 feet wide was purchased through the town for the canal. The power house, which also serves the purpose of a dam, is at the lower end of the canal fronting on the river, and the turbines discharge directly into the river.

The canal and power house building are at present writing practically completed. Water wheels have been installed in more than half of the wheel pits, and four electric generators have been installed. Contracts for the electrical apparatus and installation are being carried out by the Stanley Electric Manufacturing Company, which company secured the contracts through the Michigan Electric Company, its Michigan agent, Mr. E. O. Sessions, construction engineer for the Stanley Electric Manufacturing Company, is in charge of his company's part of the work.

The water wheels were furnished by the Webster-Camp-Lane Company, of Akron, Ohio. There are four of these wheels in each unit, placed on a horizontal shaft, which shaft extends through a

water-tight joint in the bulkhead into the generator room, which is on the down-stream side of the power house. The turbine lies ordinarily submerged in water, and when in operation the four wheels discharge into one short central shaft tube. The gates for starting and stopping the wheels and for governing are located around the periphery of each turbine wheel. As the wheels are immersed directly in the water which drives them, and are not dependent upon columns of water confined in a pipe for supply, the governing can be very perfect, as there is so little trouble from the inertia of the moving column of water. The governing is to be by Lombard water wheel governors, and to vary the speed in order to obtain synchronism, electric motors controlled at the switchboard and changing the tension on the governor will be employed on the same principle as the synchronizing apparatus on steam engines. Six Stanley three-phase, 2,400-volt, 30-cycle alternators, to run at 180 r.p.m., are under contract, three of which have been installed. An old 60-cycle Westinghouse alternator has also been put on one of the wheels.

Mr. H. von Schon has been chief engineer of the undertaking. Mr. W. Owen Thomas is electrical engineer in charge of the electrical work, who designed many interesting electrical features to be described in a later issue.

At the present time the market for the company's electrical output is practically undeveloped but for one exception, mentioned later, and there is abundant power for industries desiring cheap electrical power to secure it at the Soo. The investment in the completed plant will be, it is announced, about $4,000,000, or $135 per kilowatt. This is not high as investments in water plants run, and the company ought to be able to make a very low rate. The exception referred to is the Union Carbide Company, which arranged before the power house was erected to take part of the building and output.

10,000-Volt Alternating-Current Locomotive.

ABOUT the time of the Zossen experiments we printed a description of the Siemens & Halske motor car used on the trials, written by the chief engineer of the company, Herr Walter Reichel. With this a speed of 96 miles per hour was repeatedly obtained, and on one occasion 99.5 miles. Owing to the insufficiency of the road-bed, higher speeds were not attempted.

The accompanying illustrations show a locomotive and some of its details, which has since been designed by Herr Reichel, and built by the same company, with the object to reduce weight. To this end transformers have been discarded and current supplied at the Zossen line voltage—10,000 volts direct to the motors. Instead of 96 tons, the new car weighs but 76 tons, including passengers, and the total horse-power has been reduced from 1,000 to about 920. The decrease in weight also facilitates starting.

For experimental purposes it was deemed advisable to build a locomotive rather than a motor car, and to employ gear to reduce the speed of the motors in the ratio of 2 : 1, the speed of the motors being 885 r. p. m. and that of the locomotive 100 kw per hour.

The underframe of the locomotive is of the double-truck construction, the axles and axle boxes being similar to those of the previous experimental car. The gauge is standard, and the wheels have a diameter of 49 inches (1,250 mm.) and conform in other respects with the standard dimensions of the Prussian State Railways. The wheel base of each bogey is 10 feet 8 inches (3¼ meters). Although only fitted with one motor each at present, there is room on each bogey for two. Fig. 4 is a general arrangement of the locomotive, with a pair of motors.

The design of the details of the motor are closely similar to those of motors for narrow-gauge track. It is necessary to make the utmost use of the space between the wheels, and the bearings are, therefore, placed within the space enclosed by the motor windings, as shown in Fig. 5. In order to keep the pressure on the two bearings equal, the motor shaft is geared at each end to the car axle, there being a narrow spur wheel at each end of the motor shaft instead of a wider one at one side only. Another reason for this arrangement is that not only the pressure on the teeth, but also the velocity of the teeth is exceptionally great. The latter amounts to about 59 feet (18 meters) per second, with 147 teeth in the larger wheel and 69 in the smaller wheel. The pitch is 1.41π inches (6π mm.), and the width of teeth 3.93 inches (100 mm.).

Previous to deciding on the system of lubrication, a number of experiments were tried with tooth velocities of 82 ft. (25 meters) per second. These demonstrated that it was not sufficient to fill the gear box with oil or grease and let the gear run in it, and consequently a system of forced lubrication with compressed air was adopted. By means of a pump, a pressure of air corresponding to 2 inches (5 cm.) of mercury is produced in the oil reservoir. This drives the oil out of the reservoir to a distributing cock, which is turned to the right or left according as the locomotive is to run for-

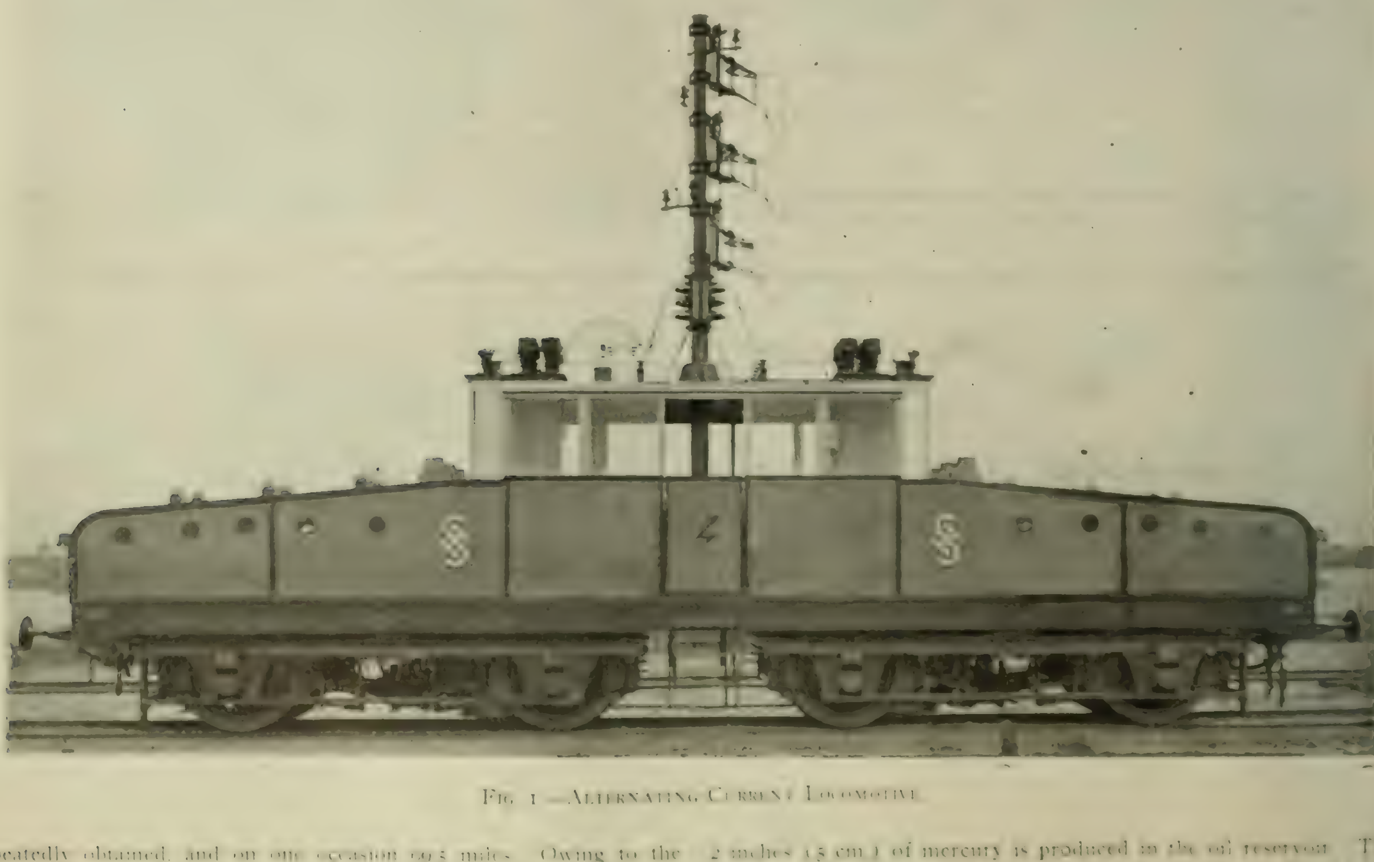


Fig. 1.—Alternating Current Locomotive.

wards or backwards. Thence the oil flows through one or other of two sets of pipes to the nozzles above or below the toothed wheel.

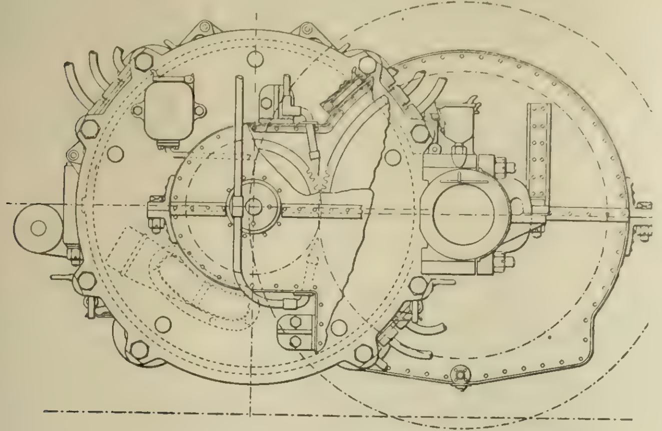


FIG. 2.—ELEVATION OF MOTOR AND GEAR CASE.

After the oil has been used, it collects at the bottom of the gear case, and is thence pumped by a hand or motor pump back to the oil reservoir. This system of lubrication is only necessary with a gear ratio of 2 : 1. If a ratio of from 1.35 to 1.4 is used, the velocities of the teeth are smaller, and the ordinary lubrication with grease is sufficient. The construction of the gear box is in other respects the ordinary one, as is also the suspension of the motor.

The motor case is of cast-steel, and is made in two parts. It is carefully turned inside—the internal diameter being 39 inches (990 mm.)—so that there is a firm bearing surface for the active iron, and a good conduction of heat through it. The bushes of the bearing are in one part, and of bronze lined with white metal. They are 11.8 inches (300 mm.) long and 3.9 inches (100 mm.) internal diameter, so that there should be little wear. This makes it possible to reduce the air-gap of the motor to 5/64 inch (2 mm.). The active iron which carries the primary winding is fastened into the motor case with screws. The rotor of the motor is fastened to the motor shaft by means of a special sleeve, so that the motor can subsequently be arranged on the car axle for direct driving. The active iron of the rotor is held together by a number of screws and pressure discs, and carries the secondary winding. On the rotor sleeve two collector rings are held by a second sleeve, and the current is collected from the rings by means of carbon brushes. There are three apertures in the upper casting of the motor case on the collector-ring side, to render possible the inspection of the motor within. The motor itself is lubricated by means of oil and wicks, the oil being contained in vessels screwed on to the motor, and communicating with the bearings by copper tubes, this arrangement having been rendered necessary by the small space available.

To obtain a better casting, the axle bearings are screwed on to the motor casing. On the other hand, the lugs which, with the assistance of the springs, transfer the weight of the motors and the turning movement to the underframe, are cast directly on to the motor casing.

In the first Siemens & Halske's Zossen motor car, described in the previous article above referred to, the primary winding of the motor was on the rotor. This is only feasible with bar winding, which is not applicable in this case owing to the high pressure. In this case, also, it is not necessary to construct the motor for a very high turning moment, as, in consequence of the smaller weight of the car, smaller starting torque is necessary. The rotor may, therefore, be of smaller diameter, and the primary winding can be placed on the stator. In order to afford as large a cooling surface as possible, the slots are made fairly deep, so that the coils are thin and wide. A calculation of the conditions of saturation of the active iron gave a

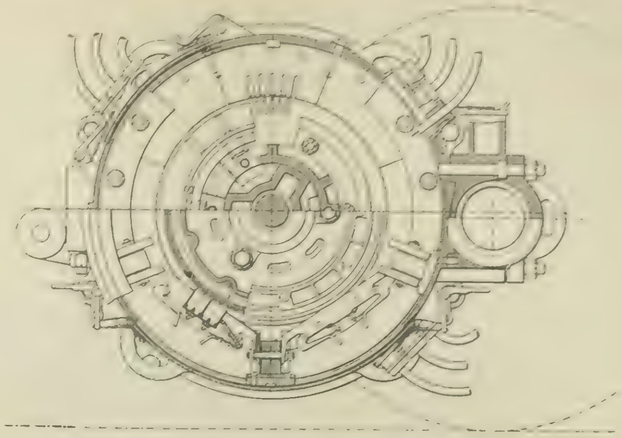


FIG. 3.—SECTIONAL ELEVATION OF MOTOR.

radius of about 13.8 inches (34 cm.) for a width of 11.8 inches (30 cm.). The cores of both stator and rotor consist of laminations, those for the rotor being stamped in one piece, and those for the

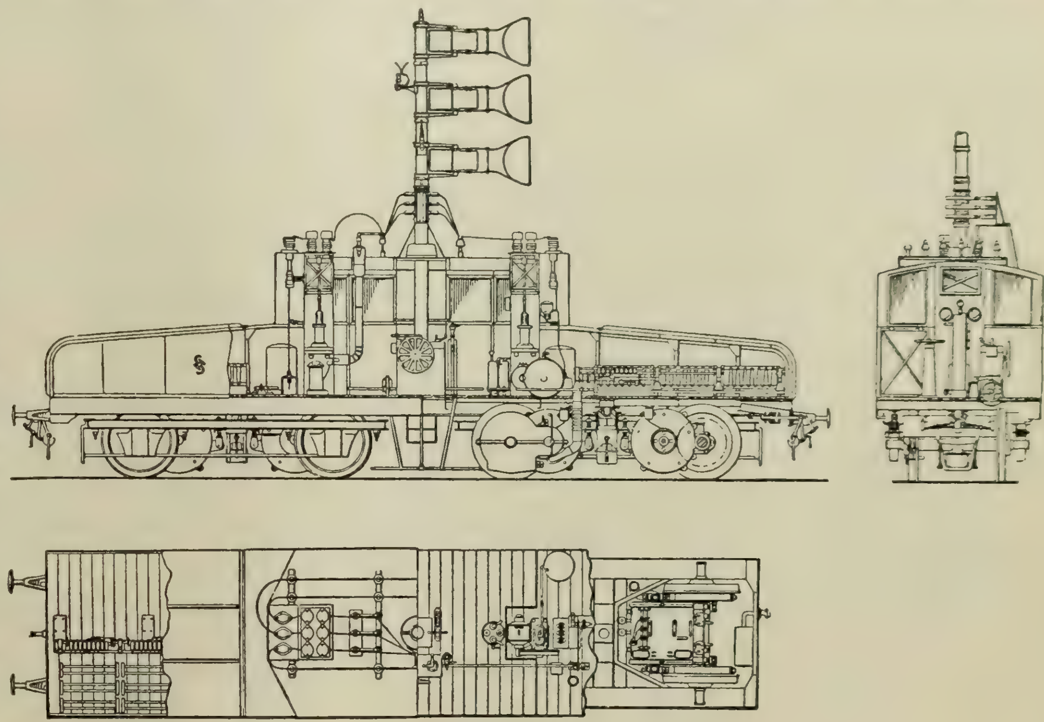


FIG. 4.—PLAN AND ELEVATIONS OF LOCOMOTIVE.

stator being made up of segments. The calculation for the winding gave 72 open slots, and 72 wires per slot of the primary. Star connection is employed, and the wires are placed in mica tubes. To save space and to secure certainty of insulation the coils are placed alternately in longer and shorter tubes, so the longer ends always lap over the shorter ones. By this means the possibility of sparking over from one phase to another is considerably reduced. The method of insulating the high-pressure winding was determined upon after several trials, in the final one of which the winding withstood a pressure of 22,000 volts without disclosing any sign of a fault.

The winding of the rotor is placed in 90 half-closed slots, and consists of a number of single flat copper bars arranged in series and four in each slot. It is a wave winding connected in star. The three free ends are connected to two slip rings and the frame of the rotor, respectively. At starting, the pressure in the rotor winding is 700 volts. The employment of bars for the rotor winding facilitates the addition of bronze binding wires, and also permits of a very effective ventilation. The air enters the neighborhood of the shaft and is directed outwards through the openings in the rotor casting by vanes which are cast on to the latter. This current of air also cools the stator coils. Tests have shown that the air pressure thus caused corresponds to several millimeters of water. The velocity of the air was about 19.6 feet (6 meters) per second, and about 4½ cubic feet (120 litres) of air was forced through per second. To prevent the

high-pressure sparking over when the motor gets warm, the inside of the frame is covered with a thick layer of mica wherever it is adjacent to the primary winding, and the distance of this winding from the frame is always kept as large as possible.

The leading-in of the three high-pressure cables is done with particular care. The cables, which are insulated to stand 15,000 volts, are led through three soft rubber brushes, which are placed inside hard rubber brushes. They end in the three terminals which are mounted on corrugated porcelain insulators attached to saddles which

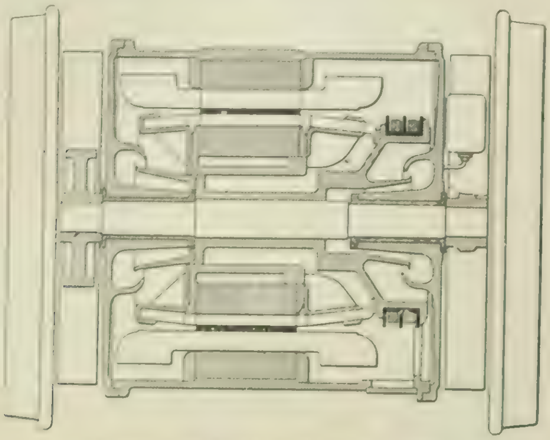


FIG. 5.—SECTIONAL VIEW OF MOTOR.

are supported on mica-insulated iron tubes fixed to the casing of the motor. The weight of the motor and gear is 9,000 lbs. (4,090 kg.).

Fig. 6 shows the connections of the motor and controller. With the exception of the resistances, nearly all the apparatus employed is similar to that used in the previous experimental car. The speed at starting is regulated by varying the resistance in the rotor or secondary circuit. This is insulated from earth, as the third secondary phase of the motor is connected to earth through the motor shaft, as already stated. The current to the stator coils passes from the main switch through fuses. As shown, the switch is driven by an air piston, and at the same time it serves as a reversing switch by charging the phases. The motor driving the pump for compressing the air is driven through a 10,000 : 110-volt transformer.

The rotor resistance has 24 steps, and the resistance coils are spirals of Kruppin wire, held by porcelain insulators on an iron frame, and presents no new features. A hand-wheel on a vertical spindle controls this resistance. The switches for the primary high-pressure circuit are of the tubular type, and, as already stated, are worked

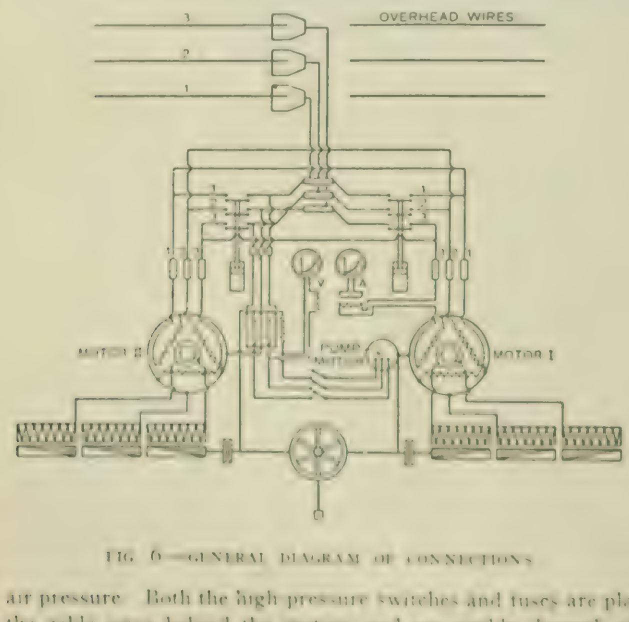


FIG. 6.—GENERAL DIAGRAM OF CONNECTIONS.

by air pressure. Both the high pressure switches and fuses are placed in the cable ways behind the motors, and are visible through glass windows.

When the locomotive was completed, tests were made at a gradually increasing pressure, starting at 6,000 volts and about 50 alternations. The final test was made at 11,000 volts and 95 alternations, and with a trailer weighing 31 tons, and a speed of 65 miles (105 km.) per hour was attained. The toothed gear ran fairly quietly, and the motor stood the high pressure. About 260 kw were developed. This corresponds to a load of about 280 hp on the driving wheels, which agrees with experience already obtained at 62 miles (100 kw) per hour.

The Armature Reaction of Alternators—II.

By C. F. GUILBERT.

CASE OF A SINGLE-PHASE ALTERNATOR.

IN order to simplify calculations, we will suppose that the current is entirely wattless—that is to say, in quadrature with the no-load voltage. The current in phase with the voltage at no-load gives rise to no mean direct magnetomotive force. One can, in fact, admit, as Blondel has proposed, that the total current can be decomposed in its two components, $I \sin \psi$ and $I \cos \psi$, ψ being the phase angle of the current with the no-load voltage.

We will retain the notation used previously, and referring to Fig. 1, let b^1 be the width of an armature coil from one axis to the other of the slots. The width, b^1, which we will take for the spreading of the poles, is not the width of the latter, but the width of the flux proceeding therefrom and entering into the armature, as has previously been explained.

We will calculate for each relative position the magnetomotive force due to the armature at all the points of the polar width, b, in assuming that this magnetomotive force varies suddenly from the quantity $N I \sqrt{2}$, along each axis of a slot. We will take the mean of this magnetomotive force at each point in order to obtain the mean magnetomotive force for the position considered. Finally, we will take the mean magnetomotive force during a half period or, more exactly, during a quarter period, which amounts to the same thing.

Let the current be expressed by $i = I_0 \cos \frac{\pi x}{a}$; x will thus designate the displacement of the axis of the inducing pole with respect to an axis of the induced pole.

We will suppose in order to fix ideas that the width b is superior to b^1; and the relative positions will be divided into three series.

1. $x < \frac{b - b^1}{2}$. As long as x is comprised between 0 and $\frac{b-b^1}{2}$ the induced coil remains in the interior of the space b; the mean magneto-motive force with relation to the surface $A\,B\,C\,D$ and width b is

$$N I_0 \cos \frac{\pi x}{a} \cdot \frac{b^1}{b}.$$

N being the number of turns of the coil or the number of conductors per slot.

2. If x is greater than $\frac{b-b^1}{2}$ but less than PQ, then $\frac{a-b}{2} + \frac{a-b^1}{2} = a - \frac{b+b^1}{2}$, the induced coil has partly left the space b, and the mean magnetomotive force is only

$$\frac{\text{surface } A\,B\,C\,D}{b} = N I_0 \cos \frac{\pi x}{a} \left[b^1 - \left(x - \frac{b-b^1}{2}\right)\right] \frac{1}{b}$$

$$= N I_0 \cos \frac{\pi x}{a} \left(\frac{b+b^1}{2} - x\right) \frac{1}{b}$$

3. Beyond the value $a - \frac{b+b^1}{2}$, of x, the space b comprises a part of the coil of a pole, which is the seat of an opposite magnetomotive force, and consequently additative to that of the inducing pole considered.

It is thus necessary to take the differences of the rectangles $A\,B\,C\,D$ and $A^1\,B^1\,C^1\,D^1$, whence

$$\frac{\text{surface } A\,B\,C\,D - \text{surface } A^1B^1C^1D^1}{b} = N I_0 \cos \frac{\pi x}{a} \left[b^1 - \left(x - \frac{b-b^1}{2}\right)\right] - \left[x - \left(\frac{a-b}{2} + \frac{a-b^1}{2}\right)\right] = N I_0 \cos \frac{\pi x}{a} (a - 2x) \frac{1}{b}$$

The mean magnetomotive force during a half period is obtained

then for an inducing pole having an apparent width b, by taking the sum

$$F_1 = \frac{2}{a}\left| \int_0^{\frac{b-b^1}{2}} N I_0 \cos\frac{\pi x}{a} \times \frac{b^1}{b}\, dx + \int_{\frac{b-b^1}{2}}^{a-\frac{b-b^1}{2}} N I_0 \cos\frac{\pi x}{a}\left(\frac{b+b^1}{2}\right.\right.$$

$$\left.\left. - a\right)\frac{dx}{b} + \int_{a-\frac{b+b^1}{2}}^{\frac{a}{2}} N I_0 \cos\frac{\pi x}{a}(a - 2x)\frac{dx}{b} \right|$$

To integrate the different impressions it suffices to assume $\frac{\pi x}{a} = y$. The mean magnetomotive force is then

$$F_i = \frac{2 N I_0}{\pi b}\left[b^1 \int_0^{\frac{b-b^1}{a}\frac{\pi}{2}} \cos y\, dy + \int_{\frac{b-b^1}{a}\frac{\pi}{2}}^{\pi - \frac{b+b^1}{a}\frac{\pi}{2}} \left(\frac{b+b^1}{2} - \frac{a y}{\pi}\right)\cos y\, dy + \right.$$

$$\left. \int_{\pi-\frac{b+b^1}{a}\frac{\pi}{2}}^{\frac{\pi}{2}} \left(a - \frac{2 a y}{\pi}\right)\cos y\, dy \right]$$

These integrations offer no difficulties but lead, all reductions being made, to particularly simple results, as follows:

$$F_i = \frac{4}{\pi^2}\,\frac{a}{b}\, N I_0 \sin\frac{b}{a}\,\frac{\pi}{2}\,\sin\frac{b^1 \pi}{a\, 2} \qquad (4)$$

or, by introducing $I_0 \sin\psi$ for the maximum wattless current, we have

$$F_i = \frac{4}{\pi^2}\cdot\frac{a}{b} N I_0 \sin\frac{b\pi}{a\,2}\,\sin\frac{b^1\pi}{a\,2}\,\sin\psi \qquad (5)$$

We have assumed $b > b^1$; the calculation leads to the same result when $b < b^1$, except when b is inferior to $a - b^1$, a condition evidently never met with. When each induced coil consists of several concentric coils, the formula is applied to each and the results added. As a particular case, if each pole has six slots, of which four only are utilized, we have

$$F_i = \frac{4}{\pi^2}\cdot\frac{a}{b} N I_0 \sin\frac{b}{a}\cdot\frac{\pi}{2} \times 0.836 \sin\psi \qquad (6)$$

N always representing the number of conductors per complete coil, or double the number of turns per pole. With eight slots, of which six are utilized, we have

$$F_i = \frac{4}{\pi^2}\cdot\frac{a}{b} N I_0 \sin\frac{b}{a}\,\frac{\pi}{2} \times 0.81 \sin\psi \qquad (7)$$

It may be objected that formula (5) does not take account of the width of the opening of the slots. It would be a simple matter to correct the formula to take into account this width by assuming that the induced ampere-turns decrease linearly from one edge of a slot to the other. The calculation leads readily to the following expression, β being the width of the opening:

$$\frac{\pi}{64} N I \left(\frac{\beta}{a}\right)^2 \sin\frac{b}{a}\cdot\frac{\pi}{2}\cos\frac{b^1}{a}\cdot\frac{\pi}{2} \qquad (8)$$

which should be added to the value as above determined of F_i. This expression shows that the correction may be neglected.

CASE OF A POLYPHASE ALTERNATOR

In the case of a polyphase machine, it is apparent that a calculation analogous to the preceding one can be made, but introducing the different phases in such a manner that their combined effect enters. It is evident that each phase will figure as if it alone were acting, since the integral of a sum is equal to the sum of the integrals of the different parts, and it will, therefore, be possible to divide the several integrals in three groups which will give the same sum. The expression in this case for the ampere-turns will thus be

$$F_i = m\frac{4}{\pi^2} N I_0 \frac{a}{b}\sin\frac{b}{a}\cdot\frac{\pi}{2}\sin\frac{b^1}{a}\cdot\frac{\pi}{2}\sin\psi \qquad (9)$$

assuming always that there are N turns per pole of the induced element. This amounts to saying that it is necessary to couple two by two the slots that are not adjacent to the same pole, thus constituting as many fictive slots, of which the width, b^1, will be introduced into the formula. Some examples will make this method clear.

1°. Take first the case of a three-phase alternator having one slot per pole and phase. We then have, if $2N$ is the number of turns per coil, N turns per pole; and since $b_1 = a$, we have

$$F_i = 3\frac{4}{\pi^2} N I_0 \frac{a}{b}\sin\frac{b}{a}\cdot\frac{\pi}{2}\sin\psi \qquad (10)$$

Designating by N the number of conductors per pole and per phase ($N_1 = 2N$).

$$F_i = \frac{3}{2}\cdot\frac{4}{\pi^2} N_1 I_0 \frac{a}{b}\sin\frac{b}{a}\cdot\frac{\pi}{2}\sin\psi \qquad (11)$$

2°. Next take the case of a three-phase alternator having two slots per pole and per phase. The two slots not adjacent to the same phase are distant $\frac{5}{6}a$, and consequently $b^1 = \frac{5}{6}a$; therefore, N, being the number of conductors per pole and per phase ($N_1 = 2N$), we have

$$F_i = \frac{3}{2}\cdot\frac{4}{\pi^2} N_1 I_0 \frac{a}{b}\sin\frac{b}{a}\cdot\frac{\pi}{2}\sin 75^\circ \sin\psi$$

$$= 0.588\, N_1 I_0 \frac{a}{b}\sin\frac{b}{a}\cdot\frac{\pi}{2}\sin\psi \qquad (12)$$

3°. With three slots per pole and per phase, it is readily seen that there is one coil of $\frac{N}{3}$ turns per pole and one of $\frac{2N}{3}$ turns. We thus have for the first $b^1 = a$, and for the second $b^1 = \frac{7a}{9}$, N_1 being equal to $2N$.

$$F_i = \frac{3}{2}\cdot\frac{4}{\pi^2} N_1 I_0 \frac{a}{b}\sin\frac{b}{a}\,\frac{\pi}{2}\left[\frac{1}{3}\sin\frac{\pi}{2} + \frac{2}{3}\sin 70^\circ\right]$$

$$\sin\psi = 0.584\, N_1 I_0 \frac{a}{b}\sin\frac{b}{a}\cdot\frac{\pi}{2}\sin\psi \qquad (13)$$

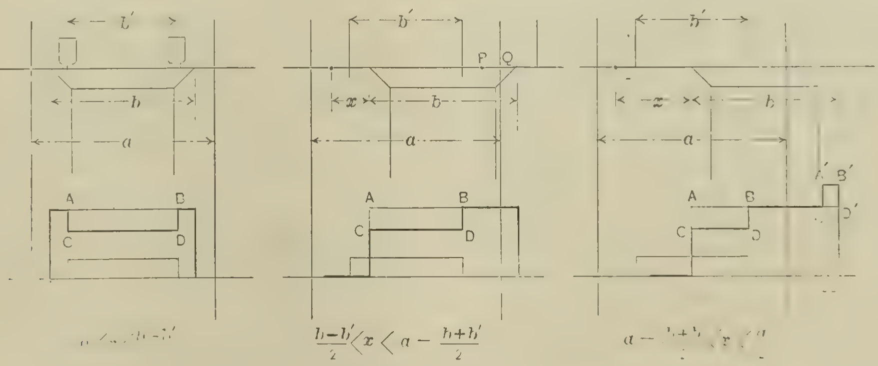


FIG. 1.—CASE OF A SINGLE-PHASE ALTERNATOR.

The Use and Advantages of the Alternating Current for Land Telegraphy—I.

By Edward F. Northrup.

MUCH theoretical and practical work has been done in the last few years in applying the alternating current to wire telegraphy. The public, however, has had little information concerning what has been accomplished. The purpose of this paper is to furnish some information and to describe and discuss the fundamental electrical principles involved in applying the alternating current to transmitting telegraphic signals, and in maintaining synchronous motion over long telegraph lines.

It is to the late Professor Henry A. Rowland, of Johns Hopkins University, Baltimore, Md., that are chiefly due the interesting and valuable results that have been accomplished in alternating current telegraphy. He first turned his attention to the matter of devising new methods in telegraphy in 1895 and devoted the greater portion of his time and thought to the subject until his death in April, 1901. The beautiful system known as the "Rowland Multiplex Printing Telegraph" is the result of his labors and genius. My purpose is not, however, to describe this particular telegraph system, but rather to discuss in a broad way the electrical principles involved, and the advantages to be derived by employing an alternating current on a telegraphic land line for maintaining synchronous motion and for trasmitting signals.

I shall not, therefore, describe any special devices or mechanical features employed by the Rowland or other telegraph systems. Anyone desiring to inform himself regarding the particular contrivances by means of which results, that I shall mention, have been accomplished, can obtain such information from United States patents recently granted for inventions in alternating current telegraphy.

In the ordinary telegraphic methods of the Morse, Wheatstone and other systems, current is supplied to the line only at the moment when a signal is being transmitted. This momentary signaling current may be made to flow in either direction by putting to the line either pole of the current source. Telegraphing with such reversed currents, where each current impulse produces a whole or a part of a signal, does not constitute the kind of alternating current telegraphy that we are about to consider.

In the above case to transmit the signal, current is supplied to the line which at other times may be without current. In true alternating-current telegraphy, on the other hand, a current is continuously maintained upon the line, and the sending of a signal is accomplished by cutting out, or modifying in some manner, one or more of the alternating-current waves. Curiously enough, as will later appear, two signals can be simultaneously transmitted, by this latter system, at a moment, when there is no current flowing on the line.

Most of the results which have been obtained by the use of an alternating current on the line have, also, been accomplished by using a pulsating current, which rises to a maximum value and falls to zero with periodic regularity. Such a current is, in fact, only an alternating current which has been modified, by having added to it a direct current, of value equal to the maximum value above zero of the wave of the alternating current. I shall, however, confine myself to a discussion of the use of the alternating current proper. For telegraphic purposes this current is equally effective, however produced, and whatever may be the form of its waves. A direct current, which is periodically reversed, with sufficient rapidity, by means of commutating devices serves in practice quite as well as an alternating current of pure sine wave form. However, by assuming the current to have a sine wave form, a discussion of the manner in which the current is propagated in a long telegraph line is rendered much easier.

The ultimate perfection of any system must be chiefly dependent upon the theoretical possibilities of the signaling capacity of the line current that is employed. The ingenuity and the perfection of the electrical and mechanical devices of any system must, finally, be of small relative importance compared with this. We are thus led to inquire how an alternating current flows in very long lines, such as are used in telegraphy. And the following problems, as being of most immediate consequence, ought to be considered.

What is the greatest practical length of an overhead telegraph line, as lines are at present constructed, over which it is possible to transmit clear signals; first, when the line is not duplexed, and, second, when duplexed signaling is maintained?

In what manner, and to what extent, can the construction of present lines be modified so as to increase the length of transmission?

In what manner, and how rapidly, can signals be impressed upon the line current?

In discussing the above and other questions which will arise, it is not necessary to consider how the signals are translated after being received, and it is entirely needless to consider the special character of any of the local apparatus, which is not directly in circuit with the line. In order, however, to bring the questions to be considered into more definite form I shall assume, that sufficient current is received at the end of the line to maintain in rapid vibration the tongue of a polarized relay, connected in series with the line. Practical tests show, that for this purpose, the received current should be about 25 milliamperes. As will be shown later, if the tongue of such a relay can be kept by the alternating-line current in rapid vibration, perfect synchronous motion can be maintained between the moving apparatus at the two ends of the line, and signals can be transmitted at great rapidity, and can be automatically translated into any desired form, such as Morse signals or printed characters.

In telegraphy a single line wire with ground return is invariably used. When a line is several miles long and a periodic e. m. f. is continuously applied at one end, the current which flows in the line varies in phase and in intensity from point to point of the line. The various relations of the currents, the e. m. f.'s and their phases can, however, be accurately investigated by mathematical analysis.

Every telegraph line has four constants, none of which can be

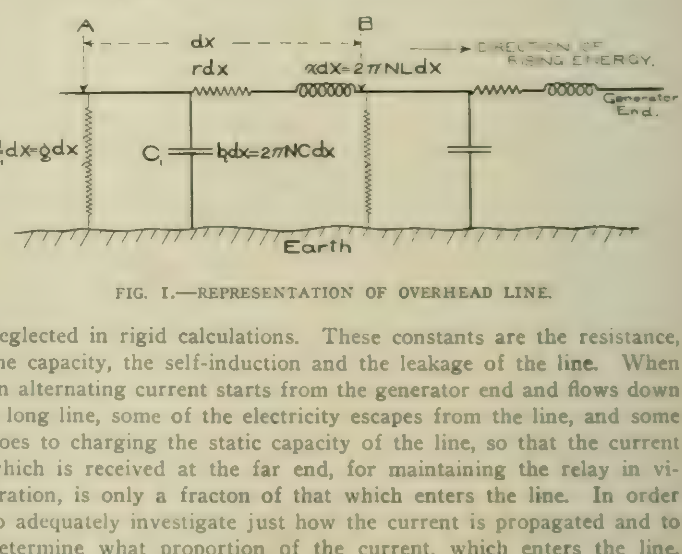


FIG. I.—REPRESENTATION OF OVERHEAD LINE.

neglected in rigid calculations. These constants are the resistance, the capacity, the self-induction and the leakage of the line. When an alternating current starts from the generator end and flows down a long line, some of the electricity escapes from the line, and some goes to charging the static capacity of the line, so that the current which is received at the far end, for maintaining the relay in vibration, is only a fracton of that which enters the line. In order to adequately investigate just how the current is propagated and to determine what proportion of the current, which enters the line, will reach the far end, and serve for transmitting signals, it is necessary to resort to a mathematical analysis of the manner of flow of alternating currents in long lines.

The fundamental equations, necessary to a complete discussion of the subject, have been beautifully derived by Mr. Steinmetz and are to be found on page 169 in his book, "Alternating Current Phenomena." He has, however, only applied these equations to the discussion of problems relating to power transmission lines. I shall make free use of his analysis and results, in obtaining expressions convenient to use in the discussion of alternating current telegraph problems.

In Fig. 1 a portion of a single overhead line is symbolically represented. Let the section A to B be a differential element of the line. For such a line there are four constants that must be considered: These constants per unit length of the line are the resistance, r, the reactance, $x = 2\pi N L$, where N is the frequency and L the self-induction per unit length of the line, the conductance, $g = \frac{1}{r_1}$ where r_1 equals the resistance of the insulation per unit length of line, and the susceptance, $b_c = 2\pi N C$, where C equals the static capacity against ground per unit length of line.

Consider X positive when measured in the direction of rising energy, that is, towards the generator end of the line. In the above line, e. m. f. is consumed by the resistance, which is in phase with

the current, the e. m. f. consumed in the element, dX being $I\,r\,dX$ where I is the current. E. m. f. is also consumed by the reactance, x, of the line.

This e. m. f. is in quadrature with the current, and the portion consumed in the element dX is $-j\,I\,x\,dX$, where $j=\sqrt{-1}$, and symbolizes rotation of the vector through 90 degs. Then the total e. m. f. consumed in the element, dX, is,

$$dE = I\,(r - j\,x)\,dX \quad \text{.......................} (1)$$

In the element dX there are likewise two sources of current consumption. Current will leak out of the element, dX, through the insulation equal to $\frac{E}{r_1}\,dX = E\,g\,dX$, and this current will be in phase with the e. m. f. Current will also flow into the condenser C_1, that is, be consumed by the capacity of the line, and will be 90 degs. ahead of the e. m. f. This current will equal $-j\,E\,b_c\,dX$. The total consumption of current in the element then is,

$$dI = E\,(g - jb_c)\,dX \quad \text{......................} (2)$$

We derive from (1) and (2), by differentiation, the two following differential equations, which have the same general form and express all the relations of the current and the e. m. f. in a long alternating-current line, having resistance, leakage, self-induction and distributed capacity.

$$\frac{d^2E}{dX^2} = E\,(r - j\,x)\,(g - j\,b_c) \qquad (3)$$

$$\frac{d^2I}{dX^2} = I\,(r - j\,x)\,(g - j\,b_c) \qquad (4)$$

For the method of solving these equations the reader must be referred to Mr. Steinmetz' book, "Alternating Current Phenomena," pages 167-169. I have carefully verified the solutions there given. They are:

$$E = \frac{-1}{g - jb_c}\left\{(A\varepsilon^{\alpha X} - B\varepsilon^{-\alpha X})\cos\beta X - j(A\varepsilon^{\alpha X} + B\varepsilon^{-\alpha X})\sin\beta X\right\} (5)$$

$$I = \frac{1}{\alpha - j\beta}\left\{(A\varepsilon^{\alpha X} + B\varepsilon^{-\alpha X})\cos\beta X - j(A\varepsilon^{\alpha X} - B\varepsilon^{-\alpha X})\sin\beta X\right\} (6)$$

In these solutions A and B are the two constants of integration. Their values can always be determined for particular cases. We will determine them for the special cases we have to consider, but must refer the reader again to Steinmetz for a discussion of the general methods of determining the constants.

α and β are two symbols introduced into the equations merely as abbreviations. Their values are:

$$\alpha = \sqrt{\tfrac{1}{2}\left\{\sqrt{(r^2 + x^2)(g^2 + b_c^2)} + (g\,r - x\,b_c)\right\}} \qquad (7)$$

$$\beta = \sqrt{\tfrac{1}{2}\left\{\sqrt{(r^2 + x^2)(g^2 + b_c^2)} - (g\,r - x\,b_c)\right\}} \qquad (8)$$

Equations (5) and (6) can be made to express the relations of the current and e. m. f. in a line with ground return, or a double line feeding into any kind of receiver circuit. For problems relating to telegraphy, however, very much simplified solutions can be derived by making the assumption that the line is a single wire and feeds directly into the ground which serves as the return circuit. The telegraph line in reality has relays in circuit with it at each end, but, their disturbing influence upon the flow of the current, as expressed in the equations used, is small, and their influence may be neglected in arriving at the solutions of the problems before us.

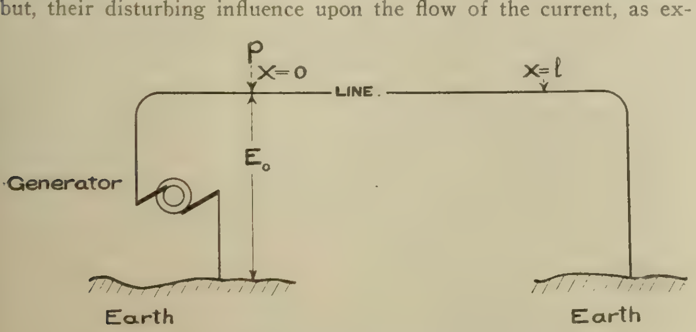


FIG. 2.—LINE CARRYING ALTERNATING CURRENT.

We have first to inquire what are all the relations of intensity and phase, of both current and e. m. f., in a long telegraph line carrying an alternating current and grounded at its far end. Let Fig. 2 represent such a line.

Equations (5) and (6) assume that X is counted positive in the direction of rising energy, that is, towards the generator. Since the measurements on a telegraph line for determining the values of the constants A and B are most conveniently made near the generator end of the line, it will be preferable to count X positive in the direction of decreasing energy, and to arbitrarily select some point, p, as the beginning of the line where $X = O$. If we do this, X, in equations (5) and (6) will change into $-X$, and the equations will become

$$E = \frac{1}{g - jb_c}\left\{(A\varepsilon^{-\alpha X} - B\varepsilon^{\alpha X})\cos\beta X + j(A\varepsilon^{-\alpha X} + B\varepsilon^{\alpha X})\sin\beta X\right\} (9)$$

$$I = \frac{1}{\alpha - j\beta}\left\{(A\varepsilon^{-\alpha X} + B\varepsilon^{\alpha X})\cos\beta X + j(A\varepsilon^{-\alpha X} - B\varepsilon^{\alpha X})\sin\beta X\right\} (10)$$

To completely solve equations (9) and (10) and obtain numerical values it is only necessary to know the values of the four constants, $r, g, x,$ and b_c of the line; its length from the point p to where it is grounded and the potential difference between the line and ground at the point, p, where $X = O$. Assume the e. m. f. at the point $X = O$ as the zero vector. Since by giving X the value O in equation (9)

$$E = E_0 = \frac{1}{g - jb_c}\,(A - B)$$

$$A - B = E_0\,(g - j\,b_c) \qquad (11)$$

The phases of the current and e. m. f. begin to repeat themselves, and the line is said to be one wave length long, if $X = \frac{2\pi}{\beta}$. Let the line be assumed to have this length. Then, as it is put to earth, at its end, $E = O$ when $X = \frac{2\pi}{\beta}$ and equation (9) gives

$$E = O = \frac{1}{g - jb_c}\left(A\varepsilon^{-\frac{2\alpha\pi}{\beta}} - B\varepsilon^{\frac{2\alpha\pi}{\beta}}\right)$$

whence,

$$A\varepsilon^{-\frac{2\alpha\pi}{\beta}} = B\varepsilon^{\frac{2\alpha\pi}{\beta}} \qquad (12)$$

From the relations (11) and (12) we derive

$$A = \frac{E_0\,(g - j\,b_c)}{1 - \varepsilon^{-\frac{4\alpha\pi}{\beta}}} \qquad (13)$$

$$B = \frac{E_0\,(g - j\,b_c)}{\varepsilon^{\frac{4\alpha\pi}{\beta}} - 1} \qquad (14)$$

Substitute the values of A and B in equations (9) and (10) and we obtain

$$E = E_0\left\{\left(\frac{\varepsilon^{-\alpha X}}{1 - \varepsilon^{-\frac{4\alpha\pi}{\beta}}} - \frac{\varepsilon^{\alpha X}}{\varepsilon^{\frac{4\alpha\pi}{\beta}} - 1}\right)\cos\beta X - j\left(\frac{\varepsilon^{-\alpha X}}{1 - \varepsilon^{-\frac{4\alpha\pi}{\beta}}} + \frac{\varepsilon^{\alpha X}}{\varepsilon^{\frac{4\alpha\pi}{\beta}} - 1}\right)\sin\beta X\right\} \qquad (15)$$

$$I = \frac{E_0\,(g - j\,b_c)}{\alpha - j\beta}\left\{\left(\frac{\varepsilon^{-\alpha X}}{1 - \varepsilon^{-\frac{4\alpha\pi}{\beta}}} + \frac{\varepsilon^{\alpha X}}{\varepsilon^{\frac{4\alpha\pi}{\beta}} - 1}\right)\cos\beta X + j\left(\frac{\varepsilon^{-\alpha X}}{1 - \varepsilon^{-\frac{4\alpha\pi}{\beta}}} - \frac{\varepsilon^{\alpha X}}{\varepsilon^{\frac{4\alpha\pi}{\beta}} - 1}\right)\sin\beta X\right\} \qquad (16)$$

Equations (15) and (16) are complete solutions for the e. m. f. and current in a line one wave length long, grounded at the far end and where the e. m. f., E_0, at the beginning of the line is known. The forms, however, of equations (15) and (16) lead to rather lengthy calculations in obtaining numerical values. The constant, B, in the case of a line one wave length long, grounded at the end, is very nearly equal to zero, and if the line were infinitely long would exactly equal zero. To a close approximation B can be con-

sidered equal to zero and equations (15) and (16) will reduce very much. Then $1 - \epsilon^{-\frac{4a\pi}{\beta}}$ is very nearly equal to 1, and $\frac{\epsilon^{aX}}{\epsilon^{\frac{4a\pi}{\beta}} - 1}$ nearly zero. Then we can write,

$$E_1 = E_0 \epsilon^{-aX} (\cos \beta X + j \sin \beta X) \quad (17)$$

and

$$I_1 = E_0 \epsilon^{-aX} \frac{\beta}{r} \ldots (\cos \beta X - j \sin \beta X) \quad (18)$$

Equations (17) and (18) are easily applied to calculating numerical values when the values of the line constants are calculated, assumed, or experimentally measured. We proceed to obtain numerical values and to plot curves for a telegraph line of No. 9 hard-drawn copper wire. We will assume this line to be 20 feet above ground on poles by itself. We will take the kilometer as the unit of length. The effective resistance, which should strictly be taken to include all energy losses due to consumption of e. m. f. in phase with the current, may here with sufficient exactness be taken as the ohmic resistance per kilometer length of line. Its value will then be $r = 2.672$ ohms. The insulation resistance of the line, r_1, we will assume to equal one megohm per kilometer.

Hence $g = \frac{1}{r_1} = \frac{1}{10^6} = 10^{-6}$, $x = 2\pi N L$, where N is the frequency or number of complete periods of the current per second, and L the self-induction of the line per kilometer. Practice has shown that, for printing telegraphy, the best results are obtained when $N = 100$. The value of the self-induction may be calculated from the formula, $L = 2 \times 10^{-4} \log_\epsilon \frac{4D}{\delta}$ henrys per kilometer, where δ equals diameter of conductor, D equals height of wire above ground. Assuming $D = 20$ feet we derive $L = .0018$ henrys per kilometer. Whence $x = 1.13$.

The constant $b_c = 2\pi N C$, where C is the static capacity of the line against ground per kilometer of length. It may be calculated by the formula,

$$C = \frac{.111 \times 10^{-6}}{2 \log_\epsilon \frac{4D}{\delta}}$$

farads per kilometer.

For No. 9, wire 20 above ground $C = .0062 \times 10^{-6}$. Whence $b_c = 3.89 \times 10^{-6}$. Having the values of the four line constants we obtain for the values of a and β, page —,

$a = 2.23 \times 10^{-4}$

$\beta = 2.59 \times 10^{-3}$

Since we have chosen the line to be one wave length long, its length is $\frac{2\pi}{\beta} = \frac{6.283}{2.59 \times 10^{-3}} = 2425$ kilometers or 1,515 miles.

With these numerical values for the constants of the line I have given numerical values to the constant terms of the exact equations (15) and (16) and obtained

$$E = E_0 \{(1.00002045 \epsilon^{-aX} - .00002045 \epsilon^{aX}) \cos \beta X + j (1.00002045 \epsilon^{-aX} - .00002045 \epsilon^{aX}) \sin \beta X\} \quad (19)$$

$$I = 10^{-4} E_0 \{[(105 \epsilon^{-aX} + .00215 \epsilon^{aX}) \cos \beta X - (52 \epsilon^{-aX} - .00106 \epsilon^{aX}) \sin \beta X] + j [(52 \epsilon^{-aX} - .00106 \epsilon^{aX}) \cos \beta X + (105 \epsilon^{-aX} - .00215 \epsilon^{aX}) \sin \beta X]\} \quad (20)$$

If in general $I = K(a + jb)$, the absolute value of I is $K\sqrt{a^2 + b^2}$ and the phase of I is $\phi = \tan^{-1} \frac{b}{a}$.

With aid of equations (19) and (20) (though the approximate equations (17) and (18) would have served as well for practical purposes) I have plotted (4) curves, calculating 25 points for each curve.

Curve No. 1 gives the intensity of the e. m. f. at all points along the line assumed to be one wave length long (2,425 kilometers).

The values of the e. m. f. as given by the curve are to be multiplied by the e. m. f. given to the line at its generator end to obtain the actual absolute values.

Curve No. 2 gives the relative values of the current at all points of the line. To get the absolute values, the values as given by the curve must be multiplied by $E_0 10^{-5}$. Thus if E_0 is made 100 volts the current at the beginning of the line is 117 milliamperes.

Curve No. 3 gives the phase, in degrees, of the e. m. f. at all points of the line, its phase at the beginning of the line being taken as the zero vector. Curve No. 4 gives the phase in degrees of the current at all points of the line, the phase of the e. m. f. at the beginning of the line being retained as zero vector.

Equations (15) and (16) or the approximate equations (17) and (18), and curves Nos. I., II., III. and IV., contain much information regarding the possibilities of telegraphing long distances with alternating currents.

Referring to curve No. 2 we note that the current has decreased

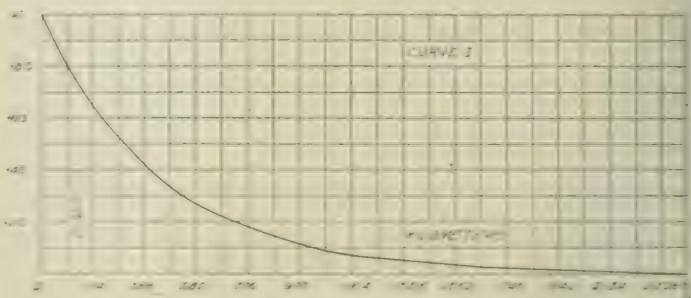


FIG. 3.—INTENSITY OF E. M. F.

to half the value which it has at the beginning of the line, in the first 310 kilometers or in about 194 miles. It has decreased to one-tenth of its initial value at a point about 1,028 kilometers, or 643 miles from the beginning of the line. At a distance of one wave length, or 2,425 kilometers, or 1,515 miles, the value of the current is only about $\frac{1}{117}$th of its initial value. But as the current at any point of the line will always be proportional to the e. m. f. applied

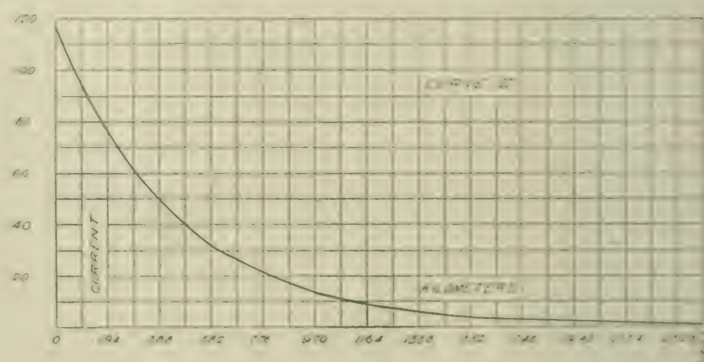


FIG. 4.—RELATIVE VALUE OF CURRENTS.

at the beginning of the line (as appears from equation 20) it is possible, by using a sufficiently high initial e. m. f., to deliver a current of any desired value, within limits suggested by line insulation, etc., to the end of a line even much longer than the one here considered.

The problem of how far it is possible to signal or telegraph with the alternating current, is seen by having regard to the above facts

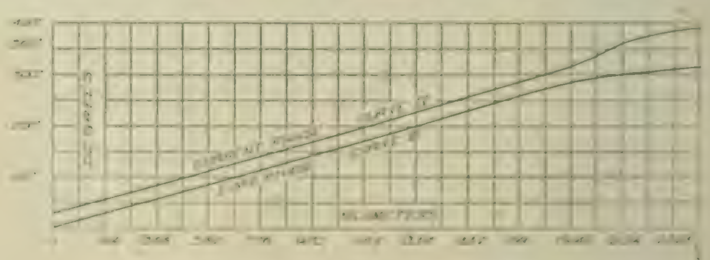


FIG. 5.—PHASES OF E. M. F. AND CURRENT.

respecting the flow of the current, to divide itself into two distinct problems.

The first is, how can signals be sent over a simplex line, that is a line in which the signaling is only carried on in one direction at a time, there being no balanced or duplexed relays. The second problem is, how can signaling be carried on over a duplexed line, that is, a line in which signals are being sent simultaneously in opposite directions at the same time, a balanced or duplexed relay being in circuit with the line at each end, and each end of the line being supplied with a current source. We will consider the latter case first. Let a duplexed line be represented in Fig. 6.

Here (A) and (B) represent each a polarized differentially wound relay at opposite ends of the line, (D) and (D_1) alternating current generators or any other source of periodically alternating e. m. f.

(T) and (T_1) transmitters for breaking the line and cutting out or modifying in some manner the half waves of the alternating current for the purpose of signaling. a and a_1 are artificial lines with which to balance the relays (A) and (B). a is first adjusted so that when (T_1) puts the other end of the line to earth the current from (D) will not in the least effect relay (A). Then a_1 is adjusted, with the line at the opposite end put to earth, by means of (T) so that the current from (D_1) will not effect the relay (B).

When these adjustments can be accurately made, the duplexed line is balanced, and an operator at either end of the line can, by operating his transmitter effect the relay at the opposite end without effecting the relay at his own end. If, temporarily, it be assumed that a signal is impressed upon the alternating current by cutting out one of its half waves, then when (T) sends a signal to (B), the tongue of (B), which ordinarily vibrates continuously, from the continuously flowing alternating current, comes momentarily to rest. This pausing of the tongue of (B) is the form in which the signal sent from (T) is received at (B). At the same instant (T_1) can likewise send a signal in the same manner to (A), the signal being primarily received in the form of a momentary pause in the vibration of the tongue of (A). Thus, as previously stated, two signals may be simultaneously transmitted at the same instant when there is no current on the line, the line being put directly to earth at both ends at the same instant the signals are being received.

It will now be understood that the length of line over which duplex working can be maintained will depend upon how well the relays can be balanced at each end of the line. The two relays, one at each end, must be kept so accurately balanced that the cutting of the current off one end of the line will effect the relay at the

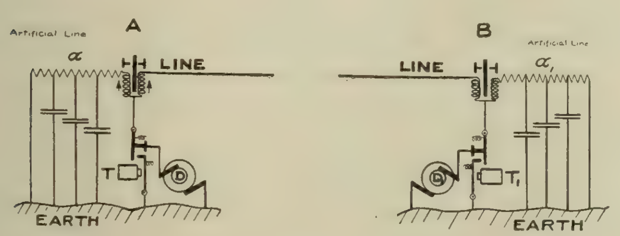


FIG. 6.—DUPLEXED LINE.

opposite end of the line far more than any accidental disturbances, or the current from the dynamo at its own end, effects it.

Thus if 7 units of the current from the dynamo (D) traverse the coils of relay (A) and 1 unit of current reaches (A) from the dynamo (D_1), (A) must be dead to the 7 units of current from (D) and vibrate from the 1 unit of current received from (D_1). When the current from (D_1) is cut off the tongue of (A) must practically cease to vibrate. Now, it becomes in practice, rapidly more difficult to accurately balance the duplex line as the line grows longer, or, more properly speaking, as the ratio of the current received at one end of the line to the current sent into the opposite end of the line, grows smaller. Only actual experience in working with lines will tell how small it is feasible for this ratio to be. If the ratio of received current to current sent is 1 to 6, experience shows that the line may be duplexed with considerable ease. For a line like that for which curve No. 11. was plotted a ratio of 1 to 6 would correspond to about 815 kilometers, or 510 miles. Such a distance is easily worked over duplex. If the ratio is as small as 1 to 10 it would be found quite difficult to maintain the relays sufficiently well balanced for continuous good working. If the relays are made less sensitive, then they are not sensitive to signals transmitted, and if their sensitiveness is increased they show a small lack of balance and are easily effected by slight line disturbances. Thus no change in the form of the relays can be made to increase the possible distance of duplex working. As a ratio of 1 to 10 is probably the extreme practical working limit, we have for a line of No. 9 copper wire, like that for which curve No. 2 was plotted, 1,028 kilometers, or 643 miles, as about the limit of practical duplex working with alternating currents of frequency 100. It should be parenthetically stated, that automatic relaying is perfectly feasible with alternating current telegraphy.

Underground Work for Telephone Exchanges—X.

By ARTHUR V. ABBOTT, C. E.

TABLE No. 7 enumerates the probable prices for the various forms of duct material laid into place, calculated in a manner similar to the preceding tables, including a percentage column showing the effect of each item upon the total expense.

TABLE NO. 6.

Constant Cost per Conduit Foot in Dollars.

Item.	Minimum Cost	Minimum Per Cent.	Average Cost	Average Per Cent.	Maximum Cost	Maximum Per Cent.
1 to 9 ducts.						
Excavation	.105	32.6	.1575	23.4	.210	13.0
Paving	.695	21.2	.185	27.5	.279	17.4
Engineering	.05	15.2	.08	11.9	.12	7.5
Removal of obstacles ...	.10	32.0	.25	37.2	1.00	62.1
Total	.3245	100.0	.6725	100.0	1.609	100.00
10 to 16 ducts.						
Excavation	.16	38.6	.24	29.1	.32	17.0
Paving	.0845	20.2	.222	27.0	.3315	17.7
Engineering	.05	12.1	.08	9.8	.12	6.5
Removal of obstacles....	.12	29.1	.28	34.1	1.10	58.8
Total	.4145	100.0	.822	100.0	1.8715	100.0
17 to 25 ducts.						
Excavation	.225	43.0	.3375	32.8	.45	19.2
Paving	.0970	18.6	.26	25.3	.52	22.2
Engineering	.05	9.6	.08	7.8	.12	5.1
Removal of obstacles....	.15	28.8	.35	34.1	1.25	53.5
Total	.522	100.0	1.0275	100.0	2.34	100.0

From the data thus collected, the total cost of a conduit of any size is readily determined by taking first the cost per foot of street for manholes and sewer connections; second, the cost of the constant street items as given in Table No. 5, depending upon the number of ducts, and, third, the cost per duct foot, determined from Table No. 6, multiplied by the number of ducts to be laid, and

TABLE NO. 7.

Cost of Duct Material in Place in Dollars.

Item.	Minimum Cost	Minimum Per Cent.	Average Cost	Average Per Cent.	Maximum Cost	Maximum Per Cent.
Hollow brick.						
Duct material	.02	44.4	.035	36.8	.05	34.5
Placing	.005	11.2	.01	10.5	.015	10.3
Encasement	.02	44.4	.05	52.7	.08	55.2
Total	.045	100.0	.095	100.0	.145	100.0
Multiple Duct.						
Duct material	.035	67.5	.05	50.0	.065	46.7
Placing	.011	2.2	.0025	2.5	.004	2.9
Encasement	.015	30.3	.0475	47.5	.07	50.4
Total	.051	100.0	.10	100.0	.139	100.0
Cement Lined Pipe.						
Cement Pipe.						
Wood Pulp.						
Duct material	.04	62.5	.06	53.6	.08	48.2
Placing	.002	3.2	.004	3.4	.006	3.6
Encasement	.022	34.3	.05	43.0	.088	48.2
Total	.064	100.0	.114	100.0	.166	100.0
Creosoted Wood.						
Duct material	.04	98.04	.05	98.0	.06	95.0
Placing	.0008	1.96	.0015	3.0	.003	5.0
Encasement	.00	0.00	.00	0.0	.00	0.0
Total	.0408	100.00	.0515	100.0	.063	100.0

adding these three items together, giving immediately the total cost per conduit foot.

The use of these tables as described will give a more accurate, though somewhat more laborious estimate of cost of conduit construction than it is possible to gain by single assump-

tion of price per duct foot or per conduit foot, as would be necessitated by a cost exhibition in a single tabular or graphical form.

The cost of conduit construction is constantly and steadily decreasing, owing to improvement and cheapening in the manufacture of materials employed, natural competition tending to decrease prices, and increasing experience and skill in designing and building work of this character. Consequently actual conduit costs derived from experience are likely to be higher than would now be required to reconstruct the same system from which they were obtained. Nevertheless, graphical tables, Figs. 52, 53, 54 and 55, are given indicating average and maximum costs of construction of a number of large systems of conduit from actual experience. Fig. 52 shows average costs per conduit foot. Four lines will be found in this table, applying respectively to conduits from 1 to 9 ducts, 10 to 16 ducts, 17 to 25 ducts and 26 to 36 ducts. The horizontal scales at the top and bottom of these sheets indicate the number of

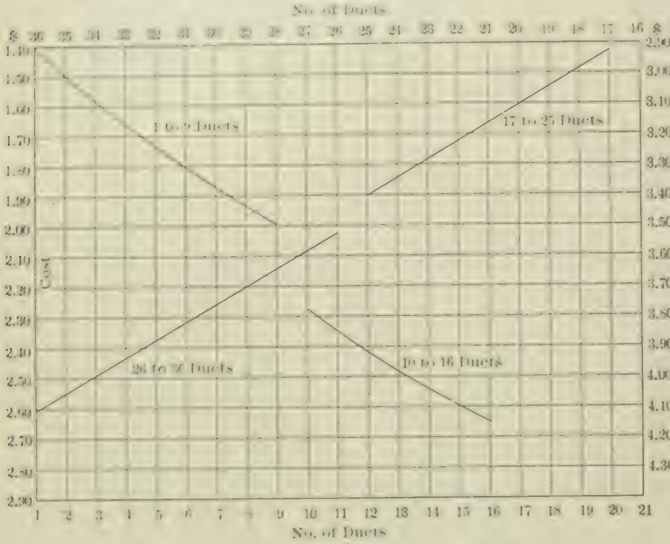


FIG. 52.—COST PER CONDUIT-FOOT; AVERAGE.

ducts, while the vertical scales at the right and left hand sides respectively give the cost per conduit foot. Fig. 53 is a similar table showing maximum prices. Fig. 52 is likely to apply to the middle and outer portions of large cities of, say, 200,000 in-

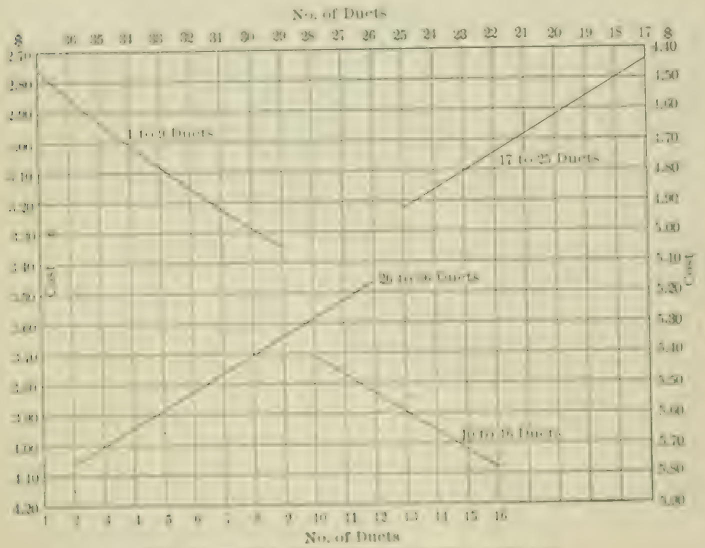


FIG. 53.—COST PER CONDUIT-FOOT; AVERAGE.

habitants or over, where street obstructions are not numerous, and where work can be carried on at usual hours without severe interruption to traffic. Fig. 53 indicates cost in the central portions of similar cities, where obstacles are numerous, and where work must be prosecuted at irregular hours, owing to the impossibility of traffic interruption.

Figs. 54 and 55 are transformations of tables Figs. 52 and 53, showing cost per duct foot, and are the reciprocals of Figs. 52 and 53.

It has been shown that a large proportion of the cost of conduit construction is independent of the number of ducts installed. It is then a pertinent question as to how many ducts can be economically placed in a conduit system when future probable demands are considered. Evidently, if at any future time the conduit system must be increased, the expense of the removal of the paving, excavation and replacement of the street surface must be completely repeated. The cost of the manholes will not need to be reincurred in full, though a certain expense must be allowed to provide for opening the side walls of the manholes and build in the new ducts. If ducts are installed which are not needed for a long period of time, the interest upon the capital invested in their installation, the inevitable depreciation, the cost of maintenance necessary to keep them in good condition will form an annual charge against them. The sum of these items must be contrasted with the cost of opening the street and placing ducts at such future time as will call for increased conduit capacity. If in any instance the probable time elapsing before additional conduit capacity will be needed can reasonably be estimated, the cost of the superfluous ducts placed when the system

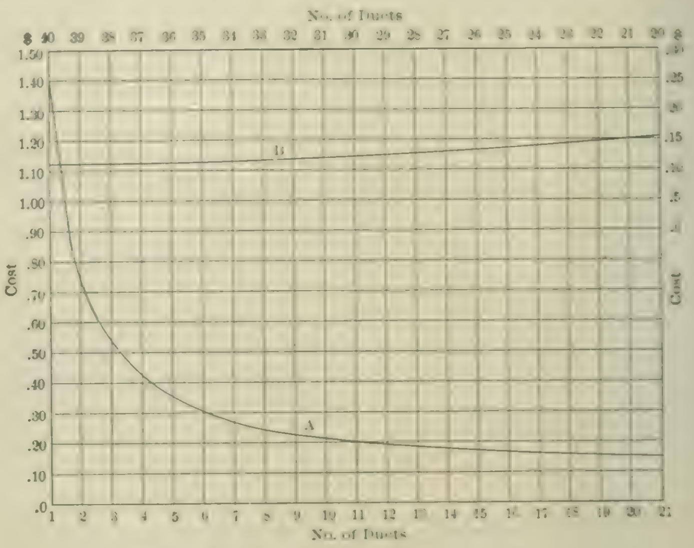


FIG. 54.—COST PER DUCT-FOOT; AVERAGE.

is built, plus the annual charges against them, may be contrasted with the expense of installation in the future, and a decision as to which plan is the more economical reached. To facilitate such calculation attention is directed to Fig. 56. This table shows four

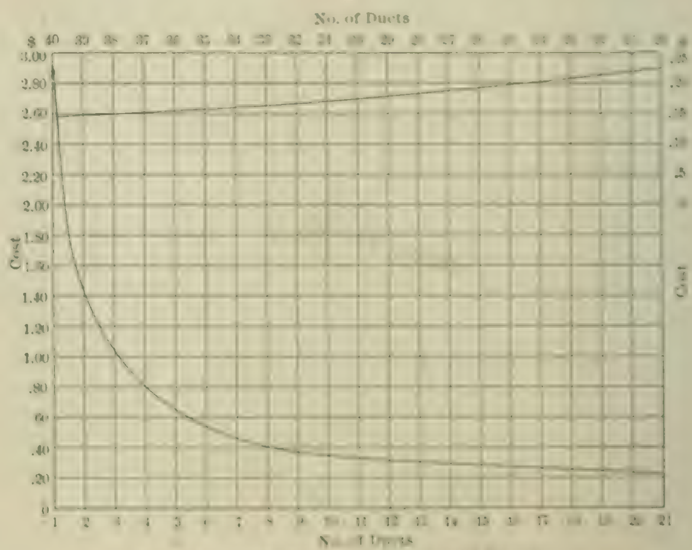


FIG. 55.—COST PER DUCT-FOOT; MAXIMUM.

curves, calculated for varying cost of street paving, from 50 cents to $3.00 per square yard. The horizontal scale gives the number of years, while the vertical scale is devoted to the number of idle ducts. The use of the table is illustrated by the following example:

Suppose a conduit of 16 ducts to be in process of construction, and that it is probable that after a certain lapse of time 20 ducts will be needed. The question arises at once, shall the four additional ducts be placed at the time of original construction, or shall they be left for future installation. Assume paving to be worth $2.00 per square yard, and that 20 ducts will be needed before the lapse of four years. Select on the left-hand scale the number 20, and

follow a horizontal line to curve marked $2.00, and a vertical line downward to the horizontal scale, finding 5.6 years. The interpretation of this result is that if the 20 ducts are to be needed sooner than 5.6 years, it will be more economical to install them at the original street opening. But if more than 5.6 years will pass before these ducts will be required, it will be cheaper to omit them and reopen the street when additional capacity is required.

ANNUAL CHARGES.

It is necessary to provide for two kinds of annual expense—Depreciation and Maintenance.

Depreciation.—There is no human device that even with the best possible care will not gradually wear out, and there are few that escape that destructive march of invention that sooner or later renders it necessary to replace old appliances with those of a more modern and economical design.

Depreciation, therefore, is such an annual allowance as will, at the end of the probable useful lifetime of the plant under consideration, provide a sufficient sum to pay the entire cost of complete replacement. It is folly to ignore this charge, for if, owing to a false sense of security, such provision be omitted, the fateful day of reckoning will surely arrive when an empty treasury and a plant that is worn out or obsolete render bankruptcy inevitable. There are many cases in which the permissible rates of depreciation may be simply that necessary to provide for the actual wearing out of the plant, due to natural destructive causes and, in some instances, for example

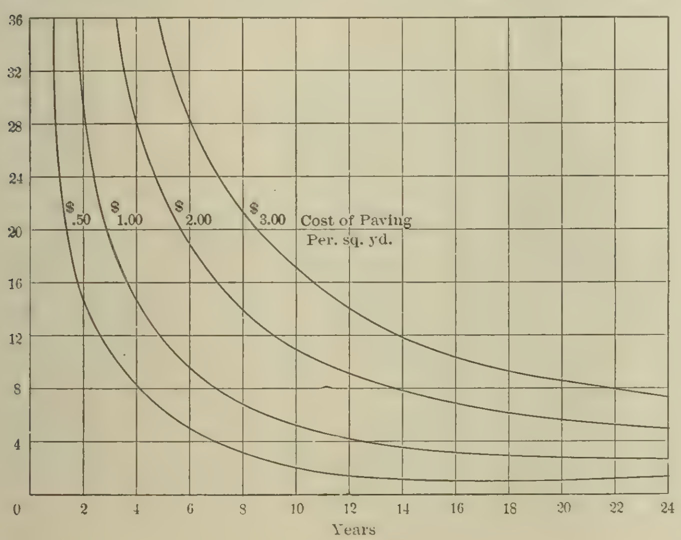


FIG. 56.—NUMBER OF DUCTS.

earthwork construction, the rates may be very low, for such structures are almost imperishable. But with dynamic machinery, which is constantly in operation, where the wear and tear is much greater, higher rates are necessary. In the case of telephone installations, particularly at the present time, a large factor in the depreciation account is the constant improvement in methods and systems which renders the best constructed plants obsolete and valueless long before they are actually worn out. There are few telephone offices in the country that have survived five years without rebuilding, and none that have lived a decade, owing to the very rapid improvements which have taken place in switchboard and substation construction. With the wire plant, life is longer as the rate of improvement is slower, and, in case of underground construction, the plant is on the whole of a durable character.

Depreciation is usually, and most conveniently, expressed as such as annual percentage rate upon the prime cost of construction as will amount at the end of the probable lifetime of the plant to the cost of replacement. Strictly speaking, legal rates of interest on each of the annual amounts set aside should be allowed for the number of years each is held in reserve. But as this refinement adds to the labor of calculation, and as the probable lifetime of plants varies considerably with time and place, sufficient accuracy is usually secured by the simple plan of annual percentage.

As actual experience with underground conduits does not extend over more than a decade and a half, rates of depreciation must be largely estimated. Methods of manufacturing duct material are being improved; competition tends to reduce prices; superior and cheaper methods of street construction all operate to reduce depreciation charges upon subways. Conduits constructed of terra-cotta, in concrete, from all experiences with similar structures, are of great durability. Doubtless, well-burned and well-placed clay laid in first-class concrete would be, if undisturbed, almost everlasting, but even with the best inspection, some defective work will creep in; the constant upheaval of city streets tends to disturb the security of all underground structures, and, finally, there is always a chance of either such improved methods of construction, or the rearrangement of substations as will necessitate the abandonment of existing wireways.

For these reasons 3⅓ per cent. on the cost of main conduit runs, in installations of magnitude, is the lowest advisable rate. For smaller systems, and the branch lines of larger ones, where changes are imminent, 5 per cent. should be allowed, while for lateral ducts, frequently constructed of perishable materials, 10 per cent. is necessary. For conduits of creosoted wood, or other materials more perishable than terra-cotta, from 8 to 15 per cent. for both main and lateral runs should be allowed.

Maintenance.—It is is somewhat difficult to draw a sharp line of demarcation between depreciation and maintenance, for the same charge under one set of circumstances would appear as depreciation, and at another time and under different conditions as maintenance.

Maintenance is best defined as that annual expense which is required to keep a plant in constant uniform running condition, other than that which is chargeable to general decay or the march of invention. For example, the cost of replacing an old rotten pole line is properly chargeable to depreciation, while the expense of rebuilding a new line blown over by a cyclone is maintenance. The cost of removing a line that had been in service, say for five years, should be charged half to depreciation and half to maintenance. The expense of repairs to a switchboard damaged by fire should be charged to maintenance, while the purchase of a new switchboard to replace an obsolete though otherwise serviceable one, is depreciation. Maintenance, like depreciation, is most conveniently estimated as an annual percentage on the prime cost of construction, but no interest can be allowed on maintenance funds, for they are drawn upon from day to day. Theoretically, only such a sum should be appropriated to maintenance as can carry the plant through one fiscal year. If by good luck or good management there is an unexpended balance, it may be returned to general profit and low account, though where estimates are careful, it is wiser to charge such surplus to deferred maintenance, and keep it for that day of misfortune that the Fates always have in store.

An underground conduit would, at first sight, appear to require an almost infinitestimable amount of maintenance, but further consideration reverses this opinion. It is constantly necessary to watch and guard a subway system. Manhole covers are displaced and broken by the impact of passing wheels and must be renewed; vaults must be cleaned out and the masonry repointed and repaired; street paving around vault frames and along the line of the trenches is subject to settlement and must be resurfaced; ever-occurring street excavations tend to disturb and injure conduits and must be watched, and, if necessary, repairs made. Maintenance expense can only be determined as a "factor of experience." For large systems, in favored localities, maintenance may fall as low as one per cent., while in small plants, or under unfavorable conditions, three to four per cent. is necessary.

Adding, therefore, depreciation and maintenance charges the annual expense of large subway systems will be from 4½ per cent. to 5 per cent. for the main runs. For small plants and the outskirts of large ones, from 5 per cent. to 7 per cent. is required. While for ducts of perishable materials from 10 per cent. to 15 per cent. must be calculated on.

Rapid Telegraphy in Hungary.

Despatches from Budapest announce that further improvements have been made in the Pollak-Virag system of rapid telegraphy. Telegrams are now transmitted from Presburg to Budapest, over one wire at the rate of from 50,000 to 70,000 words an hour. A Vienna newspaper describes a dispatch which it received by this process. It consisted of a strip of stiff parchment like paper, bearing 230 words. There was an ordinary dash between the words, which were easily read. The message occupied 15 seconds in transmission.

An Integrating Photometer for Glow Lamps and Sources of Like Intensity.*

By Charles P. Matthews.

In a previous paper, read before the Institute, I described an equipment designed for the photometric study of arc lamps. The most valuable feature of this equipment lies in its ability to yield a value of the mean spherical luminous intensity from a single photometer setting. It is the purpose of this paper to describe an apparatus possessing this same valuable feature, and several others worthy of note, when used for the photometry of the incandescent lamp and other sources of the same order of brightness.

Designed especially for incandescent lamp measurements, the apparatus has several functions, and might have been styled a "universal glow lamp photometer." It is capable of use for all photometric measurements on the glow lamp that do not lie in the province of spectrophotometry. To particularize, it may be used as follows:

1. As a simple photometer for any unidirectional measurements, such as occur in standardizations, ratings and candle-power distributions.

2. As an integrating instrument for the direct determination of mean horizontal, mean spherical, mean hemispherical or mean zonular candle-power.

3. As an integrating instrument for the direct determination of the spherical reduction factor; that is, the ratio—mean spherical; mean horizontal candle-power.

The fact has long been recognized that the only strictly fair basis for the comparison of incandescent lamps is that of the total flux of light emitted, a quantity proportional to the mean spherical candle-power. It is possible by altering the configuration of the filament to concentrate luminous flux in particular solid angles at the expense of flux in other angles. Hence, two lamps of equal rated candle-power may yield total light flux in quite different amounts. On the other hand, if two lamps have initially the same mean spherical candle-power, their relative value is determined simply by their power consumption and sustained candle-power. The vexed question of what is the most useful light may well be left to the purchaser, who can select the type of filament best adapted to his own needs. The question is comparable to that which asks: What is the best diet for man?

Of the methods in use in the determination of the mean spherical candle-power, the most accurate is that in which measurements are made at equal angular intervals through 180 degrees in a plane passing through the axis of symmetry of the filament, the lamp being rotated meanwhile about this axis. From the readings so obtained, the mean spherical value may be found either by formula or the graphical construction known as the Rousseau diagram.

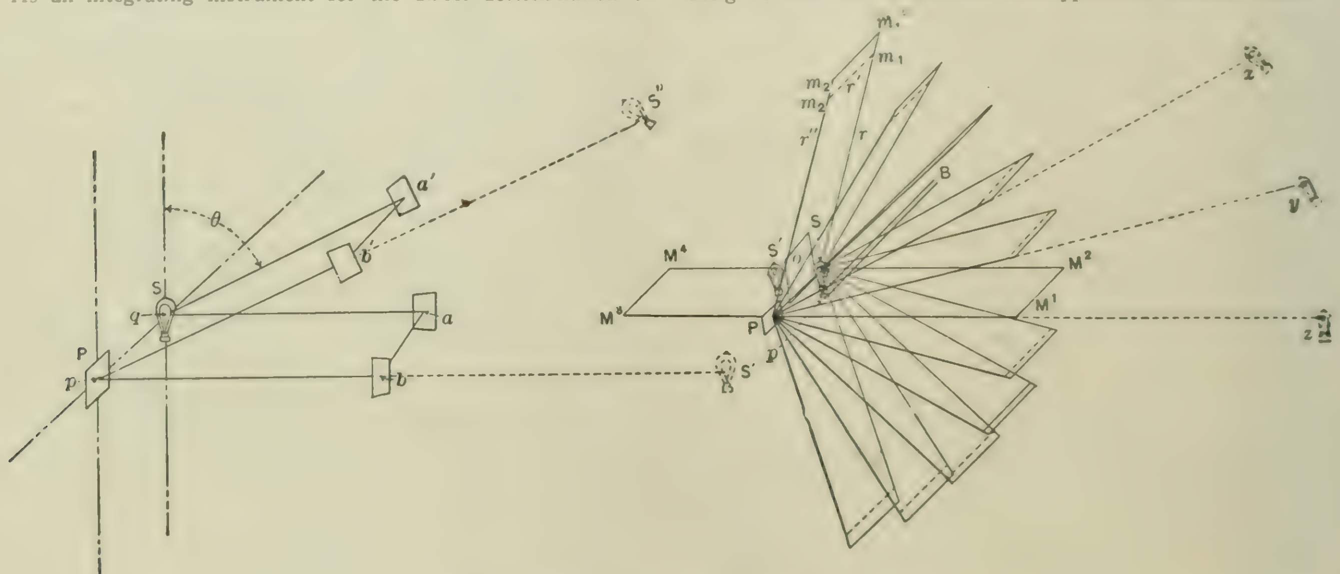
The method employed in the Franklin Institute tests of 1884 involes the mean of 38 candle-power values taken in such directions as to give a nearly uniform space distribution. The mean of these values is the result sought.

Both of the foregoing methods involve a large number of readings—so large, in fact, that their application to the practical rating or extended study of lamps is out of the question.

A third method consists in the use of the spherical reduction factor appropriate to the type of filament under consideration. Unfortunately, this factor is not a constant for any given type of lamp. With some types, the method yields a good result; with others the variations are such as to render the results only roughly approximate. A disadvantage is the large and increasing number of types on the market and the necessity for determining and keeping account of the corresponding constants.

Liebenthal found as the result of an extended series of measurements that the mean of the intensities taken at 51.8 degrees north polar distance and 51.8 degrees south polar distance on a spinning lamp is a value approximating the mean spherical intensity, regardless of the type of lamp. The errors resulting from the application of this method range from —.1 per cent to + 3.9 per cent. This is probably the most accurate of the simpler approximative methods.

From what has been said, it would appear that there is need of a photometer capable of giving the mean spherical candle-power of an incandescent lamp with the ease and celerity obtainable in the ordinary photometric measurement. With this need in mind, I have designed and had constructed the apparatus descibed below.



Figs. 1 and 2.—Integrating Photometer.

The theoretical basis of the design is the approximate equation for the mean spherical intensity,

$$I_{ms} = \frac{\pi}{2n} \sum_{0}^{\pi} I_\theta \sin \theta \qquad (1)$$

wherein I_θ is the intensity of a ray making an angle θ with a vertical passing through the light center and n the number of terms in the summation. In order that equation (1) may apply to a glow lamp, it is necessary to spin the lamp precisely as is commonly done in determining mean horizontal candle-power.

To see how equation (1) may be made the basis of an integrating photometer, let us consider a source of lights (Fig. 1), and a photometer screen P, whose plane extended contains the effective light center of S. We will hereafter denote the center of the photometer screen by p, and the effective light cente by q. For convenience we will further assume that p and q lie in the same horizontal plane, to which the plane of P is normal, and we will call the line pq the axis of the system. Now consider two mirrors whose planes are vertical and make an angle of 90 degrees with each other. Let the centers of these mirrors, designated by a and b, come into the horizontal plane in such positions that the lines qa and pb are equal and respectively normal to the axis of the system. Let a' and b' be the centers of a second pair of mirrors occupying a position such as would be found by swinging a and b, without mutual displacement, upward about qp as an axis until qa makes the acute angle θ with the vertical. Having thus located a' and b' angularly, we may now assume that some radial movement of this pair of mirrors is possible. The eye placed at p will see virtual images of the source in horizontal and θ aspects, respectively. The images s' and s''

* A paper read at the October meeting of the American Institute of Electrical Engineers.

may be regarded as producing jointly an illumination on the photometer screen of

$$i_0 + i_\theta = \frac{K_0 I_0}{d^2_0} + \frac{C K_\theta I_\theta}{d^2_\theta} \qquad (2)$$

where K_0 and K_θ are the reflection coefficients of the pairs of mirrors, d_0, d_θ, the distances from source to screen by way of the mirrors, and C a factor varying with the incidence of the light upon the photometer screen P. Now if n pairs of mirrors be placed similarly to **a**, **b** and **a′**, **b′**, but spaced at equal angular intervals of $\Delta \theta$ such that $n \Delta \theta = \pi$, we shall have as the resulting illumination

$$\sum_0^\pi (i) = \sum_0^\pi \frac{C K_\theta I_\theta}{d^2_\theta} \qquad (3)$$

If by radial adjustment of the mirror pairs we make

$$\frac{C K_\theta}{d^2_\theta} = \frac{K_0 \sin \theta}{d^2_0} \qquad (4)$$

then

$$\sum_0^\pi (i) = \frac{K_0}{d^2_0} \sum_0^\pi I \sin \theta \qquad (5)$$

That is to say, the total illumination of the screen is proportional to the mean spherical intensity of the source. (See equation 1.) To evaluate this intensity, it is necessary merely to balance this illumination against that due to a source of known intensity at a known distance.

Fig. 2 shows the disposition of twelve pairs of mirrors, m_1, m_2, etc., in order to produce the desired results. If the illumination of a given surface varied exactly as the cosine of the incidence of the light upon that surface, and if all mirrrors used were of equal reflecting power, then there would be no need of radial adjustment of the mirror pairs, for in such case $S\ C = \sin_\theta$ and $K_\theta = K_0$. But the so-called cosine law is only approximately true, and mirrors vary in reflecting power, hence it is necessary to compensate for discrepancies in C and K_θ by slight changes in d_θ. The extent to which this correction is of importance depends, of course, upon the nature of the photometer screen. The plaster of Paris surface of the Lummer-Brodhun screen obeys the cosine law with exactness up to an incidence of 50 degrees, but beyond this point a divergence of increasing magnitude occurs (Fig 3). Hence, for the Lummer-Brodhun screen the only adjustment of mirrors necessary is that to overcome variations in their reflection coefficients, except for angles greater than 50 degrees. With mirrors cut from one sheet of glass, the correction for variation in reflecting power is often negligible.

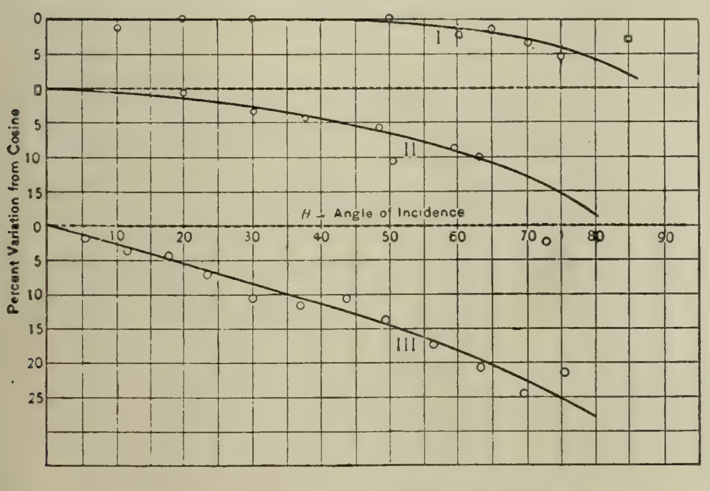


FIG. 3.—VARIATIONS FROM COSINE LAW.

With the Bunsen screen, correction must be made for all angles of incidence. For example, the second curve in Fig. 3 is the result of measurements made upon ordinary draughting paper, from which the Bunsen screen is often made. Here the departure from the cosine relation is noticeable from the very beginning, and becomes as high as 15 per cent. at 75 degrees incidence. The third curve in the same figure shows the results obtained with ordinary glazed writing paper. The cosine relation is not even roughly approximate in this case.

Fig. 2 also shows the method of balancing the illumination produced by the series of images, due to the circular system of mirrors. The curves show the percentage of variation from cosine relation for different screens; Curve I, referring to the Lummer-Brodhun screen; Curve II to a screen of unglazed paper, and Curve III to a screen of glazed paper. Mirrors M_1, M_2, M_3, M_4 are cut from one piece of glass, just as are the mirrors in the ordinary Bunsen photometer. It is not essential that the other mirrors of the system should have the same coefficient, since, as already explained, the initial adjustment corrects for failure of the cosine relation and inequalities in the mirror coefficients at the same time. With the standard at S′ separated from S, the source to be tested, by an opaque screen, a balance in the illumination is obtained by moving M_3 and M_4. The method of doing this will be better understood by reference to Fig. 4 which shows in elevation and plan the essential elements of the apparatus.

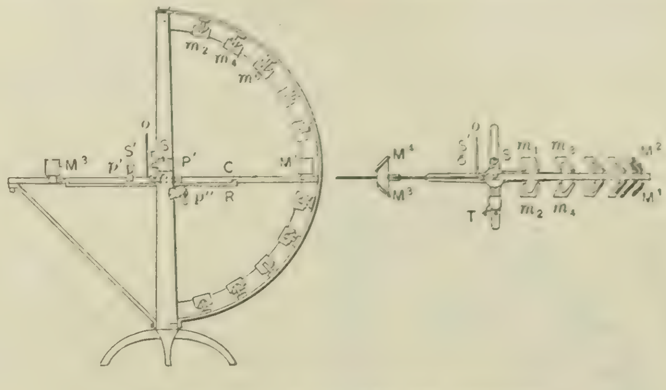


FIG. 4.—ELEVATION AND PLAN OF APPARATUS.

To the right of these figures is seen the mirror system, each pair of mirrors being capable of a certain amount of radial movement for purposes of the initial adjustment of the instrument. S is the lamp to be tested, mounted upon a rotator, S′ is a standardized glow lamp. The mirrors M_3 and M_3, rigidly connected, may be moved along the bar by means of a rack and pinion conveniently under control of the observer at the photometer P. The photometer is fixed, and hence the operation of making a setting is more convenient than that which obtains with the ordinary sliding form. As the design is based upon the approximate equation (1) and not upon the integral form, some error arises from this cause. With eleven pairs of mirrors the error is negligible for all practical purposes.

Fig. 5 shows a photograph of the finished apparatus with all screens removed, in order that the details of construction may be better seen. This particular instrument is fitted with a Lummer-Brodhun photometer screen. Each mirror bracket is povided with two pins. These pins extend through the frame of the ring radially. By means of this construction, each mirror pair may have independent radial adjustment.

We will now consider in detail the different operations to which the instrument readily lends itself.

Operation 1.—Measurement of Mean Horizontal Candle-Power.— In this operation the apparatus is used as a simple photometer. Hence, all mirrors except the four horizontal ones are covered by black screens suitably provided for the purpose. The right pair of mirrors (Fig. 4) is connected at C to the sliding rod carrying the rack. The lamp, S, to be tested is mounted in the rotator and driven at a speed of, say, 180 r. p. m., and a standardized incandescent lamp, of intensity $I_{s'}$ is placed in a suitable holder, at S′. The rod R may be moved by the hand for a rough adjustment, and the pinion P″ used only for the final setting. Since a displacement, d, of the mirror pairs means a change in the light paths of $2d$, the moving rod is graduated in divisions one-half the unit (centimeters) in which the light paths are conveniently measured. A reading, R, means that the distance from S′ to the screen by way of the mirrors M_3, M_4, is R centimeters. If now the total photometric distance between the sources is 300 cm, we have for the intensity I of the light under test,

$$I_s = \left[\frac{300 - R}{R}\right]^2 I_{s'} \qquad (6)$$

$$= T_1 I_{s'} \qquad (7)$$

where T_1 is the value of the expression in brackets and stands for "tabulated value corresponding to the reading R." When the apparatus is used with a standard of always the same intensity, it is a simple matter to make the instrument direct reading.

Obviously, the mean intensity in any north or south polar zone may be found by clamping the arm of the rotator at the proper angle and spinning the lamp, readings being taken as for the mean horizontal measurement. The mean horizontal candle-power of a flame

source must be found by taking the horizontal distribution stepwise, since it is impracticable to rotate such a source. Equation (7) is applicable in such measurements.

Operation 2.—Distribution of Candle-Power in Vertical Planes.—The distribution of intensity of an incandescent lamp in any vertical plane is obtained with the apparatus arranged as described under Operation 1. The arm of the rotator is merely tilted about a horizontal axis so as to bring any desired aspect of the lamp toward the photometer screen. From equation (7) the different intensities are easily found.

The vertical distribution of candle-power from a flame source cannot be obtained by tilting the arm of the support. The following method is available in such cases: Mount the burner vertically at S; disconnect the mirrors M_1, M_2 from the movable rod and push them to their place at the extreme right (Fig. 4). Now with a

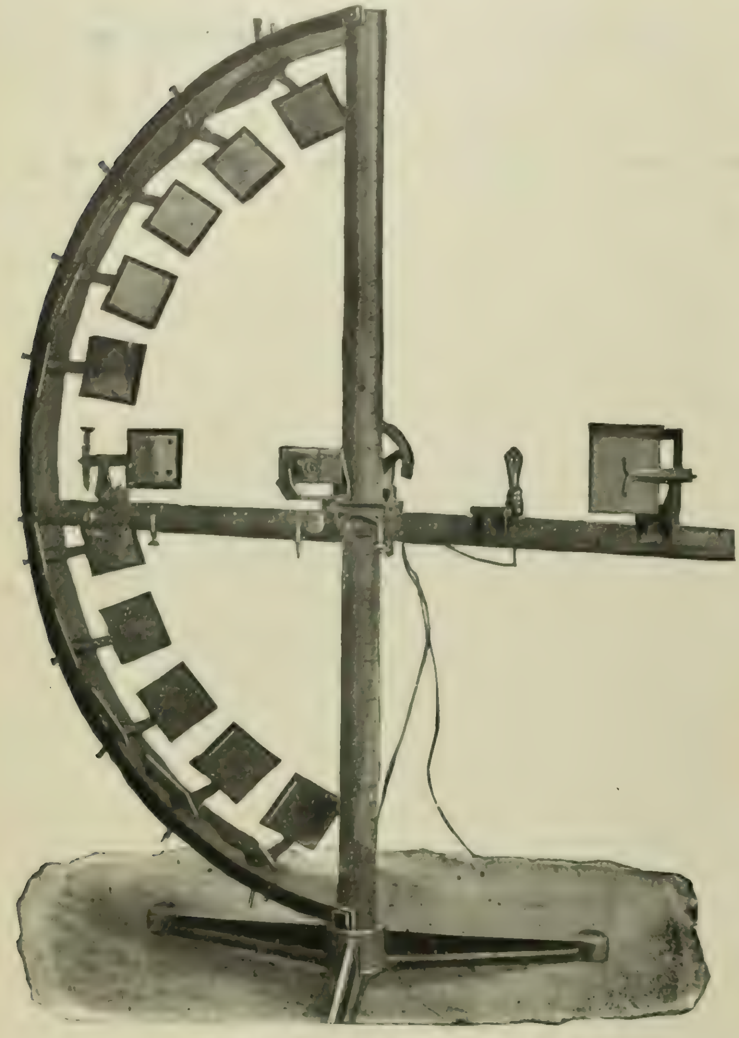


FIG. 5.—GENERAL VIEW OF APPARATUS.

standard of the same order of brightness as the source to be tested, make a setting. The horizontal intensity is given by

$$I_h = \left[\frac{200}{R}\right]^2 I_{s'} \qquad (8)$$

$$= T_h I_{s'} \qquad (9)$$

where T_h is the tabulated value of the expression in brackets corresponding to the reading R.

To obtain the intensity of the source in a direction of $\theta°$ to the vertical, the horizontal and θ mirrors should both be used. This prevents the limit of the bar being reached by mirrors M_1, M_2. The intensity is given by

$$I_\theta = \frac{T_\theta I_{s'} - I_h}{\sin\theta} \qquad (10)$$

where I_h is the intensity found in the horizontal measurement.

Operation 3.—Standardization of Glow Lamps.—For this operation the lamp, S, is removed and a horizontal circular plate mounted in place of the lamp. This plate is ruled with concentric circles, which facilitate the centering on the amylacetate lamp or other primary standard. The lamp to be standardized is mounted at S'. With all mirrors screened except the horizontal ones, and with M_1, M_2 attached to the bar, settings are made as usual. The value of S' is given by

$$I = \frac{1}{T_1} \qquad (11)$$

if the standard is unity.

Operation 4.—Measurement of Mean Spherical Intensity.—(*a*) *Glow Lamp.*—The lamp to be tested is mounted in the rotator and driven at a speed of about 180 r. p. m. Mirrors M_1 M_2 are detached from the movable rod and pushed to the extreme right, in which position they may be considered a part of the system of eleven mirror pairs. With a standardized lamp at S', a setting is made in the manner already described. If R is the reading, we have

$$I_m = T_s I_{s'} \qquad (12)$$

where T_s is a tabulated value corresponding to the setting R and $I_{s'}$, the intensity of the standard as heretofore. Thus the operation has all the simplicity of any photometric measurement.

The intensity of the standard used should be approximately that of the lamp to be tested. For example, if a 16-cp lamp is to be tested, a standard of not less than 16-cp is best. With such a standard, the range of possible measurement depends upon the limit of travel of the mirrors M_3 M_4. A 16-cp lamp will serve as a standard for the measurement of mean spherical intensities ranging from 2 to about 25 cp, when the limit of travel is about one meter. It is best to substitute a 32-cp standard for intensities much greater than 16 cp.

(*b*) *Flames.*—To obtain the mean spherical intensity of a flame or of any source that cannot be rotated, it is necessary to repeat Operation 4 at equal angular intervals on the horizontal circle. The mean of the results may then be taken.

Operation 5.—Direct Measurement of the Spherical Reduction Factor.—If the standard S' and the opaque screen O be removed, it is clear from the figure that the left side of the photometer screen will be illumined by the horizontal rays of the lamp S. In fact, if S be rotated, we will have on the right side of the photometer screen an illumination proportional to the mean spherical intensity of S, and on the left side of the screen an illumination proportional to the mean horizontal intensity of the same source. Under these conditions the photometer setting yields the spherical reduction factor. In other words, the mean spherical intensity is measured against the mean horizontal intensity as a standard. The reduction factor is given by

$$f = T_3. \qquad (13)$$

As the removal of the standard S' lengthens the distance from source to screen, it is necessary to add a constant to the reading. This is provided for by a second reading point, marked R F. All readings for Operation 5 must be taken at this reference mark

Operation 6.—To Check the Horizontal Mirror Constants.—As before stated, it is essential that the four mirrors attached to the movable bar should have the same constant. To ascertain if this condition exists, remove the opaque screen and the lamp S', as in Operation 5. Connect the horizontal mirrors to the moving rod and, screening all other mirrors, take reversed photometer readings on a rotating lamp S. If the mirror coefficients are equal the mean reading will be 150, indicating equal light paths on each side of the photometer screen. Here again the R F reading mark must be used.

Operation 7.—To Check the Adjustment of the Circular Mirror System.—In case of any doubt as to the accuracy of the initial adjustment of the photometer, or in case of the substitution of a new screen, it may be necessary to readjust the mirrors of the half ring. This operation is best performed as follows: Mount at S' a 32 nominal cp lamp, and at S an 8-cp lamp, the latter being in circuit with a rheostat capable of continuous variation. With mirrors M_1 and M_2 free from the moving rod, and with all other mirrors on the half ring screened, set R equal to 100 cm. Now, while maintaining the 32-cp lamp at constant voltage, vary the voltage impressed on the 8-cp lamp until the photometer shows equal illumination. Note voltage on 8-cp lamp. Repeat measurements with reversed photometer. The lamp should finally be maintained at the mean voltage so found. Under these conditions the two lamps have a candle-power ratio of 4 : 1. Next tilt the lamp holder to an angle of 15 degrees. Uncover the corresponding mirrors (θ = 75 degrees or θ = 105 degrees) and cover the horizontal ones. Under these conditions we

have the same aspect of the lamp toward the photometer, but with the light incident at 15 degrees. Set the bar at

$$R_{15} = \frac{R_0}{\sqrt{\cos 15^\circ}} \qquad (14)$$

Adjust the 15 degree mirrors radially until an equality of illumination is obtained, then secure them by means of the set screw. This operation may be repeated until all the mirrors have been adjusted.

Electrical Equipment of a Smelting Plant.

About three miles from the town of El Paso, Texas, are located the smelting works of the American Smelting and Refining Works, known as the El Paso Smelting Company. This new plant, which is one of the largest in the country and, perhaps, the best equipped in the world, takes the place of an old smelter burned down in the summer of 1901, the ashes of which were hardly cold before the plans of the new and far superior plant were begun. Although second in size and capacity, the plant covers not more than nine acres. Not a foot of space has been wasted, although the matter of convenience and room for working is plainly shown in every detail.

Approaching the plant from the El Paso side, the first thing to attract the eye are the four smoke stacks of brick, and the fortified appearance given it by the 3,000 feet of flue brick walls on the south and west sides. The steep rock hills on the east side adds to the fort-like appearance of the works. The capacity of the plant at the present is about 50,000 tons of ore per month, and it is capable of large expansion. When the plant is running at full capacity it employs about 1,000 men.

The buildings consist of blacksmith shop of cream-colored brick, a small steel building for copper and tin shop, a few short steps from which is found the power house of brick, having a steel roof and iron floor. North from the power house is the furnace building, which, as it now stands, is 240 feet long, and material has been ordered for extending it 36 feet further. This structure is of steel throughout, and here are placed the nine furnaces--seven for lead and two for copper—with space for two more.

On the south side of the furnace building are large ore and coke

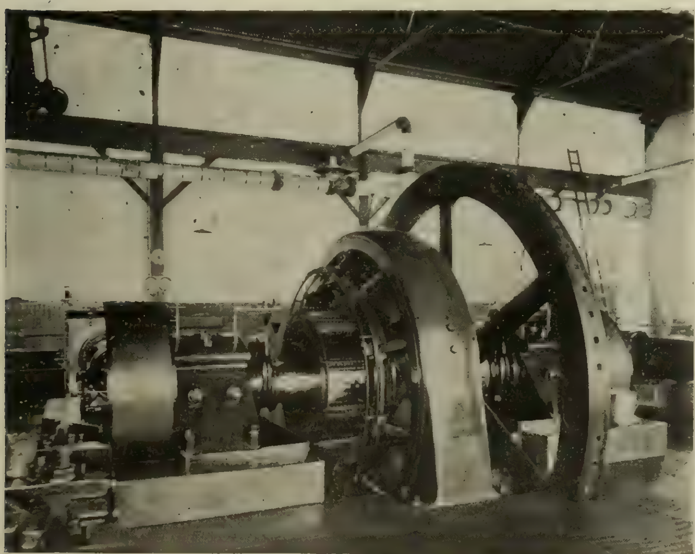


FIG. 1.—500-KW GENERATOR.

bins, with elevated tracks where freight cars can be run and conveniently loaded. The next building on the south is the sampling works, which is also steel, and fitted out with smaller roller mills. In the northwestern portion of this structure is the assay office. Southwest of this comes the low steel structure where the 14 roasters are found. Down by the river a pumping plant is located, which elevates the large amount of water necessary for the use in the plant and in the small town which surrounds it.

From the finely equipped power house electric power is transmitted to every part of the plant, pump house and for lighting the plant and town. In this building are four large Corliss engines, of the compound condensing type; two General Electric motors, of 500-kw capacity, and two motors of 75-hp, and one 2,000-light dynamo. All or very nearly all, of the machinery is directly connected—the exceptions being that operated by small motors.

The boiler room contains six 150-hp tubular boilers of high pressure, space being provided for two more of the same type, or for one of a larger type tubular that is being considered. The pump room contains large hydraulic pumps for the elevator service used about the furnace room for moving the elevator that lifts the ore, coke, fluxes, etc. This room also contains the fire pumps to be used in case of fire. These are in duplicate; in case of failure of one or more, there are others to be called into service. Here also are the large water pumps for supplying and forcing water to the reservoirs in different parts of the plant and town. These pumps are also in duplicate and direct connected to electric motors.

The sole fuel used in the plant for power development purposes is Beaumont oil. The oil for the boilers is supplied from a storage tank of 75,000-gallon capacity, sunk beneath the ground.

All the machinery in the entire plant, including pumps at the river, are driven by electric motors, no steam being used except in the engine room. All of the power plant given above except the pumping plant at the river is under one roof, a building of cream-colored brick with a steel roof and iron floor, and absolutely fireproof.

All the material, such as coke, the charges of ore and fluxes, is carried to the top of the furnaces by electric cars of eight-tons capacity each, using the third-rail system. These cars are loaded from beneath the freight cars from a convenient system of bins, taken thence to the hydraulic elevator and again by electric power through a system of switches to any designed hopper, automatically dumped and returned.

Wherever electricity can be used, electric motors have been in-

FIG. 2.—ELECTRIC ORE CHARGER.

stalled. Every detail as to economy of space, labor, energy and money has been thoroughly planned and scientifically put into practice. Every building has been made absolutely fireproof, and another disaster, like that of last year, can never fall on the present plant.

Much credit is due to F. C. Earl, manager, and his assistants, F. S. Austin, superintendent, and J. J. Omsby, assistant, for the masterly way the construction of the plant was handled. This establishment is at the head of many similar plants now owned by the American Company in point of size, new and modern machinery, and is the leader in labor and time-saving devices.

Annual Report on United States Signal Service.

The annual report of Gen. A. W. Greely, Chief Signal Officer of the army, says the corps have actually built and put in working order in Alaska 1,121 miles of land lines and submarine cables within a period of 24 months. The accomplishment of such results, he says, would be most creditable to officers and men concerned therein if Alaska was an ordinary country, for this work included not only surveying, construction and installation of this length of line, but also involved the manufacture and inspection of enormous quantities of material, instruments, etc., many hundred tons in weight, and their transportation over distances ranging from 4,000 to 7,000 miles. When one considers, however, the exceedingly difficult physical conditions within the Territory, he says, the work must be considered simply phenomenal, as in all parts of Alaska traversed by this great length of line there are not a dozen miles of wagon road and much of the region is unexplored.

Speaking of improvements effected by the corps in Cuba, Gen. Greely says: It is unquestioned that on occupying Cuba the American army found a few dilapidated telegraph lines, operated by antiquated methods, with tariff rates increasing in proportion to the length of the message without free delivery, and with grave uncertainties as to espionage, secrecy and delivery. This system, bad as it was, served only the western half of the island. In leaving Cuba, there was turned over to the government a system of 3,500 miles, extending from San y Martinez in the west to Cape Maysi in the extreme east, with every seaport or town om importance electrically connected. The present instruments are of the best modern types, the transmission speedy and reliable, and the tariff rates exceedingly low, while the certainty of delivery and inviolability of messages are beyond question.

Of the work in the Philippines, the report says: The magnificent system of telegraph lines and cables was very largely constructed and installed under Col. Allen. This system, increased during the fiscal year by 2,600 miles, consisted on June 30, 1902, of 31 submarine cables, 1,326 miles in length, and land lines 5,108 miles in length, making an aggregate of 6,434 miles. It is almost needless to say that the work of construction and installation, under the disturbed and difficult conditions existing in the archipelago demanded talents of the highest order. The system stands to-day a monument to the energy, skill and resourcefulness of the American soldier. On entering the Philippine Islands, the American army found practically no existing telegraph lines, as the few land lines connecting the Visayan cables of the Eastern Extension Telegraph Company had been promptly destroyed by the insurgents, as well as the lines in Luzon, when they retired before the advance of our army. The only lines of any importance that came into our possession were several hundred miles of dilapidated and antiquated lines in the Cagayan Valley, and along the west coast of Luzon.

Gen. Greely calls attention to the necessity of a Pacific cable. Owing to the great pressure of work, he says, not as much time has been given to wireless telegraph tests as Gen. Greely desired, but he reports that progress has been made. He again calls attention to the necessity for international cables regulations, and recommends that the War Department be represented at the international telegraph conference, to be held in London next year.

Electricity for North Pole Expedition.

Capt. Bernier, who is organizing the Canadian North Pole expedition will take with him two of the latest improved windmills to be used in driving machinery in the ship workshop, and a dynamo for electric lighting. A London firm has sent Capt. Bernier an equipment of the latest appliances for use in the electric treatment of any diseases that may develop among the members of the expedition while in the Arctic regions.

Dogs on Paris Underground.

The crusade of dog lovers for transportation of their best friends by the Metropolitan lines has bobbed up again, and the management of the underground road, at last touched by the appeals of dog owners, seriously contempiates placing on cars in which the inseparable master and dog will be allowed passage

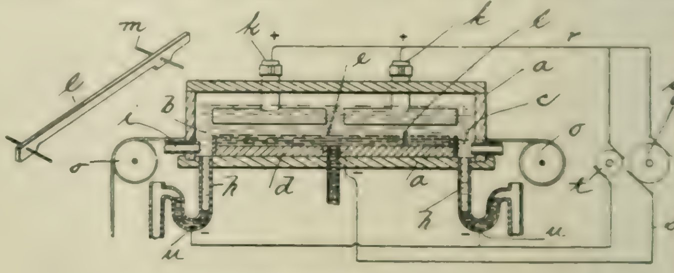
Recent Electrochemical Developments.

By Clinton Paul Townsend.

MERCURY CATHODE CELL.

Mr. Arthur E. Truesdell, of Pittsfield, Mass., clearly states the conditions which govern the reoxidation of sodium in the electrolyzing compartment of a mercury cathode cell, and suggests an ingenious construction for minimizing the losses from this source. Sodium set free upon a quiescent cathode of mercury at the limiting surface of an electrolyte does not readily diffuse through the body of metal, but the lighter amalgam forms a surface layer which tends to react with the electrolyte. Mr. Truesdell proposes to remove the amalgam as rapidly as possible from the surface of the mercury; to restrict as far as possible the area of its contact with the electrolyte; and to further check its tendency to solution by a supplemental cathode connection to the amalgam at its contact surface. He states also that the fresh brine is a less energetic oxidant for sodium than the spent solution, and prefers therefore to introduce the brine at or near the point of withdrawal of the amalgam.

The disposition of parts will be clear from the accompanying diagram in which the mercury cathode, *e*, rests upon the conducting base, *d*, of the cell, *a*, anodes, *k*, lying in the electrolyte above its surface. Lateral ribs, *b*, projecting from the base of the cell determine the limits of the cathode, and the surface amalgam formed upon the mercury is caused to flow over these ribs into the outlet traps, *h*. A sweep, *l*, is caused by means of appropriate cords and pulleys, *m*, *o*, to reciprocate in the mercury, whereby the amalgam is flooded into the lateral channels, *c*, between the ribs, *b*, and the sides of the cell. The bottoms of these channels, *c*, are inclined in either direction



TRUESDELL MERCURY CATHODE CELL.

to the outlet trap, *h*, so that the amalgam will flow directly into the latter, and its contact surface with the electrolyte will be reduced to the cross sectional area of the trap. Further protection is afforded by a supplemental cathode connection, *u*, from a secondary current source, *t*, whereas the main electrolyzing current comprises the dynamo, *q*, and the lead wires, *r*, *s*.. The fresh brine is introduced through pipes, *i*, into the lateral channel, *c*, immediately over the amalgam traps.

ELECTRICALLY PREPARED FERTILIZER.

The applications of electricity to a preparation of fertilizers have been limited hitherto to the treatment of insoluble phosphates for the purpose of increasing their proportion of available acid, or of separating such iron as they may contain. It is now proposed by John J Crooke, of New York, to treat the deposits of peat and analogous accumulations of matters rich in humus which occur in bogs and salt marshes, with the object of producing therefrom a fertilizer, or better, a soil dressing; for humus is hardly to be classed as a plant food.

The process consists in subjecting "sour" humus to electrolysis for some hours between electrodes of iron, under current conditions not fully defined. The chemistry of this would be sufficiently obscure even without the singular statement that hydrogen, hydrogen sulphid, carburetted hydrogen, and chlorine, are liberated together at the anode. Freshly dug peats, like all bodies of strong reducing properties, are inimical to agricultural plants; they are also germicidal and hinder those processes of nitrification which are so essential to fertility. Further, many peats are positively poisonous, owing to their content of sulphid of iron. Exposure to air and weather corrects these defects, and it would not be surprising if electrolytic oxidation should prove equally effective.

METAL COATINGS BY ELECTROLYSIS.

Electrolytic metal coatings, especially those deposited at moderate or high current densities, are usually of somewhat loose texture. An

obvious remedy is a mechanical compacting device, and such have met with a measure of commercial success. For the production of metal tubes or of sheets upon mandrels, the elaborate burnishing tools of Elmore and of Kugel, are effective, and for small articles the tumbling drum is in common use. In the latter case the compacting or polishing effect is attained through the mutual contact of similarly coated particles. Mr. C. J. Reed, of Philadelphia, claims that superior results may be reached by the action of a non-conducting granular polishing material, such as sand, the polishing action on the metal coating being secured by the movement of the negative or plated electrode. In the simplest embodiment of the invention, the mandrel or article to be plated is revolved, or given a circular movement, in a mixture of the electrolyte and the abradant. For small articles the tumbling drum is employed, sand being mixed with the articles, and the latter plated intermittently during their periods of contact with the cathode.

New Telephone Patents.

Last week five more telephone inventions were presented in the patent issue, that of October 28. Of these, one issued to R. Gaillard and E. Ducretet, both of Paris, France, is of especial interest, as it seems to indicate a possible repetition of a past difference in European and American practice. The invention is what may be called a multi-circuit-granular transmitter. Some years ago European standard transmitter practice, or rather European universal transmitter practice, for there was no European standard, provided several parallel microphonic circuits, while in America but one such circuit was ordinarily used. This difference in practice was largely done away with by the introduction of the granular carbon transmitter. Now comes from Europe this multi-circuit granular carbon transmitter, which bears the same relation to our single-chamber granular transmitters as did the old muliple-circuit microphones to the single-contact transmitter.

Fig. 1 shows the transmitter of Messrs. Gaillard and Ducretet, being two sectional views taken at right angles to each other. The rear or stationary electrode is corrugated, and across the corrugations are cut a number of slots. The stationary electrode is surrounded by a ring of elastic fabric, and the slots carry strips of the same material, so that the transmitter is divided up into a number of long narrow compartments. Each of these is filled with granules of carbon, and the whole is so covered by the diaphragm that the granules of the various compartments are kept distinct. It is claimed by the inventors that this transmitter is adapted to currents of large volume. It will be interesting to note in what light foreign engineers will consider this transmitter.

A further telephone transmitter invention of this issue is that styled a "sound concentrator." This is an appliance for transmitters used with instruments for the deaf. It consists of a cup-shaped vessel, near the mouth of which a transmitter is so mounted as to leave an annular opening, the diaphragm of the transmitter facing the bottom of the cup. The periphery of the bottom of the vessel is so rounded or inclined, and the middle of the bottom is so raised,

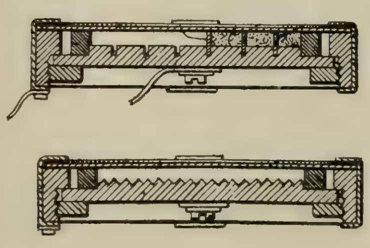


FIG. I.—GAILLARD AND DUCRETET TRANSMITTER.

that all sound entering the annular opening will be concentrated by reflection upon the center of the diaphragm.

Two patents, issued to David S. Hulfish and assigned to the American Bell Telephone Company, represent the component parts of a divided original application, and they are so mutually involved that for convenience they will be recombined in the following description: The invention provides a common-battery subscriber's line circuit, such that the stations of a party line may signal and communicate with each other without involving the central office operator; and it also provides that while the stations are so communicating the line will be protected from incoming calls.

Fig. 2 shows Mr. Hulfish's complete circuit. At the right are three subscribers' station, S, S^2, S^3, while at the left is the corresponding line apparatus at the central office. There are two kinds of calls to be considered, those for other lines and those for stations of the same line. In the case of the calls for other lines, it will be necessary only to consider the operations in detail through the notification of the operator.

Suppose station S^3 originates the call, he first removes his receiver from the hook, and, ascertaining the line not busy, he depresses his left-hand push key until he hears the operator answer. Observing the drawing, it will be noticed that when the receiver was removed from the switch, the latter in rising closed the bridged circuit con-

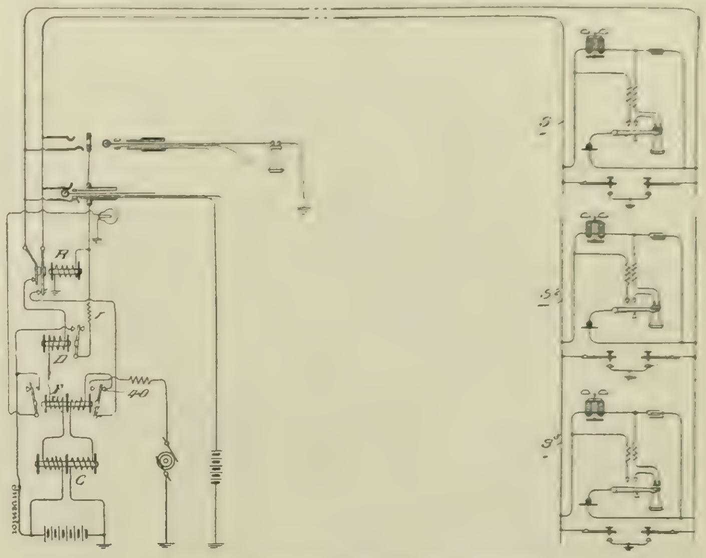


FIG. 2.—HULFISH BUSY TEST SYSTEM.

taining the telephone instruments. Current from the central office battery thereupon flowed through the windings of the retardation coil, G, and through the relays F and D. Relay F fails as its windings are differentially connected. Relay D, on the other hand, operates, but this is incidental only, and this operation has at this time no useful function. Subscriber S^3 now depresses his left-hand key, and thereby grounds the corresponding side of the line, virtually short-circuiting one of the windings of relay F. This relay therefore operates under the influence of its non-short-circuited coil, closing the line-lamp circuit. The relay F also at this time connects the grounded ringing generator to one side of the subscriber's line, but as this is the side that is grounded by the depression of the push key at S^3, no effect is produced on the bells at the various stations, nor on the receiver at S^3. When the operator answers the insertion of her plug in the line jack operates the cut-off relay, removing the relays and signals from the circuit in the usual manner.

If subscriber S^3 had desired a station on his own line, such as station S, after having ascertained that the line was not busy he would have returned the receiver to the hook, thereby opening the bridge on the line and removing the current from all relays. He would then depress his right-hand push key a number of times to correspond exactly with the code signal or ring of station S. The depressing of this key grounds one side of the line, as did the other key, but it is the opposite side from that previously grounded. This completes the circuit of one coil of the relay F, which operates as before, flashing the line lamp once for each depression of the key. The operator ignores these flashes, being instructed to respond to a steady light only. At the same time relay F connects the ringing generator to the line, this time to that side which is not grounded. The bells at the stations of the line, therefore, do respond and ring the code signal corresponding to the number of depressions of the key at S^3. Station S only responds, as it was his signal which S^3 sent. After he has responded and S^3 has also removed his receiver from the hook, the transmitter current for both is supplied through the retardation coil and relays. Relay F is at this time unoperated, but relay D is operated, and with the result that battery is connected to the sleeves of the jacks through the resistance r. This resistance is the true key to the situation, for it is of such size that while a sufficient busy test potential is provided, there is not enough current flowing to operate the cut-off relay.

The fifth and last patent to require mention is that granted to Geo. T. Newman, and termed a "telephone attachment." This device consists of a polarized bell and special switch, so wired to two telephone lines that one subscriber's set may be used interchangeably on the two lines. Simultaneously with the transfer of the subscriber's set from one line to the other the extra magneto-bell is transferred, but in the reversed direction so that each line always has one or the other of the bells. Just why the inventor should prefer this arrangement to the simpler and well-known one wherein the bells are permanently connected each to its own line, and the instrument and generator are alone shifted by the switch is hard to understand, especially as the latter method not only indicates at once by the sound of the bell which line is calling, but also requires a two-pole switch instead of the four-pole switch of the patented device.

Earnings of Street Railways in New York State.

The last of the dividend-paying railroad companies operating in this State has made its report for the fiscal year ended June 30 to the New York State Railroad Commission. Three surface steam roads, which paid no dividends last year, are credited with dividends this year. In the mechanical traction and horse-propelled railroad group of dividend-paying companies there have been so many consolidations and mergers that it is not possible to make any definite comparisons. In the aggregate the dividends paid during the year recently closed, compared with the previous year, footed up:

	1901.	1902.
Surface, steam	$16,608,614	$19,679,339
Elevated	1,920,000	1,920,000
Mechanical traction	4,273,817	4,095,337
Total	$22,802,531	$25,694,676
Net increase		$2,892,145

In surface steam railroads, six of the companies increased their dividends over last year, while but one made a decrease. In the mechanical traction and horse companies, four show increased dividends and two decreased dividends. The "mechanical" roads are virtually all electrical.

Telephone Pay Stations.

Pay station service is gradually forcing its way to the front for the reason that it is appreciated by the public and is resulting in a handsome revenue to the telephone companies. A representative of one of the leading pay-station companies recently made a six months' trip for the purpose of studying the outlook, and reports very hopefully as to future business. Many companies have gone into this class of service, and wherever pay stations have been placed in a territory they are proving good investments.

Why a non-subscriber should expect free telephone service at a drug store or other public place to which he has access is just as ridiculous as a man entering a store and requesting a cake of soap gratis. Telephone officials throughout the country appreciate this fact, and are now facing the problem with a view of arriving at a satisfactory understanding regarding the advisability of eliminating this feature of "dead-head" service entirely. A company gives the service, thus increasing its operating expense, etc., without receiving in return a penny, and also slows down its service for subscribers who do contribute regularly toward the support of the company. It is advisable, it would seem, to meet this situation by a generous use of pay stations, as this is one way of securing more revenue than is possible with the ordinary flat rate, which makes it very easy for a non-subscriber to abuse the service.

The Shawinigan Power Company.

The first hydro-electric unit in the Shawinigan Power Company's power house at Shawinigan Falls, Quebec, has been started, the power being delivered in Montreal. The second unit will be started up at once, and will furnish power for the operation of the plant of the Shawinigan Carbide Company, which is now nearing completion.

CURRENT NEWS AND NOTES.

BRITISH IMPERIAL CABLE LAID.—The last section of the British Imperial Pacific cable was laid at the Fiji Islands Thursday, last week, and King Edward received the first message.

ELECTRICAL ENGINEERS WANTED.—The New York State Civil Service Commission will examine candidates for the positions of electrical engineer and assistant electrical engineer. Persons desiring to enter the examinations must file their applications at the office, in Albany, before noon on November 24.

AUTOMOBILE CLUB OF AMERICA.—The annual meeting will be held November 17. The governors have nominated the following ticket: For president, A. R. Shattuck; for first vice-president, Winthrop E. Scarritt; for second vice-president, James Stillman; for third vice-president, W. K. Vanderbilt, Jr.; for treasurer, Jefferson Seligman; for three governors, to serve three years (class of 1905), Col. John Jacob Astor, Geo. F. Chamberlin, Peter Cooper Hewitt; for governor, to serve one year (class of 1903), Harlan W. Whipple.

POLYPHASE INDUCTION REGULATOR.—Wherre polyphase systems of electrical distribution are used for both lighting and power purposes, a serious difficulty encountered is that of unequal variations of electromotive force across different mains of the system, commonly known as "unbalancing," and caused in general by unequal distribution of load between different mains of the system. In some cases, moreover, as, for instance, in interconnected two-phase systems—if the loads are reactive or the transmission lines contain reactance, the electromotive forces across the two sides of the system become unequal, even if loads on the two sides of the system are equal. Two patents issued October 28 to Charles P. Steinmetz describe an arrangement for simultaneously operating upon the electromotive forces between two sides of a polyphase system, the action being such as to produce an opposite variation in the electromotive forces, either raising one and simultaneously lowering the other, or the reverse. The arrangement consists in two co-operatively arranged induction regulators, one on each side of a two-phase system. The apparatus in practice is similar in structure to an ordinary induction motor, and consists of a suitably constructed toothed ring of laminated magnetic material, within which a similarly toothed cylinder of laminated magnetic material is mounted so as to be partially rotatable. One member carries two coils, in series respectively with the two phases, while on the other member two coils in shunt respectively with the two mains are similarly mounted. The coils are so arranged that in one position of the regulator the lines of force produced by each shunt coil will all pass through or tend to pass through the corresponding series coil. The e. m. f. induced in each series coil by the action of its corresponding shunt will thus be a maximum and will accordingly add to or cut down the e. m. f. of the line a maximum amount, depending upon the direction in which the coils are connected into circuit. The coils operating upon one circuit are so connected as to have an effect opposite from that of the coils which act upon the other circuit. One set of coils thus acts to raise the electromotive force of one circuit a maximum, and to depress that of the other a maximum in the opposite direction. If now the shunt-coils be rotated or moved away from the corresponding series coils, the mutual induction between the coils becomes less, thus decreasing the boosting effect on one circuit and the lowering effect on the other. A continued relative movement of the coils finally results in bringing them into a neutral position, where no effect is produced on either circuit. A continued movement beyond this position causes a reverse action to take place, lowering the electromotive force of that circuit whose electromotive force had previously been raised and raising the electromotive force on that circuit whose electromotive force had been lowered. This provides a means for producing any desired relation between two electromotive forces without changing their mean value. The action of the device is not dependent upon the current flowing in the two branches of the system, and it does not have as its object the equalization of current flowing, thus differing essentially from many devices for balancing polyphase systems, which depend for their operation upon unequality of currents in the system.

CANADIAN NIAGARA POWER.—The International Harvester Company is erecting a large plant in Canada which will derive its power from the Cataract Power Company, Hamilton, Ont. A contract has just been closed with the Cataract Company for 3,500 electrical horse-power for this purpose.

AUTOMOBILES IN FRANCE.—According to statistics issued by the inland revenue authorities of France, the number of automobiles existing in France is 5,386, of which 2,893 are cars with accommodation for more than two passengers, and 2,493 for one or two only. Paris alone has 1,149, or about one-fifth of the total, 751 being cars for more than two persons.

BURIAL OF PROF. S. H. SHORT.—The remains of the late Prof. Short have been brought to this country and will be given interment at Woodlawn Cemetery, New York, on Tuesday next, November 11th. Services will be held at 2:30 P. M., at the Church of the Messiah, East Thirty-fourth Street and Park Avenue, to which all friends of the deceased engineer are invited. After the service, a special car will carry to Woodlawn, over the Harlem branch of the New York Central, all who desire to see the body committed to the receiving vault there.

BOOSTER REGULATION.—To obtain a nearly straight external characteristic of a booster is the object of a patent, granted October 28 to Harold Edwards. A series booster is driven by a direct-connected shunt motor and supplied with two auxiliary windings; one of these windings is in series with the motor field, and the other in series with the motor armature circuit. By these means it is stated the external characteristics becomes approximately a straight line. A similar result is claimed to be produced by a method patented on the same date, to H. F. T. Erben and A. F. Knight, according to which a series booster, driven by a belt or otherwise from a shunt motor, is supplied with an auxiliary winding connected with a source of constant potential—for example, across the mains of the distributing system including the booster.

WIRELESS TELEGRAPHY ON SOUTH AMERICAN COAST.—It is stated that the United Fruit Company has made arrangements to use the wireless telegraph system in connection with the operation of its fruit vessels in Central America. There is now no telegraphic system to or between the fruit ports of Central America. The company will establish two stations, one at Bocas del Toro, Colombia, and the other at Port Limon, Costa Rica. These are 100 miles apart. The experiments will be conducted by the company itself, under the charge of Mr. M. Musgrove, who has been laying the telephone wires for the company in Colombia and Costa Rica. The company has built 300 miles of telephone line in Costa Rica, connecting Port Limon with all the towns and stations with which the United Fruit Company does business. It will build about the same mileage in Colombia.

SIGNAL FOR ELECTRIC-CAR CROSSINGS IN LEIPZIG.—Consul B. H. Warner sends the following from Leipzig: Until a few months ago, the method in vogue in this city of avoiding accidents at crossings of electric street railways was either to station a flagman at the crossings, or to have the conductor run forward to see if the other line was clear. An automatic signal lantern has been introduced by the street railway company, which does away with these inconvenient methods. The lantern consists of two boxes, arranged one above the other, each having two sides fitted with red and the other two with green glass, the red being above the green. The cars on one line cause the incandescent lamps in the upper box to burn; the cars on the other line, the lamps in the lower one. This causes, owing to the arrangement of the glass in the boxes, a green light to appear to the first line, which indicates "free passage," and a red light to the second line, which means "stop." Signals are also visible in day time, as reflectors shut out the light of the sun, and the lantern is well lighted from the inside.

DYNAMO EXCITATION WITHOUT FIELD WINDING.—Two patents, granted October 28 to Harold W. Buck, relate to a system whereby the field winding of direct-current machines may be dispensed with. The principle consists in connecting condensers in the armature circuit in such a manner that the currents therein will be leading with respect to the impressed e. m. f., and will, therefore, have a component m. m. f. in the same direction as the required field-exciting m. m. f. In an example described, the armature is connected at three equidistant points to collector rings, which in turn are connected to the three terminals of a three-phase transformer, in the secondary of which is a condenser of the three-phase type. The number of turns of secondary in circuit with the condensers can be varied, thereby varying the capacity effect of the condenser, and consequently the field excitation and machine voltage. In construction the machine would resemble a rotary converter, one side of the armature being connected to a commutator in the usual manner and the other side tapped at regular intervals and connected to collector rings, which in turn are connected to condensers—either directly or with a transformer interposed, as above described, to enable the machine voltage to be simply regulated. With the transformer the size of the condensers may also be greatly reduced.

THE LONDON TUBE QUARREL.—A cable dispatch from London, of November 4, says: The acrimonious controversy arising from the Morgan-Yerkes "tube" rivalry was added to last evening by a statement given out for publication by George White, chairman of the London United Tramways. Mr. White characterizes as a "myth" one of the assertions in the letter from the Morgans, printed in the *Times* on Saturday, declares that another statement in the letter is "not a fact," and concludes as follows: "The facts are that after an experience of the methods of Messrs. Morgan, extending over four months and culminating in their insolent message to us through their solicitor that they absolutely declined to discuss our proposals, we determined that nothing on earth should induce us to continue business relations with that firm." The principals now seem inclined to drop the newspaper campaign. Yesterday Edgar Speyer said: "I deprecate all such press controversies. We certainly should never have appeared in print but for the harsh words of Sir Lewis McIver in the House of Commons debate, which, coming from the chairman of the tubes committee, might easily have been misunderstood. Since his letter to the *Times,* entirely exonerating my firm of any imputation of improper dealings, the matter, so far as we are concerned, is ended." Sir Lewis McIver, in the debate in the House of Commons on October 29, described the transaction of the United Tramways as "a scandal without precedent in committee work." Later he wrote to the *Times* saying he believed that the company had acted within its rights.

LETTER TO THE EDITORS.

Proposed Electrochemical Units.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with much interest the account of the system of electrochemical units, proposed by Mr. Alfred H. Cowles. There is no question but that the relation he has discovered is very interesting, and the coincidence remarkable. Coincidences in physics can never be lightly treated. An instance of this is the case of the electric theory of matter which was first put forth in the ELECTRICAL WORLD in 1891. It was there shown that the tensile strength, rigidity and compressibility of the pure metals had such values as they would have if all atoms were electrically charged, and consequently the theory was put forward that all atoms were electrically charged, and that these charges were sufficient to account for all the phenomena of matter. At that time it was objected that this relation was merely a coincidence; in fact, the editorials commenting on it described it as merely a remarkable coincidence. Such was the prejudice against the idea that conducting bodies contained charges inside of them that it was not until I had further applied the theory to determine the relation between sound velocity and electric conductivity, and had discovered the rotation of the ions in a magnetic field, the relation between magnetic rotation and absorption, between electromotive force and osmotic pressure, and similar relations, that the theory finally obtained a hearing. Of its later developments it is unnecessary to speak, but at the present time it is safe to say that no physical theory is more generally accepted than the electrical theory of matter.

Having seen thus that coincidence in physics may lead to important developments in theory, it must be pointed out that care should be observed to note whether the coincidences are really physical and not merely temporal. A physical coincidence is one which holds irrespective of the date at which the experiment took place and can be

reproduced at any time. A temporal coincidence is one which depends upon the time at which the experiment is made.

Let us apply this to Mr. Cowles's proposed units. The coincidence which he discovered is based upon the relation between the amount of hydrogen in a cubic meter at atmospheric pressure and the amount of hydrogen liberated per coulomb of electricity. We can see at once that this coincidence is not a physical one for the reason that atmospheric pressure is a temporary thing. In the carboniferous age the atmospheric pressure was probably much higher than it is now. One million years from to-day the atmospheric pressure will probably be much less than it is now. Consequently, Mr. Cowles's relations must be merely coincidences and not the expression of any physical law, and cannot, therefore, serve as a proper basis of a system of units.

Nevertheless, it is a fact that Mr. Cowles's relation is an extremely convenient and fortunate one, and one adapted to greatly facilitate the labor of calculations in electrolytic work.

OLD POINT COMFORT, VA. REGINALD A. FESSENDEN.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Compensation for the Phase Shifting in Induction Motors.—OSNOS.—An illustrated article on a new method which is different from that of Goerges or of Heyland. One essential point is that he supplies the secondary part directly with current of the frequency corresponding to the slip; this can be done through a few points which are fixed with respect to the secondary part, while another set of fixed points is short-circuited. The change of the exciting current from the frequency of the network to the frequency of the slip, is accomplished automatically. Assume an ordinary two-pole direct-current machine with stationary poles and revolving armature. If the brushes are revolved, then in an external circuit connecting them there is an alternating current, the frequency of which equals the number of revolutions of the brushes, while the phase corresponds to the position of the brushes with respect to the poles. The brushes may form any angle with each other; if there are several brushes and all are revolved with the same speed, alternating currents are obtained between any two brushes, all the currents being of equal frequency, but of different phases. The mean voltage of these alternating currents depends, however, upon the speed of the armature and upon the distance between the brushes. If the machine has n pairs of poles, the frequency of the alternating current is n times the number of revolutions of the brushes. By means of the commutator and revolving brushes with a direct current dynamo, one therefore gets an alternating current, the voltage and frequency of which are entirely independent of each other. It is therefore possible to get a current of any frequency at high speeds of the field, hence with small dimensions of the machine. In the adjoining Fig. 1, let p be the primary and r

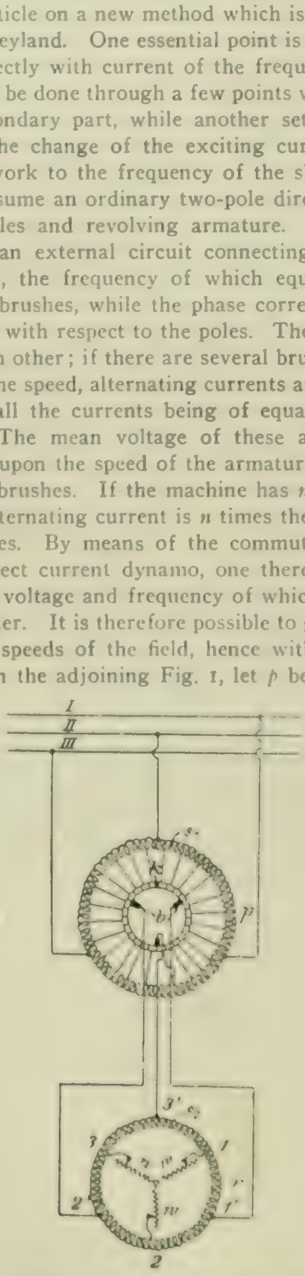


FIG. 1.—COMPENSATING FOR PHASE SHIFTING.

the secondary of a two pole induction motor. The primary winding is connected with a direct current commutator, k, on which there are sliding three brushes which form with each other angles of 120 deg.; they are mechanically and electrically coupled with the secondary. From these brushes the exciting current is supplied to three points of the secondary. If the primary is supplied with polyphase currents, a rotary field is produced, which in its motion cuts the primary winding with synchronous speed. At any speed of the rotor the voltage between the brushes varies with a frequency which is exactly proportional to the slip. Hence at any speed frequency of the current supplied to the secondary equals the frequency of the secondary

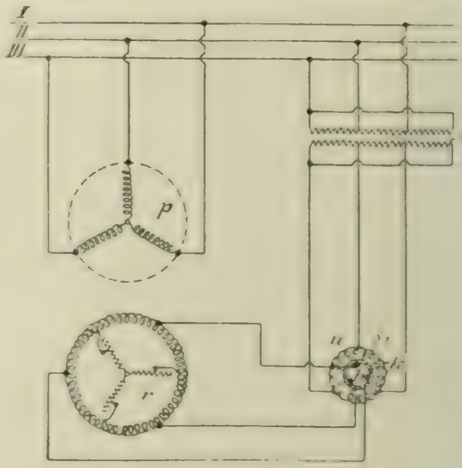


FIG. 2.—COMPENSATING FOR PHASE SHIFTING.

e. m. f., so that the principal condition for the existence of a torque at any speed is fulfilled. In order to enable the main power currents induced by the slip to combine with each other without going through the brushes, three symmetrical points, 1, 2, 3, are connected with each other by adjustable resistances, w, which serves as ordinary starting resistances when the motor is started and which are short-circuited during normal operation. These three points are situated symmetrically with respect to the three points at which the currents are introduced. He thinks that his principle may be of special advantage for the compensation of the phase difference in existing plants with a low power factor, and for large new machines in which it is desirable to avoid a special direct current winding with commutator on the machine itself. According to this principle, it is possible to take the exciting current, not from the primary, but from a separate exciting machine, n, shown in Fig. 2, which is built entirely like the primary, p, in Fig. 1. It consists of a laminated iron ring in which is embedded the direct current winding leading to the commutator. The winding, u, is connected at three points with the network, and the three brushes, b, are connected with the secondary, r. The secondary, r, and the primary, p, are made like in an ordinary induction motor. In order to reduce the voltage and the number of commutator segments, the transformer, t, is provided. Instead of using a separate transformer one may provide two windings on the exciting machine, the one with many windings being connected to the network, the other with a few windings to the commutator. As the commutator voltage of the exciting machine is proportional to the synchronous speed of the field, the strength of the latter, and hence the iron and copper required for the exciting machine, may be small, so that no more material is required than in the exciting transformer used in other methods. The mechanical coupling of the exciting machine with the induction motor can be made in different ways, one of which is shown in Fig. 3. p and and r are again the primary and secondary, respectively, of an ordinary induction motor, which is provided with slip rings, R, and start-

ing resistances, *w*. On the other side there are two other slip rings which are connected with the secondary and serve for providing the exciting current. The brushes, *b*, are at rest and transmit the exciting current to the slip rings on the right from the exciting machine, *k*, mounted on the axle, *A*, and itself provided with three slip rings,

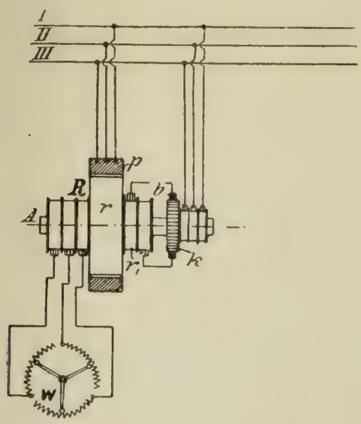


FIG. 3.—COMPENSATING FOR PHASE SHIFTING.

which are connected with the lines. If the primary is movable, the arrangement is greatly simplified, because the slip rings of the exciting machine and those on the right of the main machine, as also their brushes, become superfluous.—*Elek. Zeit.*, October 16.

Commutation.—Rothert.—A very long theoretical article on the theory of commutation, illustrated with numerous diagrams. His theory is based on the assumption that the breadth of a brush is exactly equal to that of a segment and that the insulation between the segments is infinitely small. As a basis for his investigation he makes the condition that the position of the brushes is assumed to be fixed and independent of the load. The formation of sparks at the commutator depends mainly on the "spark voltage," *i. e.*, upon the voltage existing at the instant when the connection between the segment and the rim of the brush is broken, and also upon the current per brush. While in the calculation of the so-called "reactance voltage," and in some theories the contact resistance between brush and segment is assumed to be constant, the author's method does not make this assumption, which, indeed, is wrong, as the contact resistance is first infinitely large and then decreases to a minimum which depends upon the conductivity of the brush, and later increases again and becomes infinitely large. He discusses by a graphical method the curve representing the current in the short-circuited coil as function of the time. With no self-induction in this coil, this curve is a straight line, while with increasing self-inducton the curve becomes more and more bent. To obtain good commutation it is necessary to get this curve as nearly as possible a straight line. This can be accomplished by three means: either by decreasing the self-induction or by increasing the brush resistance as a whole, or by using composite brushes of such a construction that the first parts of a brush have a better conductivity than the last part. For instance, he shows that if the total resistance of the brush is the same in two cases, the commutation is much poorer for a uniform brush than for a brush in which the first third has twice the specific conductivity of the two last thirds. The ideal case would be to use a brush the conductivity of which varies continually from point to point in the form of a parabola. This cannot be accomplished in practice, but he recommends to divide a brush in two or more parts of different conductivity and to choose the resistances of the different parts in such a way that their reciprocal values approximate nearly a parabola. He has not examined his conclusion experimentally, but says there cannot be any doubt concerning its exactness. He mentions, however, that the Schuckert Company uses composite brushes consisting partly of copper and partly of carbon. The fundamental differential equation of the theory of commutation is developed, and the solution is given graphically, but not analytically.—*Elek. Zeit.*, September, 25, October 2.

REFERENCE.

Voltage Drop in Polyphase Generators.—Kesselring.—A brief article on the predetermination of the voltage drop in polyphase alternators. There are in use two different methods, the one by Rothert, based on the combination of the ampere windings in armature and field, the other by Eschenburg, based on the combination of e. m. f.'s generated by the field system and induced by self-induction. He shows that the two methods are not quite correct in principle. He points out that the ampere windings of the armature must be decomposed into two components, one for the middle point of the pole and the other for the middle point between two poles. He gives several diagrams.—*Elek. Zeit.*, October 2.

Lights and Lighting.

Incandescent Lamps.—Wikander.—A communication in which he supports the suggestion of Lummer (recently noticed in the Digest), to use incandescent lamps at higher than the "normal" voltage, as it is more economical to use three overheated lamps each of 300 hours life, instead of one normally burning lamp of 1,000 hours life. He points out that the "normal" power should be that at which the economy is a maximum, *i. e.*, when there is a certain equilibrium between the cost for lamp renewals and that of the price of the current; 10 or 15 years ago the economy was highest for 3 to 3.6 watts per candle; since that time a lamp which is operated with this power is said to be burning normally. Since that time the price of lamps has decreased to one-third or one-fifth the former price and at the same time the construction of the lamps has become better, and this shows that the highest economy will now nc longer be at the same point as before. In most cases a life of 100 to 150 hours should now be more favorable than a life of 300 hours. More data are required to decide the exact point. The cost of attendants for renewals should be taken into account. He points out that if this proposal would be followed, it would be possible to allow a larger voltage drop in the network, and that would mean a cheaper network.—*Elek. Zeit.*, October 9.

Power.

British Power Plant.—A long illustrated article on the supply system of the Midland Electric Corporation for Power Distribution. The plant has just commenced operation and is still incomplete, the works furnishing at present power to one tramway company only, but provision has been made for a large and varied load. The power house is situated nearly at the centre of the district to be supplied, and coal is very cheap there. The radius over which the company supplies power is about 7 miles. The plant contains at present two 800-kw. and one 1,500-kw. alternators, there being room for two more sets of the larger size. The alternators generate two-phase currents directly at 7,500 volts. The most interesting part of the plant is the new Ferranti switchgear, used for the first time at this plant for "extra high" voltages. It embodies the advantages of the cellular, backless and single-pole construction, and remains almost as compact as the ordinary Ferranti board for lower pressures; but in a separate editorial note the opinion is expressed that for general use it might be too expensive. The switchgear is described in detail and illustrated. It includes oil-break switches of new design and a modification of the Ferranti oil-break fuse. The switches are on the divided-break system. The main contact outside the oil container breaks circuit first, and the final break is in shunt with this, taking place at seven blades within the oil vessel, each of the blades, together with the corresponding clip contact being fixed to the interior of the vessel, constituting as it were a double-break switch, so that the spark is divided among 14 breaks in series and all under oil. In switching off, the handle while being turned to break the main contacts winds up a spring, which releases suddenly and rotates the ambroin sleeve carrying the contact blades. In switching on there is a synchronising contact at half-cock, but the break does not pass through this intermediate stage. The box containing the oil and the shunt blades is of porcelain and is entirely enclosed; the main break, which is at the back of this and therefore at the end of the compartment of the switchboard containing the switch, is also quite inaccessible until the whole piece of apparatus is withdrawn and contact is thus broken. Distribution of current to the consumers takes place in three ways: directly from the substations at 200 volts two phase; from street transformers fed at 2,700 volts from the substations and delivering at 200 volts two-phase to the consumers' networks; and from a single rotary converter substation at 500 volts direct current for tramways.—Lond. *Elec.*, October 3, 10.

REFERENCE.

Gas Engines and Waste Gases.—Perkins.—An illustrated article on electrical stations in Germany, operated by gas engines, supplied with waste blast furnace gases.—*Elec. Rev.*, October 25.

Traction.

Aurora, Elgin & Chicago Railway.—A descrption of this high-speed road on which speeds of from 65 to 80 miles per hour can be made with safety. The regular speed figured upon is 65 miles per hour, with an acceleration of 2 miles per hour per second. The line is 80 miles long. Each car is equipped with four 125-hp motors. When accelerating at the rate given above, the motors require 300 amperes each. Current is taken from the third rail, placed 6 3/16 ins. above the top of the track rails and 19⅛ ins. outside the nearest track rail. The rails weigh 80 lbs. per yard, and the third T rail 100 lbs. per yard. Power is transmitted at 26,000 volts. All switching is done on the high voltage side of the step-up and step-down transformers. Full particulars are given of the transmission system. Six hundred volts are used on the trolley wire.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Three-Cent Fares in Detroit.—A statistical article. As Detroit is the only city in the United States where a three-cent fare is charged, particulars of the experience are of interest. The experience in Detroit indicates that low fares do not increase the traffic and gross receipts enough to compensate for the lower revenue per passenger. and that a slightly higher fare will be readily paid by passengers to a line which gives a more direct and hence a quicker service.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Freight and Express on Interurban Electric Railways.—Lang.—A description of the development of this feature of the interurban service, with special reference to the experienc of the Ohio companies. Schedules have been arranged on the several roads so that the freight cars are run at such hours of the day and night as not to interfere with the regular schedules of passenger cars and at the same time not to overcrowd the tracks in the freight station. This gives the service the character of an express rather than an ordinary freight system. One of the companies operates six freight trains daily, and each of the others, two trains a day. Besides these regular runs extra cars are frequently used. Regular freight cars are used on all of these roads. An interesting feature of the experience in this particular field is the fact that the small dealers in the towns within reach of Toledo make a specialty of ordering their supplies by telephone, giving instructions at the same time to ship them over the electric lines. This arrangement has the advantage of permitting the dealer to make daily requisitions upon the wholesale houses and securing delivery the same day. As the result of an exhaustive examination of the subject, the writer concludes that the value of an ordinary electric road does not depend upon its ability or capacity to carry freight or express, although its value is greatly enhanced thereby. He believes that it should develop the freight and express business as rapidly as possible, but that it should not become involved or sacrifice the regular passenger business until it is well assured that the freight will prove a profitable branch. The article is illustrated with a number of photographic reproductions, showing the class of cars used on the lines described and also the forms which are employed in the accounting departments of the several concerns.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Suburban Traffic Conditions of London.—Dawson.—An article in which he first gives a table showing the area and square miles of the County of London and the City of London, with the population for the last three decades. The surface transportation facilities in the centre of the city are extremely poor, as the existing busses are neither convenient nor economical in time, and tramways are not looked upon with favor. The result is that there have been a large number of tube lines built. The writer gives a table showing the existing tube railways and tramways in London with the train miles run, miles of route and passengers carried during 1901. The effect of the tube railways and tramways has been to reduce largely the suburban business on the steam railroads, not only in London, but throughout Great Britain. This competition is being severely felt. The only salvation of the steam railroads seems to be the installation of an electric suburban service. This will be very expensive as the capital charges on the existing steam roads are now very high, but the writer sees no other course. To indicate what can be done in this respect he cites the suburban business of the London, Brighton & South Coast Railway, and gives the names of some sixteen stations, most of them within a radius of 1½ miles from the London Bridge station, with time taken by the present steam trains and average speed in miles per hour. The effect of electrical equipment on the distribution of the population in London will be very considerable, as shown by statistics quoted, which indicate a great congestion of population within the city. These people, he believes, could be so rapidly and cheaply moved between their homes and places of business by electricity that they could afford to reside from 12 to 24 miles from the city, where now they cannot go farther out than one-half that distance. The article is illustrated by maps showing the tramways, tube railways and steam railways in the city of London, and a number of smaller maps giving the routes of some of the principal London suburban steam railroad systems.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Boston and Worcester Electric Railway.—A description of this new electric railway connecting two important cities, about 40 miles apart in New England. Entrance into each city will be secured over the local tramway system and running time between centres of cities will be two hours; the fare will be 35 per cent. of the steam railroad fare. The rails are in 60-ft. lengths and weigh 72 lbs. per meter. Very heavy poles are used. The power will be generated in one station, and will be transmitted at 13,200 volts and 25 cycles. The generators are of the fly-wheel type. The power house is the largest in New England; full particulars are given. The substations contain 400 kilowatt rotaries. The cars are equipped with four 50-hp motors.—*St. R'y Jour.*, October 4. and *Int. Ed.*, October.

reference.

Power Houses.—Kerr.—An article on the design of power plants for interurban railways and the general principles underlying it. Among the power plant features which seem to require better engineering than is now usually practiced are type and sufficiency of power house construction, feed-water purification, feed-water saving, furnace sufficiency, steam piping, protective device for electric circuits and the proper correlation of every feature with each of the others.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Installations. Systems and Appliances.

Electric Power and Light in Harbor.—Langner.—A long illustrated description of the electric installation in the Emden harbor in Germany. There are two 65-kw and one 135-kw direct-current dynamos, the voltage being 500; there is also a battery giving 370 amperes in one hour. For lighting, the three-wire system with 440 volts between the outers is used, the middle wire being earthed. The motors are operated at 500 volts. Power is used for the operation of five cranes and a coal conveyor. Each crane is built for a normal load of 2,500 kg, but may carry loads of 3,250 kg; each crane is operated by two series motors. The construction of the cranes and the conveyor is described and illustrated.—*Elek. Zeit.*, October 2, 9.

Electro-Physics and Magnetism

Radioactivity.—Elster and Geitel.—An account of researches in which they investigated the fact that any conductor becomes radioactive when charged and exposed to air, especially when the air is contained in a closed subterranean space. To shed some light on the origin of this radioactivity, they have made experiments with air enclosed for three weeks in a boiler, and on air sucked up out of the ground. If the activity is due to a process within the air itself, it will be evolved in the boiler, and if it is due to contact with the earth, it will be shown in the air sucked up. The results were altogether in favor of the view that the activity of the air in a cave or cellar is due to contact with the earth and to exhalation of ground air. They now claim to have traced two distinct sources of radioactivity, one of them being the action of the sun upon the higher strata of the atmosphere, and the other being the exhalation from the soil of air which has been in intimate contact with it, and which diffuses up through capilliary passages in the ground.—*Phys. Zeit.*, September 15; abstracted in Lond. *Elec.*, October 10.

Becquerel Ray Photographs.—Elster.—A description of the simplest method of obtaining Becquerel radiographs. The radioactive substance is obtained by exposing negatively charged copper wires to the air, and rubbing off the surface layer after exposure. If cotton batting is used for rubbing it off, it should be moistened with a little hydrochloric acid; this is afterwards neutralized with ammonia and eliminated by igniting the cotton; the activity of the ashes is the same as that of the cotton. The radioactivity last for about five hours; as its loss is greatest at first, the exposures must be made as soon as possible. To save time it is advisable to substitute a piece of leather, moistened with ammonia, for the cotton, since it can be quickly dried in a spirit flame. The exposure is then made for about four hours, and the leather is again made radioactive. After about five such repetitions, good radiographs of lead stencils are obtained through

aluminum foil 0.1 mm. thick. The radioactivity of the exxposed wires depends, of course, to a great extent upon the weather. Air free from mist and dust is specially favorable; but the best of all is a cellar free from dust, and the author has found that the leather rubbed over charged wires suspended in a cellar exerted some visible action upon a fluorescent screen. He points out that the whole surface of the earth is practically a cathode.—*Jahrbuch f. Photographie,* 1902; abstracted in Lond. *Elec.,* October 10.

Induced Radioactivity.—Sella.—An account of experiments in which he found that a temporary radioactivity can be imparted to a spiral spring by means of a charged rod placed in its axis and provided with needle points. The most remarkable circumstance observed was that the spring, and, indeed, any metallic body exposed to the "effluvium" from an influence machine may thus be made radioactive even if positively charged. The amount of radioactivity acquired depends largely upon the state of the atmosphere.—*Nuovo Cimento,* August; abstracted in Lond. *Elec.,* October 10.

Radioactivity of Polonium.—Behrendsen.—It has been known that if pitchblende is powdered and ignited in a porcelain crucible, and the lid is kept cool, the latter is covered with a reddish-grey deposit which shows a strong radioactivity. The present author proves that this deposit consists largely of polonium. He considers it definitely established that polonium is an independent element.—*Phys. Zeit.* September 15; abstracted in Lond. *Elec.,* October 10.

Attractive Force and Magnetic Induction.—Poucher.—A brief illustrated account of experiments in which he tested whether a formula of Kapp for the relation between the attractive force of a magnet upon its keeper, the magnetic induction and the geometrical dimensions, holds good for objects not in immediate contact with the magnet. He finds that the exact relation between the inductive and attractive force given in this formula does not hold for objects at a distance from the magnet, but so far as his observations go they bear a constant relation to each other.—*Phys. Rev.,* October.

REFERENCE.

Radium Bromide.—An article in which he gives some particulars on the properties of radium bromide and on the flame spectrum of radium.—*Phys. Zeit.,* September 15; abstracted in Lond. *Elec.,* October 10.

Electro-Chemistry and Batteries.

E. M. F. of Ozone Cells.—Brand.—An account of an investigation of whether the heat produced by the decomposition of ozone—which, according to Berthelet is 29,600-gram calories per 48 grams of ozone—can be utilized wholly or in part for the production of electrical energy. He found an amount of energy of 0.5 joule per coulomb The total work of ozonization amounts to 0.642 joule per coulomb, so that there is a rather high electrical efficiency. *Ann. d. Phys.,* No. 10, 1902; abstracted in Lond. *Elec.,* October 10.

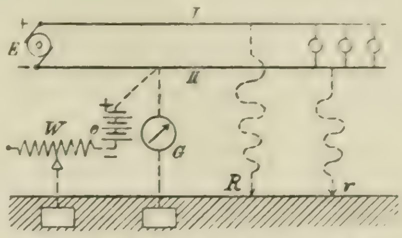
REFERENCES.

Alizarine Industry.—Simon.—An account of a new application of electro-chemical methods. Alizarine has been manufactured from coal tar, but up to the present the methods for recovering the chromium salt contained in the mother liquor as chromium sulphate have been very troublesome. The electrolytic recovery has hitherto been hindered by the fact that no diaphragm was found that would last. This difficulty has now been overcome by Leblanc's invention of diaphragms consisting of 25 per cent. alumina and 75 per cent. silica, which not only are very durable, but also have a low resistance.—*Jahresber. Phys. Ver., Frankfurt,* 1902; abstract in Lond. *Elec.,* October 3.

Zinc.—An article giving a review of the various patented processes for the production of zinc from its ores. *Sc. Am. Sup.,* October 18.

Units, Measurements and Instruments.

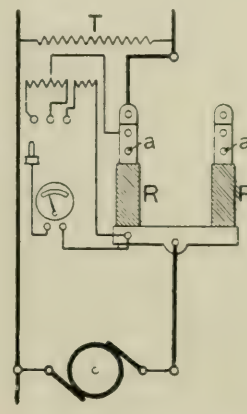
Measuring the Insulation Resistance of Direct Current Installations.—Bruger.—An illustrated description of the following method for measuring the insulation resistance of a direct-current installation during operation. For a two-wire system the arrangement is shown in the adjoining diagram. *E* is a dynamo supplying lamps, the feeders being indicated by I and II, and their insulation resistance to earth by *R* and *r* respectively. To measure *R,* a convenient point on II is connected to the positive pole of a storage battery, *e,* while its negative pole is connected to earth through an adjustable resistance, *W.* The same point on II is also connected to one terminal of a galvanometer, *G,* the other terminal of which is connected to earth. If the variable resistance, *W,* is so adjusted that no current flows through the galvanometer, *G,* then the insulation resistance, *R,* is equal to the resistance, *W,* multiplied by the ratio of the e. m. f., *E,* of the dynamo to the e. m. f., *e,* of the battery. This latter ratio may be conveniently



MEASURING INSULATION RESISTANCE.

chosen, for instance, so that the e. m. f. of the battery is one-tenth the voltage, *E,* of the plant; then the insulation resistance, *R,* is ten times the resistance, *W.* He describes a conveniently arranged apparatus based upon this principle.—*Elek. Zeit.,* October 9.

Measuring Instruments.—Field.—An illustrated British Association paper, in which he describes several novelties in electrical apparatus. The first described is a "compensated voltmeter," designed for indicating at the station the voltage between either the positive or negative and the neutral main at the far end of a three-wire feeder, being compensated for the feeder drop, no matter how much or how little the network may be out of balance. This instrument has already been noticed in the Digest. He then describes a hot-wire instrument which will read amperes, volts, true watts hence power factors, giving readings consistent with one another. The drop of voltage across the instrument does not exceed 0.5 volt, so that measurements can be made by it on motors or other apparatus while connected to their normal circuits, thus no special provision for higher voltages is necessary when making such tests. The instrument is essentially for workshop and testing-room purposes, not for switchboard work. The connections of this particular instrument are those shown in the adjoin-



MEASURING INSTRUMENTS.

ing diagram. R_1 and R_2 are two alternative non-inductive resistances of different carrying capacities, either of which can be inserted in the main circuit. *T* is a potential transformer with three secondary windings giving equal voltages. A plug arrangement is attached to the instrument. The first two plug holes (from the left-hand side) give the connections necessary for the determination of watts; the third converts the instrument into a voltmeter, and the fourth or fifth, both marked *a* in the figure, into an ammeter, special calibration tables being employed. With the plug inserted in the first hole, it is practically the same arrangement as his compensated voltmeter modified for a two-wire circuit. The position with the plug in the second hole is the same, but with the secondary e. m. f. of the transformer reversed. If the instrument is calibrated to read the square of the voltage at its terminals in each case, the difference of the two readings is a measure of the watts. He then describes a fault indicator for tramway circuits; it is based on the principle of the Wheatstone bridge. Finally a new synchronizing gear is described.—Lond. *Elec.,* October 3.

REFERENCE.

Measuring the Electrical Resistance of Liquids.—Dinwiddie.—A brief illustrated description of a very simple cell for determining the

resistance of an electrolyte by Kohlrausch's method for laboratory use by students.—*Phys. Rev.*, October.

Telegraphy, Telephony and Signals.

Magnetic Detectors in Space Telegraphy.—Wilson.—An illustrated British Association paper in which he discusses experiments made by Rutherford and himself concerning the effect of high frequency electric currents upon magnetized wires, and the use of magnetic detectors in space telegraphy over short distances. Marconi has meanwhile achieved great success over larger distances.—Lond. *Elec.*, September 26.

Miscellaneous.

Electric Response.—Bose.—An abstract of a British Association paper on "electric response in animal, vegetable and metal." The electric response is a measure of the physiological activity of the tissue, and is generally considered to be "the most general and most delicate sign of life." These response phenomena are considered to be due to some unknown superphysical "vital" force and are regulated as beyond the region of physical inquiry. The author shows that this view is not justified. He has obtained electric response in all plants and by all their organs; when the plant is killed by poison or hot water the electrical response disappears. The electric response is also present in the inorganic bodies, such as metals. The responses in plants and metals are modified by the influence of external conditions exactly in the same way as the responses of animal tissues are modified. There is not a single phenomenon in the response in muscle and nerve that has not an exact parallel in the response of metal and plants. He notices a few special cases.—Lond. *Elec.*, September 26.

New Books.

Electric Arc Lighting. By Edwin J. Houston, Ph. D., and A. E. Kennelly, Sc. D. Second Edition, Enlarged. New York: Electrical World and Engineer. 437 pages, 172 illustrations. Price, $1.00.

The second edition of this work is brought up to date by the addition of four chapters, the subjects of which are enclosed arc lamps, series alternating arc lighting from constant-current transformers, multiple-circuit arc-light generators, and photometry of the arc light. The descriptive matter, as in the other chapters, is accompanied with numerous illustrations.

Jahrbuch des Schweizerischen Elektrotechnischen Vereins. Mit einer Beilage in folioformat enthaltend die Tabellen, Statistik über Starkstromanlagen. Zurich: Jacques Bollmann.

The annual publication of the Swiss Association of Electrical Engineers has little in common with publication of similar bodies, and is also peculiar in that the greater part of the text is printed in two languages—German and French. The greater portion of the matter has reference rather to the commercial than the professional aspect of electrical industries. The first portion opens with lists of officers and members, from which we learn that there are 160 company members (members anonymes) and 280 individual members (membres effectifs). Following is the report of the proceedings of the general meeting, including reports of committees, one of which is on the Nernst lamp Among the subjects discussed at this meeting was a code of rules for electrical installation. A new federal law on the same subject was also discussed, and a petition adopted asking for certain amendments to the law.

The final portion of the volume is devoted to statistics, including a financial statement of the Swiss central station and electric railway industry A list is given of Swiss patents granted during the year, and statistics of the Swiss telegraph and telephone service

In the final pages is a directory of the professors of physics and electrical engineering at the several Swiss universities and higher technical schools; a directory of all government officials having contact with the electrical industry; a directory of electrical railways and central stations The directory is also classified by Cantons.

Statistics in great detail of the Swiss central stations are given in a folio supplement to the Jahrbuch.

Books Received.

Opere di Galileo Ferraris. Pubblicate per Cura Della Associazione Elettrotecnica Italiana. Vol. I. Milan: Ulrico Hoepli. 492 pages, 52 illustrations. Price, 12 lire.

Die Darstellung des Chroms und Seiner Verbindungen mit Hilfe des Elektrischen Stromes. Von Dr. Max Le Blanc. Halle: Wilhelm Knapp. 110 pages. Price, 6 marks.

Text Book of Chemistry. By Svante Arrhenius. Translated by John McCrae, Ph. D. New York: Longmans, Green & Co. 344 pages, 58 illustrations. Price, $2.50.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York.

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

New York Electrical Society, Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association, Secretary, Thos. R. Mercein, Milwaukee, Wis.

Old-Time Telegraphers' and Historical Association, Secretary, John Brant, 195 Broadway, New York.

The Electrical Trades Society (member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

An Automatic Telephone Exchange at Westerly, R. I.

The Westerly Automatic Telephone Company, of Westerly, R. I., using the Strowger automatic telephone exchange system, under an exclusive license from the Eastern Automatic Telephone Company, of Boston, Mass., has just opened its exchange for business with its original equipment, 100 switches in use and 30 subscribers awaiting additional telephones, already ordered. The system has been so fully described in these columns that further description at this time is not needed. Suffice it to say that it is the same system now in use by the Fall River Automatic Telephone Exchange, of Fall River, Mass., that is to be used in Chicago by the Illinois Telephone and

Fig. 1.—Switchboard.

Telegraph Company, and also in Columbus and Dayton, Ohio. The system is one that requires no operators at central, each subscriber to the exchange making his own connections by means of a small dial on the face of each telephone, and disconnecting by simply hanging up the receiver on its hook.

Work on construction was begun early in September, and has progressed rapidly. The capital stock of the company is $25,000, divided among about 30 stockholders, prominent local business and professional men The company has erected its own poles, all of square-

sawed and dressed chestnut and pine, ranging from 8 in. x 8 in. to 14 in. x 14 in. The exchange occupies a room in the Champlin Block, on Main Street, in the center of the town. The rentals are $30 a year for business, and $20 a year for residences.

Power for operating the switches, busy signal and ringing is furnished by a 25-cell chloride accumulator battery of 30-amperes capacity. This is charged by a ¼-hp Holtzer-Cabot dynamo (with another

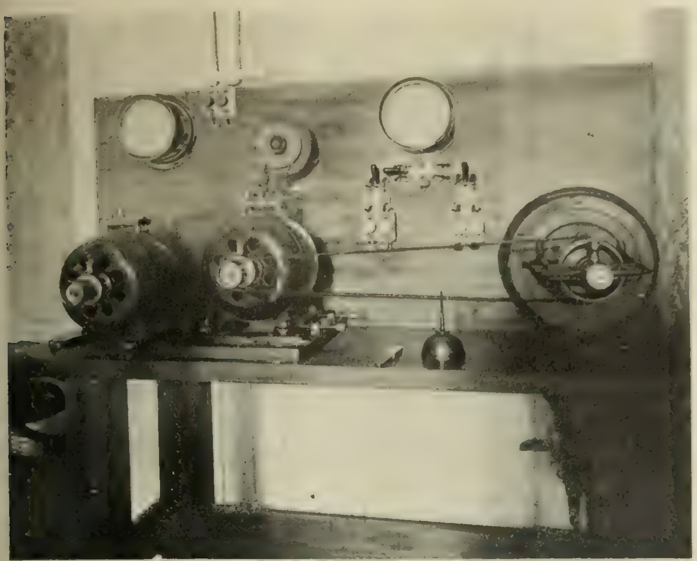


FIG. 2.—POWER BENCH.

in reserve) belted to a 2-hp "Little Giant" Belknap water motor The power bench is equipped with Whitney round-pattern ammeter and voltmeter, and the necessary jackknife switches, fuse boxes and field rheostat for the dynamos.

The distributing board is equipped with four 50-pair Sterling combined carbon plate and heat coil arresters with Standard hard-rubber cable heads, one 60-pair and five 30-pair. Six aerial dry-paper lead-covered cables, with an electrostatic capacity of less than 0.11 microfarads per mile, are used, supported by malleable cast-iron hangers from 5/16-in. galvanized steel stranded suspension wire.

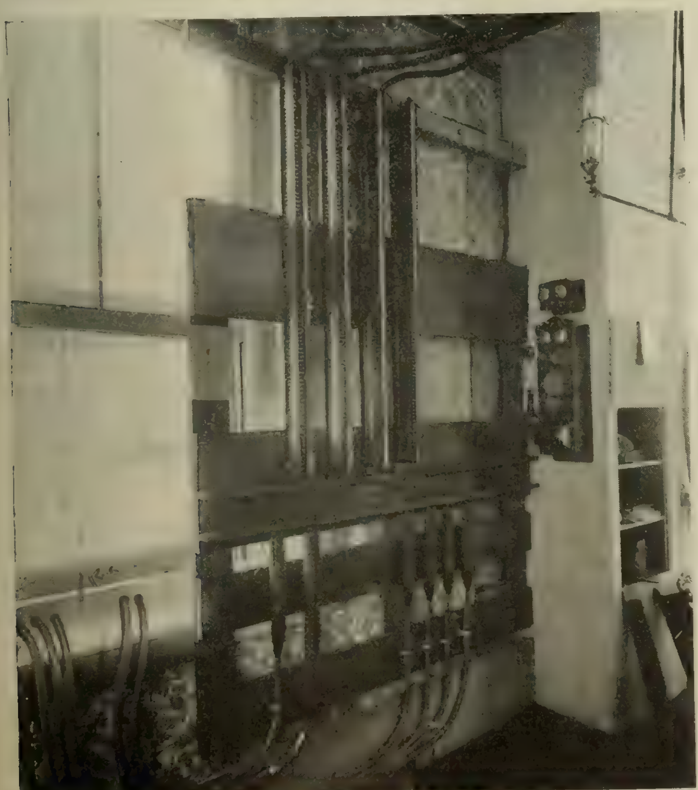
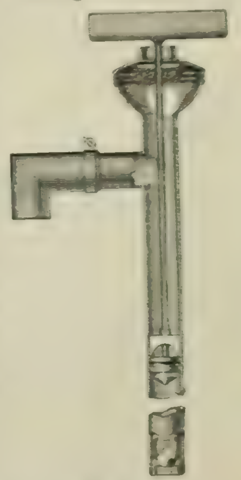


FIG. 3.—OFFICE CABLE HEADS.

The 17 cable boxes distributed throughout the town contain Sterling tubular fuse arresters. Distribution is effected from the cable boxes to the substations through twisted pairs of No. 14 and No. 16 braided rubber insulated wire. Hard-rubber cable heads are used except in a few instances where pot-heads of red-black twisted pair No. 20 wires joined directly to No. 20 cable conductors are used. At the substations the outside wires are brought in through porcelain tubes and connected with D. & W. combined tubular fuse, heat coil and carbon plate arresters. Telephones are wired to the arresters by triple-braided rubber wire. Ground wires from telephones and arresters are No. 16 single-braided rubber wire. Six-foot, 6-pin cross-arms are used, mostly with a few 10-pin arms. Pole hardware is of standard size and weight throughout, and galvanized. On cable poles a special form of galvanized iron cable seat was designed for use on the square poles. All cables, cable heads and insulated wire were furnished by the Standard Underground Cable Company.

Oil Pump.

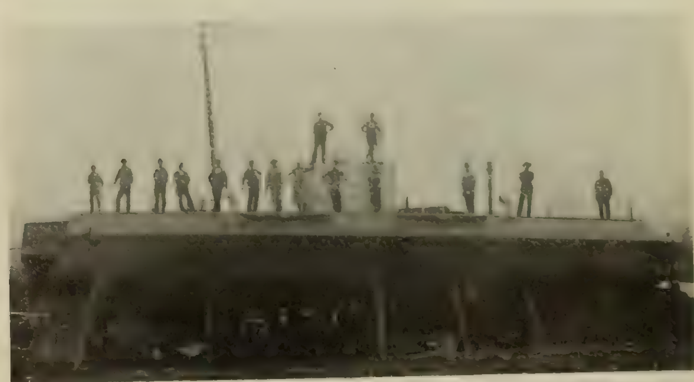
The pump illustrated herewith is provided with valves of such construction as to permit heavy oils, even when cold and stiff, to readily pass through them. The arrangement of the stuffing box is such as to prevent the oil from being carried up by the stem which carries the plunger, and spilled over the outside of the pump. In the bottom of the tube is a ball valve consisting of a seat screwed into the end of the tube and having an opening wherein is seated a ball. Vertical arms permit the ball to rise and fall without leaving the vicinity of the seat. The lower end of the valve stem consists of a plunger which has a cylindrical portion to snugly fit within the tube, an annular groove in the periphery of this portion fills with oil and serves to make a tight-working joint, the vertical portion acting merely as a guide in keeping the valve in position. The stem carries at its end a tapered block, which rests within a seat of the same taper, being also tapered on the bottom so as to form less resistance to the oil as the valve descends. The top of the tube is flared to form a head, to which a cap is engaged by means of threads, and forms a guide for the stem. Depending within this cover and surrounding the stem is a chamber composed of an annular wall and fitted with a cap, and within this chamber is a metal washer and other suitable packing material. This pump, which is made entirely of brass, is the invention of Mr. Frank O. Sterrett, and is manufactured by the Sterrett Pump Company, St. Paul, Minn.



OIL PUMP.

The New Submarine Boat "Protector."

At Bridgeport, Conn., the "Protector," the first submarine torpedo boat of the Lake type, was launched a few days ago at the works of the Lake Submarine Torpedo Boat Co. Miss Della Miller, of Elizabeth, N. J., daughter of President L. B. Miller, of the Singer Sewing



SUBMARINE BOAT "PROTECTOR."

Machine Manufacturing Company, named the boat as she glided into the water. The "Protector" is 60 feet long, 14 feet deep, 11 feet wide, and draws 12 feet of water. She is still devoid of parts of her mechanism, although all of it is ready for installation. The company is planning to begin its preliminary trials in the Sound off this city about December 1, after which a date will be fixed for her inspection by Government officials at Washington.

Simon Lake, inventor of the boat and president of the company, said after the launching to-day that the vessel, when finished, will be capable of submergence to a depth of 150 feet, of traveling on wheels along waterbeds or in the ordinary manner on the surface. Gasoline is used for power when on the surface, and electricity while submerged. Various details have already been given in these pages as to Lake boats.

Moulding Ceiling Rosettes.

Those having to do with the installation of mill and other plants where ceiling blocks or rosettes are largely used, will appreciate the advantages of a new type which is shown in the accompanying illus-

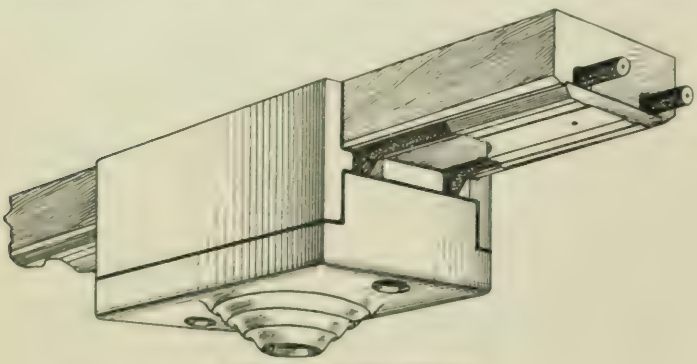


FIG. 1.—CEILING ROSETTE.

trations. Fig. 1 shows in a very clear manner the construction of this rosette. The cover and its base are provided with dove-tail joints to prevent the cover from slipping sidewise, and where it is screwed home, the flexible cord terminals, inside of the cover, engage two lugs

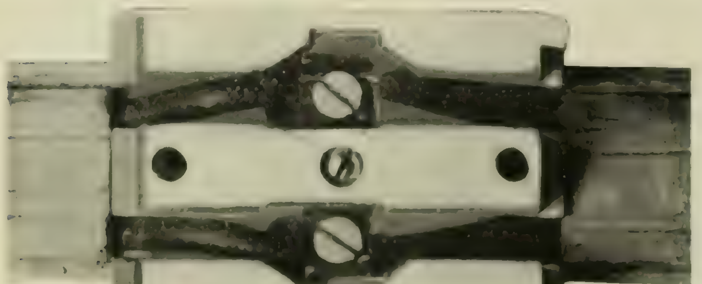


FIG. 2.—CEILING ROSETTE.

on the base, which constitute the tap terminals. In Fig. 2, which gives an interior view of the rosette, the design and combination of the various parts are plainly shown. From a moment's consideration, it is evident that it is an easy matter to add a new rosette at any time, or remove one, without marring the appearance of the main part of the moulding in any way, the porcelain base being of such a form that it straddles the same. Aside from the great saving in labor in installing by reason of the fact that the moulding need not be cut, the rosette presents a neat appearance, its shape being in conformity with the line of the moulding. This device was recently patented to Chas. Frederick Lewis, and is being placed on the market by J. Jones & Son, 64 Cortlandt Street, New York.

Cable Clip.

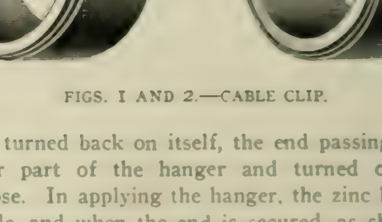
The cable clip illustrated herewith, which is manufactured by the New Haven Novelty Machine Company, New Haven, Conn., is claimed to be one of the strongest devices of its kind now on the market. The illustrations on this page show its construction very clearly. The band which encircles the cable is of zinc, and offers considerable resistance to slipping. It is brought around the cable

FIGS. 1 AND 2.—CABLE CLIP.

once and then turned back on itself, the end passing through a slit in the smaller part of the hanger and turned over to prevent its slipping loose. In applying the hanger, the zinc band is made as tight as possible, and when the end is secured, as shown, the screw is tightened, which operation brings the two steel parts of the hanger closer together. The more the screw is tightened the firmer the steel bend presses on the cable. Thus a grip is obtained that is impossible to become loosened in any other way than by releasing the screw. The two steel parts of the hanger are interlocked, as shown, so as to prevent all danger of the device coming apart.

Reverse Tapping Machine.

The horizontal bench tapping machine illustrated herewith is manufactured and being placed on the market by A. E. Faber, Jr., 355 Mulberry Street, Newark, N. J. It is designed to meet a demand for doing rapid and accurate tapping of light work, and is especially adapted to tapping holes to the bottom without breaking the taps.



TAPPING MACHINE.

The amount of work that can be done with this machine is only limited to the speed of the operator. No special taps are required, nor is a countershaft needed, as the machine is provided with tight and loose pulleys, and is intended to be belted direct to a shaft. A vise fitted to work forward and backward freely on the two parallel rods for holding the work or a jig is furnished when so ordered.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was fairly active, with a good demand for the shorter periods. The closing rates were 6 per cent. for 60 to 90 days and 5½ to 6 per cent. for four, five and six months. The approaching elections, the uncertainty about the railroad labor situation and the continuance of limited supplies of time money and high rates produced extreme dullness in the stock market. Large interests were inactive and traders inclined to be bearish, but prices rallied from the early-week decline by short covering. During the latter part of the week Manhattan was a feature, advancing over 5 points on the idea that the completion of the electrical equipment of its lines will result in a further and very material improvement in the earnings of the property. The industrial stocks were rather neglected. United States Steel shares, although somewhat irregular, were not affected by a decision of the New Jersey court continuing one of the injunctions against the proposed bond issue. In the traction list, Brooklyn Rapid Transit closed at 62⅞, a net decline of ⅛; Metropolitan Street Railway, on rather limited trading, made a net gain of ¾ of a point, closing at 140¾; General Electric fluctuated between 185 and 187½, and closed at 186, a net loss of one point; Western Union lost ¾ of a point, closing at 91, and Westinghouse 5 points, the closing price being 215. Other closing quotations were: Am. Dist. Tel., 40½, a net gain of 3½ points, and Commercial Cable, 177, a net loss of 3 points. The following are the closing quotations Nov. 3:

NEW YORK.

	Oct. 28.	Nov. 3.		Oct. 28.	Nov. 3.
American Tel. & Cable..	90	90	General Electric	185	185¼
American Tel. & Tel...	163	163	Hudson River Tel......	107	—
American Dist. Tel.....	39¼	38	Metropolitan St. Ry....	139½	140
Brooklyn Rapid Transit.	62½	62¾	N. E. Elec. Veh. Trns..	—	—
Commercial Cable	—	—	N. Y. & N. J. Tel....	—	—
Electric Boat	18½	19	N. Y. E. V. T. Co....	12	12
Electric Boat pfd.......	37	35	Tel. & Tel. Co. Am....	—	—
Electric Lead Reduc'n..	3⅝	3⅝	Western Union Tel.....	91	91¼
Electric Vehicle	4½	4½	Westinghouse Com.....	213	212
Electric Vehicle pfd.....	11	9	Westinghouse pfd......	213	211

BOSTON.

	Oct. 28.	Nov. 3.		Oct. 28.	Nov. 3.
American Tel. & Tel..	164½	164½	Western Tel. & Tel. pfd.	99	—
Cumberland Telephone..	—	—	Mexican Telephone....	2⅛	2⅛
Edison Elec. Illum.......	270	—	New Eng. Telephone....	138¼	137½
General Electric	185½	—	Westinghouse	213	—
Western Tel. & Tel....	28½	—	Westinghouse pfd.......	213	—

PHILADELPHIA.

	Oct. 28.	Nov. 3.		Oct. 28.	Nov. 3.
American Railways.....	—	—	Phila. Traction.........	97⅞	98
Elec. Storage Battery...	85	84	Phila. Electric	8⅝	9
Elec. Storage Bat'y pfd.	—	—	Pa. Elec. Vehicle.......	—	—
Elec. Co. of America...	9⅝	9⅝	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	Oct. 28.	Nov. 3.		Oct. 28.	Nov. 3.
Central Union Tel......	—	—	National Carbon pfd....	100½	—
Chicago Edison.........	—	—	Northwest Elev. com...	—	—
Chicago City Ry.......	212	212	Union Traction	17¾	17¼*
Chicago Tel. Co........	—	—	Union Traction pfd.....	47	47
National Carbon	30½*	—			

*Asked.

DETROIT LIGHTING SCHEME.—Vice-President W. F. White, of the North American Company, and Alex. Dow, manager of the Edison Illuminating Company, say that the articles in the New York papers regarding Detroit light consolidation are largely guesswork. They declare that J. Pierpont Morgan has not the slightest connection with the deal, and that the North American Company will not buy or own the Detroit plants, but is merely acting as the agent of a syndicate composed of Eastern and Detroit capitalists. The new owners will have an independent plant, not connected with or controlled by any other corporation. The present company will not even be reorganized, and there will be no changes in the board of directors. The only electric light companies in Detroit are the Edison, capitalized at $1,000,000, with 40,000 shares at $25 each, par value; the Peninsular Electric Lighting Company, capital $150,000, which is under a long lease to the Edison Company, and A. Jacobs & Co.'s small plant on the east side, capitalized at $25,000. The syndicate represented by the North American Company is buying Edison shares at $60 each, but even if every stockholder sold it would make a total of only $2,400,000. Before starting in, the North American was assured of enough stock to give control, but it was stipulated that all minority holders might come in at the figure paid for control, or $60 a share. The time expires November 1, after which minority stockholders may be sorry they did not sell, as about $2,000,000 are to be spent in developing the plant, and this means no dividends for some time. Mr. Dow says the company will have a splendid new plant, equipped with turbine engines and the very latest machinery, and will put Detroit manufacturers on as good a power basis as if they got their current from the Clergue plant at the Soo.

ALBANY & HUDSON RECEIVER AT ALBANY, N. Y.—Justice D. Cady Herrick, on motion of Sheehan & Collin, attorneys for the Colonial Trust Company, of New York, has appointed George T. Blakeslee, of Kinderhook, receiver for the Albany & Hudson Electric Railway and Power Company. This company operates the longest third-rail electric railway in the United States. The Colonial Trust Company guaranteed its bonds, and its attorneys in their petition alleged that the road is bonded for more than its true value. Damage suits are pending against the railroad as a consequence of two collisions, due to gross carelessness of the motormen, in which a large number of persons were killed and injured. Officials of the railroad say the appointment of the receiver is the first step in a plan for its complete reorganization, and that it will continue in operation. The officers of the company are: A. C. Salisbury, president; M. E. Stark, vice-president; G. C. Blakeslee, general manager.

CANADIAN ELECTRO-CHEMICAL.—It is announced from Philadelphia that under the authority of the courts and by the direction of the receiver of the American Alakli Company, an agreement has been entered into by which a 50 per cent. interest in the Canadian Electro Chemical Company, all of whose stock is owned by the American Alkali Company, is transferred to the Consolidated Lake Superior Company in settlement of the latter company's claim for $80,000. Under the same arrangement, the American Alkali Company gives up its claim against the Canadian Electric Company for advances made to it. The Consolidated Lake Superior Company will now have the manufacturing end of the Alkali concern so far as Canadian territory is concerned, and the Alkali Company is left without a plant to do any business. It is the expectation of the Consolidated Lake Superior Company to raise some $50,000 to $75,000 by a mortgage on the plant, and go on with the business.

MINNEAPOLIS GENERAL ELECTRIC.—The Minneapolis General Electric Company reports for the year ended August 31, as follows:

	1902.	1901.	Changes.
Gross	$477,153	$401,423	Inc. $75,730
Expenses	235,055	221,933	Inc. 13,122
Net	$242,097	$179,490	Inc. $62,608
Charges	97,603	100,086	Dec. 2,482
Surplus	$144,494	$79,404	Inc. $65,090

SALE OF AUTOMOBILE PLANT.—Vice-Chancellor Emery, of New Jersey, has signed an order authorizing the sale of the Hoboken plant of the American Electric Vehicle Company for $15,000 cash. The order was issued on the recommendation of Charles J. Roe, who was appointed receiver soon after the assignment of J. Herbert Ballantine, who was interested largely in the enterprise. The prospective purchaser is George T. Lister, formerly the vice-president and general manager of the concern, who says that he is acting on his own accord.

ELECTRICAL DEAL AT STAUNTON, VA.—S. D. Furguson, of Roanoke, Va., and E. M. Funkhouser, of Staunton, Va., have completed the purchase of the Staunton Street Railway, electric light and gas plants from Messrs. Sullivan and Cromwell, attorneys for the Seventh National Bank of New York, the consideration being $250,000.

DEAL AT WHATCOM, WASH.—Cyrus Pierce & Co., of Whatcom, who, together with some of their friends a month or so ago, purchased the gas plant in the city of Whatcom, Wash., have since sold out to Messrs. Stone & Webster, of Boston, who are consolidating the gas, electric lighting and street railway interests in that locality.

A WESTERN UNION PURCHASE.—The Western Union Telegraph Company has bought out the Alabama Midland Telegraph Company, whose lines reach from Montgomery, Ala., to Thomasville, Ga., along the old Plant System Railroad.

MICHIGAN TELEPHONE COMPANY'S BONDS.—Proceedings have been instituted in the United States Circuit Court at Detroit to foreclose the trust mortgage executed by the Michigan Telephone Company, March 2, 1899, to secure a bond issue of $5,000,000. The complainant is the Old Colony Trust Company, of Boston, Mass., trustee, and the cause of the suit is the telephone company's default in the payment of interest on these bonds. A feature of the bill is the averment that the acquisition of the Detroit Telephone Company's plant and franchise was without authority, knowledge or ratification of the complainant and all rights and liberties which might accrue under the transfer are disclaimed as not binding on the mortgagees.

BUFFALO BELL TELEPHONE STOCK.—A proposition to increase the capital stock of the Bell Telephone Company, of Buffalo, from $5,000,000 to $10,000,000 will be presented to the stockholders at a special meeting to be held November 15.

Commercial Intelligence.

THE WEEK IN TRADE.—Highly favorable reports continue to be received by the mercantile agencies regarding trade conditions. Confidence in the outlook for the next year's business, according to *Bradstreet's* summary, is a notable feature. The volume of orders booked for next spring's delivery is large for this season of the year, and is explained by the exceptionally good business done on fall and winter accounts, and the large crop yields of the year; also by the good condition of the winter wheat crop as cold weather approaches. Complaints are increasing as to the tardy movement of freight, miles of cars being stalled for lack of motive power and many roads refusing to accept further shipments until the blockades are relieved. The iron and steel industry, in which confidence in next year's business has heretofore been marked, shows some signs of hesitation. Finished products have tended to accumulate, apparently because of high prices. Where price reduction has occurred, however, new business has come in gratifying volumes. Strength is maintained in the cruder forms, particularly rails, bridge and structural material. The acceptance of reduced wages by tin plate mill hands enables American mills to capture orders for 1,500,000 boxes of so-called drawback plates. This will be an entirely new addition to the country's production. The copper market was extremely dull, with slowly receding prices. The demand for home consumption was small, and that for export proportionately smaller. The closing quotations are: 11.75c. @ 11.95c. for Lake; 11.60c. @ 11.70c. for electrolytic and casting stock. The business failures for the week ending October 30, as reported by *Bradstreet's*, number 194, as against 194 the previous week and 172 the corresponding week last year.

THE METROPOLITAN SWITCHBOARD CO.—It appears that the Metropolitan Switchboard Company, of No. 229 West Twenty-ninth Street, New York City, was not involved in any way by the failure of the American Union Electric Company, as reported in last issue. The Switchboard Company is a strong corporation and never has been connected with the American Union Company. The statement made by Mr. S. Marsh Young some weeks ago that the American Union Company had bought the Metropolitan Company was based upon the fact that an offer of purchase had been made to the stockholders of the Metropolitan Company, but was never accepted by them. The company is doing a large and profitable business and its shop is crowded with the best grade of work. It is building many of the largest switchboards in the city, and is now hard at it constructing the boards for the Blair Building, New York Stock Exchange, Mt. Sinai Hospital, Hall of Records, National Lead Co., Women's Hospital, St. Vincent's Retreat, Johnstone Building, etc., etc. It has recently designed a novel automobile charging board, and has installed it for Messrs. Arnold, Constable & Co., Tiffany & Co., Miss Helen Gould and the Rainier Co., New York University and others. Its work has always been of a high grade, and Mr. T. J. Murphy, the president of the company, is one of the pioneers in the switchboard business. The company has some influential and good financial backing, and there appears to be no reason why it should not continue a very decided factor in its line of work for years to come. We are indebted for the above to the well-known electrical engineer and contractor, Mr. Chas. L. Eidlitz.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended October 25: Antwerp—22 pkgs. material, $1,442; 2 pkgs. machinery, $500. British Australia—131 pkgs. machinery, $24,278; 56 pkgs. material, $1,770. Brussels—3 pkgs. material, $100. Bremen—3 pkgs. material, $140. British Possession in Africa—67 pkgs. material, $4,991. Brazil—54 pkgs. material, $5,670; 40 pkgs. machinery, $17,908. British East Indies—6 pkgs. material, $1,000. British West Indies—24 pkgs. material, $284; 11 pkgs. machinery, $1,625. Cuba—426 pkgs. material, $8,559. Central America—14 pkgs. material, $337. Copenhagen—2 pkgs. machinery, $325. Chili—32 pkgs. machinery, $1,588. Ecuador—1 pkg. machinery, $89. Glasgow—33 pkgs. machinery, $6,006; 17 pkgs. material, $2,105. Genoa—1 pkg. material, $25. Guernsey—1 pkg. material, $25. Gibraltar—1 pkg. material, $25. Havre—13 pkgs. material, $310; 4 pkgs. machinery, $205. Hamburg—8 pkgs. machinery, $460; 35 pkgs. material, $7,523. London—202 pkgs. machinery, $11,233; 69 pkgs. material, $3,708. Liverpool—169 pkgs. machinery, $12,603; 21 pkgs. material, $1,606. Milan—1 pkg. material, $25. Naples—2 pkgs. material, $50. Newcastle—7 pkgs. machinery, $325. Peru—2 pkgs. material, $37. Preston—2 pkgs. material, $1,143. Rotterdam—17 pkgs. material, $310. St. Petersburg—7 pkgs. material, $418. San Domingo—24 pkgs. material, $188. Southampton—40 pkgs. material, $4,832. U. S. Colombia—1 pkg. material, $13. Venezuela—48 pkgs. material, $771. Wardeau—3 pkgs. machinery, $500.

MERGER AT DALLAS, TEX.—The sale of the Dallas Ice Factory, Light and Power Company is believed to be another move towards the merging of all the electrical plants of the city and many of those in the surrounding towns and cities of Texas. The Dallas Electric Corporation just chartered in New Jersey with a capital stock of $8,500,000, is said to have absorbed the Dallas Electric Light and Power Company, the Standard Light and Power Company, the Rapid Transit Street Railway Company and the Consolidated Street Railway Company, with an ultimate intention of building a network of interurban lines within a radius of 100 miles of Dallas, which district has a population of over a million inhabitants. A Boston concern, understood to be Stone & Webster, has acquired several valuable franchises for a metropolitan street-railway system in Dallas, within the last few months, and has installed part of the system. Interurban lines are in operation between Dallas and Fort Worth, a distance of 30 miles, and between Denison and Sherman, nine miles. A representative of an Ohio corporation, which has several hundred miles of electric lines in operation in Ohio, Indiana and Michigan presented a proposition to a meeting of Sherman business men recently for the building of an electric line between Sherman and Waco, via Dallas, to cost $3,000,000. It was said that the projectors had an ultimate object of extending the road to Austin, and the construction of from ten to twenty feed lines of from 20 to 40 miles, to connect with the main, or Sherman-Austin line. The proposition is being considered by a committee of eleven.

ADDITIONAL ELECTRICAL EQUIPMENT FOR CUBAN SUGAR PLANT.—The United Fruit Company's Sugar factory at Banes, Cuba, which was recently equipped with American machinery, all electrically operated, with the exception of the crushers, at a cost of some $750,000, is reported to be about to be extended. The initial electric plant consists principally of three 100-kw generators of General Electric build, together with a number of motors, and three 160 ihp simple automatic high-speed horizontal centre crank engines turned out by the Ridgway Dynamo and Engine Company, of Ridgway, Pa. The plant was constructed by Hugh Kelly, the sugar machinery expert, of 71 Wall Street, New York. The electrical equipment was let through Percival R. Moses, the electrical engineer, 35 Nassau Street, New York. A contract for a small boiler equipment has been ordered from the A. D. Granger Company, contracting engineers, whose offices are in the White Building, 95 Liberty Street, New York. The equipment will be built at the Union Iron Works, Erie, Pa.

SEPTEMBER EXPORTS.—The export figures for September are extremely encouraging. They are the largest ever shown, with the single exception of that month in the year 1900, and fall less than a half-million dollars below the high-water mark made in that year. The figures, as just presented by the Treasury Bureau of Statistics, show the total exports in September, 1902, to be $115,521,984, against $106,080,026 in September, 1901, and $115,001,722 in September 1900, the highest figure ever shown by September exportations. This seems to indicate that the downward tendency in the export trade, caused by the corn crop failure of last year, has reached its lowest point, and that the reverse movement toward normal conditions has begun.

RENOLD CHAIN ORDERS.—Recent sales of Renold silent chain by the Link-Belt Engineering Company include: nine line-shaft drives from motors for the new works of the Patton Paint Company, Newark, N. J.; eight drives from motors to line shafts and elevators in the new model plant which the Crompton & Knowles Loom Works are erecting in Philadelphia, and eight 60-hp drives for induced draft blowers in the new Waterside station of the New York Edison Company. There are now sixty-one Renold silent chains in use in the new building of R. H. Macy & Co., varying in capacity from 1 to 90 hp.

SUSQUEHANNA RIVER POWER.—The engineers who, in the interest of the Continental Trust Company, of Baltimore, have been investigating the utility of the Susquehanna River for the development of great electric power on the Niagara plan, have reported favorably. Plans for the work have been finished, with the exception of certain details as to hydraulic engineering. It is proposed to furnish light and power to Baltimore and many towns in the northern part of the State, and also Elkton, Wilmington, Del., and other points east of the river. The Continental Trust Company, which has an option on the purchase of the United Electric and Power Company, of Baltimore, until November 15, will, it is reported, soon close the deal, involving nearly $1,000,000. A new company will likely be formed to take in this and other lighting and power companies as part of the Susquehanna power plan.

LOUISVILLE TROLLEY EXTENSIONS.—It is proposed to build an interurban trolley line between Louisville and Bardstown, a distance of about 40 miles, over a thickly settled and prosperous section. The population is much greater than for the territory served by the Louisville, Pewee Valley and Anchorage line, which has been in operation a year and is meeting with the greatest success. Another line is projected to run up the river to Prospect, about 11 miles. Still another road is projected by Louisville capitalists to run between Elizabethtown and Bowling Green, a distance of about 40 miles. The right of way has been secured. There are rich lead mines on the proposed route, fine coal deposits and a population of 20,000 people, who are 10 to 20 miles from a steam railroad. Both freight and passenger cars will be run over this line.

POWER AT THE SOO.—Advices from Philadelphia state that considerably less than half of the 60,000 hp which will be supplied by the power canal of the Consolidated Lake Superior Company has not been sold. Contracts are said to have been made by the Union Carbide Company for 20,000 hp, by the Trans St. Mary Traction Company for about 500, by the Great Lakes Paper Mill for nearly 1,500, and by a large smelting and refining company for probably 2,000 additional, making a total of 24,000 hp, leaving at present a power balance uncontracted for of 36,000. The Consolidated Company will only use the new canal themselves as a reserve, for their small power canal on the other side of the river. The officers expect in the early future to sell more power from the new canal.

BOILERS, ETC., FOR ST. PAUL POWER PLANT.—The Great Northern Railroad Company is at present letting contracts through the Robinson & Cary Company, of St. Paul, Minn., for the equipment of a central power station at St. Paul, intended to be used for operating the machinery in the company's large repair shops there and for lighting the shops. The boiler capacity will be 1,500 hp. The Edgemoor Iron Works, of Edgemoor, Del., has been awarded the contract calling for six units of 250-hp each. The coal and ash handling apparatus, capable of handling 45 tons per hour, will be built by John A. Mead & Company. The St. Paul plant has been designed so as to permit of considerable extension.

POWER DEVELOPMENT IN MAINE.—A syndicate of New York and Boston capitalists proposes to utilize the water power of Union River, at Ellsworth, Me., for the generation of electrical energy. It is thought that about 40,000 horse-power can thus be generated and transmitted to Bar Harbor and Bangor. Ellsworth manufacturers have already signed for 4,000 hp, and negotiations are in progress for the delivery of power to the Eastern Manufacturing Company, at Bangor, and other large concerns. A corporation with $1,000,000 capital has been organized. A dam will be constructed at Ellsworth, and another twelve miles above.

LIGHTING PLANT FOR CUBAN SUGAR FACTORY.—The Cape Cruz Construction Company, which is constructing an $800,000 sugar house in the vicinity of Manzanilla, located in the southeast part of Cuba, has let contracts, through O. B. Stillman, the sugar plant expert of 80-82 William Street, New York, for a lighting plant. The equipment will include two 14-in. x 12-in. horizontal Skinner engines ordered from the A. D. Granger Company, of 95 Liberty Street, New York. These engines will be each direct connected to 50-kw generators, made by the C. & C. Electric Company.

H. P. CAMERON ELECTRICAL MFG. CO., INCOR., of Ansonia, Conn., has just completed organization. It is incorporated under the laws of Connecticut with a capital of $50,000. The new company has purchased the interests of the old company, which was organized under the laws of the State of New York. It will move into a new factory, which is being erected for it, about December 1. It intends to put in a complete line of new machinery for the manufacturing of all kinds of commutators, armature coils and electrical supplies in general.

SOME C. & C. ORDERS.—The C. & C. Electric Company, 143 Liberty Street, New York, reports an increased demand locally in clothing and other manufacturing plants throughout the city. Two 50-kw. engine-type generators have been ordered for lighting purposes in the new Horn & Horn Building, Philadelphia. Huyler's candy factory in Irving Place, New York, where electricity is employed entirely as a motive power, is to be equipped with two 10-hp and one 50-hp motors, supplementing several C. & C. machines already installed.

THE BERLIN CONSTRUCTION CO., of Berlin, Conn., has opened an office in Boston, Mass., in the Board of Trade Building, 131 State Street. This office is in charge of Mr. H. C. Collins, contracting engineer, who has been for many years identified with the structural steel business in New England. The Berlin Construction Company also maintains offices at 220 Broadway, New York, and 142 Market Street, Newark, N. J.

BOOK TYPEWRITERS FOR SOUTH AFRICA.—The Elliott & Hatch Book Typewriter Company, whose New York offices are at 256 Broadway, has just secured a contract through its Cape Town agency for 300 machines, which are intended to be installed in South African municipal and railroad offices. The company reports that the sales in England during October were the largest of any month hitherto.

ELECTRIC CIGAR LIGHTERS FOR GERMAN STEAMSHIPS.—Stanley & Patterson, of 93 Liberty Street, have secured the contract for the furnishing of Matchless electric cigar lighters in all the ships of the North German Lloyd Steamship Company. The Kaiser Wilhelm II., now building in the Vulcan Shipbuilding Works, Stettin, is to be equipped with over 100 of these specialties.

NEW RIO GRANDE SHOPS are being planned for Salt Lake City, and a new power plant will be put in under the direction of Mr. R. F. Hayward, the electrical engineer. It is to furnish power for every machine in the five or six separate shops, and each tool is to be direct-motor driven. The new shops are to be equipped with tools for handling the heaviest work connected with locomotives.

ANDERSON TROLLEY MATERIAL FOR ABROAD.—The Albert & J. M. Anderson Manufacturing Company, of Boston, Mass., has just secured a contract calling for the shipment of 24 miles of trolley material to South Africa. A substantial contract has been received from South America. The company is also reported to be securing considerable orders for British roads.

CONTRACTS PENDING FOR YONKERS' SUGAR PLANT.—The Federal Sugar Refining Company, 135 Front Street, New York, will shortly let contracts for the equipment of its large plant, now under construction at Yonkers, N. Y. The initial capacity of the installation will be 4,000 hp. There will be a fair-sized electric lighting plant.

THE NIAGARA HYDRAULIC POWER & MFG. CO. has broken ground for a new power house to be located at the water's edge in the Niagara gorge. The new station will be located some distance down the stream from the present station, and it is thought that the equipment will be different from that now in use at the old station.

MUNICIPAL LIGHTING PLANT FOR FRANKFORT, N. Y.—The municipality of Frankfort, N. Y., has contracted with the A. D. Granger Company, of 95 Liberty Street, for a 200-hp steam plant to generate electricity for lighting purposes. The boiler will be built by the Union Iron Works, of Erie, Pa. The engine is to be a Corliss machine of Whitehall build.

EQUIPMENT FOR WESTERN STREET RAILWAY PLANT.—The Cleveland, Elyria and Western Railroad Company is to be furnished for installation in its new plant with four 500-hp Heine boilers. The plant is also to be equipped with a new Heine superheater, having 150 degrees of superheat. The plant is to be equipped with Westinghouse turbines.

KING EDWARD ORDERS WESTINGHOUSE PLANT.—The Westinghouse interests have secured a contract for a gas engine and dynamo equipment, which is intended to be used for charging motar car batteries at King Edward's country residence, Sandringham Hall, Norfolk, England.

WILKINSON & RICHARDSON, 276 Main Street, Poughkeepsie, N. Y., informs us that they have opened a branch of their electrical contracting business. They have an office also at Middletown, N. Y. They desire to receive a complete line of catalogues of electrical supplies.

THE STANLEY ELECTRIC MANUFACTURING CO. has recently opened a sales office in Atlanta, Ga., to take care of the increasing demand for S. K. C. apparatus in the South. The office is in the Empire Building, and is in charge of Mr. George P. Hardy.

CARS FOR CHICAGO.—An expenditure of $500,000 will be made on the Lake Street Elevated, the money to be borrowed through the Northwestern Elevated. The cost of new cars is about $350,000.

General News.

THE TELEPHONE.

SCOTTSBORO, ALA.—A company has been formed at Scottsboro to build a telephone line from Scottsboro to Tupelo, Ala.

COVINA, CALIF.—The Home Telephone Company has applied for a charter at this place.

PENSACOLA, FLA.—It is announced that the Southern Bell Telephone Company will soon begin work placing its wires underground in Pensacola.

AUGUSTA, GA.—The Southern Bell Telephone Company will build a line from Augusta to Columbia, via Johnston, S. C.

GAINESVILLE, GA.—Col. H. P. Farrow, of this place, will build a telephone line from Porter Springs to Cleveland to connect with a line, just completed, between Cleveland and Blairsville.

ATLANTA, GA.—J. A. Earl, of Atlanta, has been awarded $1,000 damages in a suit against the Bell Telephone Company for taking a telephone out of his store because he refused to pay a bill contracted by the former occupant of the store, after Earl had signed a contract with the company.

LEWISTON, IDAHO.—Articles of incorporation of the Miners' Telephone Company, with a capital stock of $45,000, have been filed. G. A. Nehrhood is president and D. W. Bailey secretary. The company will build and operate telephone and telegraph lines from Lewiston, Idaho, to Ballards Landing on Snake River, thence to Baker City, La Grande and other points in eastern Oregon and to points in the Salmon River country, Idaho.

BRYAN, ILL.—The Bryan Telephone Company has been organized, with a capital of $5,000, by G. F. Bunn, F. A. Nott and C. E. Soule.

FARMER CITY ILL.—The Farm & City Telephone Company has under construction a trunk telephone line between Clinton and Farmer City, Ill. Six wires are being put up.

JACKSONVILLE, ILL.—The Illinois Telephone Traffic Association has been organized in this city by representatives of twenty-three independent telephone companies from twelve counties of western Illinois.

PLAINVILLE, ILL.—The Adams-Pike Counties and Hannibal Telephone Company, Plainville, has been incorporated by Wm. H. Breckenridge, John W. Buttz and Chas. H. Rankin. The capital is $7,000.

CHICAGO, ILL.—The Western Telephone Construction Company, of Chicago, has been incorporated, with a capital of $2,500, to manufacture mechanical and electric devices. Incorporators: A. E. Ziehme, G. Hallett Johnson and John E. Kavanaugh.

SPRINGFIELD, ILL.—The court has refused to grant a writ of injunction against the Northwestern Telephone Company on the petition of the Chicago Telephone Company. The former company had a system in operation in Aurora, and the city council recently granted a franchise to the Northwestern Company for the construction of a second system. After it began the work of construction the Chicago company prayed an injunction in the Kane County Circuit Court to stop the work on the ground that the Northwestern's ordinance was invalid.

INDIANAPOLIS, IND.—The New Telephone Company, of this city, paid a quarterly dividend of one and one-half per cent. This is the company's first dividend.

FAIRMOUNT, IND.—The Citizens Telephone Company, of this city, has filed articles of incorporation. The capital stock is placed at $10,000, but this will be increased. The directors are Charles I. Parker, John Kesey, W. A. Beasley and Charles Small.

PADUCAH, KY.—The People's Independent Telephone Company, of this city, has closed a deal with the Alexander telephone system of 450 miles of wire and about 1,200 subscribers. The consideration was $45,000. The line covers Livingston, Lyon, Caldwell, Crittenden, Webster, Union, Hopkins, McLean and Muhlenberg Counties. By building a line twelve miles long Paducah will have direct long-distance connection with Louisville, Owensboro, Henderson and other points.

NEWTONIA, MO.—The Uneeda Telephone Company, of Newtonia, Mo., has been incorporated to build a telephone line from Granby to Newtonia, Rocky Comfort and Pioneer. The capital stock is $3,500. The incorporators are G. W. Harrison, J. W. Lansford, D. N. Dabbs, Ira Bell, J. A. Hudson, D. P. Weems, Ed Haas and others.

ST. JOSEPH, MO.—Toll lines will be built in Missouri, Kansas and Nebraska by the Central States Telegraph, Telephone and Construction Company, just organized here with a capital stock of $100,000. The independent companies in Kansas City, Leavenworth, Atchison and St. Joseph are identified with the enterprise. The principal stockholders are F. M. Baker, of Atchison, and W. F. Rankin, of Tarkio.

HAW RIVER, N. C.—Dr. Knight is building a telephone line to Oak Ridge where an exchange will be established.

NEW HOLLAND, PA.—The Enterprise Telephone & Telegraph Company has been organized at this place with a capital stock of $5,000. It will build a line from New Holland to Reading. W. M. Stauffer is president.

GLANDORF, OHIO.—Farmers in this vicinity are organizing an independent mutual telephone company.

TROY, OHIO.—The Troy Telephone Company has purchased the exchange of the St. Paris Telephone Company and the new owners will make extensive improvements.

MIAMISBURG, OHIO.—W. Wyant, of Toledo, has made application for a franchise for an independent telephone exchange. The Home Telephone Company, of Dayton, will also seek a similar grant.

TORONTO, OHIO.—The East Springfield Telephone Company has purchased from the Steubenville Phœnix Telephone Company the Richmond exchange, with franchise and toll lines in Wintersville.

COLUMBUS, OHIO.—The recent special session of the Ohio legislature cost the State $2,118 for long distance telephone bills. The service was practically unlimited for members of the legislature and the State paid all the bills.

XENIA, OHIO.—Messrs. D. and Oscar Bradfute have purchased the interests of Rankin Brothers, of South Charleston, in the Cedarville Telephone Company, of Cedarville. They expect to extend the system and thoroughly overhaul it.

DELAWARE, OHIO.—The Stromberg-Carlson Company, of Chicago, has about completed the installation of the new exchange of the Columbus Citizens' Telephone Company in this city and it is expected it will be ready for operation within a few weeks.

URBANA, OHIO.—The Urbana Telephone Company has increased its rates from $12 to $15 per year to take effect January 1. The original switchboard was designed for 500 lines, but at present the company has over 1500. It is now necessary to make numerous improvements.

MILLERSBURG, OHIO.—The Millersburg, Wooster & Orrville Telephone Company has elected officers as follows: George Adams, president; Frank L. Beam, Mt. Vernon, vice-president; B. C. Sill, secretary; J. E. Koch, treasurer, and M. M. Herron, general manager. The company contemplates making improvements to its system.

CINCINNATI, OHIO.—Many Cincinnati merchants are beginning to realize that they are losing business through lack of independent telephone connections. Local business people at Hamilton, Wilmington, Circleville and numerous other towns in that section of the State are unable to reach Cincinnati by the independent lines and their business is diverted to Columbus or Dayton.

BOWLING GREEN, OHIO.—The Bowling Green Telephone Company has passed out of existence and has been succeeded by the Wood County Telephone Company, one of the properties controlled by the Federal Telephone Company, of Cleveland. Directors are J. B. Hoge, W. L. Carey and W. B. Woodbury, Cleveland; L. Black, N. W. Morrison, F. A. Baldwin and J. G. Hickox, of Bowling Green. L. Black is president, J. B. Hoge, vice-president; W. L. Carey, secretary-treasurer; W. H. James, general manager. The new company proposes to cover a large section of the country with toll lines and farmers' systems.

CLEVELAND, OHIO.—The syndicate headed by E. L. Barber, of Wauseon, Ohio, has completed the deal for the purchase of an interest in the property of the United States Telephone Company, the Ohio long-distance company. The United States Company has $1,865,000 of stock out, all of which is owned by the Federal Telephone Company. The Barber syndicate will take 4,000 shares at 25, which will yield the Federal Company $100,000 in cash. This will be turned over to the United States Company for extensions and the United States Company will then increase its capital stock $250,000 and the new stock will be sold at once for 25, the Barber interests receiving their pro-rata with the Federal. The combined fund will be applied to make needed extensions in southern Ohio, West Virginia and Indiana. The financial changes will enable the United States Company to pay the interest on its bonds which was due July 1. The December interest will also be taken care of on time. The control of the United States Company will be lodged in a voting trust for five years. R. A. Harman and J. R. Nutt will represent the Everett-Moore syndicate or Federal Telephone Company and a third member will be selected by E. L. Barber. Work of improving the system will start at once on a large scale.

PAYSON, UTAH.—At the council meeting a franchise was granted for uniting Utah County with an electric railway and telephone system. The estimated cost of railway is about $600,000 and the telephone system $150,000.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company has completed its new switchboard in its exchange in this city. The board is of the most modern design and pattern. Among its features is the doing away with the storage battery click when the operator cuts in to answer a subscriber. The main board contains ten sections. There are signal lamps of four different colors, white for unlimited service calls; red for registered party lines in regular service; green for individual limited service, and blue for public stations. These colors enable the operator to determine at once which class of service is demanded when a call is made. The usual call and clearing-out signals are of white. The operators use the breat-plate transmitter. The old switchboard will be divided into sections and distributed among country exchanges.

GLOUCESTER C. H., VA.—The Tidewater Telephone Company has decided to rebuild the line from here to Saluda, using new poles and longer cross arms and increasing the number of wires.

ELECTRIC LIGHT AND POWER.

DENVER, COL.—G. H. Sethman, W. H. Sherrod and W. F. Sperry have organized the Denver Eureka Power Company to develop water power in Middle Boulder Creek for the purpose of generating electrical energy which will be transmitted to various places.

GRIFFIN, GA.—Capt. Seaton Grantland is planning to establish an electric plant at High Falls, where it is proposed to develop between 30,000 and 40,000 horse power. The power will be conveyed to Griffin. The estimated cost of the plant is $[illegible],000.

BOISE, IDAHO.—Articles of incorporation of the Banville Mining Company, of Boise City, have been filed. The directors are F. R. Reed, G. F. Redway, V. B. Cutler, W. A. Davenport, W. W. Dunn and J. J. Blake. The capital stock is $100,000, of which $[illegible]00 has been subscribed.

POCATELLO, IDAHO.—The delivery of power from American Falls in Pocatello was turned on a few days ago by the American Falls Power, Water & Light Company. Within the next 30 days all the smelters, factories, street lights and other enterprises will be connected and in operation.

PANA, ILL.—By the recent decision of the judge in the Christian County Circuit Court modifying the injunction granted in the case of Taylorville Electric Light vs. F. W. Anderson, restraining the city from erecting an electric light plant, it is thought that Pana will be granted a like decision. The Pana City Council some months ago voted to erect a municipal light plant at a cost of $16,000. At the instance of Robert Johns the Circuit Court issued a temporary injunction restraining the city from erecting the plant on the grounds that the indebtedness of the city would exceed the lawful limit. The contract was let to J. D. Reid, of St. Louis, who agreed to light the city for $4,000 yearly for a period of four years, at which time the city would pay him $1,000 and he would tender it the plant. At present the city of Pana is in darkness, and the people are nightly carrying lanterns.

TAYLORVILLE, ILL.—In the Circuit Court the injunction previously granted was modified by the Master in Chancery some weeks ago in the case of F. W. Anderson against the city of Taylorville. The city has been lighted for many years by the Taylorville Electric Company and its contract expired Oct. 25. The City Council a few months ago voted to issue $20,000 in bonds and to build a municipal light plant. At the instance of Anderson the Master in Chancery issued a temporary injunction restraining the city from issuing bonds, on the ground that with this additional debt the indebtedness of the city would exceed the constitutional limit. The indebtedness proven in the trial is held by the judge to be such that bonds may be issued for $16,000. As the contract for building the plant was let for $18,000 the decision amounts to a practical dissolution of the injunction, and unless other steps are taken the plant will be built immediately. Anderson is the president of the electric company and one of the largest taxpayers in the city. Until the city plant is built the city will be in darkness.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company, of this city, which recently secured a franchise, finds it exceedingly difficult to find space in the streets and alleys in which to construct its conduits. The streets and alleys of Indianapolis are completely underlaid with the pipes of three natural and one artificial gas company, the conduits of the Indianapolis Light and Power Company, the New Telephone Company, the Central Union Telephone Company and the Western Union Telegraph Company. The Merchants' Company is threatened with an injunction if it attempts to construct its conduits near any of the above, and how to conserve the rights of all has become a serious question.

ST. JOSEPH, MO.—The St. Joseph Railway, Light, Heat & Power Company has increased its capital stock from $3,500,000 to $6,000,000.

ST. LOUIS, MO.—The city council has passed the ordinance appropriating $33,000 for the establishment of an electric lighting plant in the basement of the new city hall. A similar ordinance for a lighting plant in the insane asylum was also passed. The former plant will furnish light for all the city buildings in what is known as the central district, including the Four Courts, old city hall, etc.

HELENA, MONT.—A flash from a short circuit of high tension lines set fire to the power building of the Helena Light & Power Company and the building was destroyed. Loss, $45,000; insurance, $30,000. An estimate of the loss includes the loss of the Missouri River Power Company building, which was fully insured.

NORTH AMHERST, OHIO.—The proposition to bond the town for $10,000 to build a lighting plant has passed and plans are being prepared.

CLEVELAND, OHIO.—The George S. Rider Company has made plans for a large electric power house for the W. S. Tyler Company, Cleveland.

GENOA, OHIO.—The village has placed a contract with the Toledo Motor & Machine Company, Toledo, for equipment for a municipal lighting plant. The station is to be erected at once.

DESHLER, OHIO.—The electric lighting plant in this place was offered for sale a few days ago, but was not disposed of for want of bidders. Those present claimed the appraisement of $7,000 was much too high.

DEFIANCE, OHIO.—Surveys made of the Auglaize River here indicates that it has a fall of 17½ feet, capable of affording 2,700 horse-power. The village is planning to establish a plant to furnish light and power.

TOLEDO, OHIO.—The Central Heating & Lighting Company has submitted a new proposition to the city to enter in a contract for street lighting at $58 per lamp. At present the city is paying $83 per lamp. C. S. Ashley is at the head of the new company.

CLEVELAND, OHIO.—Mr. A. Mosher, of New York, is in the city endeavoring to interest prominent capitalists in a project to equip the Ohio & Erie Canal, from Cleveland to Dresden, with electric towing equipment similar to that now being installed on the Miami & Erie Canal. It is announced that the company will soon make application to the State board of public works for a franchise to build the line.

COLUMBUS, OHIO.—The Public Service Company incorporated under the laws of West Virginia by Ohio men, has qualified with the Secretary of State. The capital stock is $500,000. The incorporators are Chas. L. Kurtz, Eli M. West, Joseph Slater, A. S. Green, W. H. Sharp, of Columbus, and R. H. Sharp, of Fairfield County. The purpose of the company is to construct and operate a plant in Columbus for the purpose of producing electric energy and furnishing electric current: producing steam and hot water, cold water and cold storage. Joseph Slater is president and A. S. Green secretary of the new enterprise.

BELLWOOD, PA.—The Citizen's Electric Light Company, of Bellwood, has been incorporated; capital, $1,000. Directors: Daniel G. Owens, John M. Hamer, Tyrone; Charles W. Hooner, of Bellwood.

PITTSBURG, PA.—The Duquesne Light and Power Company, of Pittsburg, has been chartered; capital, $20,000. Directors: G. C. Watts, H. E. Bechtel, F. H. Kreimeir, J. J. Kitner, Perry N. Gleim, Pittsburg.

YORK, PA.—One year ago a company was formed at Wrightsville, Pa., for the purpose of erecting an electric light plant. Permission was obtained from the municipal authorities for the erection of the poles and arc and incandescent lamps were ordered. Then the project became dormant. New life was given to it several weeks ago when a party of New Haven capitalists purchased a majority of the stock of the company. The councilmen were then asked to extend the time in which the plant is to be erected and the town lighted. This was granted and work on the plant which is to cost $20,000, will begin at once. The plant will be operated by water power.

PROVO, UTAH.—The City Council Committee which has been investigating the matter of water supply for the purpose of generating electric light for the city's needs has reported favorably on the project. A sufficient supply was found in various springs in Provo Cañon from which water for drinking as well as for power purposes will be obtained.

SPOKANE, WASH.—R. E. Strahon, of Spokane, has purchased the Ellis water rights near Sumpter, Oregon. It is intended to utilize the water for generating electric power for lighting at Sumpter and for other plants in and near the city. It is estimated 1,000 horse-power can be obtained.

OSHKOSH, WIS.—In the United States Court, at Milwaukee, Judge Seaman authorized A. E. Thompson, receiver for the Oshkosh Electric Light and Power Company, to issue $20,000 worth of certificates for the purpose of erecting a new power house.

CITY OF MEXICO, MEX.—Vicente Viegra, a wealthy land owner of the state of Jalisco, Mexico, is constructing a large electric light and power plant in the town of Talmazula de Gordiano, that State. The plant will be used to furnish light for the town and power for the operation of pumps for irrigating a large tract of land situated about six miles from the town.

THE ELECTRIC RAILWAY.

BATTLE CREEK, MICH.—A company headed by C. W. Post, has applied for franchises to operate railways on various streets in this city. The company offers better service than is now afforded.

PIQUA, OHIO.—The council has granted a franchise through town to the Springfield, Piqua & Sidney Traction Company. A. W. DeWeese is chief promoter of the road.

TOLEDO, OHIO.—Spitzer & Company, Toledo bankers, will undertake the financing of part of the bond issue of the proposed Detroit to Chicago interurban road which is to connect Jackson and Battle Creek.

MANSFIELD, OHIO.—The Ohio Central Traction Company has opened service on its line between Mansfield and Crestline and an hourly headway will be maintained over the entire road from Bucyrus to Mansfield.

BELLEFONTAINE, OHIO.—The Urbana, Bellefontaine & Northern Traction Company will erect a temporary power house here, so that local service can be begun in Bellefontaine by December 1. Material for the line is on the ground.

YOUNGSTOWN, OHIO.—The Youngstown & Southern Railway Company has elected officers as follows: Asa W. Jones, president; J. H. Ruhlman, secretary; W. S. Anderson, treasurer; R. L. Andrews, vice-president and general manager, and W. H. Ruhlman, right of way agent.

CINCINNATI, OHIO.—Articles of incorporation of the Traction Terminal Company, capital $100,000, have been certified. The incorporators are J. B. Foraker, Randolph Mathews, George H. Warrington and Frank H. Wilcox, of Cleveland, general counsel for the Mandelbaum syndicate.

NAPOLEON, OHIO.—The People's Rapid Transit Company has received a 25-year franchise for its line through the town. The company proposes to establish its car barns, repair shops and power house at Napoleon and it is probable that the water of the canal will be used for the generating of power.

COLUMBUS, OHIO.—It is announced that Senator J. B. Foraker has become interested in the Urbana, Mechanicsburg & Columbus Railway, and President Axline, of the company, states that it will be pushed to completion. The company has been having financial difficulties and construction work has been tied up.

OBITUARY.

EDWARD B. MALTBY, who was formerly president of the Boston Electric Light Company, died at his home in Boston, on October 30, of paralysis. He was 63 years of age. Mr. Maltby was also a director of the Boston Edison Company and held positions in various other New England enterprises.

PERSONAL.

MR. MORTON ARENDT has been appointed lecturer in electrical engineering by the trustees of Columbia University, New York City.

MR. G. R. NEWCOMER has joined the forces of the Columbia Incandescent Lamp Company, of St. Louis, and has his office and headquarters at Memphis, Tenn.

MRS. JOHN W. MACKAY and her daughter, the Princess Colonna, are to accompany the body of Mr. Mackay to this country this week. Mrs. Mackay is not expected to make a long stay.

MR. H. S. BURROUGHS has withdrawn from the firm of Ballantyne & Evans and opened an office at 27 William Street, New York, for the practice of electrical and mechanical engineering.

MR. W. MARCONI has arrived at Table Head, Sydney, Nova Scotia, on the Italian man-of-war "Carlo Alberto," and is engaged there installing new apparatus to use between that station and England.

MR. L. R. POMEROY, of [illegible] department of the General Electric Company, is to present a report on "[illegible] Driven Shops," before the Central Railway Club, Hotel Iroquois, Buffalo, on November 14, at 2 p. m.

PRESIDENT H. H. VREELAND, of the New York Metropolitan Street Railway, denies the report that he contemplates leaving the Metropolitan Street Railway Company to take charge of the traction companies in London, controlled by Mr. Yerkes.

MR. CLARENCE MACKAY is shown in a full page portrait by *Harper's Weekly* as one of the coming men, and there is no doubt he has a great career before him in administering wisely and generously the great properties and vast wealth left by his famous father.

MR. KARL G. ROEBLING will give his bachelor dinner on the night of Tuesday week, Nov. 11, at Sherry's. Mr. Roebling is a son of Ferdinand W. Roebling, of Trenton, N. J., and his marriage with Miss Blanche Estabrook, daughter of Henry Estabrook, of Chicago, will take place a few days later.

MR. J. W. YOUNG, secretary of the Allis-Chalmers Company, whose New York offices are in the Broad Exchange Building, has been given the post of general manager of the London offices of the company. He will be succeeded in the secretaryship by Mr. J. H. Seaman, third vice-president of the company.

MESSRS. KERN DODGE and Charles Day, of the firm of Dodge & Day, modernizing engineers, have just returned from an extensive trip through the middle West where they visited many of the principal machine shops and foundries, gathering data on shop efficiency and critically comparing factory methods.

MR. GISBERT KAPP, the celebrated Anglo-German electrical engineer, physicist, journalist and good fellow is honored by the Bullock Electric Mfg. Company by having his portrait on its dainty illuminated calendar for November. The crisp biographical sketch on the back was prepared by his clever pupil now in this country, Mr. B. A. Behrend.

MR. WILLIAM SELLERS, of Philadelphia, has been nominated by the committee of the society as president of the American Society of Mechanical Engineers for the ensuing year, associated with F. H. Stillman, as treasurer; F. H. Daniels, Jas. Christie and J. R. Freeman as vice-presidents, and R. C. McKinney, S. S. Webber and H. Sanders as managers.

MR. HENRY A. EVERETT, of the Everett-Moore syndicate, Cleveland, Ohio, has resigned the presidencies of the Federal Telephone Company and the Cuyahoga Telephone Company, of Cleveland. He is succeeded in both positions by Mr. Frederick S. Dickson, of Trenton. It is stated that Mr. Everett will continue as a director in the Federal Telephone Company.

MR. R. T. E. LOZIER has been elected to the managership in the American Institute of Electrical Engineers left vacant by the election of Mr. C. F. Scott to the presidency. Mr. Lozier has not only been designated by the suffrages of his fellow members for such office, but as a committeeman has given ample pledge of his intelligent and enthusiastic devotion to the best interests of the profession and its national organization.

MR. ROBERT ROBINSON, electrical engineer of the Clyde Valley Power Company, which concern recently placed a contract valued at some $2,500,000 with the British Westinghouse Electrical & Manufacturing Company, Limited, for the equipment of two large generating stations, etc., is now visiting the United States. He was in Pittsburg in the early part of the week and intends to remain in the West for some ten days or so for the purpose of inspecting some of the larger electrical plants.

MR. GEORGE F. PORTER, who was for ten years and until quite lately secretary and treasurer of the National Electric Light Association, has become sales manager for the Atlantic Insulated Wire & Cable Company, with his offices at 120 Liberty Street. Mr. Porter is already widely known in the insulated wire industry and trade, and has a host of friends throughout the electrical field. His new duties have already begun, and there is no doubt that his devotion to work and intelligently directed efforts will succeed as heretofore.

COUNT TAEGGI, the inventor of the new electric post, has, it is stated, just left Rome for London on invitation of the British Postmaster General. Before his departure a commission appointed by the Italian government reported most favorably on his invention. All the same, Taeggi is far from confident that immediate action will be taken here. He said the other day: "If the Italian Postmaster General puts any undue delay in the way of an electric post between Rome and Naples, I shall offer to make my first experiment in the system between London and Liverpool."

MR. W. P. MACKENZIE, formerly manager of the New York offices of the Harrisburg Foundry & Machine Works, of Harrisburg, Pa., has made a copartnership arrangement with Mr. A. B. Quarrier for the purpose of acting as exclusive sales agents for the Harrisburg people in New York State as far west as Rochester, and Olean; in New Jersey as far south as Trenton, and in the entire State of Connecticut. The new firm, which is to be styled Mackenzie & Quarrier, will also act as export agents of the Harrisburg Company and proposes to handle the products of other engineering concerns in addition.

THE OFFICERS of the Rooney Westbury Electric Lamp Company, Messrs. John Rooney, president, William H. Meadowcroft, vice-president; Harry Westbury, treasurer and sales manager, F. J. Rooney, secretary, and J. J. Rooney, general manager are represented in the accompanying group portrait. Mr. John Rooney, the president, read law in his early manhood, and was connected with a leading New York railroad law firm for over twenty-five years. Among the many business enterprises with which Mr. Rooney's name has been connected was the St. Paul Water Works, the construction of the Southern Minnesota R.R.; the Iowa Eastern R.R., and subsequently, the Erie and Atlantic and Great Western Railroads; and he was prominently identified with the Boston, Hartford and Erie R. R. Co., of which he was president for years. He was also part owner of the New York and West India Steamship Co., and its treasurer and general manager. Mr. Rooney entered the electric field in 1881, and was one of the organizers and the president of the American Electric Light Company, and one of the promoters of the Consolidated Electric Light Co., and the Sawyer-Man Electric Company, all of which were subsequently merged into the Westinghouse Electric Manufacturing Company.

Mr. William H. Meadowcroft, vice-president, also started on a legal career, having been admitted to the New York Bar in May, 1881. Major Easton, of the law firm with which Mr. Meadowcroft was connected, having accepted the vice-presidency of the Edison Light Company, Mr. Meadowcroft left the legal profession and became identified with the Edison company and continued his association with the same and its successors over eighteen years, two years being spent in the legal department. During the last years of his association with the General Electric Company he devoted his entire time to the miniature and decorative lamp business, a branch of the lamp department which he originally started in 1885; and he took part in the development of the Röntgen ray business of the company from its commencement. In the early 80's he took an active part in the Edison Electric Illuminating Company, the Edison European Company and the Edison Ore Milling Company, as well as with various standardizing and technical committees that were organized in those days for operating part of the business. He also wrote the first commercial pamphlet on incandescent electric lighting that was published in this country, and prepared all the catalogues for the Edison Companies in 1884, as well as a number of booklets that were published in 1887 and 1889, and some other special catalogues in later years. Mr. Meadowcroft has also done some other writing in his leisure moments, such as, for instance, his popular manual "A B C of Electricity," of which over 76,000 copies have been sold. In the summer of 1899 Mr. Meadowcroft left the General Electric Company to go into the storage battery business, and the Perret Storage Battery Company was organized, with a factory in Brooklyn and an office in New York. After considerable preliminary work had been done and by the time that the battery was ready to put on the market, the president and financial member of the company, Mr. Theodore Berbell, unexpectedly died, and Mr. Perret was taken seriously ill. It was therefore deemed advisable to suspend for a time the operations of the Perret Company. Mr.

THE MESSRS. ROONEY, MR. MEADOWCROFT AND MR. WESTBURY.

Meadowcroft having some financial interests in the National Bread Company and the United States Bread Company, and being a director in both, accepted the position of treasurer of both these companies and still occupies the same official relations. His love of the old business of decorative and miniature incandescent lamps has prompted his joining forces with Messrs. Rooney and Westbury.

Mr. Harry Westbury, the treasurer and sales manager of the company, graduated from one of the largest colleges in the west of England, and for some years held a position as head accountant and afterwards as salesman in the brass foundry business. On coming to this country he entered the employ of the General Electric Company, at Harrison, N. J., and was associated with Mr. W. H. Meadowcroft in developing and increasing the sales and uses of the miniature lamp and after that gentleman resigned his position in 1899 conducted the commercial end until he recently resigned to enter the above company. His name has been intimately associated with the developments in Röntgen ray work for several years past and is well known in scientific circles, both in this country and Europe, as an expert on Röntgen tubes, etc.

Mr. Francis J. Rooney, the secretary of the company, is a mechanical engineer and a graduate of the Polytechnic Institute of Brooklyn. He was for over two years assistant manager of a large manufacturing business in New York City and subsequently superintendent of an electro-therapeutic establishment and private secretary to his father up to the organization of this company.

Mr. John J. Rooney, the general manager of the company, is a graduate of the Polytechnic Institute of Brooklyn, being one of the first students to take the electrical engineering course established in 1893 by Dr. Samuel Sheldon. He early devoted himself to storage battery work and perfected a new type which, however, he did not place on the market owing to the patent situation. He then turned his attention to high tension electro-therapeutic work and recently installed a large plant of this character in London.

Trade Notes.

THE MAXWELL M. MAYER ELECTRIC COMPANY, 216 Centre St., New York, has just issued Bulletin No. 113, giving general specifications of its line of direct-current motors and dynamos of the enclosed type. A list of some of the users of these machines is given.

THE MARINE ENGINE & MACHINE COMPANY, 80 Broadway, New York, has increased its capital stock and has purchased the real estate and buildings comprising its plant in Harrison, N. J. Mr. E. C. Benedict is president of the company and J. B. M. Showell, secretary.

SIGHT FEED LUBRICATOR.—The Lunkenheimer Company, Cincinnati, Ohio, reports that it is receiving some very flattering testimonials in reference to its graphite sight-feed lubricator. The company prints a circular describing and illustrating this device, and a copy of it may be obtained on application.

STOREY MOTORS.—The Storey Motor & Electric Company, Harrison, N. J., has recently issued a catalogue describing and illustrating its well known enclosed and dust and moisture proof machines. Illustrations show the machine in section and various applications, and diagrams and tables give the dimensions of the various sizes.

MINIATURE LAMPS.—The Jaeger Miniature Lamp Manufacturing Company, Fourth Avenue and Eighth Street New York City, has issued a catalogue illustrating and briefly pointing out the features of its extensive line of miniature lamps. These lamps are used for a great variety of purposes including telephone, dentistry, surgery and decoration.

ELECTRIC LABORATORY FURNACES.—Eimer & Amend, 205 Third Ave., New York, have issued a well-illustrated catalogue of electric furnaces, which includes also illustrated descriptions of an electric pyrometer and an electric heating apparatus for distilling ether. Five types of electric furnaces are shown, namely, two for crucibles, a muffle, a sectional combustion and a Moissan type.

THE ELECTRIC APPLIANCE CO., Chicago, is advising the sale of arc lamps to merchants for store lighting. It claims that this is the season when store advertising pays and that a merchant cannot advertise to better advantage than to have a well lighted and therefore attractive store. In this connection, it states that there is one arc lamp a little better than all others, namely the Adams-Bagnall.

MESSRS. CROSELMIRE & ACKOR, 42 Walnut St., Newark, N. J., platinum refiners are just closing their first year in business with excellent results. They have been compelled to enlarge their plant several times and at present they have facilities for filling all orders promptly. The New York office is at Forty-second St. and Sixth Ave. (Harvard Building) for the convenience of metropolitan customers.

THE BUFFALO FORGE COMPANY, Buffalo, N. Y., has recently issued two new pamphlets on the subject of the Buffalo engines and this company's system of mechanical induced draft. In the former bulletin the features of a typical engine are given, which are followed by illustrations of engines of various types manufactured by the company. The pamphlet on induced draft is gotten up on the same plan.

THE NILES TOOL WORKS COMPANY, Hamilton, Ohio, is planning to erect a large addition to its plant, which, it is claimed, will make it the largest of its kind in the country. The total floor space in the new structure will be 85,000 square feet. The erection of the proposed addition is, however, contingent upon the company securing larger foundry facilities. The present foundry is taxed to its full capacity.

SECOND-HAND MACHINERY.—Wickes Bros. machinery manufacturers and dealers in second-hand machinery, Saginaw, Mich., have a very full line of machines and apparatus of various kinds all ready for immediate delivery. The October list contains 34 pages of closely-printed matter and gives dimensions, etc., of the stock of new and second-hand machinery on hand. The firm handles boilers, engines, machine tools, etc.

THE STERLING ELECTRICAL MFG. CO., Warren, Ohio, which recently distributed among its many friends a souvenir in the shape of an ash tray for a business man's desk has excelled its generosity in producing a new souvenir. This is a reproduction in bas-relief of the celebrated painting "Diana's Chase," by Makart. It is a highly ornamental production of the picture now hanging in the Metropolitan Art Museum, New York City.

THE GREEN TRAVELING LINK GRATE is the subject of the well illustrated catalogue just issued by the Green Engineering Company, Chicago, Ill. This make of grate is well illustrated and several half-tone cuts give views of plants in which they have been installed. Illustrations also show the details of the grate. At the back is given some tabulated information about coal in Illinois, Pennsylvania and Ohio, giving analyses, heat value, etc.

THE "EXPRESS."—In a small pamphlet under the title "The 'Express' and Some of its Stopping Places," the Kellogg Switchboard & Supply Company, Chicago, gives copies of 51 testimonial letters received from as many users of these boards. Judging from these letters the boards are giving the best of satisfaction. The "Express" boards are made for small exchanges of 50 to 500 lines. They are simple, rapid and easy to operate, and many hundreds of them have been sold.

THE VAN DORN-ELLIOTT ELECTRIC COMPANY, Cleveland, Ohio, has greatly increased its facilities for making armature and field coils. This department of the business heretofore has not been able to meet the demands upon it, and its enlargement was necessary in order to enable the company to get out the work with greater promptness. Mr. J. Norman Elliott has been appointed general superintendent of the factory, Mr. J. T. Thompson being foreman of the winding department.

THE AMSTUTZ-OSBORN COMPANY, of Cleveland, Ohio, has been succeeded by the Osborn-Morgan Company, P. J. Morgan having bought out the interest in the concern formerly held by N. S. Amstutz. The company has just opened a new factory at the corner of Case Avenue and Kelly Street, where it will carry on a general manufacturing business, giving especial attention to the production of several new patterns of arc lamps which it has recently perfected. The new factory is 120x60 feet, very light and well equipped for the production of these goods.

VENTILATING FANS.—The Western Electric Company has just issued a catalogue of its line of ventilating fans for removing heat, dust, moisture, steam and impure air from engine or dynamo rooms, kitchens, restaurants, laundries, churches, schools, theatres, mills, mines or cold storage rooms. For pressure work, hot and cold air ventilated systems, the company supplies steel plate blowers direct driven by its motors. Various illustrations show the application of the Western Electric motor to different styles of fans. Two pages are devoted to illustrations and brief descriptions of motor speed-controllers.

PACKARD'S "ELECTRICAL ARENA."—This is the title of a pamphlet recently issued by the New York & Ohio Company. It is a strange combination of stage and "Packard" lamps, and the plot is cleverly developed. This "allegorical phantasmagoria entitled Thunder and Lightning," is written up in the language of the stage and in proper dramatic form, and is illustrated with various characters in the play. The Packard lamp triumphs over the competitive lamp, which is represented by the "villain" in the plot. Mr. A. H. Mustard, 120 Liberty Street, is the author of this tragedy, and incidentally the New York representative of the Packard lamp.

THE WISCONSIN GRAPHITE COMPANY, Pittsburg, Pa., has just issued a booklet giving information about Wisconsin flake graphite which is commended for its high lubricating properties. It is stated to be particularly serviceable for electric plants, for high-speed engines and machinery and for steamship and other powerful engines. The company also manufactures a graphite paint, which is the subject of another pamphlet. This paint is recommended for use on iron and steel structures particularly where exposed to the weather. It is made in various colors. The cover of the pamphlet on flake graphite is shaped to represent a can in which this substance is packed. Copies of these booklets may be obtained by addressing the company, and those concerned in lubrication and paints will no doubt find something of interest in both of these publications.

THE ROONEY-WESTBURY ELECTRIC LAMP CO, of 154 E. 23d St., New York has been incorporated to manufacture all kinds of miniature incandescent lamps and accessories. There are at the present time upwards of 7,000 varieties of miniature lamps and this number is continually being added to, as more and more fields of usefulness and ornament are being found for them. The manufacture of the miniature lamp is one requiring the most delicate care and attention, as while the large standard lamp is now more or less made by machinery, the miniature on the contrary is still almost entirely a handmade product demanding the most expert labor and skill in glass blowing, etc., that can be obtained. The above-named company has a number of novelties it intends placing on the market which should commend themselves to the users of miniature lamps. One is a double filament battery lamp on which a patent has not been granted, so arranged that it can be burned with both filaments at once or one at a time, as preferred, thus giving either double brilliancy or double life. Another is a special form of miniature reflector lamp with a silvered bull's eye more than doubling the candle power for the same expenditure of current. Several ingenious novelties in automobile lamps with reflectors should commend themselves to automobile users.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 28, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

711,941. SUBMARINE CABLE TELEGRAPH; A. C. Crehore, Hanover, N. H. App. filed Nov. 3, 1898. Relates mainly to the manner of distinguishing the various characters of any code from one another by a combination of the elements of time, polarity and difference of electro-motive force applied to the circuit.

711,942. TELEGRAPHY; A. C. Crehore, Tarrytown, N. Y. App. filed Oct. 21, 1901. In a quadruplex telegraph apparatus, continuous current and pulsatory current apparatus for the two sides of the double transmission at each station, balancing branches for both sides of the system, ground branches or connections from which said balancing branches are derived and an inductance in the ground branch or connection for the continuous current side.

711,943. TELEGRAPHY; A. C. Crehore, Tarrytown, N. Y. App. filed March 8, 1902. An object is to permit two separate parties each on a single Morse wire, to communicate independently with distant stations over a single main-line wire operated as a superposed telegraph circuit by the use of suitable repeating apparatus.

711,944. ELECTRIC CLOCK; C. M. Crook, Bristol, Conn. App. filed Sept. 30, 1901. Details.

711,973. SIGNALING AND SWITCHBOARD APPARATUS FOR TELEPHONE-EXCHANGE CIRCUITS. D. S. Hulfish, Chicago, Ill. App. filed November 5, 1901. (See page 751.)

711,974. SOUND CONCENTRATOR; C. L. Hyde, Tuxedo Park, N. J. App. filed December 12, 1901. (See page 751.)

711,997. PROCESS OF FORMING ELECTRIC ACCUMULATORS; W. Morrison, Chicago, Ill. App. filed March 18, 1901. Current is passed

through a solution containing fluorine with the chlorates and nitrates or other oxidizing compounds.

712,026. ELECTRIC OR AUTOMATIC SWITCH THROWING MECHANISM; J. M. Walker, Newcastle, Pa. App. filed Feb. 25, 1902. Details.

712,041. EXCITING-DYNAMO; Harold W. Buck, Schenectady, New York. App. filed September 2, 1898. (See Current News and Notes.)

712,045. PROCESS OF CONVERTING SALT MARSH MATERIAL, ETC., INTO A FERTILIZER AND THE PRODUCE RESULTING THEREFROM; J. J. Crooke, New York, N. Y. App. filed Feb. 21, 1902. The process consists in subjecting the material to electrolysis.

712,046. MEANS FOR ATTACHING COMMUTATOR LEADS; W. F. Dawson, Schenectady, N. Y. App. filed April 27, 1901. The commutator bar has fitted to one end, before assembling, a flat copper tube, into the end of which the lead is soldered after the commutator is mounted on the machine.

712,050. SYSTEM OF ELECTRICAL DISTRIBUTION; Harold Edwards, Schenectady, N. Y. App. filed March 30, 1901. (See Current News and Notes.)

712,052. SYSTEM OF ELECTRICAL DISTRIBUTION; Hermann F. T. Erben and Arthur F. Knight, Schenectady, N. Y. App. filed April 3, 1901. (See Current News and Notes.)

712,056. MICROPHONE FOR HIGH TENSION CURRENTS; R. G. E. Ducretet, Paris, France. App. filed March 3, 1902. (See page 751.)

712,057. DENTIST'S ELECTRICAL ANNEALING FURNACE; N. S. Garhart, Indianapolis, Ind. App. filed Aug. 22, 1902. The furnace has a flat heating surface and a similar cover connected to the main body by parallel links, whereby it may be swung aside and maintained horizontal to temporarily receive articles undergoing treatment.

712,060. OVERHEAD ELECTRIC CONDUCTOR, OVERHEAD TELEPHONE, TELEGRAPH, OR LIKE WIRE; R. Hacking, West Bridgeford, England. App. filed Feb. 26, 1901. Details.

712,063. ANTICREEPING DEVICE FOR ELECTRIC METERS; C. D. Haskins, Schenectady, N. Y. App. filed March 30, 1901. Mechanical means for preventing creeping of the rotating member of the meter, arranged to alternately retard and accelerate said member when the meter is in operation.

712,090. ELECTRIC METER; W. H. Pratt, Lynn, Mass. App. filed March 15, 1901. Means for opening the circuit of the actuating motor through a step by step gradation of resistance, when the speed of the motor approximates proportionally with the quantity to be measured.

ceives the metallic deposit and is movable in the mixture, for the purpose of producing a uniform plating which does not require polishing.

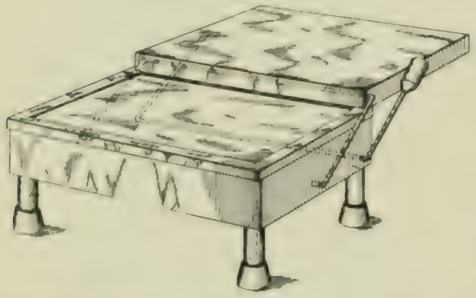
712,174. SYNCHRONISM INDICATOR; J. F. Begole, St. Louis, Mo. App. filed June 9, 1902. In a synchronism-indicator, two sources of alternating current, a voltage indicator energized from said sources, and a phase indicator comprising two coils, one of which is movable relative to the other, one of said coils being supplied with current from one of said sources and the other of said coils being supplied with current from the other of said sources.

712,178. SEPARATOR FOR STORAGE BATTERY PLATES; R. N. Chamberlain, Depew, N. Y. App. filed May 13, 1901. A perforated box-like inclosure having internal and external ribs.

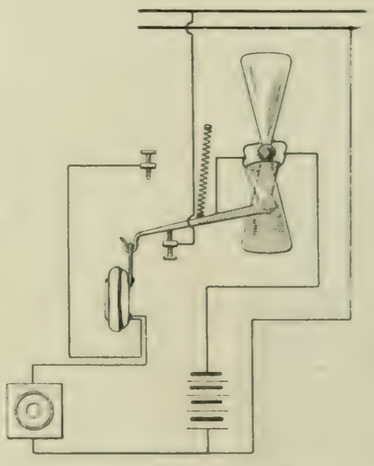
712,201. SIGNAL FOR TRAVELING CABLES; M. Norden, New York, N. Y. App. filed Nov. 23, 1901. A circuit is closed by a broken strand of the cable in passing a given point.

712,204. AUTOMATIC SWITCH FOR FUSE WIRES IN ELECTRIC CIRCUITS; E. W. Pelton, Springfield, Mass. App. filed Nov. 30, 1901. An arm normally under tension is restrained by the fusible strip; when the latter breaks, the arm closes a circuit through the next fuse of the series.

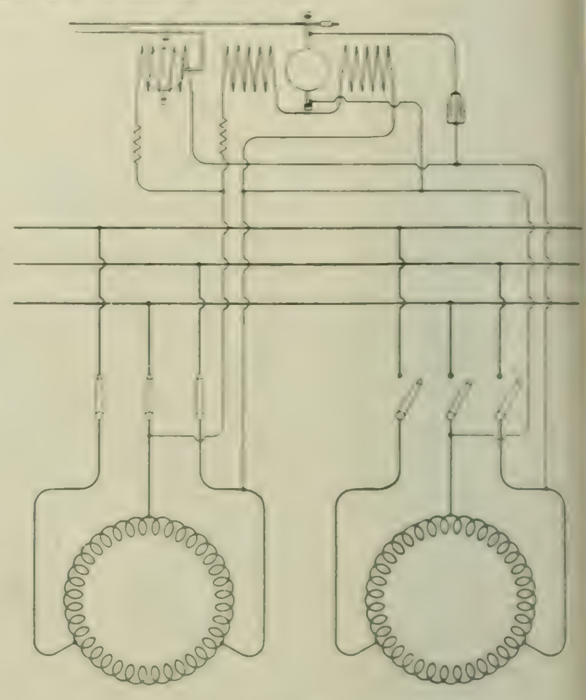
712,218. ELECTROLYTIC CELL; A. E. Truesdell, Pittsfield, Mass. App. filed April 13, 1901. The cell is adapted for the treatment of solution containing the salts of the alkaline metals. The object is to provide for a positive separation of the amalgam from the cathode body, to provide for the smallest possible area of contact between the amalgam and the solution and to introduce a recharged solution at or near the point of contact of the separated amalgam with the solution. (See page 750.)



712,057. Dentist's Electrical Annealing Furnace.



712,134. Electric Time Switch.



712,174. Synchronism Indicator.

712,103. POLYPHASE INDUCTION-REGULATOR; C. P. Steinmetz, Schenectady, N. Y. App. filed February 27, 1899. (See Current News and Notes.)

712,104. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles P. Steinmetz, Schenectady, N. Y. App. filed July 11, 1900. A synchronous motor driving a rectifier having in circuit a constant-current transformer, is started from the constant-potential mains and then switched on the constant-current circuit. The claims are on the method.

712,106. ELECTRIC METER; E. Thomson, Swampscott, Mass. App. filed Oct. 13, 1898. When the speed of the motor exceeds a certain point with respect to the current flowing, the motor circuit is opened by a fan driven by the motor.

712,107. THERMAL CUT OUT; M. O. Troy, Lynn, Mass. App. filed Dec. 11, 1899. A fuse wire encased in a tube, closed at one end and open at the other, the weak point of the fuse located near the closed end of the tube.

712, 131. INSULATED RAIL JOINT; G. L. Hall, Brooklyn, N. Y. App. filed Jan. 18, 1902. Fish-plates are flanged laterally at the joint and secured together with insulation between.

712,132. INSULATED RAIL JOINT; G. L. Hall, Brooklyn, N. Y. App. filed Feb. 12, 1902. A modification of the preceding patent.

712, 134. ELECTRIC TIME SWITCH; M. R. Hutchison, Upper Montclair, N. J. App. filed Nov. 22, 1901. A reversible closed chamber containing a body of mercury which flows from one end to the other at a rate determined by the angle of inclination, said angle being adjusted by a scale so that in either charging or discharging a storage battery, the number of ampere hours will be the same.

712,140. ELECTRIC LAMP SOCKET; H. T. Paiste, Philadelphia, Pa. App filed April 6, 1901. A multi filament lamp with a switch for throwing the filament successively into circuit.

712,153. METHOD OF AND APPARATUS FOR ELECTRODEPOSITION OF METALS, C. J. Reed, Philadelphia, Pa. App filed Aug. 1, 1901. An electrolytic apparatus comprising a mixture of a liquid electrolyte and a non-conducting granular substance, and two electrodes, one of which re-

712,220. AUTOMATIC MEDICAL ELECTRICAL APPARATUS; A. F. Vetter and J. C. Vetter, New York, N. Y. App. filed Feb. 26, 1901. The electrode through which the current is applied to the body is made of various materials to obtain difference of electrical resistances.

712,257. ARMATURE FOR DYNAMO ELECTRIC MACHINES; J. Burke, Berlin, Germany. App. filed Jan. 6, 1900. An armature having means for magnetically saturating the teeth when the coils adjacent thereto are in the commutation zone.

712,316. ELECTRIC ACCUMULATOR; E. Loppe, H. Morin, G. J. A. Grenier, and D. P. Martin, Paris, France. App. filed Oct. 26, 1899. Details.

712,333. ELECTRIC RAILWAY SIGNAL; C. V. Richey, Washington, D. C. App. filed April 8, 1902. Details.

712,402. TELEGRAPH ATTACHMENT; G. T. Newman, Bonaparte, Iowa. App. filed Sept. 6, 1901. (See page 751.)

712,430. RAILWAY SIGNAL; G. L. Wilson, Chicago, Ill. App. filed Sept. 16, 1901. A colored slide on the signal arm is moved along the arm by the pull exerted on a connecting wire, by the train.

712,440. INSULATOR; J. L. Shreffler, Lewistown, Pa. App. filed April 2, 1902. Two metallic shells, one embedded within the other in insulating material and the outer shell having a clamp for the wire.

712,451. EXCITING DYNAMO; H. W. Buck, Niagara Falls, N. Y. App. filed September 2, 1898. (See Current News and Notes.)

712,455. BUSY-TEST SYSTEM; David H. Hulfish, Chicago, Ill. App. filed November 5, 1901. (See page 751.)

712,463. POLYPHASE INDUCTION REGULATOR; C. P. Steinmetz, Schenectady, New York. App. filed Feb. 27, 1899. (See Current News and Notes.)

712,464. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles P. Steinmetz, Schenectady, N. Y. App. filed July 11, 1900. A synchronous motor driving a rectifier having in circuit a constant-current transformer, is started from the constant-potential mains and then switched on the constant-current circuit. The claims are on the combination of a motor and circuits to accomplish this object.

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CONTENTS.

Genius at its Prime.

The relative youth of the men engaged in electrical development has again been brought home forcibly by the sad and sudden death of Prof. Sidney H. Short, of whose funeral service in New York note is made this week. Here was a man who had devoted all his active life to electric traction and whose car, the "Joseph Henry," in Denver fifteen years ago, on the streets, was one of the harbingers of the new development; yet when he was stricken down the other day in London, he was barely forty-four years. In the brief interval from Denver to London, he had seen and had helped bring into being a new art, the capitalization of which in this country has reached about $2,500,000,000, and he was busily engaged pushing a proportionate and kindred growth in England. In many ways, and in traction conspicuously, Prof. Short was an integral part of these electric times; and it is not to be forgotten that he was one of the first to do successful work in telephony.

Nikola Tesla has said that no inventor is good for anything after forty-five; but while we may demur to this dictum, even in behalf of its author, we cannot help feeling that in the full and rounded career of Prof. Short, there is some compensation and offset to his untimely decease, regarded professionally. Had he lived he would have tried to fill up many deficiencies that he knew still to exist in the electrical industries, and his ripened business sense would have found larger opportunity. He was already intent on automobilism, and would doubtless have scored in that direction. But after all is said and done, it has been given to few men so young to do so much, and in his tragic taking-off, the parallel can only be found in the death of poor Dana Greene. In such careers there is lesson and encouragement for the younger men. Sidney Short began electric traction, indeed, with disheartening failure, and with desperate courage sought to work out the feasibility and practicability of the series method. He was alert enough and shrewd and flexible enough when he detected for us all the inherent defects of that fundamental method, to make himself one of the strong figures in the multiple art upon which the whole fabric of electric traction is now built up. Moreover, having made his record here, he was again able to fit himself into the difficult new conditions awaiting any American who transplants himself into England, and as an exponent of what our good cousins across the Atlantic like to call, "the American invasion," he was a notable and decided success. It is said that the concern with which he became associated has been doing the largest electric railway work in England; and there can be no question as to the happy results that have flowed from that combination of American experience with British capital and enterprise. We are glad to record here the prompt appreciation given in his case, as in so many others, by Englishmen, of American ability and push; and in reality they were but approving one of their own race and stock.

Electrical Development at the "Soo."

The erection of an electrical generating plant with a capacity of 32,000 kilowatts is not an every-day affair, even in the present advanced stage of the electrical art. The water-power plant of this capacity, which is under construction at Sault Ste. Marie, Mich., has perhaps not attracted the attention in the electrical field which its size would warrant. The various articles which have appeared in recent issues of this paper, have served to call the attention of elec-

trical men to the importance of this water-power plant, which is exceeded in size only by that at Niagara. The generating station at the "Soo" differs from other large generating stations recently erected in that the units are relatively smaller, being of only 400 kilowatts capacity each. As eighty of these are required to make up the 32,000-kw capacity of the station, the size of the generating plant runs into astounding figures, the length being something over a quarter of a mile. The difficulty of getting large turbine units to operate on as low a head as 20 feet seems to have been the factor limiting the size of the generating units. Although in some ways the smallness of these units has made the engineering of the plant very simple as presenting no problems that have not been solved before, there is one respect in which there has been opportunity for pioneer work, and that is in designing a comprehensive scheme of switchboard control. This involved placing easily within the reach of one man the electrical controlling apparatus for forty electrical units, each of which, while being small as compared with some of the largest generators now built, is nevertheless sufficiently large that with the usual size of switchboard panel for the direct hand control of each generator circuit, a board would have been required, so long as to make supervision of the entire board by one man impossible, and involving besides an enormous amount of copper in the power house for generator leads and bus-bars. The problem has been solved by the use of edgewise instruments and very narrow switchboard panels, with electrically-operated switches, so that no main circuits are taken to the switchboard. Incidentally, the use of the edgewise type of instrument has made possible a very neat scheme for enabling the attendant to see at a glance the relative load and the relative field current on all the generators operated. It is notable also that the plan contemplates the use of circuit-breaking switches, operated by solenoids, the switches being held closed as long as current flows in the solenoids.

On account of the distance of Sault Ste. Marie from any large industrial center, and its location favorable to cheap water transportation, the electrical output is more likely to be all utilized near that point than transmitted a long distance. The industries naturally seeking the Sault Ste. Marie power will be those requiring large quantities of electrical energy, such as for the operation of electric furnaces and in electrochemical work. In fact, no small part of the output of the generating plant has already been contracted for, to be used in calcium carbide furnaces. The industrial development of the Canadian "Soo" has been marvelous the past five years, under the financial cultivation of the enterprising Clergue Syndicate, and with the approaching completion of the great water-power plant on the American side by the same interest, the electrical development there is likely to be no less impressive than the collection of miscellaneous, but closely allied industries on the Canadian side. For the reasons spoken of, the American "Soo" development is likely to be most interesting in an electrical way, as indeed it is already proving to be.

Terminology of Primary and Secondary Battery Electrodes.

The article by Professor Marsh on this subject, at page 777, draws attention to the confusion in terminology existing on the subject of the polarity of voltaic battery electrodes. We agree with this article that the terminology should be revised and simplified. As usual, the confusion in terminology is associated with a confusion in ideas upon the nature of polarity. The literature upon the subject is copious and distracting. He must needs be a learned man who is familiar with all that has been written upon the subject; but he will not thereby necessarily be a wise man, or able to decide so vexed a question. It is only necessary to read the well and long established text-book, Fleeming Jenkin's "Electricity and Magnetism," with reference to the polarity of the plates in a voltaic cell, to recognize the confusion which has existed since the date at which that book was written. An adequate understanding of the theory of polarity there presented is almost as difficult as that of fourth dimensional space. A battery plate is indicated as being, say, positive under the surface of the electrolyte, while above that surface the same plate is represented as negative; or, if not the plate itself, at least the wire connected thereto.

This anomalous conditon of theory, in which an electrode is called positive from an external and negative from an internal standpoint, was introduced partly to accord with some perplexing experimental voltaic phenomena, and partly because the relations of two plates forming a voltaic couple were always studied with respect to each other, and not each independently with respect to the electrolyte, its immediate environment. The Nernst theory of solution pressures, changes this state of affairs and presents a prospect of the conditions between any plate and its surrounding electrolyte, without reference to any other plate dipping in the same electrolyte. According to this more modern theory, as explained by Professor Marsh, the polarity of a battery plate or electrode can be properly regarded as one and the same, both inside and outside of the solution. The zinc plate of a Daniell cell may thus be regarded as a negative plate, and also as a negative pole of the cell; while the copper plate may similarly be regarded as both the positive pole and the positive plate.

According to generally prevailing doctrines, the copper electrode forms the positive pole on top, but the negative plate below, and this is an unnecessary complication. According to the hitherto prevalent view, this plate receives current below the solution, and is consequently there negative, while it delivers current above the solution and is, therefore, positive in that region. The proposed plan would make the solution or electrolyte of the cell a sort of neutral ground in respect to which one electrode is wholly positive, both inside and out; while the other electrode is wholly negative, both inside and out. It is clear that this is a matter of language and terminology, as distinguished from a matter involving the phenomena of the cell. But the gain would be in simplicity, and a theory freed from complications. We should then have the peroxide electrode of a secondary cell the positive pole and plate, such as they are now termed in commerce, instead of having a conflict between commercial and technical phraseology.

Alternating-Current Telegraphy.

The serial article of Mr. E. F. Northrup, appearing in this and in the preceding number, contains data interesting to the telegraphist. Alternating-current telegraphy forms a sort of connecting link, or intermediate step, between telephony on the one hand, and power transmission on the other. Thus, the frequency of power transmission is commonly 25 cycles per second. The important frequencies of telephony are supposed to range from 150 to 1,000 cycles per second, while alternating-current telegraphy steps between them at 100 cycles per second. An advantage of alternating-current telegraphy is that it lends itself to calculation much better than battery-impulse telegraphy. The battery impulses that are sent into a long telegraph line, enter as waves of the rectangular type. As they run along the line

their angles or corners are gradually rounded off, until, at the distant end, they are undistinguishable from simple sine waves, and the automatic rounding-off process is very difficult to calculate. With, however, simple sinusoidal waves sent into the line by an alternator at the sending end, the waves run along unchanged in form, although diminishing in amplitude, until they make their appearance as sinusoids at the receiving end. This simplifies the calculation.

In computing the current amplitude and phase along power-transmission lines, it is usually sufficient to assume all the capacity of the line as aggregated into an ideal condenser at the center. By this device the computation is much facilitated. But with the greater lengths and higher frequencies of telephony this approximation will not suffice; and hyperbolic formulæ are the next simplest keys to unlock the phenomena. If the hyperbolic analysis is not used, the formulæ becomes long and tedious, but ultimately equivalent. Alternating-current telegraphy shares with telephony the hyperbolic method of analysis. Some of the practical results contained in Mr. Northrup's article are very interesting. Thus the range of effective duplex between received current ratios of one-sixth and one-tenth the sending current, is a generalization that, if applicable to all types of commercial alternating-current telegraph apparatus, cannot fail to be useful to the engineer. Such a generalization has not hitherto been possible with battery impulse telegraphy.

Long Distance Wireless Telegraphy

One of our London contemporaries contains a report with comment, abstracted in the Digest this week, upon the recent cruise of Marconi on the Carlo Alberto, experimenting with long distance messages. The statement is made that good working was obtained up to a distance of 1,200 kilometers—about 750 miles—which has been already reported in our columns. If, as our contemporary intimates, some of these very messages were caught by independent instruments in various parts of England, the case for a clean transmission seems to be well made out, and, in fact, with an ample supply of energy at the sending station there is no special reason for doubting the feat. We have steadily maintained that lack of energy has been a fruitful source of failure in wireless experiments. One cannot expect great results from insufficient apparatus, and when the working energy is not directed, but radiated from a point, a very large "factor of safety" is called for. So little is yet known of the actual mechanism of the wave transmission concerned that it is idle to speculate on the probable maximum distance to which readable signals can be sent, but it would seem to be merely a question of available energy. This statement may or may not imply an indefinite distance. An antepenult Greek philosopher once remarked that he could move the earth single-handed, given a long enough lever and a suitable fulcrum, but it is not of record that he actually did shake things up as per programme.

The great station at Poldhu has quite certainly shown itself capable of sending signals to a distance greatly in excess of anything previously recorded. From a practical standpoint the vital thing is the distance over which transmission of signals is reliable, and the account we are considering appears to show that this is very much inferior to the maximum distance. Both these and other experiments seem to show lack of certainty in the working, depending upon factors as yet rather imperfectly comprehended. Atmospheric conditions assuredly play an important part here, and it is a common experience of transatlantic travel to find the wireless not working satisfactorily, while at times remarkable results are achieved. At moderate range most of the difficulties seem to disappear. The energy supplied must apparently be great enough to drive through unfavorable conditions of unknown kind and extent in order to secure anything like complete reliability. We note that our contemporary lays great stress on the fact that some of the Poldhu messages were received on independent apparatus, as evidence that wireless telegraphy will lack the secrecy that would be commercially desirable. We do not see that such is the logical conclusion, for the object of the experiments was to get results quite irrespective of syntonism. Just how far it will be possible to develop syntonic apparatus using very large amounts of energy remains to be seen. It is certainly within the bounds of possibility to attain at least syntonism to a moderate extent enough to prevent the interference of stations with slightly overlapping spheres of influence. Whether a very powerful long distance station could be kept from interference with numerous local stations is another question, but aside from the annoyance to the local stations, no harm would result from lack of complete syntonism. One can, and ordinarily would, use code for wireless messages, as for cable dispatches, and the mere ability of meddlesome persons to pick up wireless messages is not a matter of importance.

The difficulties are enormous, however, for such syntonic working as would obviate the possibility of malicious interference with the system. Indeed, such syntonism is theoretically impossible, for any possible range of frequency can be duplicated. A military interference station industriously worked, say, at Calais, could probably be made to break down the wireless transmission of messages for any but the shortest distances all over the United Kingdom and the surrounding waters. At very short range—merely a few miles—far distant from the interfering station, the local supply of energy could be made to break through the interference, but syntonism would be of small use against an intelligent attack. With these obvious failings we still feel confident that wireless telegraphy is capable of very great practical use, less in supplanting than in supplementing our present means of communication. If we remember aright, the telephone in its early days was booked to drive ordinary telegraphy off the face of the planet; but, although the telephone is on every desk, Morse still holds its own. And so with wireless telegraphy—when the war of rival systems is over and the smoke of battle has blown away, the survivors will come to their own, not to the undisputed inheritance of the whole earth, but to such reasonable part of it as the circumstances warrant. Meanwhile, there is need for a deal of hard work, for, truth to tell, the whole subject is in a condition of rank empiricism—like the early science of medicine. It reminds us of the historic days when they used to administer half a gallon of the infusion of Peruvian bark to do the work of a few grains of quinine. Every new art has to pass through such a stage, and should be not in the least discredited thereby. Marconi is following the path of wisdom in doing a deal of hard work, and talking very little—success attend his efforts. In the meantime, we most sincerely hope that Congress will turn a deaf ear—for some years at least—to the bureaucrats who would have the infant art consigned to their tender care on the plea that if not governmentally supervised it may have an unruly growth. In view of the incompetency thus far displayed by the Navy Department in its relations with wireless telegraphy, the suggestion above referred to comes with ill grace from one of its Bureau chiefs.

Funeral Service Over the Late Prof. S. H. Short.

The remains of the late Prof. Sidney H. Short reached this country on the "St. Louis" on Sunday last, and on Tuesday, November 11, at 3:30 P. M., a funeral service was conducted by the Rev. Minot J. Savage, at the Church of the Messiah, New York City. The family of the deceased were present and a number of friends, and a great many flowers were received from distant cities. The pall bearers were Judge W. B. Sanders and Howard H. Burgess, of Cleveland; Benjamin Graham, of Cuyler & Morgan, an associate wtih Prof. Short in the pioneer road at Rochester, N. Y.; H. McL. Harding, president of the United Telpherage Company; James H. McGraw, of the *Street Railway Journal;* T. C. Martin of ELECTRICAL WORLD AND ENGINEER, and R. W. Pope, secretary American Institute of Electrical Engineers. After the service, in which Dr. Savage referred felicitously to the public services of him who was taken away so soon, the body was taken by special train to Woodlawn Cemetery, accompanied by the family and many friends. It was there placed in the receiving vault to await the selection of a burial lot.

Chicago Drainage Canal Power.

A contest has recently been going on in the courts between the trustees of the sanitary district of Chicago and the Gaylord syndicate, regarding the ownership of some of the water power made available in the vicinity of Joliet by the opening of the Chicago drainage canal. The Gaylord syndicate attempted to take advantage of the old State law, which enabled anyone desiring to start a grist mill to condemn land along the river. The trustees of the drainage canal had previously started to build a dam and water-power plant, but work was stopped, and while this was being done, the Gaylord syndicate stepped in and tried to condemn land enough to take the water power away from the sanitary district. Judge Hilscher, of the Circuit Court of Will County, on November 7 dismissed the suit brought for condemnation by the syndicate, on the grounds that the syndicate did not desire the land for public use. The text of the decision was, in part, as follows: "It is clearly the duty of the court in this kind of case to determine whether the purpose of the taking is for a public or private use. If the purpose is, in fact, for a private use, though under cover of a pretense for a public use, then it is the duty of the court to deny the exercise of the right of eminent domain. After a careful study of the petition, the evidence and the authorities cited, as well as the mill act and the sanitary district act, and of the well-known industrial conditions of which it is the duty of the court to take notice, I am led to the unavoidable conclusion that the purpose for which condemnation is sought in this case is not to acquire private property for a public use, but is to acquire public property for a private use."

Conditions of Award for the John Fritz Medal.

Last week we reported the proceedings connected with the foundation of the John Fritz medal and the banquet given to celebrate its creation and the eightieth birthday of Mr. Fritz. The following rules were adopted by the General Committee, to govern the foundation of the medal:

1. The John Fritz medal was established by the professional associates and friends of John Fritz, of Bethlehem, Pa., U. S. A., August 21, 1902, his eightieth birthday, to perpetuate the memory of his achievements in industrial progress.

2. The medal shall be awarded for notable scientific or industrial achievement. There shall be no restriction on account of nationality or sex.

3. The medal shall be of gold and shall be accompanied by an engraved certificate, which shall recite the origin of the medal and the specific achievement for which the award is made. Such certificate shall be signed by the chairman and secretary of the board of award.

4. The medal may be awarded annually, but not oftener.

5. No award of the medal shall be made to any one whose eligibility to the distinction has not been under consideration by the board of award for at least one year.

6. Awards shall be made by a board of 16, appointed or chosen in equal numbers from the membership of the four national societies, the American Society of Civil Engineers; the American Institute of Mining Engineers; the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. The governing bodies of each of these societies shall be requested to appoint from its membership one representative who shall hold office for one year, one for two years, one for three years, and one for four years, and each succeeding year to appoint one member to serve for four years.

7. In case of failure of any of the national societies to make the original appointments as requested, the selection of representatives from its members shall be made by those appointed from the other societies, and should any future vacancy occur by reason of the failure of any of the said societies to act, or otherwise, such vacancy shall be filled by the board of award from the membership of the society so failing.

8. Should one or more of the four national societies go out of existence its representation on the board shall cease and determine, and future awards shall be made by the representatives of the remaining societies.

Convention of Kentucky and Southern Indiana Telephone Associations.

A joint convention of the Independent Telephone Associations of Kentucky and Southern Indiana was held in Louisville, Ky., on October 28 and 29. The joint meeting was called to order on the 28th by Mr. R. V. Bishop, of Cynthiana, Ky., the president of the Kentucky association. He introduced the Hon. H. L. Stone, city attorney of Louisville, who delivered an address of welcome to the delegates. The address was responded to by Mr. G. A. Keinle, president of the Southern Indiana Association.

Mr. S. P. Sheerin made some remarks as to the patent litigation being carried on by the national association, and asked the Kentucky association and the Southern Indiana association to contribute $1,000 and $2,000, respectively, to the cause. A committee was appointed to devise a plan for the assessment.

"Long Distance Toll Lines and Connections" was the subject of a paper read by Mr. H. K. Cole, of the Kentucky association. This paper was supplemented by a report from Mr. J. S. Brailey, Jr., who is superintending the construction of the Independent Long Distance system out of Louisville, on the work he is engaged in.

Mr. E. M. Coleman, secretary of the Louisville Home Telephone Company followed with a paper on the "Interstate Association."

The proceedings of the second day included the reading of a paper by Mr. James S. Brailey, Jr., on "Merging of Independent Telephone Plants." The point he made was that the companies should not consider their own service more than the service of their neighbors, and that they were mutually dependent upon one another. He prophesied that it would only be a question of a short time when the independent companies would be merged into district, state and national organizations.

Mr. A. L. Têtu, of Louisville, followed with a practical paper on "Operating and Governing a Telephone Plant." A paper on "Rates" was next read by D. L. Pendleton, of Winchester, Ky. Mr. Pendleton exhaustively discussed the subject.

"Our Relation Toward the National Asociation" was the title of a paper read by President G. A. Keinle, of the Southern Indiana Association.

After the reports of various committees were submitted, the election of officers for the two associations was taken up. Mr. D. L. Pendleton was elected president of the Kentucky Association, and H. K. Cole, of Lancaster, and James Maret, secretary and treasurer, respectively. The old officers of the Indiana Association were re-elected, as follows: G. A. Keinle, of Huntingburg, president; C. D. Knofel, of New Albany, vice-president; E. W. Pichardt, of Huntingburg, secretary, and T. M. Thorn, of Lamar, treasurer. The joint convention then adjourned. The social entertainment of the delegates included a smoker given by the Louisville Home Telephone Company and a banquet by James S. Clark, Jr., at Fountain Ferry Park, to which the delegates were conveyed in chartered cars. There were present about 150 delegates from Kentucky, Indiana and Ohio.

Electrical Features of the Michigan Lake Superior Power Company's Plant at Sault Ste. Marie, Michigan.

IN the issue of last week and that of September 27, 1902, were given descriptions which afford a good idea of the hydraulic equipment, dam and power house of the Michigan Lake Superior Power Company, at Sault Ste. Marie, Mich., the opening of which was recently celebrated. It is the purpose of the present article to go more fully into the electrical equipment of this mammoth water-power plant, which is second only to that at Niagara in size.

Although but a small portion of the electrical apparatus has been installed in this plant, the plans for it have all been outlined by Mr. W. Owen Thomas, the electrical engineer of the company, and include a number of interesting and original features, as certain problems have naturally come up in a plant of this size, containing, as it does, so many units, which have not been heretofore solved. The total capacity of the power house is 32,000 kw, in 80 units of 400 kw each. These units are small according to present standards, but comparative simple piece of work, following along established lines. In the matter of switchboard and electrical control, however, many points of special interest have come up. The plans have been worked out by Mr. Thomas, with the co-operation of Mr. C. C. Chesney, chief engineer, and Mr. E. O. Sessions, consulting engineer, of the Stanley Company.

It is easy to see, in the first place, that the control of the generators in one-half of this great power house, which is over a quarter of a mile long over-all, must be very complete to insure successful operation. The switchboard plans, which have been so far worked out, provide not only for the electrical control of the generator after it has started, but for starting and stopping it. The switchboard contemplated is in line with modern switchboard practice for large stations, in that none of the main circuits will be brought to the switchboard. All of the control will be by pilot circuits operating solenoid switches. The first plans contemplated, when the power house was started some four years ago, would have arranged all the generators to connect onto a continuous set of bus-bars extending the whole length of the board, each generator having a panel of the usual size with hand throw switches. This would have made the switchboard imposing in length, but would have also resulted in some

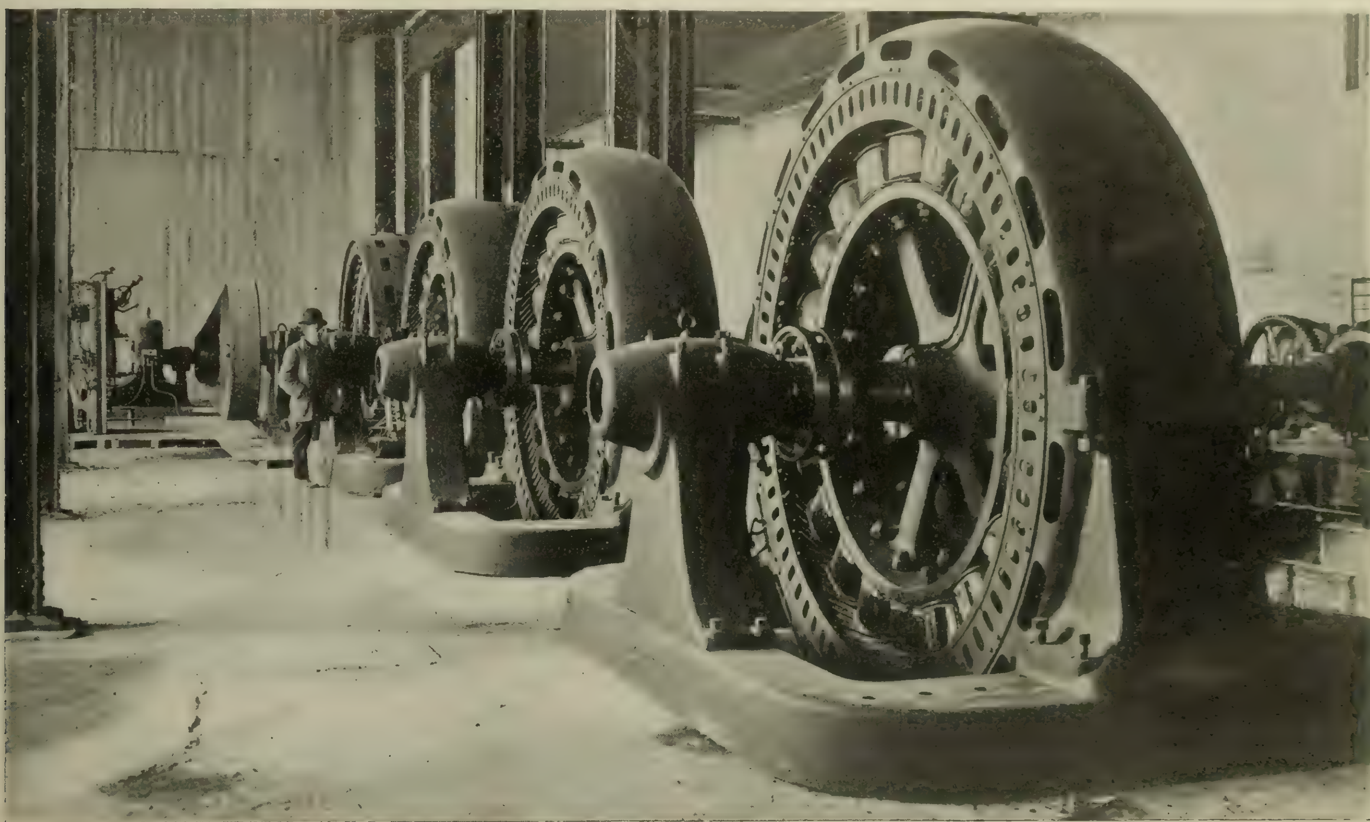


Fig. 1.—Four of the Three-Phase Generators, Sault Ste. Marie Power Plant.

four years ago, at the time the power house was planned, it is said that no turbine maker could be found who would undertake to make a horizontal-shaft turbine unit for such a low head as 20 feet, of larger capacity than this. As it is, there are four turbines on the same shaft for driving each electric generator. One-half of the output of the power house, as well as the space on the second floor of the power house, has been contracted for by the Union Carbide Company.

The original contract for machinery was made with the Walker Company, and taken over by the Westinghouse Company, which will supply 42 single-phase, 60-cycle, 90-volt generators and two 220-volt direct-current generators, all of 400-kw. The carbide furnaces are to be placed on the second floor, directly above these generators in the power house itself. The balance of the output will be taken care of by the Michigan Lake Superior Power Company itself, and will consist of 33 Stanley, three-phase, 30-cycle, 2,400-volt generators and four direct-current, 600-volt, compound-wound generators for exciters. A 60-cycle, single-phase generator, previously belonging to the company, will also be used for local lighting. Each generator is connected to its turbine through a flexible coupling. As to civil and hydraulic engineering, the power house has been a rather startling results in the section of copper bus-bars required. It would also have the practical result of putting all the generators in the power house subject to interruption from a short-circuit anywhere on the switchboard. The switchboard now contemplated, as designed by Mr. Thomas, is in line with the modern idea of dividing the power house into sections, so that only a part of the generators feed into any one set of bus-bars. The effect of this is not only to cut down the amount of copper required for the bus-bars, but also to make it impossible to disable the whole station by short-circuit on the switchboard. The switchboard is to be divided into three sections with eleven generators on each section. Each section of the switchboard will be but 12 feet long, and the three sections will be placed to form three sides of a square, so that an attendant sitting in the middle can see the instruments on every section of the board. In order to make the board sufficiently compact, to make these small dimensions possible, each generator panel will be but six inches wide. The instruments will be Stanley make, redesigned so that they can be used as edgewise instruments. There will be two sets of bus-bars. Each feeder and each generator will be provided with a double-throw switch, so that it can be connected to either set of bus-bars.

There will be about half as many feeders as generators. The feeder

panels are to be located at the top of the generator panels, so that over each two generator panels there will be one feeder panel. The feeders themselves will connect to the bus-bars at the same points that the generators tap into the bus-bars. The bus-bars will, therefore, act simply as equalizers of the load between different generators and feeders, and only a small per cent. of the station output will flow over the bus-bars for any considerable distance. The three switchboard sections will have circuit-breaker switches for connecting them in parallel, if it is desired to deliver the load from one section on another. There will also be circuit-breaker switches for connecting together the two sets of bus-bars, and it is expected that ordinarily these switches will be closed in order to get the benefit of the copper in the two bus-bar sets. Half of the machines will then be operated on one set, and half on the other. The switches will probably be oil-immersed, will be held closed by a current flowing in a solenoid, and will open automatically on overload or no voltage. Whenever current is broken in this solenoid, the switch will open so that in case anything goes wrong with the pilot circuits controlling the solenoids, the switches will open and a dangerous condition of affairs cannot be caused by having the switches closed, with no means of opening them from the switchboard. This is in a line with automatic block-signal practice, where any failure of electric circuits is on the side of safety, and it is an excellent idea to carry out in switchboard design. Beginning at the top of each panel of this novel switchboard, there will be a short panel devoted to one outgoing feeder, with ammeters of the edgewise type in each leg of the three-phase circuit. At one side of these three instrument dials is the pilot switch controlling the main-feeder switch. This control switch when thrown up connects its feeder to one set of bus-bars, and when thrown down, to the

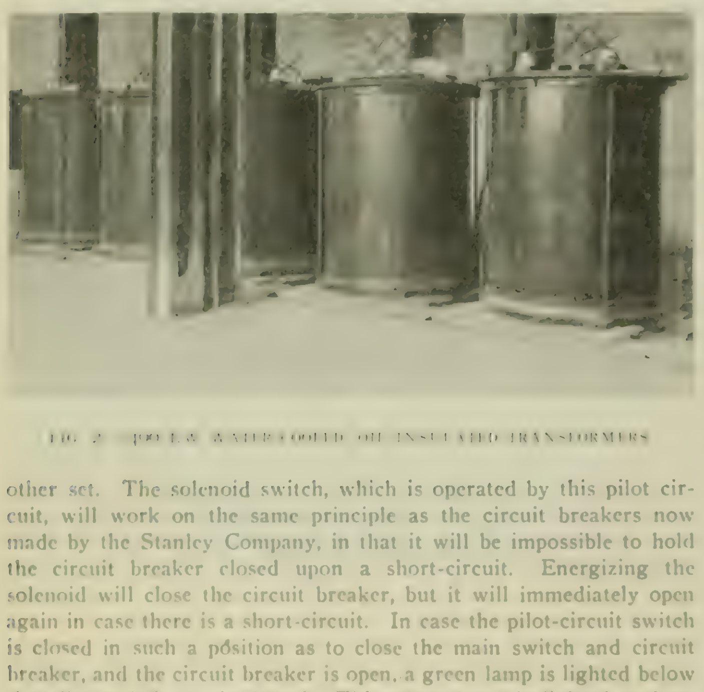


FIG. 2.—[illegible] WATER-COOLED OIL-INSULATED TRANSFORMERS.

other set. The solenoid switch, which is operated by this pilot circuit, will work on the same principle as the circuit breakers now made by the Stanley Company, in that it will be impossible to hold the circuit breaker closed upon a short-circuit. Energizing the solenoid will close the circuit breaker, but it will immediately open again in case there is a short-circuit. In case the pilot-circuit switch is closed in such a position as to close the main switch and circuit breaker, and the circuit breaker is open, a green lamp is lighted below the pilot switch on the board. This green lamp is lighted as long as the circuit breaker is open and the pilot switch closed; this, of course, being a condition of affairs which should not exist for any length of time. If the pilot switch is open, the circuit breaker will necessarily be open, and the green lamp will not be lighted.

Immediately below the feeder panel are two generator panels. Beginning at the top, each generator panel has an indicating wattmeter, at the side of which is the double-throw, pilot switch, controlling the solenoids of the main operating switch and circuit breaker, which is of the same type as that just described as used on the feeder. Next below this is an edgewise ammeter in one leg of the generator circuit, at one side of which is a voltmeter switch. This voltmeter switch is for the purpose of connecting the generator to a voltmeter located elsewhere on the switchboard. There are two voltmeters on the board, one of which is permanently connected to the bus-bars, and the other one used only when a generator is being started up. The voltmeter switch will spring back to off position as soon as the attendant lets go of it. Next below the generator ammeter on the board is an edgewise ammeter in the field circuit of the generator. This ammeter has beside it a switch, by which the attendant at the board can regulate the speed of the water wheel driving the generator and can also start or stop the wheel. The principle of this control is very simple. A small direct-current motor is attached to the Lombard water-wheel governor so as to change the relative opening of the gates at a given tension of the governor balls. By rotating the motor in one direction, the gates are opened wider with the governor balls in a certain tension, and by rotating it in the other direction, the reverse action takes place. In starting up and increasing the speed, the attendant holds in the switch, which will cause this motor to revolve to open the gates wider. The motor will run to open the gates as long as the attendant holds the switch closed, but the switch will open as soon as the attendant lets go of it. The attendant can, therefore, bring the machine into exact synchronism without leaving the switchboard.

One very important feature of the way this switchboard is arranged is the facility with which the attendant can note any variation in the load carried by the several machines in operation. The dials of all the indicating wattmeters and ammeters being very close side by side, like instruments being in the same horizontal plane, and provided with scales of similar dimensions; it is easy to note the relative positions of the pointers on the same kind of instruments clear around the switchboard. To facilitate this, the pointers will be made broad and tapered to a point at one end for accurate reading of the scale. When the load is equal on all the generators, the wattmeter needles should show a continuous unbroken band around the length of the switchboard, and a variation on any instrument is easily noted by the break which it would cause in the line. The same thing will hold true with the ammeters in the field circuits of each generator. If the current in the field circuit of each generator is the same, the only thing which could cause a variation to the load taken by the different generators, would be a lack of sufficient gate opening on the turbines to hold a generator fully up to synchronism, or the reverse. In order to make the generator take its share of the load, the attendant would only have to hold his speed-regulating switch up so as to rotate the synchronizing motor for a few seconds, to change the governor adjustment and give a greater gate opening on the turbine driving that generator. The compactness and completeness of this switchboard commend themselves to every electrical engineer who has had to do with the switchboards of large power stations.

On each generator will be an emergency switch, as it is called, by which a man on the generator-room floor can open all the circuits leading to any generator in case of trouble. When this emergency switch is open, a red lamp is lighted on that generator panel. In addition to the red and green lamps on the generator and feeder panels for indicating the opening of the circuit breakers and emergency switches, all these signal circuits are connected to gongs, which ring whenever a lamp lights. The green lamps indicating the opening of the circuit breakers, of either the feeders or generator circuits will be accompanied by the ringing of an 18-inch gong, and the red lights indicating the opening of an emergency switch will be accompanied by the ringing of a 24-inch gong. All secondary circuits from potential transformers and from series transformers for operating indicating instruments will be grounded on one side as a safety precaution to prevent possible damage from the 2,400-volt generator current, in case of a cross between the primary and secondary coils of these small transformers.

The switches connecting the three different sections of the switchboard and also the switches for cross-connecting the two sets of bus-bars will be oil-immersed, solenoid control, circuit breakers similar to those used in the generator and feeder circuits. It will, therefore, be possible to isolate the short-circuit offering one any section or bus-bar of the switchboard, even though the entire switchboard is normally operated and connected in parallel.

For transmission to neighboring industries, 15,000 volts have been adopted as the standard, and the transmission lines will be run as far as possible along the company's canal. The transmission lines will be put on 60-foot Idaho white cedar poles, 90 feet apart, and mounted on Locke No. 3 insulators. The step-up transformers will be Stanley 400-kw, water-cooled and oil-insulated. In addition to the direct-current machines mentioned there are to be some Stanley synchronous motor-generator exciter sets. The direct generators driven therby will be in parallel with a Chloride storage battery, consisting of 144 cells in lead-lined tanks. This battery is rated to maintain a discharge of 50 kw for eight hours, 70 kw for five hours, and [illegible] kw for three hours.

The Measurement of Bodies Smaller Than Atoms.

BY S. N. TAYLOR, PH. D.,

THE object of this article is to show as simply and briefly as may be how the masses and velocities of the particles which constitute cathode rays are measured. References will be made to original papers for any who may wish a fuller knowledge of the subject.

It is now generally admitted that cathode rays are made up of minute particles called ions, thrown with great velocity from the cathode terminal of the vacuum tube. If the masses of these particles can be measured, and if the velocity with which they move can be determined, the truth of the hypothesis is made manifest. Such measurements have been made by Professor J. J. Thomson and others, with results which show that the ions are approximately only $\frac{1}{1000}$ as large as the hydrogen atom, and that they move with a velocity approaching that of light.

The first investigations of the masses of atoms were made by Loschmidt, Stoney and Lord Kelvin, some 30 years ago. Their results show that in a cubic centimeter of gas at standard temperature and pressure there are some twenty million million million (2×10^{16}) molecules. This has been verified many times since then.

One way of determining the masses of atoms is by the electrolytic method. The principle of this is as follows:

From Faraday's laws it has been deduced that when a current of electricity passes through a liquid, the electricity transmitted is carried through by the moving atoms, or ions of the substance, each one carrying an equal charge. Hence the number of atoms and the total weight of the atoms set free will be proportional to the quantity of electricity transmitted. In the electrolysis of water, for example, the weight of hydrogen set free by the transmission of one c. g. s. unit of electricity is always found to be $\frac{1}{10}$ milligramme in round numbers, and this is called the electrochemical equivalent of hydrogen. If, then, it requires n atoms of hydrogen to convey one unit of electricity through the liquid, and if q denotes the quantity of electricity on each atom of hydrogen, then $\frac{1}{q}$ must equal n, the number of atoms liberated by one unit of electricity. But this is the electrochemical equivalent of hydrogen, and in round numbers has been found to weight $\frac{1}{10}$ milligramme. In other words, one atom of hydrogen weighs $\frac{1}{10n}$, or $\frac{q}{10}$ milligramme. So that if we can find n, the number of atoms set free, or if we can find q, the quantity of electricity on each atom, in either case we can determine the weight of the individual atom of hydrogen.

The same method of reasoning may be applied to the minute particles in cathode rays, but the application, experimentally, is far more complicated in the latter case than in case of the liquid.

Cathode rays, as they stream through the vacuum tube, are now conceded to consist of minute particles of matter, negatively electrified, proceeding with great velocity from the cathode or negative terminal. That these particles or ions are not atoms will be seen from their masses, which are to be determined.

Sir George Stokes has proven that a ray of electrified particles can be deflected from its path by the action of a neighboring magnet. When the magnetic lines of force are perpendicular to the velocity of the particles, the force acting upon the particles is expressed by $\mathcal{H} q\ v$, where $\mathcal{H}$ denotes the strength of the magnet field, q the charge upon each particle, and v the velocity. Stokes also found that the path of the ray would be bent so as to form the arc of a circle, the radius of which would be expressed by the formula

$$(1)\quad r = \frac{mv}{q\mathcal{H}}, \text{ or } v = \frac{qr\mathcal{H}}{m}$$

where r denotes the radius of the circle and m denotes the mass of each particle.

Then let this method be applied to the cathode ray, and let the ray pass between the poles of a magnet (†). If, then, N denotes the number of particles which pass a point in a given time, and if Q denotes the quantity of electricity carried by them, then

$$(2)\quad Q = Nq.$$

These particles strike with great velocity upon any interposed object and raise its temperature, thereby doing work. The work done can be measured by noting the rise in temperature produced, if we know the mass and specific heat of the object whose temperature is raised. But the work done is also expressed by the formula for kinetic energy, namely,

$$(3)\quad W = \tfrac{1}{2}Mv^2.$$

Hence, from equations (2) and (3), since $M = Nm$,

$$\frac{Nmv^2}{2Nq} = \frac{W}{Q} \quad \text{and from (1)}$$

$$v^2 = \left(\frac{qr\mathcal{H}}{m}\right)^2 \quad \text{whence}$$

$$(4)\quad \frac{m}{q} = \frac{Qr^2\mathcal{H}^2}{2W}$$

So that to determine the ratio of the mass of the ion or particle to the charge upon it by this method, we must find how to measure four different quantities. Q can be measured by letting the charged particles fall upon the terminal of a quadrant electrometer; W is obtained from the rise in temperature produced by the particles, as indicated by a thermopile placed in their path; is obtained by knowing the current passing through the coils of the electromagnet which produces the magnetic field; and r is measured by optical methods.

There is another way of determining $\frac{m}{q}$, namely by static method. If the cathode rays are made up of particles of matter charged with negative electricity, they should be attracted or repelled in the presence of other charged bodies. This is found to be the case, and the fact is made use of for determining the ratio $\frac{m}{q}$.

Suppose a cathode ray be made to pass between two metal plates, A and B, placed parallel to its path. As long as the plates are uncharged, the ray continues in a straight line, and the point where it strikes the end of the tube may be noted on a scale placed in the tube, but if A is then charged positively and B negatively, the particles of the ray will be attracted by A and repelled by B, and the ray will be deflected from its former straight line, and the amount of deflection can be noted on the scale at the end of the tube. Let F denote the strength of field produced by the charges on A and B, and let q denote the charge on each particle of the ray, then Fq will equal the displacing force acting on each particle. Let l denote the distance passed over in the field F during the time t. Also let v denote the velocity of the particles parallel to A and B, due to the cathode; let v^1 denote the final velocity of the particles perpendicular to A and B, due to the force Fq, and a denote the acceleration produced by force Fq perpendicular to A and B. Then $v^1 = at$. But

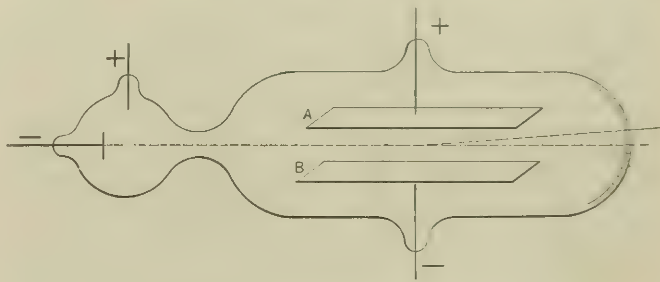


FIG. 1.—DETERMINATION BY STATIC METHOD.

$$a = \frac{Fq}{m} \text{ and } t = \frac{l}{v}$$

Therefore $\quad v^1 = \frac{Fq}{m} \times \frac{l}{v}$

But the angle θ, which the deflected ray makes with the velocity v, is $\frac{v^1}{v}$ hence

$$(5)\quad \theta = \frac{Fq}{m} \times \frac{l}{v^2}$$

If in the place of the plates A and B charged statically, electromagnets, of strength H, had been used, then since, according to Stokes's formula, the displacing force is $H e v$, Φ the angle of displacement produced by the magnetic field would have been,

$$(6)\quad \phi = \frac{\mathcal{H}qv}{m} \times \frac{l}{v^2}, \text{ or } \frac{m}{q} = \frac{\mathcal{H}}{\phi} \times \frac{l}{v}$$

† Cathode Rays: J. J. Thomson; *Phil. Mag.*, Oct., 1897.

Combining equations (5) and (6),

$$v = [illegible]$$

[illegible] this value of v in equation [illegible]

$$[illegible] \quad \frac{m}{q} = \frac{\mathcal{H}^{2}\,[illegible]\,l}{[illegible]\,F}$$

If, however, the static method and the magnetic method are both used at the same time, one in opposition to the other, and if the strength of the magnetic field is adjusted so that the deflection which it produces exactly equals that produced by the static field, then the length l of the field being the same in both cases, Φ will be equal to 0, and equations (7) and (8) become, respectively,

$$[illegible] \quad v = \frac{F}{\mathcal{H}} \quad \text{and}$$

$$[illegible] \quad \frac{m}{q} = \frac{\mathcal{H}\,[illegible]}{F\,[illegible]}$$

Thus, if both static and magnetic methods are used, all that is necessary to determine v, the velocity of the particles, is to know F, the strength of the static field, and $\mathcal{H}$ that of the magnetic. To determine the ratio $\frac{m}{q}$, we need to know both F and $\mathcal{H}$, and also l, the length of the field, and θ the angle of deflection produced when the static force alone is acting, all of which can be accurately determined, as has been shown.

Now cathode experiments of this kind, made with different gases, though consistant with themselves, do not agree with the results for similar elements determined by the electrolysis of liquids. In cathode rays the velocities differ for different gases, and also differ with different conditions of the same gas. The ratio $\frac{m}{q}$ of the mass of the cathode particle to the charge upon it is the same for all gases, whatever the materials, though in the electrolysis of liquids the value of the ratio is different for every different kind of atom. Moreover, the value of the ratio, as determined for all gases by cathode rays, is about a thousand times smaller than the smallest value obtained by electrolysis; that is, smaller than the value obtained by the electrolysis of water, which gives us the weight of the hydrogen atom.

The question arises, is the smallness of this ratio due to the fact that the mass of the cation is a thousand times smaller than the hydrogen atom, or is the charge upon the cation a thousand times greater? Since the mass of the hydrogen atom is known, the crucial test would be to measure independently either the mass of the cathode particle, or the charge upon it. This does not seem to be possible, however, in the case of the cathode ray, but the ionization of gases at low pressure can be produced in many ways. For example, it can be done by means of Röntgen rays (J. J. Thomson, *Phil. Mag.*, May, 1899); by means of a heated wire (E. Rutherford, *Phys. Rev.*, December, 1901); by a carbon filament raised to incandescence (Elster and Geitel, *Wied. Ann.*, Vol. 38), or by the method of ultra-violet light (J. J. Thomson, *Phil. Mag.*, December, 1899). So far as similar determinations can be made by these various methods, applied to gases, they seem to give essentially the same results. The velocities obtained by the different methods are commensurate with themselves, though in all cases vastly greater than the velocities obtained for liquids. The value of $\frac{m}{q}$, however, is the same for all gases by whatever method determined. Therefore, scientists feel justified in assuming that the mass of the particle is the same, and that the quantity of electricity upon it is the same whether the gas is ionized by means of cathode rays or by one of the other methods.

The simplest way by which the charge q upon the ion of gas has been measured is, perhaps, the process in which the gas is ionized by means of ultra-violet light. In this the ratio $\frac{m}{q}$ is first determined by methods which may be omitted here. The value of the ratio as thus obtained is found to be essentially the same as the value obtained by the cathode ray methods, and there is every reason for believing also that the values of both m and q are identical in both processes. If this is true, then the value of the charge q obtained by this method will be the charge upon each particle in the cathode ray, and the value of the mass of the particle will be known in both cases.

The apparatus used for determining q by the ultra-violet light method, is as follows:

A zinc plate, AB, Fig. 2, is suspended in an air-tight vessel, RS, and carefully insulated from it. The vessel has a quartz bottom, CD, through which the ultra-violet light can be transmitted, and the bottom of the vessel is covered with water, which is connected electrically with the earth. Also by means of a tube, T, at one side the vessel is connected to an apparatus by which the gas in the vessel can be exhausted, or the pressure of the gas can be quickly diminished a known amount at pleasure. The plate AB is connected with one pair of the quadrants of an electrometer, and the other pair of quadrants is connected with the earth. The gas in the vessel having been exhausted the desired amount, AB is charged negatively, the ultra-violet light is then turned on, and the deflection of the electrometer is noted. Let b denote the distance between the plate AB and the surface of the water, and let KD denote the initial potential difference between them, as indicated by the electrometer, then $\frac{KD}{b}$ will be the potential gradient between the two surfaces.

Under the action of the ultra-violet light the gas becomes ionized, and negative electricity is conveyed from AB to the water by means of the ions, but the quantity of electricity transmitted between unit surfaces will be proportional to the number of ions between them, to the charge upon each ion, and to the velocity with which the particles are driven by means of the electric force, or, in other words, it will be expressed by n^1qu, where n^1 denotes the number of ions in each cubic centimeter of the gas, q denotes the charge upon each

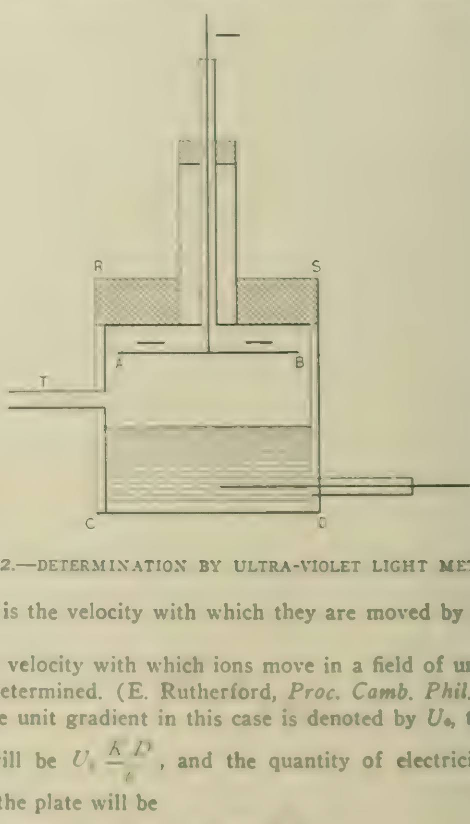


FIG. 2.—DETERMINATION BY ULTRA-VIOLET LIGHT METHOD.

ion, and u is the velocity with which they are moved by the electric force.

Now the velocity with which ions move in a field of unit gradient has been determined. (E. Rutherford, *Proc. Camb. Phil. Soc.*, Vol. 19.) If the unit gradient in this case is denoted by U_0, then U, the velocity, will be $U_0 \frac{KD}{b}$, and the quantity of electricity lost per second by the plate will be

$$A n^1 q U_0 \frac{KD}{b}$$

where A denotes the area of the negative plate.

Also, if the fall in potential, as indicated by the quadrant electrometer, is Kd units per second, then the quantity of electricity lost by the plate AB each second will be

$$K d C$$

where c is the electrical capacity of the electrometer system. Therefore

$$A n^1 q U_0 \frac{KD}{b} = K d C \quad \text{or}$$

$$(11) \quad q = \frac{b C d}{N^1 U_0 A D}$$

All of these are known quantities except q and n^1. In order, then, to determine q by this method, it is necessary to count the number of ions in each cubic centimeter of gas. This is a difficult problem, and great ingenuity and skill have been displayed in its solution.

Mr. C. T. R. Wilson (*Phil. Trans.*, 1897) has shown that in a vessel containing dust-free air saturated with moisture, ions act as particles of dust would do, in assisting condensation; that if the air containing these ions is suddenly cooled by expansion, each ion becomes a nucleus around which a minute drop of water is formed.

Moreover, Sir Geo. Stokes has proven that the velocity with which a drop of water falls through a gas is

$$(12) \quad V = \frac{2 g R}{M u}$$

where g is the acceleration of gravitation, R is the radius of the falling drop, and M is the coefficient of viscosity of the gas through which the drop falls. In other words, since g and M are both known, if V, the velocity of the falling drop, can be measured, R the radius of the drop can be calculated. Making use of this fact and the previous one, the following method is adopted for counting the number of ions per cubic centimeter of the rarified gas in question.

The gas in the vessel RS is carefully freed from all particles of dust, and, since there is water in the vessel, the rarefied gas is saturated with moisture. If, then, the gas is quickly expanded a known amount, its temperature will fall a known number of degrees. The drop in temperature would naturally cause condensation of moisture if the gas contained particles of dust, but almost no condensation without them. Mr. Wilson has shown that in the absence of these the moisture will condense around the negative ions, each ion being the nucleus of a drop of water.

The requisite ions are produced by the ultra-violet light, hence a cloud of moisture becomes visible and is seen to settle gradually, due to the action of gravitation.

The total mass of moisture deposited upon the ions becomes known, from the known expansion of the gas. The size of each drop in the cloud becomes known from the observed velocity with which the cloud falls, and from Stokes's formula; also the mass of each drop of water is known from its size and density. Hence, knowing the mass of water in the cloud and the space in which it is formed, we know the mass of water deposited per cubic centimeter, and, knowing the size of each drop, we know the number of drops per cubic centimeter, and as each drop contains a nucleus or ion, we known n^1, the number of ions in each cubic centimeter of gas.

The value of n^1 inserted in equation (11) gives us the value of q, the quantity of electricity on each ion, as desired. Also the value of m, the mass of each ion, or negative particle, becomes known.

The results obtained from these and other similar experiments show that the negative ion of gases carries the same quantity of electricity as the hydrogen atom does in the electrolysis of liquids; while the mass of the negative ion in gases is only about one- thousandth as large as the smallest known atom, a value which seems to be identical for all gases.

The velocities of these minute particles in some cases are found to approach the velocity of light. The minuteness of their masses and the magnitude of their velocities has led J. J. Thomson to call them "corpuscles," recalling the former corpuscular theory of light.

These results have a very important bearing upon the generally accepted conception of the constitution of matter. It would tend to indicate that the various forms of matter instead of being composed of many different primary substances called elements, consist of but one fundamental substance, from which all the so-called elements are formed.

The different kinds of atoms seem to be only different groups of these corpuscles, differing only in the number of corpuscles contained, and possibly in the structure and manner in which they are united.

The negative charge of electricity always seems to be carried by these minute corpuscles, while the positive remains with the larger atom.

It would seem that when an atom contains its normal number of corpuscles, it is neutral; that if one of its corpuscles is removed from it, the separated corpuscle carries a negative charge, while the atom from which it was removed is positive. Thus the atom is said to be charged positively.

The hypotheses suggested by the above data seem to explain many electrical and optical phenomena hitherto unaccounted for.

How far the facts determined by these and many similar investigations will go toward explaining the nature of electricity, the constitution of matter, or what is gravitation, only the future can decide, but they are suggestive of many lines of investigation which cannot fail to be fruitful in the future.

Terminology of Primary and Storage Battery Electrodes.

By A. L. Marsh.

A GREAT deal has been written concerning the correct use of the terms positive and negative as applied to the electrodes of primary and secondary cells. The usage in the case of the primary cell is rather uniform, but with the secondary or storage cell, it is greatly confused. Some of this confusion has undoubtedly arisen from our imperfect understanding of the actions occurring in the cell, but probably more is due to the different points of view from which the matter is considered.

For example; it has been suggested that perhaps some consider the question from the standpoint of the charging cell. Another suggestion is that a certain terminology may be more convenient for commercial use than another. In regard to the latter point, it is more convenient because it has become a custom to use it in certain places. In the United States the peroxide electrode is generally called the positive while in some other countries it is called the negative, and no doubt each locality finds its terminology the most convenient.

A suggestion has been made to the effect that manufacturers may be justified in calling the peroxide plate positive because the pole is positive and since the layman may not be aware of the change in sign from one end of the plate to the other, this terminology is simpler and less apt to lead to mistakes. The scientific man, it was said, should not use the terms in the same loose and incorrect way.

This way of treating the matter would not tend to avoid the existing confusion, but would rather increase it. Whatever terms are eventually adopted, they should be used in the same sense by both the manufacturers and the men of science.

A number of terms have been from time to time suggested as a possible solution of the difficulty. Daniell suggested the terms zincode and platinode to designate the plates of a cell. These terms, while being definite in one case, do not seem appropriate for use in all cells.

Peroxide plate and spongy lead plate are open to the same objection.

Positive pole electrode and negative pole electrode seem useless expansions of the simpler terms.

Anode and cathode introduced by Faraday, are terms better suited to electrolytic decomposition work than to the requirements of the voltaic cell for the reason that we think of a current as entering a cell when it comes from an outside source while the current of a primary cell is generated within itself. However, these terms are well defined and ought not lead to confusion.

Gladstone and Tribe in "The Chemistry of Secondary Batteries" thus define the terms: "The two plates of a Planté or Faure battery consist essentially of lead peroxide as the negative element, and metallic lead in a spongy condition as the positive."

The International Cyclopedia contains the following: "Lead is the metal most commonly used in accumulators, the positive plate having a coating of lead peroxide, PbO_2 and the negative plate a surface of spongy lead."

Treadwell uses the term positive for the peroxide plate, but the reason which he gives, quoted from the London *Electrician*, serves better for a description of the plates.

Sir David Solomons, in his work on "Accumulators," makes this statement: "It has become a practice among makers of secondary cells to call the true positive, negative, plates, and *vice versa;* therefore not to cause confusion, the manufacturers' designations will be adhered to throughout."

Benjamin, in his book, "The Voltaic Cell," refers to the confusion and then goes on to define the terms. He thinks that the main confusion arises from the fact that writers fail to state whether they regard one electrode as positive to the other or the reverse, with reference to the direction of the current outside of the cell or to the direction of the current through the electrolyte inside of the cell, so in the case of accumulators, a new difficulty presents itself when the terms positive and negative are used without any statement as to whether they refer to the condition of the cell when it is being charged or when it is yielding its own current. He uses the terms from the standpoint of the charging cell and calls the peroxide plate, positive and the spongy lead plate, the negative, but in his description of primary cells, he calls carbon the negative, and zinc, the positive.

In primary cell the zinc element is quite universally termed the positive electrode. Zinc has always been considered an electro-positive metal, that is, electro-positive relative to the other metals commonly used in cells. It is generally the principle source of energy. In the lead cell, a large part of the electromotive force is due to the peroxide electrode and it may be for this reason that the peroxide came to be called positive, though it is more probable that this has arisen from the fact that polarity of the terminal is positive and the use of the term has been extended to the entire electrode.

Primary and secondary cell terminology should certainly agree, for the cells are the same in principle; the only difference being that the secondary cell, after being discharged, can be brought back to approximately the same condition as before discharge, by passing an electric current through it in the reverse direction.

Let us now consider the modern theory of the solution pressure of metals due to Nernst, and see what light it can throw on this matter. The following brief statement of the theory is taken from Jones' Outlines of Electrochemistry":

P = solution tension of the metal.

p = osmotic pressure of the metallic ions in the electrolyte.

"Let at first $P > p$; at the moment of contact (metal with electrolyte) a number of positively charged metallic ions, driven by this larger pressure, will pass into solution. Since by the latter a certain amount of positive electricity is carried from the metal into the solution, the liquid receives a positive charge, which arranges itself in the form of positive ions contained in the solution, on the surface of the metal. At the same time there is, of course, a corresponding amount of negative electricity set free in the metal, which also passes to the surface of the metal. We recognize at once, that at the surface of contact of metal and electrolyte the two kinds of electricity must accumulate in the form of a double layer, whose existence, as is well known, was made probable some time ago by Von Helmholtz, in an entirely different way." . . . "If now, we inquire which metals have high and which low solution-tensions, we will find that magnesium, zinc, aluminum, cadmium, iron, cobalt, nickel, and the like, are always negative when immersed in solutions of their own salts. This means that the solution-tension of the metal is always greater than the osmotic pressure of the metal ion, in any solution of their salts which can be prepared. If, on the other hand, we take gold, silver, mercury, copper, etc., we usually find the metal positive when immersed in a solution of its salt."

This brings out the fact that metals such as zinc, lead, etc., are negatively charged when dipped in a solution of their salts and metals like copper receive a positive charge, the layers of solution lying nearest the plates receive a charge opposite in sign to that of the plates.

The terminology selected should be justified not only by our conceptions of chemical generators, but also by the other well-known devices for the generation of electricity.

When glass is rubbed with silk, there is an electric separation on the two substances. Glass is charged positively, and silk negatively. In the series which shows the electrification possessed by a substance when rubbed with others, glass is placed at the positive end relative to silk. In the electrochemical series, zinc is placed at the positive end relative to copper, although zinc is charged negatively relative to copper when dipped in a solution.

If a bar of bismuth and one of antimony are brought into contact and their junction heated, a current of electricity will flow from the bismuth, through the external circuit, to the antimony. In the thermo-electric series, bismuth is placed at the positive end and antimony at the negative. It would, therefore, seem that with the electrochemical series we do not follow out the analogies of the other series.

Sodium bicarbonate, placed in a red-hot capsule, decomposes with production of carbonic acid anhydride (CO_2). The capsule is electrified positively, while the acid carries with it negative electricity.

On heating a platinum plate containing silver oxalate this salt decomposes rapidly, leaving behind silver which becomes positively electrified.

Palmieri has found that with bisulphide of carbon, benzine, petroleum, and the vegetable oils, a flame from these bodies shows positive electricity when the capsule in which the burning occurs is connected to the earth, or that the capsule shows negative electricity when connected to a condenser if there is placed in the flame a plate or wire of platinum in communication with the earth.

It is, therefore, plain that whenever a substance as a metal or oil, is burned, or oxidized in a battery, the substance and the conducting plate in contact with it, receives a negative charge; and whenever a substance is reduced by heat or in a battery, the conducting plate in contact with it, is positively electrified. By applying this rule we can determine the sign of the charge in any case. In a lead storage cell, the spongy lead is oxidized, therefore we should expect that plate to be charged with negative electricity. The peroxide of lead is reduced so that plate will be positive.

Since in the voltaic cell the zinc is negative and the copper positive, the current passing from copper to zinc in the external circuit (in the generally accepted terms) it is the simplest to regard the zinc as the negative electrode. Why a pole is positive and the plate a few inches farther down is called negative, is a complication which is not easily understood, and for which there seems to be no need.

We are in need of terms which mean the same to all and which express the truth without involving too much of the complex theories that are apt to be changeable and at variance with each other.

In the lead storage cell the positive electricity comes from the peroxide plate into the external circuit, that is, the peroxide plate is charged positively with respect to the electrolyte and to the spongy lead. Therefore, why not call the lead peroxide the positive electrode?—a thing that is generally done in this country.

Granting this, we should be consistent and call the copper or the carbon of the primary cell, the positive electrode. This seems to me to be the simplest solution of the difficulty and one, too, which is perfectly correct from the viewpoint taken.

There is another way of definitely designating the electrodes of a cell—one which does not involve the terms positive and negative. This is by use of the terms anode and cathode as suggested by Faraday. These terms are well defined and are applicable to all cases.

But it seems to me to be unnecessary to abandon the use of positive and negative. They are most convenient for commercial use because they correspond to the terms used in the other forms of electric generators, and if they are correctly used there should be no objection to using them even if they do not describe the condition of the ions corresponding to the same metal in the form of an electrode.

I think that the principal difficulty lies in this; in the theory of electrolytic action it is assumed that the ions are the carriers of electricity and that oxygen and chlorine ions carry a negative charge while the metals and hydrogen, a positive charge. Therefore, it is said, that oxygen is electronegative and the metals, electropositive. Hence they say zinc or spongy lead is the positive electrode or plate and carbon or peroxide of lead is the negative plate.

It is unnecessary and decidedly more complicated to name the electrodes according to the theories of the method by which the electrodes receive their charges than to name them with respect to the results produced on them; and this latter method has its analogies in the other forms of generators of electricity as before mentioned; is less abstract and would not change with any change in the theory of electrolytic action.

Growth by Electricity.

Dr. Maurice Springer read an interesting paper at the Academy of Medicine, in Paris, on animal growth, specifying four elements of nutrition having most effect in inducing organic development—namely, lecithin, potash, oxides and water. The doctor also pointed out that electricity is a powerful agent in the development of growth. By applying a Faraday current to certain muscles and joints of children, both growth and increase of weight have been obtained.

The Use and Advantages of the Alternating Current for Land Telegraphy—II.

BY EDWIN F. NORTHRUP.

THE question, however, arises if anything can be done to the lines to increase the limits of duplex working. This limit will be increased in proportion as the ratio of the received current to the current sent can be increased. The ratio may be increased in two ways: First, the line can be made of lower resistance and its leakage diminished by better insulation; second, by increasing the self-induction of the line, the ratio of the received current to the current sent is increased very much. Let us examine the influence of making each of these changes.

Let I_l be the current received at a point of the line distant from the beginning $X = l$. Let I_0 be the current entering the line at its beginning, that is, the point where $X = O$. Then we have to investigate the various ways of increasing the value of the ratio $W = \frac{I_l}{I_o}$

Put equation (10) in the form

$$I = \frac{1}{a - j\beta}\left\{A\epsilon^{-aX}(\cos\beta X + j\sin\beta X) - B\epsilon^{aX}(\cos\beta X - j\sin\beta X)\right\} \quad (21)$$

The current is here seen to consist of two components, one, a wave, the amplitude of which decreases in passing from the dynamo down the line, and, a reflected wave. First assume the line to be infinitely long. Then when $X =$ infinity, $I = O$, and as $\epsilon^{-aX} = O$ we see that $B = O$. Hence, for a line of infinite length the reflected wave does not exist, and

$$I = \frac{A\epsilon^{-aX}}{a - j\beta}(\cos\beta X + j\sin\beta X) \quad (22)$$

If the value of the current is known at the dynamo end of the line, or where $X = O$, then this value is, $I_o = \frac{A}{a - j\beta}$, and hence

$$A = I_0(a - j\beta)$$

Putting this value of A in equation (22) gives

$$I = I_0\epsilon^{-aX}(\cos BX + j\sin BX) \quad (23)$$

The phase of I is $\tan\omega = \frac{\sin\beta X}{\cos\beta X} = \tan\beta X$ or $\omega = \beta X$.

Thus the phase angle increases uniformly with increase of distance down the line.

The absolute value of I is

$$I = I_0\epsilon^{-aX}\sqrt{\cos^2\beta X + \sin^2\beta X} = I_0\epsilon^{-aX}$$

The ratio of the current at any point, l, of a line of infinite length to the current, at the generator end of the line, is

$$W = \frac{I_l}{I_0} = \epsilon^{-al} \quad (24)$$

This equation, which is only approximate for lines of finite length will serve to show, nevertheless, how the ratio of the current received to the current sent is affected by varying the constants of the line. When written out in full (see Eq. 7. page 741, November 8).

$$W = \epsilon^{-l\sqrt{\frac{1}{2}\left\{\sqrt{(r^2 + x^2)(g^2 + b^2c^2)} + (gr - xbc)\right\}}} \quad (25)$$

We will assume, first, that $g = o$, that is, that the insulation of the line is perfect. Putting, then, $g = o$ gives

$$W = \epsilon^{-l\sqrt{\frac{bc}{2}\left\{(r^2 + x^2)^{\frac{1}{2}} - x\right\}}} \quad (26)$$

or expanding

$$W = \frac{1}{\epsilon^{l\sqrt{\pi NC}\sqrt{(r^2 + 4\pi^2N^2L^2)^{\frac{1}{2}} - 2\pi NL}}} \quad (27)$$

Assume for the moment that L, the self-induction of the line is also zero, then,

$$W^1 = \frac{1}{\epsilon^{l\sqrt{\pi NCr}}}$$

Thus the ratio of the current received to the current sent will increase as N, C, or r, decreases. As will appear later, the number of signals that can be sent per second will be proportional to N, the frequency, so it would not be advisable to reduce N. C, the capacity of the line, cannot be reduced any appreciable amount. r, the resistance, can be reduced at the expense of using larger wire.

Let, $W^1 = \epsilon^{-l\sqrt{\pi NC \times 2.67}}$

be the ratio of the currents when No. 9 copper wire of 2.67 ohms per kilometer is used for the line.

Let, $W_1 = \epsilon^{-l\sqrt{\pi NC \times 1.24}}$

be the ratio when No. 5 copper wire of 1.24 ohms per kilometer is used. Then, if $N = 100$ and $C = .0062 \times 10^{-6}$ and l is taken 1,212 kilometers (which, if g and L had not been neglected, would be one-half wave length).

$$W^1 = \frac{1}{\epsilon^{2.76}} = \frac{1}{15.7} = .064, \text{ nearly}$$

and $$W_1 = \frac{1}{\epsilon^{1.87}} = \frac{1}{6.5} = .153, \text{ nearly.}$$

Thus in the above particular case by making the line of about half the resistance the ratio of the current received to the current sent is more than doubled.

To show more clearly the variations which can be made in the ratio of the current received, at any point of an infinite line, to the current entering the line, I have plotted two curves, V and VI (Figs.

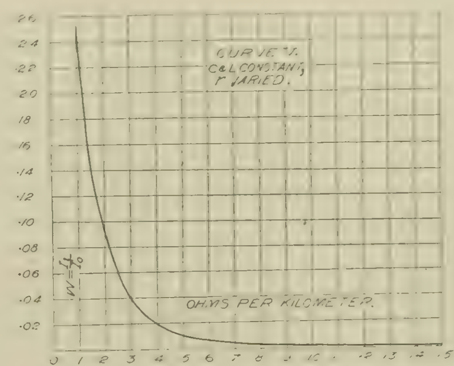


FIG. 7.—VARIATIONS IN RATIO OF CURRENT.

7 and 8). Curve V gives W (see equation 26) as a function of r, the resistance, all the other quantities in equation 26 remaining constant, and Curve VI gives W as a function of L, the self-induction, all the other quantities being considered constant. For plotting both

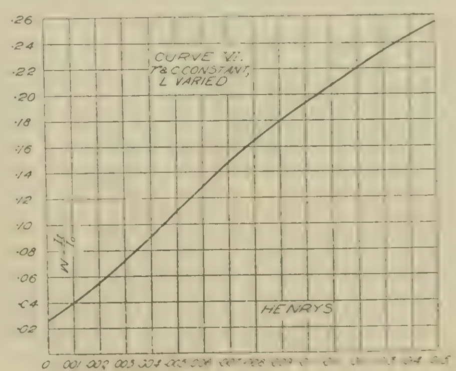


FIG. 8.—VARIATIONS IN RATIO OF CURRENT.

curves, l, the distance from the end of the line, is taken to be 1,600 kilometers, or nearly 1,000 miles. The

$$\sqrt{\frac{bc}{2}} = \sqrt{\frac{3.89}{2} \times 10^{-6}}$$

For Curve V the value assigned to x is 1.13, where $x = 2\pi NL$, and r is made to vary from 1 ohm to 15 ohms per kilometer. Then

$$W = \epsilon^{-2.23\left\{(1.28 + r^2)^{\frac{1}{2}} - 1.13\right\}^{\frac{1}{2}}}$$

The curve shows how rapidly the ratio of the currents decreases as the resistance increases. It is seen that under the assumed con-

ditions, at about 2 ohms per kilometer the value of the ratio is greatly effected by small changes in the resistance.

In order that $\frac{1}{10}$th of the current, a quantity needed for duplexing, may reach 1,000 miles, the line of infinite length would have to have a resistance as low as 1.9 ohms per kilometer, and be perfectly insulated.

Curve VI is plotted by means of the formula

$$W = [illegible]$$

where the value of $l\sqrt{\frac{c}{2}}$ is the same as for curve V and $r = 2.67$ ohms, the resistance of No. 9 copper wire per kilometer.

L, the self-induction, is varied from 0 to .015 henry per kilometer. The value of W is seen from this curve to increase almost uniformly with increase in the self-induction of the line. To increase the self-induction of the line beyond that which is natural to it, namely, about .0018 henry per kilometer, it would be necessary to insert at intervals in the line impedance coils. If these coils are made without iron the ohmic resistance of the line would be considerably increased by their use. If they contain iron there will still be energy losses due to hysteresis, etc. Since self-induction increases the current ratio and ohmic resistance decreases it, it becomes a matter of calculation for any particular case to determine what the gain will be, if any, by inserting impedance coils in the line which would have, necessarily, resistance as well as self-induction.

It would be interesting to make some calculations here on this subject, but the limits of the present article will not allow us to do so.

Equation 24, which *accurately* expresses the ratio of the current received at any point of a line of *infinite* length to the entering current, is only approximate for a line of finite length and grounded at the end. If, however, the line is very long, say over one wave length, then $W = \epsilon^{-al}$ still expresses the ratio with considerable accuracy, if l is taken as a point in the line not more than about three-quarters the length of the line from the generator end. Thus referring to the line for which curves *I* to *IV* were plotted, $W = \frac{I_l}{I_o} = \epsilon^{-al}$ gives for $l = 1{,}261$ kilometers the value, $I_l = 7.11$ instead of the correct value, 7.16, and for $l = 1{,}940$ kilometers, $I_l = 1.591$ instead of the correct value of 1.475. But if $l = 2{,}425$ kilometers, the total length of the line, then $I_l = .5284$ instead of 1.0058, the correct value. Thus, since $.5284 \times 2 = 1.0568$, which is very nearly equal to 1.058, if we wish to find the ratio of the current received at the grounded end of a long line to the current which enters the line, we can do so with a very small error by assuming that

$$W = \frac{I_g}{I_o} = 2\epsilon^{-al}$$

where I_g equals the current at the grounded end of the line and I_o equals the current at the dynamo end.

Again, if the distances are measured positive from the grounded end towards the dynamo, then, if X is the distance, it can be shown that

$$W = \frac{I_g}{I_X} = \frac{2}{[\epsilon^{2aX} + \epsilon^{-2aX} + 2\cos 2bX]^{\frac{1}{2}}} \qquad (28)$$

exactly expresses the ratio of the current I_g at the grounded end of the line to the current, I_X, at any point distant X from the grounded end.

For most practical purposes this last equation reduces to

$$W = \frac{I_g}{I_X} = 2\epsilon^{-aX}$$

which is of similar form with equation $W = 2\epsilon^{-al}$ where l is the distance from the dynamo end of the line.

As shown by the above equations, the values of the ratios of the currents, plotted in Curves V and VI, for a line of infinite length, if multiplied by 2 become very nearly the correct values for a line 1,000 miles long grounded at its end. Thus, referring to Curve V, to have the ratio $2 \times .05 = \frac{1}{10}$th, the resistance of the line would have to be as low as 2.67 ohms per kilometer, and the line perfectly insulated. Thus 1,000 miles is about the limit of duplexing for a perfectly insulated line of No. 9 copper wire unless the line is modified by having its self-induction increased. Probably, however, as lines are actually constructed, having more or less leakage, the ratio would be $\frac{1}{10}$th in about 630 miles. (See curve, Fig. 4.)

In telegraphing with alternating currents there is no falling off in the speed of the signaling with increasing distances due to a blending together of the current impulses. A current of sine wave form entering a line preserves its sine wave form however long the line.

The rapidity with which signals can follow each other on the line is absolutely independent of the length of the line. Limitations, which have been discussed, are put upon the length of a line which can be duplexed, but none of these limitations apply to simplex lines, or lines in which it is not required to transmit two signals in opposite directions at exactly the same instant. By means of the alternating current a simplex line can be operated which is of very great length. I have personally made an artificial line equal to 1,200 miles and telegraphed over it at the rate of 160 words a minute, sent in one direction and received in printed form. The received signals were just as clear and perfect as they would have been on a line of only a few miles in length. For printing telegraphy, and for synchronism, a receiving relay could be made to operate perfectly with a small fraction of a milliampere, but such a delicate receiving instrument would be easily effected by accidental line disturbances, such as induction effects from neighboring lines, or atmospheric electrical influences. (All earth current disturbances may be entirely eliminated in ways to be shown later.)

Practical tests indicate that the receiving relay should be sensitive to about 25 milliamperes. The distance then over which full speed, clear signaling in one direction at a time can be effected, is limited only by the distance to which an alternating current of about 25 milliamperes can be forced through a well-insulated line. How long the line might be through which 25 milliamperes could be forced would depend, of course, upon many circumstances, such as its resistance, its insulation, its self-induction and capacity. It would certainly be an easy matter to telegraph 160 words per minute in one direction over a No. 9 copper wire overhead line, 1,500 miles long, and probably much farther.

There are many ways in which telegraphic signals may be impressed upon an alternating current. In explaining the more valuable methods, I shall assume that it is simple and easy to maintain synchronous rotation of the local apparatus at the two ends of a line of any length through which 25 milliamperes may be made to flow. Full explanations will be given later of how this synchronism is accomplished.

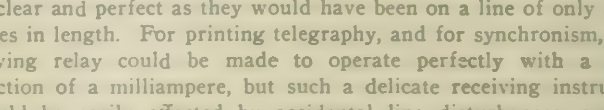


FIG. 9.—WAVES.

An alternating current of sine wave form with some of its waves modified is represented in Fig. 9. At the end of a line carrying the alternating current it is assumed that there is a receiving instrument, which is effected in a uniform manner by each of the unmodified half waves of the current, but which is differently effected whenever a modified half wave reaches it. With this arranged, it is evident that if a half wave of the current is modified at one end of the line in any particular manner, the receiving instrument at the other end will indicate the modification, and the whole or a part of a signal will have been transmitted. The two general ways in which a signal may be impressed upon the alternating current, is first to make a signal to consist of a modified single particular half wave, and, second, to make a signal to consist of a particular combination of modified half waves.

In the first instance, the half wave may be either cut out or omitted, as the half waves, 14 and 17, or reversed as the half waves 5 and 8, or altered in form as the half wave 3, Fig. 9. The cutting out and the reversing of a half wave are the only two kinds of modifications of the current which have so far been found to be of practical importance, and the only ones which I shall here consider.

A half wave or semicycle of the alternating current may be cut out or reversed in a number of different ways. But, whatever method is employed, it is desirable that the current and e. m. f. should be in *phase at the point of the line where the current is modified.* If the current and e. m. f. are not in phase, it is diffcult, if not impossible, to cut out or reverse the half wave by any transmitter method, which breaks the line circuit, without sparking at the line contacts.

In any alternating-current circuit, in which the current and e. m. f. differ in phase, there is no common point where the current and e. m. f. are both zero, and so if the circuit is broken while the current is passing through zero, the e. m. f. acting across the break produces a spark, if the circuit is broken while the e. m. f. is passing through zero the current flows across the break producing a spark.

This explanation is admittedly unsatisfactory, but experiment shows, nevertheless, if the current and e. m. f. differ in phase, that there will always be more or less sparking at whatever time the circuit is broken, and that the sparking may be avoided when there is no difference in phase.

It is very easy to bring the current and e. m. f. exactly into phase at any particular point of the line, by inserting in series with the line the proper amount of self-induction. The matter has practical importance, and I will therefore show how to calculate the proper amount of self-induction to use. The problem will be shortened if the line is considered as being infinitely long, and the result will differ from that for a line of, say ¼th wave length, by a negligible quantity.

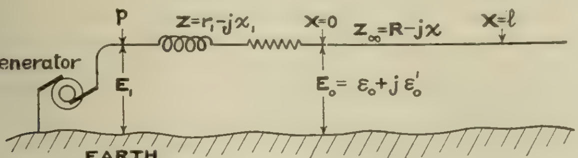


FIG. 10.—LINE OF INFINITE LENGTH.

Let Fig. 10 represent the line of infinite length. Let $X = O$ where the e. m. f. is $E_o = e_o + j\, e_o^1$. Suppose it is required, in order to cut out half waves, to break and make the circuit at some point, p, and that at this point the current and e. m. f. shall be brought into phase by inserting in series with the line the impedance $Z = r_1 - jx_1 = r_1 - j2\pi NL$. In general if $Z^1 = R^1 - jx^1$ is any impedance, the phase difference of the current and e. m. f. is $tan\ \omega = \frac{x^1}{R^1}$ and the current and e. m. f. are in phase if $tan\ \omega = O$.

Let Z_∞ be the total impedance of the line of infinite length, and let the impedance $Z = r_1, -jx_1$, be added between the point p and the beginning of the line, where X is taken to be zero. Then reckoning from the point p, the total impedance is $Zs = Z + Z_\infty$. The impedance of the line is $Z_\infty = \frac{E_o}{I_o}$, namely the ratio of the e. m. f. to the current at the point where $X = o$. As previously shown, for a line of infinite length, the constant B in equations (9) and 10) is zero and

$$E = \frac{A\, \varepsilon^{-\alpha X}}{g - j\, bc} \quad (cos\ \beta X + j\ sin\ \beta X)$$

and

$$I = \frac{A\, \varepsilon^{-\alpha X}}{\alpha - j\beta} \quad (cos\ \beta X + j\ sin\ \beta X)$$

Hence

$$Z_\infty = \frac{\alpha - j\,\beta}{g - j\, bc} = \frac{g\,\alpha + bc\,\beta}{g^2 + bc^2} - j\,\frac{g\,\beta - bc\,\alpha}{g^2 + bc^2}$$

Then the total impedance counting from the point p, where it is desired to have the current and e. m. f. in phase is

$$Zs = r_1 - j\, x_1 + \frac{g\,\alpha + bc\,\beta}{g^2 + bc^2} - j\,\frac{g\,\beta - bc\,\alpha}{g^2 + bc^2}\text{, or}$$

$$Zs = \frac{r_1\,(g^2 + bc^2) + g\,\alpha + bc\,\beta}{g^2 + bc^2} - j\,\frac{x_1\,(g^2 + bc^2) + g\,\beta - bc\,\alpha}{g^2 + bc^2}$$

Hence

$$tan\ \omega = \frac{x_1\,(g^2 + bc^2) + g\,\beta - bc\,\alpha}{r_1\,(g^2 + bc^2) + g\,\alpha + bc\,\beta}$$

The difference in phase is zero when

$$x_1\ (g^2 + bc^2) + g\,\beta - bc\,\alpha = o$$

or when

$$2\,\pi\,NL = x_1 = \frac{bc\,\alpha - g\,\beta}{g^2 + bc^2}$$

That is when

$$L = \frac{bc\,\alpha - g\,\beta}{2\,\pi\,N\,(g^2 + bc^2)}$$

If the leakage is zero, that is if $g = o$

$$L = \frac{\alpha}{2\,\pi\,N\,[illegible]} = \frac{\sqrt{2}\ [illegible]}{2\,\pi\,N\,bc}$$

or

$$L = \frac{[illegible]}{[illegible]\ 8\,\pi\,N\ [illegible]}$$

Adopting the same values for the constants of the line as were used in plotting curves I to IV we get

$$L = \frac{[illegible]\ 2.67^2\ [illegible]\ 1.13\ [illegible]\ 1.13}{[illegible] \times 3.14 \times 100 \times [illegible]\ 3\,[illegible] \times 10^{[illegible]}}$$

or $L =$ [illegible] henrys.

The self-induction required to bring the current and e. m. f. into phase at the beginning of lines of finite length such as would actually be used, is but slightly different from the self-induction required for a line of infinite length.

I have found the expression for the necessary value of L in the case of a line ¼th wave length long.

It is

$$L = \frac{bc\,\alpha - g\,\beta}{2\,\pi\,N\,(g^2 + bc^2)}\left[\frac{[illegible]\ 2\,\beta\ + [illegible]\ 2\,\beta}{[illegible]\ 2\,\beta\ [illegible]\ 2\,\beta}\right]$$

The expression in brackets differs from unity by only a very small quantity and otherwise the expression for L is the same as that obtained for a line of infinite length.

The most obvious method of cutting out a single half wave of the alternating current, is to break the circuit when the current is passing through zero and to again complete the circuit after the time of passing of a half wave of the current. An endless number of contrivances might be devised for doing this. Two only will be given to illustrate the principle.

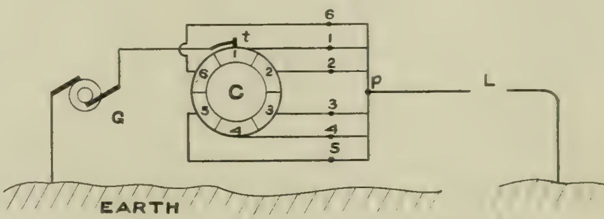


FIG. 11.—METHOD OF CUTTING OUT SINGLE HALF WAVES.

Let C be a sunflower device consisting of segments 1, 2, 3, etc., insulated from one another. Let t be a trailer which, by mechanical gearing to the axle of the generator G, passes over one segment of the sunflower for each half wave of the alternating current. Then if the segments are joined to a common point, p, an alternating current will pass down the line L. Now, if at any of the points 1, 2, 3, 4, etc., one of the segments is disconnected from the common junction p, when the trailer comes around to the disconnected segment no current will be given to the line L, and the half wave will be cut out. Any number of half waves can be thus cut out during one revolution of the trailer by disconnecting any number of segments from the point p. The breaks at 1, 2, 3, 4 can be made with keys, or other suitable devices.

Wireless Telegraph from Berlin to Venice.

A Berlin cablegram, of November 8, says: A wireless telegraph station between Berlin and Venice, with a range of 800 kilometers, will be established this winter at Ober-Schoeneweide, near Berlin, for a trial. If it proves successful for that distance, it will take in Calais on the west, Stockholm on the north and Lemberg, in Galicia, on the east. The equipment for the station, which will be that of the Slaby-Arco system, will be built here by the German Electric Company. Its capacity will correspond to that of the Marconi station at Poldhu, Cornwall, England, and the cost of installation will be $50,000. The annual report of the German Electric Company says the crisis in the electrical industry has been caused chiefly by the careless conduct of affairs. It recommends closer unions of big firms.

Cleveland as a Center in Electrochemical Development.

By Cecil L. Saunders

It is an interesting but not generally known fact, that the great development now occurring in the electrochemical industry had its beginnings in Cleveland, O. It was here that the first large carbons were made at the Brush Carbon Works, for use in the Cowles Brothers' electrical furnaces, and at the present time all the carbon electrodes in use in the various processes are still made in Cleveland. It was here that the first large electrochemical dynamos (then the largest in the world) were made and designed by Charles F. Brush for use in this work. It was in Cleveland that the rare products from the electric furnace were first made, including the reduction of the metal aluminum from its refractory ores.

Thomas L. Willson, who claims the discovery of calcium carbide, was in the fall of 1885, an employee of the Brush Company at its works in Cleveland, where the Cowles Brothers were then operating their electric furnace. Mr. Willson afterwards began experimenting with the electric furnace at Spray, N. C., in 1888, and developed a product, calcium carbide, from which acetylene is made. On the basis of Willson's work and under a license from the Cowles patents, a plant employing 13,000 horse-power and hundreds of men, is now operated at Niagara Falls, producing this remarkable substance. It was here at the chemical laboratories of Case School, during the years 1889 and 1890, that Herbert H. Dow conducted his electrochemical experiments and perfected the processes now used by the Dow Chemical Co. and The Midland Chemical Co. in their large factories in Midland, Mich., for the manufacture of bleaching powder and bromides.

It was in Cleveland that Chas. B. Taylor, then engaged in manufacturing carbon bisulphide by the old chemical method, studied and experimented with the Cowles furnace and developed his electrical process for same, and who now uses a thousand horse-power at Penn Yan, N. Y. It was here at its experimental factory that the Canadian Copper Co. of Sudbury, Ontario, carried on for years a long series of experiments with electrochemical processes for the reduction of nickel from its ores, bringing to the city many of the best known electrochemists of Europe to work out the problems involved, and which after a large expenditure of money have resulted in the successful solution of the problem by the painstaking, careful experimentalist David H. Brown, and the adoption of his process to be installed in mammoth works soon to be erected.

At Niagara Falls a large works is in operation producing all the phosphorus that is used in America by means of the electric furnace. This is also an outgrowth of the work that was started in Cleveland in 1885. A Dr. Redman, in 1890, perfected this process at the works of the Cowles Syndicate Co. at Stoke-on-Trent, in England, in one of the Cowles Brothers' furnaces, and the process is at present worked at Niagara Falls in a manner very similar to that described in some of the Cowles patents.

In 1886 the Cowles Syndicate Co., in England, was organized, and erected electric smelting works at Stoke-on-Trent. In 1894 this company was reorganized as The British Aluminum Co. with great works at the Falls of the Foyers in Scotland, where all the calcium carbide and aluminum of England are now produced.

In 1888, a group of wealthy Berlin capitalists were gotten together by agents of the Cowles Company of Cleveland, to purchase their European patents. The purchase was never consummated. An American, Grosvenor P. Lowrey, brought to the attention of this group, the experiments of a Dr. Kleiner Fiertz and one Paul Herault, who were experimenting with the electric furnace at the Falls of the Rhine in Switzerland. As there were no patent laws in Switzerland at that time, these capitalists arranged with these gentlemen, and on their work founded the great establishment at Schaufhausen, that now produces most of the aluminum, and a large amount of the calcium carbide, for Europe.

Edward G. Acheson, is a learned scientist as well as brilliant experimentalist, whose first work was in the laboratory of Thomas A. Edison. In 1890 he began experimenting with the Cowles furnace with the idea of producing diamonds. He produced some hard, lustrous crystals, carbide of silicon, which he afterwards named carborundum, and began manufacturing these crystals at Monongahela, Pa., as a substitute for emery and other abrasives. The large factories at Niagara Falls using 5,000 horse-power and employing hundreds of men, testify to his genuis and executive ability, as well as the commercial value of this product, now made in the greatest electric furnace in the world, a furnace the size and magnitude of which was undreamt of and inconceivable in 1884 when the Cowles Brothers were experimenting with their wonder of the age. All credit for the product is due him, but the United States Circuit Court of Appeals at Philadelphia recently adjudged his process an infringement of one of the patents of the Cleveland inventors. The Court in that opinion, says, referring to carborundum: "So long ago as 1884 the Messrs. Cowles produced it under their process. . . . It is true they did not manufacture it for commercial purposes, and failing to appreciate its importance, though aware of its abrasive qualities, applied their process to other branches of metallurgy."

Between the years 1885 and 1890, the Cowles Electric Smelting & Aluminum Co. and its branch company in England, first offered aluminum to the market in a cheap form. It supplied cheap aluminum alloys in large quantities, and one of the great demands for aluminum to-day is for use in addition to steel. A very small percentage alloyed with steel so improves the casting qualities of the steel that the steel casting business has been enabled to develop into great magnitude since 1886. Before the Pittsburg Reduction Co. began to manufacture, this market was fully developed and supplied a ready demand for its product as soon as it was offered for sale. Mr. Charles M. Hall, upon whose patent the Pittsburg Reduction Co. was organized, was from Oberlin, a few miles from Cleveland, and from July 1887 to July 1888, he experimented with his process at the works of the Cowles Electric Smelting & Aluminum Co. at Lockport, N. Y. At that time his process was not an electric smelting process, and was of a nature that could not in any way conflict with patents owned by the Cowles Company. Mr. Romaine C. Cole was led to believe that the process could be converted into a commercial process following the lines of Mr. Hall's patent and experimental work.

The Pittsburg Reduction Co. was organized, and changes which led to success in the production of pure aluminum also led to a patent suit between The Cowles Electric Smelting & Aluminum Co. and The Pittsburg Reduction Co., which contest has been going on in the courts for the past eleven years. Before that date the Cowles Company had announced in their trade pamphlets that they proposed soon to put pure aluminum on the market, though up to that time it had only been offering the alloys.

Charles S. Bradley, the well-known electrical engineer and experimentalist, was also from the laboratory of Thomas Edison, and has recently brought out three successful electric smelting processes at Niagara Falls, one for making cyanides, another for making barium hydrate, and another by which ammonia products are produced from the atmosphere. Again, Mr. Bradley was early connected with the aluminum business. His patents were in litigation with those of the Cowles Brothers in 1885. They were patents much of the nature of those of the Cowles Brothers, and had in view heating large masses of material by the electric current, and the electrolytic production of aluminum. All of Mr Bradley's inventions that did or might interfere with the patents or patent applications of the Cowles Brothers, were purchased by the Cleveland company, but unfortunately and to its great financial embarrassment, there arose over this assignment, protracted litigation which was only settled and the issue decided in favor of the Cowles Company, in 1897.

In connection with the foregoing, the following extracts from a paper read before the American Association for the Advancement of Science in 1885, by Professor Charles F. Mabery of Case School, are interesting historically:

"A short time since Eugene H. Cowles and Alfred H. Cowles of Cleveland, conceived the idea of obtaining a continuous high temperature on an extended scale by introducing into the path of an electric current some material that would afford the requisite resistance, thereby producing a corresponding increase in the temperature. After numerous experiments that need not be described in detail, coarsely pulverized carbon was selected as the best means for maintaining a variable resistance, and, at the same time as the most available substance for the reduction of oxides. When

this material, mixed with the oxide to be reduced, was made a part of the electric circuit in a fire-clay retort and submitted to the action of a current from a powerful dynamo machine, not only was the reduction accomplished, but the temperature increased to such an extent that the whole interior of the retort fused completely. In other experiments, lumps of lime, sand and corundum were fused, with indications of a reduction of the corresponding metal; on cooling, the lime formed large well defined crystals, the corundum beautiful red, green and blue hexagonal crystals."

"Experiments already made show that aluminum, silicon, boron, manganese, magnesium, sodium and potassium can be reduced from their oxides with ease. In fact there is no oxide that can withstand temperatures attainable in this electrical furnace. Charcoal in considerable quantities is changed to graphite; whether this indicates fusion or solution of carbon in the reduced metal has not been fully determined. As to what can be accomplished by converting enormous electrical energy into heat within its limited space, it can only be said that it opens the way into an extensive field for pure and applied chemistry. It is not difficult to conceive of temperatures limited only by the capability of carbon to resist fusion."

At this early date the Cleveland Cowles Company had recognized the importance of incandescence in electric smelting, in counterdistinction to the arc methods, which have never proven successful. It had recognized the economies that can be effected in operating upon large masses of material in electric fusion. It had recognized that refractory materials could be reduced at prices that would render their products of value to the world, and during the year 1885, they were offering and selling aluminum in their alloys, at a price of $3.00 a pound, which was soon thereafter much lowered. Speaking of its process, Dr. T. Sterry Hunt, in a paper read before the American Institute of Mining Engineers, in September, 1885, said:

"The vast importance of the new instrument which the Messrs. Cowles have placed in the hands of chemists for producing and controlling a degree of temperature never before obtained, can scarcely yet be estimated, either in its economic or its scientific results. The heat of the furnace realizes the alkahest or universal solvent so long the dream of the alchemist, and he who can rightly use it will be worthy of the ancient title of *magister magnis in ignis.*

"Up to the present time, most of the work that has been done in the electric furnace has been that of reducing aluminum direct from corundum and clay, and also the smelting of silica, common white sand or pebbles to produce silicon bronze. From our knowledge that we have of the process, we are positive that it is designed to work a revolution. . . . . We base this prediction upon the fact that by the new process, aluminum can be produced in its alloys so much cheaper than ever before. The production of pure aluminum cheaply, which is assured by the new process, is, however, also of great importance as this wonderful metal is, with the exception of calcium and silicon, the most abundant component of the earth. Its lightness, non-oxidizability and strength, as well as great power to conduct heat and electricity, render it in many respects the most astonishing of metals."

How wonderfully his prediction has come true, and what a revolution of manufacturing chemistry, as well as the reduction of metals from their ores, has been accomplished. To-day we find on the markets of the world metals and products formerly unknown. Fortunes are being rapidly made. The inventors of successful products and the more economical processes are receiving their well-deserved reward. The enormous amount of capital now invested in the electrochemical processes and power plants for same, attest their great commercial value and the confidence of the investing public. From this small beginning of the Cowles Brothers, an industrial revolution has encircled the world. The electrochemical scientist has penetrated the mountains, forests and deserts. Water powers and surrounding lands of no value have become industrial centers, teeming with the highest civilization and activity from where the electrometallurgists of to-day are sending forth their additions to chemical technology. All that has been done is only the beginning. Industrial centers will change. Present manufacturing processes and plants will be discontinued, and new cities with plants using processes and making products of electrochemistry, now unknown, will be established. Steel will be made direct from the ore, and rolled or cast in all its forms at the mine, using electric heat and power derived from adjacent water powers. Progressive colleges have recognized the value of the new science, and established courses with laboratories for the student of electrochemistry. All is change, eternal progress, no death.

The Composition of Porcelains for Electrical Purposes.

The current issue of the *Transactions* of the American Ceramic Society contains a paper by Mr. Arthur S. Watts, of Findlay, Ohio, giving the results of exhaustive tests on electrical insulating porcelain. The tests, which extended over several months, were extremely complete, covering almost the entire range of earth insulating material. The paper includes numerous tables, giving full data of the tests. Below we give an abstract of the more general parts of the paper:

The leading materials used in porcelain manufacture are certain kinds of kaolin, which are very slightly plastic, quartz and feldspar. Of course ordinary feldspar displays basic properties in the fire, uniting with silica to form silicates, thus producing an intimate mixture of all silicates. Therefore, the contents of kaolin must be in a definite ratio to the quartz and feldspar in regard to the insulating properties.

Too much quartz makes the body too little plastic, thus making it difficult to work, and after burning, the ware shows impressions and some warping due to the tendency of the clay substance to the contract. Too high a content of feldspar makes the body soft and liquid, and increases the tendency to crack. A body low in feldspar does not produce sufficient vitrification, and hence decreases its insulating efficiency.

A porcelain body may shrink 15 to 18 per cent., and it is very important that the exact degree of shrinkage be known. No crazing or shivering is allowable in the glaze used on ware for electrical materials. If the glaze is too infusible the ware will be dull, and if too fusible it is likely to be covered with blisters. Investigation has proven the condemnation of glazes containing metallic oxides to be unfair. Metallic oxides, when used in glazes combine with the silica, forming silicates.

Probably in no line of electrical investigation have greater progress and more varied experiments been made than in the shape and size of electrical insulators. The plain bell which is used for low potentials, and which is also practical and satisfactory for alternating currents up to 1,000 volts, does not meet the requirements of modern high voltage transmissions.

The first step in the way of improvement was made in 1857, by Borggreve. The product was satisfactory so far as electrical and mechanical requirements were concerned, but failed owing to the fact that the interior space was square, which gave rise to uneven tensions in the body and frequent fractures.

The second step in the way of improvement was the production of a very long insulator having a very narrow cross-section. It was the idea of the inventor to increase the resistance by means of a long arcing distance. The insulator produced was of clear glass and suffered from the contraction and expansion of the iron bolt used to connect it to the cross-arm, and which became intensely hot from the sun's rays on the insulator. This condition caused the introduction, in 1895, of the double bell insulator of porcelain. In this, the interior cylindrical part of the insulator is covered by a second bell, which prevents the radiation of heat and also the formation of dew.

Up to a tension of 3,000 volts, the ordinary double bell, 75 mm. wide and 100 mm. high, suffices, but above this voltage the question of further improvement arises.

In 1869 Lenoir and Prudhomme obtained a patent for the use of oil in insulator bells. Insulators of this type were used in constructing the famous line between Lauffen and Frankfurt. They proved impractical, as the oil must be replaced frequently, and in case of rain it was often replaced by water.

In constructing the Kaiser Wilhelm Canal Line, a triple-bell insulator, without oil, was used, and proved satisfactory even when exposed to salt spray. This type is now commonly in use for high-voltage transmissions.

At first the insulators were glazed and burned, resting on the bottom edge of the bell, but the roughness of this edge seemed to cause the collection of drops of water and to prevent this, the insulator is now glazed all over, the glaze removed from the head and the insulator burned inverted. Very recently it has been discovered that by glazing the inside of the insulator in the threaded

hole, the insulator is made much more resistant and need not be so thick.

The weight of the porcelain used in an insulator is not of the greatest importance, but rather, the quality of the porcelain and the kind of glaze.

In Europe, insulators are made by all five of the clay working processes, viz., turning, jollying, pressing, casting and dry pressing. Dr. Seger, in his work, shows very conclusively that a semi-dry process, in which the material to be pressed contains the highest per cent. of water allowing of good pressing, gives the densest and strongest body.

Turning of large insulators is done similarly to all clay turning, the product being made mouth up, and the top finished when the ware is sufficiently dry to permit of its being inverted. In this class of ware, much trouble is experienced in making the screw-thread for the pin which is to support the insulator. This thread is made by means of a threaded steel tube, which is provided with a handle on one end, and which is slowly turned in and out. In place of a full steel tube a segment may be used. Automatic boring apparatus is now being applied for this work.

Jollying is now largely replacing turning although it does not insure as dense and uniform a body as the former process. Pressing is done in molds. The clay is placed in the mold in a lump and by means of a plunger is forced to assume the shape of the inside of the mold for its exterior while the plunger shapes its interior.

Dry pressing produces more exact shapes than any other method. The molds used are of steel and are very expensive. The body must be in such shape that it will not stick to the mold. To obtain it in this condition some factories use the following process: The clay after drying and being thoroughly pulverized is placed in wet cement or plaster boxes and allowed to absorb 10 to 20 per cent. of moisture. The mass is then sieved thoroughly. Ten kilograms of the body will contain about 1 to 2 litres of water. Of course this proportion must be maintained exactly in order to insure a uniform shrinkage. The molds are sometimes complicated and are often composed of insertions. The piece of ware produced is threaded by means of a screw inserted in the bottom before the clay is introduced, and which is screwed out rapidly by means of a crank. The tendency is to make insulators without threads, as this has always been a great source of trouble and loss in manufacture.

Mr. Watts said that in outlining his tests, it seemed necessary to choose some type or standard of porcelain which could be used as a basis from which to map out varying series. The wisest course seemed to be to procure a large number of standard porcelains, and to obtain from these by comparison the most characteristic type of porcelain now in use. Acting on Professor Binn's suggestion,* Al_2O_3 was taken as unity in the formulas.

An examination of the chemical formulas of 36 specimens at first sight appeared to indicate a hopeless conglomeration, ranging to all extremes; but closer study disclosed the fact that, while the *RO* varies from .0467 in the Japanese to 5.43 in the old English, and from .114 in modern Belgium to 1.84 in modern English ware, the proportion of SiO_2 is comparatively constant. Only in two out of 36 cases does the SiO_2 run below 3.7, and in only two cases of modern porcelain does it run over 6.0 SiO_2. The average of the list was between 4 SiO_2 and 4.4 SiO_2, hence 4.2 SiO_2 was taken as the standard.

Next a standard for *RO* was chosen. To obtain this by the same method as pursued with the SiO_2 would prove unsatisfactory, since to take an average of the entire list would result in a *RO* of 1.00, while to take an average of the 30 modern porcelains would give about 0.3 *RO*. The first case would give about a cone 6 product, while the second case gives very nearly the type of an American porcelain, maturing at cone 12. As a choice between such extremes could not be satisfactory, a series was made, covering each extreme and a third about half-way between, as follows:

Series A.	1. RO,	1. Al_2O_3,	4.2 SiO_2	Cone 6 type.
Series B.	.5 RO,	1. Al_2O_3,	4.2 SiO_2	Cone 9 type.
Series C.	.3 RO,	1. Al_2O_3,	4.2 SiO_2	Cone 12 type.

The various porcelain trial bodies were produced in the following manner:

The two extremes of each set were weighed out and ground wet in a ball mill. The intermediate numbers were obtained by liquid blending of the extremes. After the blends were thoroughly mixed, they were poured into plaster molds to harden by loss of their water. Of each porcelain body the following ware was made:

Two brickettes made in standard cement—brickette molds—and having a central cross-section of 1 inch in the green state. These were made by the plastic process. Two cubes of 50 grams weight, made also by the plastic process. Two tiles, 4½ inches x 4½ inches, in green state. These were made by the dry-press process.

The material for the dry-pressed tile was prepared as follows: The dry body was thoroughly pulverized and was then dampened with water by means of a brush and the hand, thus obtaining a fairly uniform dampness. The damp clay was allowed to stand about two hours, and was then put through a 20-mesh screen and promptly pressed into the desired shape by means of a hand tile press. About 12 to 14 per cent. of water was in the clay when it was pressed.

Upon the various forms made up, there were made an electrical resistance test, tensile test, abrasion test, absorption test and shrinkage test.

While no great obstacle lay in the way of the tensile, abrasion, absorption or shrinkage tests, the difficulty was great with respect to testing the electrical resisting properties of the porcelains. In the first place, it was not known how much electrical resistance a given thickness of porcelain might display. In the second place there could be pressed only a tile of one size, viz., 4½ inches x 4½ inches. It was thus necessary to obtain, if possible, some insulating material in which to imbed the tile, and thus increase the arcing distance of the current, since with 4½ inches arcing distance 55,000 volts could not be used without the current arcing around the tile. The idea of using Portland cement, however, suggested itself, as it seemed plausible that this might be a good insulating material.

A semi-vitrified tile, 4 x 4 x ⅜ inches, was incased in a slab of Portland cement (Dyckerhoff). The cement was carefully tamped around the tile, so that a good attachment might result. Several other slabs were also made of cement, both German and American. In these no tiles were encased. All the cement slabs stood six days in water, and were then taken out and carefully dried. Their resisting properties were then tested with poor results. Each slab showed only so much electrical resistance as a like thickness of pure air would show, thus proving that the small insulating power displayed by the cement was due to the fact that its thickness held the electrodes apart and made an arc necessary.

Next the tile was tested encased in cement. The following insulating materials had also been provided: One sheet window glass, one sheet plate glass, one porcelain tea plate, one tile 4 x 4 x ⅜ inches unincased. The results of the test of the above was as follows:

Tile 4 x 4 x ⅜ inches, incased in slab of Portland cement, punctured at.......... 17,000 volts.
Tile 4 x 4 x ⅜ inches, unincased, punctured.......... 20,250 "
Sheet window glass 6 x 6 x ⅛ inches, punctured at.... 40,000 "
Porcelain Tea Plate, 6 inches in diameter x ⅛ inch, punctured at .... 49,500 "
Sheet Plate Glass, 6 x 6 x ¼ inches, stood 60,000 volts, and then the current arced around sheet and could not puncture it.

The tile incased in cement and the unincased tile were both of the same composition, and as both were porous to a degree, it is to be presumed that the incased tile which had been soaked for six days still retained some moisture when tested, which accounts for its lower puncturing point than was displayed by the unincased tile. The facts brought out by this preliminary test seem about as follows:

First.—That Portland cement does not possess any more insulating power than would be displayed by a like thickness of dry air.

Second.—That porcelain, if not perfectly vitrified, does not possess any great insulating efficiency, even when perfectly dry.

Third.—That glass ranks next and lies between semi-vitrified and vitrified porcelain.

Fourth.—That thoroughly vitrified porcelain, even though only ⅛-inch thick, possesses as much insulating strength as is necessary, since 40,000 volts is the highest voltage that can be transmitted without arcing around a 4½ x 4½ inch tile.

Fifth.—That plate glass possesses an especially high electrical resisting property.

We know that the composition of glasses has a great influence on their ability to resist electric currents. Also, that the temperature at which they are used is a factor.

The search for an aproning material to use with the tiles was continued, and it was found that a gutta percha plate could not be

* The Birth of English Porcelain. Trans. A. C. S., Vol. III, page 144.

cemented to the tile for each test and then removed, and to furnish a separate sheet of gutta-percha for each tile would mean entirely too great an expense. Selenium also was out of the question owing to its cost. It was concluded, however, to try sulphur, which is a very similar material to selenium, and to do this two bottomless flasks, by means of sulphur in the melted state, were cemented to two tiles. Two large plates of sulphur were also cast with tiles imbedded in their centers. One tile was completely imbedded, leaving only a hole ½ inch in diameter on each side to admit the electrode. The second tile was only imbedded on one side in the sulphur, the other side was left exposed. There was a ½-inch hole on the imbedded side of the tile to admit the electrode. The tiles were vitrified. A plate of sulphur, 6 x 6 x ½ inches, was also cast. The results of the electrical test on sulphur was as follows:

The plate containing the half imbedded slab stood about 58,000 volts, and then the current arced through the sulphur. The plate containing the completely imbedded tile stood about the same, the current going around the tile through the sulphur. The tiles cemented to the flasks were not satisfactory since the current found its way between the glass and the sulphur. The slab of pure sulphur ½-inch thick stood about 13,500 volts and then punctured. On its being punctured the slab caught fire from the spark.

The results showing that at least none of the materials available could be successfully used as an aproning material, the idea was discarded of aproning the tiles, and the thickness of the pieces to be tested electrically was reduced to an amount which would puncture before the current would arc around the tile.

The formulas of the three porcelains selected as fairly illustrating the types now in actual use have been given. Taking each type, as a basis, three separate sub-series of bodies were made, as follows, each sub-series consisting of a set of five porcelains:

I. Maintaining *RO* and SiO_2 constant and varying the proportion of Al_2O_3.

II. Maintaining the Al_2O_3 to SiO_2 constant and varying the ***RO*** in kind but not in quality.

III. Maintaining the *RO* and Al_2O_3 constant and varying the proportion of SiO_2.

PREPARATION OF THE REGULAR TRIAL PIECES.

The preliminary tests having been completed, the various bodies were prepared on sufficient scale, and were worked into the shapes heretofore decided upon, and after drying each lot thoroughly, they were fired. It was impossible to obtain in the small kiln used an absolutely uniform temperature over the entire kiln, but except in one case, all received an equal period of firing.

The paper discusses in detail the results of each set of tests, consisting of tests for electrical resistance, abrasion, absorption, shrinkage and tensile strength. Following are the conclusions arrived at:

The object of the investigation was to prove, if possible, the proportions of the essential constituents which go to make up the best insulating porcelains. The tests showed that porcelains of equally good appearance may possess greatly varying values when subjected to various tests. The essential properties of an electrical insulator are, that it possess, first of all, a high efficiency as a non-conductor; second, that it stand, without snapping, any reasonable strain put upon it by the exigencies of wiring; third, that it withstand the blows of missiles, even bullets, without breaking. The electrical, the tensile and the abrasion tests, respectively, were made to show these properties in the porcelains tested.

The electrical resistance tests show that every specimen standing a superior test has a high silica and moderately low alumina content. Unfortunately in each series showing the variation in proportions of *CaO* and K_2O, the content of Al_2O_3 was so high that no exceptionally good porcelains were obtained, even with high K_2O content. However, the tables show that a marked improvement is apparent upon increasing the K_2O and decreasing the *CaO*, except at the extreme of the series where we see the K_2O used alone, and here the specimens show weakness due to brittleness. This indicates that had the K_2O been somewhat increased, and the *CaO* proportionately decreased, the result would have been much better.

From a study of the abrasion tests, it is very apparent that with K_2O alone as a flux, and even with a moderately high clay substance, we obtain a brittle and weak porcelain. When as low as 20 per cent of K_2O is replaced by *CaO*, we find the product changed to a tough but well vitrified body, although the translucency is reduced by any additions of *CaO*. To just what extent this is the case is not a matter of importance in this work. In the series showing the effect of Al_2O_3 content, no great difference was noticed in the ability of the specimens to resist abrasion. Much the same statement would apply to the series showing the results of varying of SiO_2. However, the medium high SiO_2 specimens seem to clip worse than the extremely high SiO_2 specimens, while the low SiO_2 specimens show a lack of ability to resist abrasion.

A study of the test tables show that of the forty different porcelains tested, six are more or less porous. It appears that the results of the tensile tests hold here also, and that the same limits may be accepted. Moreover, *CaO*, when substituted for an equal equivalent of K_2O, does not produce an equal amount of vitrification with all cones.

A study of the tensile tests show that a moderately high SiO_2 and Al_2O_3 content will bring a good strong porcelain, but that not over one Al_2O_3 and 6.2 SiO_2 should be used. None of the specimens below .8 Al_2O_3 and 4.2 SiO_2 were safe, owing to their very narrow vitrification limits. The *RO* that proved most satisfactory in the tensile tests was between

$$\begin{matrix} 40 \text{ per cent. } K_2C \\ 60 \text{ per cent. } CaO \end{matrix} \quad \text{and} \quad \begin{matrix} 80 \text{ per cent. } K_2O \\ 20 \text{ per cent. } CaO \end{matrix}$$

The shrinkage tests tend to show that there are three factors that may cause a variation: 1. The amount of clay substance introduced. 2. The variation in the kind of flux used. 3. The amount of silica present. Hence the shrinkage may be varied to suit almost any case.

An ideal porcelain for electrical purposes, may contain from 50 per cent. to 80 per cent. of its *RO* in the form of K_2O, and the remainder as *CaO*. It may contain from .8 Al_2O_3 to 1.0 Al_2O_3, and from 4.2 *SiO* to 6.2 SiO_2. Expressing the same fact in formula form, we would have

$$\left.\begin{matrix} 0.5 \text{ to } 0.8\ K_2O \\ 0.5 \text{ to } 0.2\ CaO. \end{matrix}\right\} \quad 0.8 \text{ to } 1.0\ Al_2O_3 \quad \left\{ \quad 4.2 \text{ to } 6.2\ SiO_2 \right.$$

as the practical range of composition. Closer limits than these would be largely a matter of fancy for more translucency or more stoniness to be decided by the party interested. However, any porcelain within the limits named above, would, all other things being equal, be as good as, if not superior to the average electrical insulator porcelain now on the market.

New Telephone Patents.

It is quite interesting to see in last week's Patent Office issue evidence of the practical application of the "loading" of telephone lines, according to the patents of Dr. Pupin, by the issuance of patent to Mr. E. W. Colfitts, and assigned by him to the American Telephone and Telegraph Company, the successors of the American Bell Company. This patent has reference to arrangements of circuit, whereby a loaded line may be made available for use for simultaneous telegraphy and telephony, according to the present practice of the Bell Long-Distance Company. According to these practices, a single metallic circuit is available for the simultaneous transmission of three messages, two telegraph and one telephone. The telegraph signals each follow a path comprising one wire of the metalic-circuit line, and an earth return, while the telephone currents follow the metallic circuit just as though the telegraph apparatus did not exist. This simultaneous use of the wires depends upon the very different characteristics of the telegraph and telephone currents and the consequent ability to separate them by the judicious and proper disposition of condensers and retardation coils in the circuit.

When loading, coils are used in a telephone line; however, it is found that in order to obtain the full advantage of these, a higher potential variation must be maintained upon the loaded portion of the line than at the unloaded terminal loops, and this is obtained by the use of terminal induction coils, whose ratio of transformation, Mr. Colpitts states, should be as one to three. This induction coil or transformer not only connects the two wires of the metallic circuit together, but it also breaks their continuity for direct currents, thereby rendering them unfit for telegraph service. The present invention obviates these difficulties by making the two-line wires continuous and at the same time retaining the transformer in such relation to the line that its action is not impaired. Three methods of accomplishing this result are described in the patent, all of which methods are shown in Fig. 1. In that scheme, shown at the top of the figure, the induction coil windings are split, each into two equal sections, which are connected together through condensers. With such an arrangement, the voice currents can traverse the wind-

ings of the transformer or induction coil, passing through the condensers, just as though the windings were continuous. Also, as there is an equal portion of each coil on each side of the condenser, the condenser terminals represent equipotential points as far as the alternating telephone currents are concerned, and, therefore, conductors may connect the corresponding sections of the primary and secondary windings of the transformer without effect upon these currents. These connecting conductors complete the continuity of the two-line wires for the direct or telegraphic currents. In the scheme of wiring, shown in the middle of Fig. 1, four condensers separate the transformer from the line wire, and the continuity of these latter is completed by means of low-resistance, high-impedance coils, connecting the line and terminal sections of the circuit. These coils produce no effect upon the functions of the transformers, because their impedance to the telephonic currents is so great in comparison to that of the transformer. The third method of wiring shows a slight modification in the disposition of the condensers, and of the transformer windings.

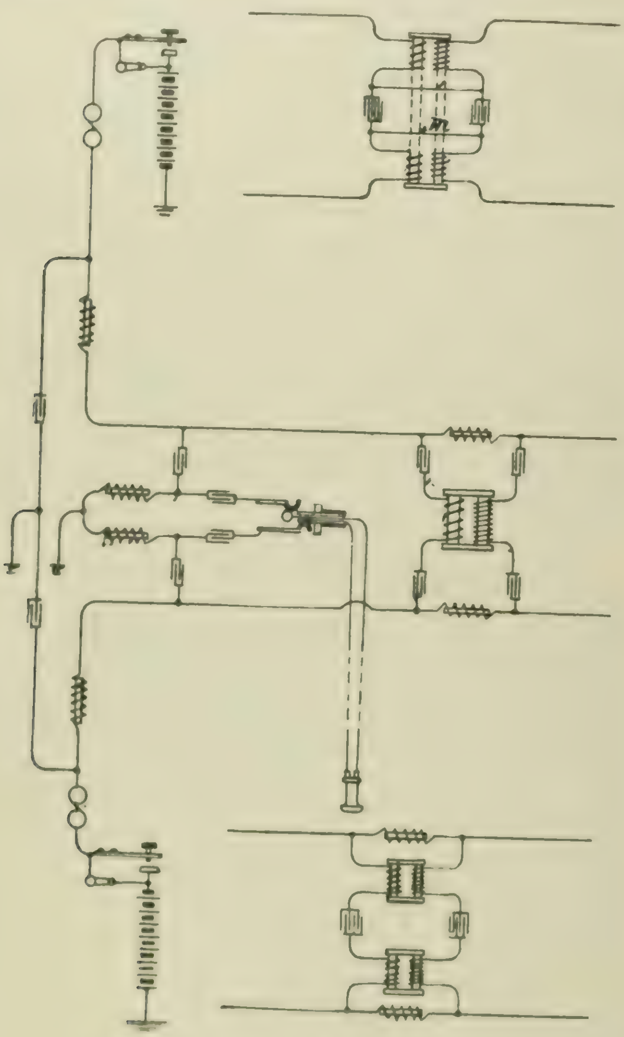


FIG. 1.—COLPITTS' COMPOSITE TRANSMISSION SYSTEM.

A second patent, assigned to the same company, is that of Mr. D. S. Hulfish, covering a connecting-cord circuit for the common battery system, in which the system of supervisory signals is worked out on lines quite different from the present standard Bell practice. This cord circuit is shown in Fig. 2, wherein P is the answering, and P^2 the calling plug. As customary, a supervisory relay, RR^2, is wired in each cord, but in addition a relay, N, is added to the circuit. When the plug P is inserted in a subscriber's spring jack, the sleeve, P^3, is grounded through the cut-off relay, while the tip and ring, p and p^2, are connected together through the subscriber's transmitter. Current is flowing in the sleeve circuit, but the lamp, S, is not glowing, as the shunt, r, controlled by the relay, R, is closed. The shunt circuit may be traced through the contacts of the relay, N.

Now, when the sleeve-wire circuit of plug P^2 is completed by the insertion of that plug into the jack of the called line, and the called party answers, instead of the relay, R^2, merely shunting its lamp, S^2, in the usual manner, this relay causes relay N to operate. As shown in the figure, the result of the operation of this relay is a complete rearrangement of circuit, by means of which both supervisory lamps are placed under the control of the shunt r, and this in turn is placed under the control of both supervisory relays. Therefore, if the shunt circuit is broken, both lamps light simultaneously, and in addition either relay breaks the shunt circuit. The combined result is that if either subscriber return his receiver to the hook after connection has once been made, the disconnect signal is given.

A patent granted to Mr. Arthur T. M. Thomson bears the title, "Electrical Relay." This device is designed, the inventor states, to

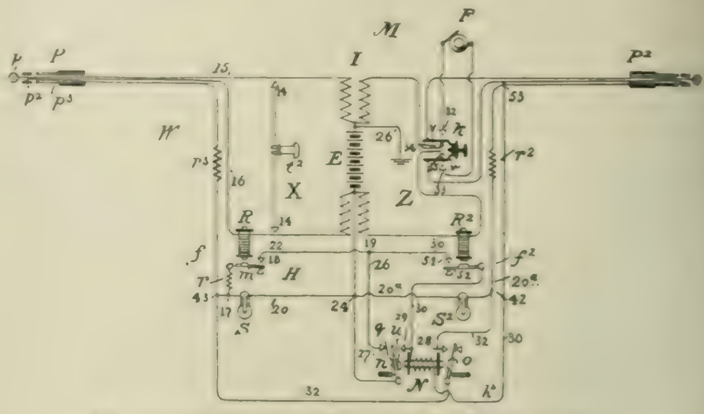


FIG. 2.—HULFISH SWITCHBOARD AND SIGNAL CIRCUIT.

automatically ring up on a called subscriber's line upon the insertion of the operator's plug into the jack, and it is arranged to continue the ringing for a considerable and predetermined length of time. Three different designs for the apparatus are shown in the patent, but all are based upon the same principle. When the plug is inserted into the jack, a circuit is closed, which operates an electromagnetic ringing key, and also sets in operation a timing device. This timing device controls a second electromagnet, adapted to restore the first to the normal position and stop the ringing. There seems to be little difference in the value of the various modifications, as the timing devices are somewhat crude, when viewed from a telephone standpoint. The first of these timing devices is an electrically-operated thermostadt, arranged to control a contact. The second is a train of gears, driving a revolving air vane and opposing the action of the armature of an electromagnet. The third is an electric motor, which is required to drive a contact wheel, by means of a reducing train, through one revolution.

A new development of the coin collector for telephone pay stations is brought out in this issue by patents. This type of coin collector is adapted to control the telephone instrument to which it is attached by locking the hook switch in the depressed position. One of these patents is granted to Mr. E. G. Lewis, another to G. P. Moore, which latter seems to be merely an improvement of the invention of Mr. Lewis. Both patents are assigned to the Controller Company.

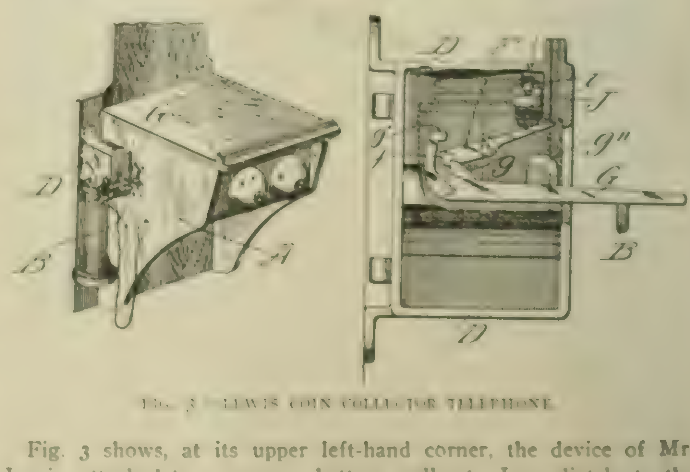


FIG. 3.—LEWIS COIN COLLECTOR TELEPHONE.

Fig. 3 shows, at its upper left-hand corner, the device of Mr. Lewis, attached to a common battery wall set. Immediately to the right of this is shown the hook-switch lock in section. Normally, the tooth, g, of the locking bar so engages the nib, f, of the lever, F, that the bar is locked down upon the hook switch of the telephone set. If a coin be placed in the slot, in falling it strikes the lever F, and the weight of the coin overbalances this lever, causing the nib, f, to clear the tooth, g. The coin is at this time, however, retained in

the slot, for the lever strikes the projection, g^1, of the locking bar, and, therefore, is prevented from moving a distance sufficient to allow the coin to leave the slot. When the receiver is removed from the hook and this latter rises carrying with it the locking bar, the projection, g^1, clears the lever and releases the coin. After a coin is once deposited, and before the operator answers, it is evident that the subscriber must use care not to depress his hook or he will lose both his money and his call. For incoming calls, an electromagnet, controlled from the central office, is provided, which serves to release the hook switch. Mr. Moore's invention consists in the substitution of a sliding bolt for the pivoted locking bar of the apparatus just described, and performs its functions in an exactly similar manner.

CURRENT NEWS AND NOTES.

NO COAL; NO CARS.—At Knoxville, Tenn., on November 8, the city was in total darkness and half of the street cars were taken off as the result of the shortage of coal.

COMMERCIAL PACIFIC CABLE.—The Pacific Commercial Cable Company has ignored the President's stipulation in regard to laying of the Pacific cable, and is going ahead in association with the British Cable Trust.

TELEPHONES FOR TRAIN WRECKS.—The Pennsylvania Railroad Company has placed a complete telephone outfit on many of its wrecking trains, and it is the intention of the company to equip all its trains with such instruments.

EXHIBITION AT ATHENS.—Greece is to have an International Exposition of Industry, Commerce, Art and Hygiene in 1903, beginning April 7, and it will include electrical apparatus of all kinds. American goods are in favor, and could be shown to advantage. Direct boats are now running between New York and Piræus.

PACIFIC CABLE CONFERENCE.—Clarence Mackay, president of the Commercial Cable Company; George G. Ward, vice-president and the general counsel of the company, have asked for a conference with Attorney-General Knox, at Washington, on the subject of the proposed Pacific cable. An appointment will be made for a date after November 16.

EXHIBITION AT JOHANNESBURG.—An international peace exhibition is proposed for Johannesburg, South Africa, in 1904-5, when that large market is expected again to reach a point of great consumption of manufactured goods. The exhibition will include several classes of electrical apparatus, machinery, prime movers, automobiles, etc.

SWEDISH ELECTRIC RAILWAY SCHEME.—The Swedish Government has decided to convert the 4,200 miles of government owned railway into electric traction systems for the purpose of utilizing the natural water power of the country. Representatives of the government were lately in London conferring with American experts. The work will be completed in three years.

PROF. J. J. THOMSON.—At New Haven, Conn., on November 10, at a meeting of the Yale Corporation, the important post of Silliman lecturer at Yale was filled for the first time by the appointment of Joseph J. Thomson, professor of experimental physics at Cambridge University, England. Prof. Thomson is regarded as one of the leading physicists in England. The lectureship is on an endowment of $85,000, left to Yale by the estate of the late Benjamin Silliman, of New York City.

STOCK TICKER DISPUTES.—A special dispatch from Minneapolis, of November 3, says: When the Chamber of Commerce took possession of its new building this morning the announcement was made that the Western Union Telegraph Company had been ruled off the floor entirely. This action was taken in consequence of the Western Union's refusal to sign a new lease increasing the annual rental. The Chamber officials declared the Western Union would never be allowed on the floor until it had come to terms.

ENGINE BUILDERS' ASSOCIATION.—The annual meeting of the Engine Builders' Association of the United States will be held at Sherry's, Forty-fourth Street and Fifth Avenue, New York, Monday and Tuesday, December 1st and 2d. Open meeting for the reading of papers is to be held Monday afternoon at 2 P. M., and several interesting papers have been prepared. Executive meeting for members, 10 A. M., Tuesday, and annual dinner at 8 P. M. of same day. Mr. D. N. McBrier, of Erie, Pa., is the secretary of the association.

TRIALS AT ZOSSEN.—A cable dispatch, of November 8, from Berlin, with reference to the 10,000-volt locomotive, illustrated and described in these columns last week, says: Electrical experiments on the Zossen-Berlin military railroad, which have been in progress for several weeks, have resulted in demonstrating that a speed of 75 miles an hour can be maintained without destructive wear of motors or roadbed. The experiments of 1901, while reaching a speed of 100 miles an hour, proved that running above the rate of 60 miles caused damage to the inadequate roadbed.

BRITISH WORKMEN are here to study American manufacturing plants and accumulate information which may be useful to British concerns. The New York Central Railroad has offered free transportation to the delegates, and the offer has been accepted. Two members of the delegation who come to New York will start for Buffalo on Thursday morning, but will stop off at Schenectady to inspect the General Electric Works. They will be at Niagara on Friday, where they will be joined by the party from Montreal. They will inspect the electrical plant at Niagara, and from Buffalo they will go to Cleveland.

YERKES AND MORGAN.—The "tube" situation in London is discussed as follows by a special cable, of November 8: The quarrel between Morgan and Yerkes has resulted in throwing the whole subject of London's underground rapid transit again into the melting-pot. Those financiers have lost their opportunity, and when the problem is next tackled their profits, if they are concerned at all, certainly will be greatly reduced. The Government will now appoint an expert commission to look into the matter, which will be treated as a whole by adopting a general scheme to which whoever undertakes the enterprise will be bound down by Parliament. The enormous profits on which the Morgan and Yerkes groups were figuring have brought into the field other competitors for the franchises, and there is a proposition now that the big railway companies having terminals in London combine to finance the undertaking in order to keep American capitalists out of English railway enterprises. The Morgan firm, which is thought to have a big "pull" through the great personal influence in the highest ministerial circles of the English partner, Clinton Dawkins, declines to join in the public controversy, but Mr. Yerkes gives interviews freely, in which he welcomes the establishing of some public body to control the general "tube" system, but he objects to intrusting that duty to the London County Council.

AN APPRECIATION OF DR. PUPIN.—A very fine and striking full-page portrait of Dr. M. I. Pupin appears as a frontispiece of last week's *Harper's Weekly*. A sketch of his work is also given, closing with this paragraph: "Professor Pupin is just 44. He is Hungarian by birth, an American from his 16th year. He is an admirable example of the boy who had spunk enough to run away from school. He worked in shops to get money enough to put him through Columbia at 25. He went over to old Cambridge, in England, the home of great mathematicians, to study; there he won the John Tyndall fellowship (the first American who ever did), and with this money he betook himself to Berlin, to study under the Olympian-brained Helmholtz. He wanted to teach physical chemistry. When he got back, in 1889, Americans had not heard of this wonderful science (few have yet). He got a post teaching electricity at Columbia, and there he is still. He created the fine laboratory over which he presides, often out of his own pocket. Evidently, though, his pluck and persistence paid, for he is rich now—famous as well. He is a fine type for imitation. If a plaster cast of him, with this little account of him stencilled underneath, were in every school-room in the country, it might stimulate other clever American boys, imported or native, to run away from school and learn to do things that are worth while."

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION will hold another meeting at the Auditorium Hotel, Chicago, December 9, 10 and 11, when a full programme of entertainment and work is being laid out.

CHICAGO ELECTRICAL ASSOCIATION.—Mr. Howard Brooks, electrical engineer of the Aurora, Elgin and Chicago Railway, will read a paper before the Chicago Electrical Association on November 21, on the electrical features of that important road.

ART AND ELECTRICITY.—An important competition just held by the Brussels Municipal Art Association was devoted to artistic public fountains, electric car waiting rooms, slabs for street names, newspaper "kiosks," electric car poles and electric clocks, advertising signs and artistic house façades. The electric car line poles on exhibition were all of them very graceful creations of the iron founder's art, and a great improvement on the poles so generally used in other countries.

ATLANTIC WIRELESS MESSAGES.—A cable dispatch from Rome, of November 11, says: "The Ministry of Marine has received a dispatch from the captain of the Italian cruiser, "Carlos Alberto," which was placed at the disposal of Signor Marconi for wireless telegraph experiments, and which is now at Sydney, Nova Scotia, stating that the ship daily communicated, by means of the Marconi system, with the station at Poldhu, Cornwall, England, throughout the voyage and after entering the port of Sydney. The experiments confirmed the possibility of communicating simultaneously with Europe and America, during the navigation of the Atlantic, at a distance of at least 3,000 miles. It will be easier to assure communication when instruments more powerful than those that can be carried on ships are installed at shore stations."

"THE ENGINEERING RECORD" through the retirement from active business life of its publisher, Mr. Henry C. Meyer, has passed into the hands of the McGraw Publishing Company, who will continue it along familiar lines, and will seek to enhance its admitted usefulness as a leading journal in the field of civil and industrial engineering. Mr. Meyer has, however, consented to give the publication the benefit of his experience in an advisory editorial capacity, so that the readers of the *Record* will still enjoy the experience and sound judgment that have won for Mr. Meyer so high and honorable a place in technical journalism. With an entire absence of the sensational in his methods, Mr. Meyer has created and built up a paper of the best standing and reputation, and his work of the past quarter century affords a splendid foundation for the development he has himself rendered possible.

THE NEW SUBMARINE BOATS.—A dispatch from Washington states that the contractors have notified the Navy Department that two submarine boats will be ready for their official trials this week, and that the trials will begin as soon afterward as the trial board is ready. Many improvements have been made in the new boats over the "Holland," the only submarine boat the navy possesses, and the trials are calculated to demonstrate the superiority of the "Adder" and "Moccasin." The new vessels are 63 feet 4 inches in length, compared to 53 feet 10 inches for the "Holland." In diameter they are 11 feet 9 inches, against 10 feet 3 inches, and they have a displacement of 122 tons submerged, against 74 tons for the "Holland." The latter vessel makes six knots on the surface and 5½ submerged, with a gas engine of 50 hp for surface running, and a 50-hp electric motor for propulsion when submerged. The new vessels will have gas engines of 160-hp, and an electric motor of 70-hp, while its batteries will have a capacity of 1,940 amp.-hours, more than double the "Holland" batteries. Three Whitehead torpedoes are carried by the "Holland," and five by the "Moccasin" and "Adder."

MARCONI AT GLACE BAY.—In an interview with a representative of a New York daily newspaper, Mr. Marconi, after his arrival at Glace Bay, N. S., on the Italian cruiser "Carlo Alberto," said: "I conducted experiments all the way across, and met with very good results, especially in transmitting and receiving messages between the cruiser and the Poldhu station. We were in constant communication with the station for about 200 miles, which was as far as the strength of the instruments on board the warship would stand. Messages had been received at a much greater distance, however.." Heavy gales were encountered during the voyage, but they did not affect the transmission of messages. Mr. Marconi stated that the wireless telegraph system would be cheaper and easier in operation than the cable system, the expense being only about 10 per cent. of that of laying cables. At present he was trying not for speed, but for the completion and perfection of the system. There are now, he said, 30 or 35 stations situated in all parts of the world—England, Italy, Holland, Germany and America, the Congo and in the Dutch East Indies. Including the ships, there were 70 in all. Seventeen ships were equipped for commercial purposes and 12 land stations.

COMPOUNDING ALTERNATORS.—Two patents issued November 4 to Charles P. Steinmetz relate to a method for compounding single or polyphase alternators whereby the excitation of the generator is increased with increased load or lagging current, and decreased with diminished load or leading current. To accomplish this a current derived, as will later be described, is supplied to the alternating-current side of a rotary converter, from the direct-current side of which the exciting current is drawn. To illustrate—by the application of the method to a single-phase alternator, in series with one of the alternator main leads is the primary of a transformer, the secondary of which is connected at one end to a separate generator winding the other end of the latter being connected to a collector ring; the other end of the secondary is connected to a second collector ring, the brushes of the two rings being connected with the rotary converter. By the use of a reactive coil (known also as an auto-converter) the auxiliary generator winding may be dispensed with. In this case a portion of the winding of the reactive coil is in series with one of the mains, the end of the other portion being tapped to an intermediate point of the armature winding, the primary of the transformer in them in the circuit between the top and reactive coil. By the composition of the two e. m. fs. thus obtained in the compensating circuit—one the main and the other an auxiliary e. m. f.—a resultant exciting e. m. f. is secured, which will tend to increase in value with lagging currents and to decrease with leading currents, and changing both with the load and with the phase displacement, which renders possible in practice the desired regulation.

ROTARY CONVERTER REGULATION.—Two patents, issued November 4, have for their object to compensate for the armature reaction of inverted rotary converters, the means described anticipating the variation in speed, which otherwise would result from a change in field strength, due to the reaction of wattless current in the armature upon the field. The arrangement consists in the employment of a regulating direct-current machine, driven synchronously with the inverted converter to be regulated, and operating to supply an e. m. f. directly proportional to the amount of wattless alternating current in the mains. The armature of this machine is provided with two distinct windings, and in structure resembles somewhat a motor generator. One of the windings is of the usual kind and connected to a commutator, the brushes of which are connected to the shunt field of the machine, and to the converter field winding, the latter being also connected to the direct-current mains. The second winding is arranged in series with the alternating-current mains by means of collector rings, and is also connected to the converter alternating-current leads. When the wattless current in the latter winding varies, its reaction upon the field of the regulating machines alters the field strength, and consequently the exciting e. m. f. derived from the first-mentioned winding. Two patents, issued on the same date to Ernst J. Berg, deal also with the regulation of converters. The method consists in varying the reactance of the alternating-current system by means of a variable inductance, which is of the ring-core type, resembling an induction motor. The movable portion is automatically adjusted at different angles by means of a solenoid connected in series in the direct-current circuit. An increase, for example, of current in the direct-current circuit would tend to cause its e. m. f. to drop, but such tendency is counteracted by a partial rotation under the influence of the solenoid of the movable member of the inductance, which reduces the inductance in series with the alternating-current side of the converter, and thereby increasing the e. m. f. on the direct current side.

Letter to the Editors.

College Education.

To the Editors of Electrical World and Engineer:

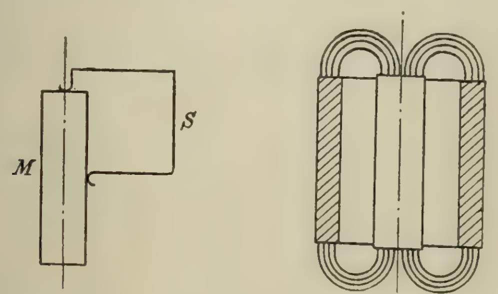
Sirs.—In am glad to see you, in a recent issue of your publication, holding up for the high standard of the American college. It does seem to me to be illogical and foolish for our colleges to lessen the number of years required for graduation. Speaking from experience, I am satisfied that I was poorly enough qualified at the end of four years for post-graduate study, although I was possibly as bright as the average. What seems to be the tendency of the college toward contraction in curriculum is, I believe, only a spurt. Within the second decade of its experience we shall see the climax of the aberration, and the true American college cycling back into line. The prodigal will return to his father's house of his own accord, and the elder brother will frown, but the household will rejoice. Americans have made rapid and substantial progress in commerce, invention and policy. The college deserves her share of credit for training the men who are in the van of the world's progress. To contract the college course is only to cripple the graduate for the work that lies before him.

Sterling, Kansas. J. H. Armstrong, B. A.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Unipolar Induction.—Cahen.—An interesting theoretical article in which he first discusses a recent experiment of Hoppe, which is essentially based upon Faraday's original typical form of a unipolar dynamo. A cylindrical magnet, *M*, which can be revolved around its magnet axle, is connected to an external circuit, *S*, by means of two sliding contacts, as shown in Fig. 1; Hoppe does not use a permanent magnet, but an electromagnet, the magnetizing coil being wound around the lower half of the core *M;* this coil is stationary, while the iron core is revolved. Hoppe wants to show with this apparatus that the total magnetic flux revolves together with the iron core. For this purpose he first revolves the iron core, while the circuit, *S*, is fixed, and find that a direct current is generated in *S*, the e. m. f. of which is proportional to the speed of the iron core. In the second experiment the circuit, *S*, is rigidly fixed to the iron core, so that both revolve with the same angular velocity;



FIGS. 1 AND 2.—UNIPOLAR INDUCTION.

in this case no current is generated in *S*. He shows this as follows: He has a galvanometer in *S*, but as he cannot make this participate in the revolutions, Hoppe inserts in *S* the primary winding of a small transformer which takes part in the revolutions. The ends of the secondary coil lead to two slip rings which slide on fixed brushes connected to the galvanometer. During the experiment, in which only direct current is generated, there is, of course, no deflection of the needle of the galvanometer; if, however, the circuit, *S*, is broken and closed, there is at such moments a deflection of the needle; the experiments show that when the iron core alone is revolved, direct current flows through *S*; if iron core and *S* revolve together, there is no current. Hoppe draws the conclusion that the seat of the induced e. m. f. must be in *S*, caused by the magnetic flux revolving with the iron core and cutting *S*, for as there is no current in the revolving *S*, the increase of the e. m. f. produced when *S* is stationary must be due to its being stationary, and must have its seat in *S*. The present author says that this conclusion is not justified; the fact that there is no current in *S* in the second experiment may be due to either of the following two causes: Either in the first experiment an e. m. f. is produced which does not exist in the second, or in the second experiment an e. m. f. is produced which is equal and opposite to that in the first. The experiment does not and can not prove in any way which of these two possibilities is a fact. The author then gives some theoretical considerations which prove that the total e. m. f. induced in the total closed circuit, *S*, is proportional to the relative speed of the iron core with relation to *S*, and entirely independent of the speed of rotation of the magnetic flux. This shows conclusively that an arrangement of the kind as described above cannot decide anything concerning the question whether the magnetic flux rotates with the same speed as the iron of the magnet or not. The author then develops a theory which is fundamentally based upon the conception of a "resistance," with which a medium opposes the motion of a magnetic flux. This resistance may be of a double nature. The one purely magnetic, is similar to the mechanical friction resistance; if two magnets attract one another, this is due to the action of the magnetic fluxes; this conception supposes that the fluxes are fixed with a certain force in the magnet—in other words, a certain resistance to this displacement. The resistance of the second kind is that with which a closed circuit opposes the motion of a flux, because an e. m. f. is induced in it which produces a current which tends to counteract the motion of the flux; this second kind of resistance may be considered as a molecular friction between matter and fluxes. The author points out that there is nothing unnatural in the conception of a magnetic flux which is to a degree independent of its magnetic mass, and can move with a speed different from that of its mass.

This is clearly indicated by the following arrangement, shown in Fig. 2. In a hollow cylindrical permanent magnet there is in the central part a solid cylindrical permanent magnet; both are capable of revolving around their common vertical axle; the upper pole of the external hollow magnet and the upper pole of the internal solid magnet have opposite signs, as have also the lower poles, then the lines of the magnetic fluxes have a form indicated in the figure; now, if one of these two magnets is revolved around the axle, while the other is held stationary, it is evident that the lines of magnetic flux must get a relative motion at least against one of the two magnets; here it is supposed that the total magnetic flux is a unit, which is self-evident from the point of view of physical science. He then gives theoretical considerations on the movement of the magnetic flux if two magnets are moved relatively to each other. He gives a mechanical analogy of the induction phenomena between two electric circuits; he compares these two circuits with two solid bodies moving in an electric medium which opposes this movement with a certain resistance; when this resistance is overcome, heat is developed equivalent to the work performed by friction; besides this heat, a part of the work is used up in deforming the elastic medium, and is stored up in the form of potential energy (analogous to self-induction). In the relative solution of solid and fluid bodies under the influence of friction forces, the total developed friction heat is a minimum. There is an exactly analogous rule for the electromagnetic phenomenon: the induction in moved conductors always takes place in such a way that the total change of electrical energy into heat is a minimum. He applies this to the phenomenon of magnetic friction, as defined above, and states that the motion of the magnetic flux is always so that the total "friction work" is a minimum; friction work is meant here in the most general sense, and comprises the electric as well as the magnetic friction work. This rule is now applied by the author to the arrangement shown in Fig. 1. He had shown before that the speed of the flux has no influence upon the induced e. m. f. and current, both of which depend

only upon the relative motion between iron core and circuit S. If this statement is taken together with the rule just developed, it follows at once that the flux does not move relatively to the magnet. For the total heat, produced during the movement, is the sum of the Joulean heat and the hysteresis heat; the former is independent of the movement of the flux, while the latter is proportional to it; hence the total heat is a minimum if the magnetic friction heat is zero, *i. e.*, if the magnetic flux does not move relatively to the iron core. He applies his principles to a discussion of the problem whether a self-exciting dynamo without iron would operate, even if current is started by other means, *i. e.*, one which is based solely upon the dynamometric principle, consisting of a system of stationary coils generating the field and a system of moving coils connected to a commutator; from the principle of the minimum of friction work it follows that such a dynamo is impossible. The author believes that this principle of the minimum of friction work is only a special case of a very general law, another special case of which is the rule that the distribution of the currents in a network takes place in such a way that the total current heat is a minimum, from which the second rule of Kirchoff on the distribution of currents in branched circuits results.—*Elek. Zeit.*, October 16.

REFERENCE.

Commutation.—FREUND.—A communication referring to the recent article of Rothert, and giving some mathematical calculations in connection with Rothert's fundamental differential equation.—*Elek. Zeit.*, October 16.

POWER.

Electric Power in Iron and Steel Industries.—SELBY-BIGGE.—A paper read before the (Brit.) Iron and Steel Institute. He gives a number of statistical data on the savings effected in actual working by the substitution of electric power for steam for power purposes in iron and steel plants, also on the cost of the electric power for such purposes in actual plants. The greatest economy results in the substitution of electricity for steam in those cases where the units of power, both in engines and boilers, are most subdivided. There are enormous advantages to be derived, especially in the case of intermittently working machinery, where the load is of a very variable nature, and particularly so in all crane work. He then gives a long table giving a complete schedule of tests made to determine the horse-power of motors adapted for the driving of various classes of machinery and of machine tools. He also refers briefly to the utilization of waste blast-furnace gases.—Lond. *Elec.*, October 3, 17.

Three-Phase Pumping Plant.—PERKINS.—An illustrated description of a three-phase pumping installation at Dortmund, Germany. The actual work required is the lifting of 5 cubic meters of water per minute from a depth of 300 meters, but the plant installed is capable of raising this amount of water 400 meters. The pump operates about five hours a day to carry off the flow of one cubic meter per minute in the shaft. The pump is driven by a large three-phase induction motor, which operates at a speed of 75 r. p. m., and with a maximum starting torque it develops 570 hp, which is about 20 per cent. higher than the normal torque. The total weight of the motor is 30,000 kg., that of the rotating portion being 11,000 kg.—*West. Elec.*, November 1.

REFERENCE.

Electricity in Iron and Steel Plants.—KYLBERG.—The first part of an abstract of a paper read before the (Brit.) Iron and Steel Institute. He thinks it is probable that at no distant date both auxiliary steam engines and hydraulic power in iron and steel works will be entirely superseded by electrical power. He refers to the development of the blast furnace gas engine, and describes some developments based on American experience and adapted to European requirements. He first discusses gas-driven engines for generating electricity in central stations, and then deals with electrically-driven ore transporting arrangements beneath the ore bins and the electric blast furnace charger, and describes an electrically-driven pig-iron casting machine.—Lond. *Elec.*, October 17.

TRACTION

Electric Traction in its Relation to Existing Railways.—JACOMB-HOOD.—An abstract of a paper, in which he shows that the present railway practice on branch lines does not provide the facilities which the growing demands of the public require. There should be more and smaller trains at more frequent intervals; there should be self-propelled cars, or trains of cars of which a large number are self-propelled, to secure economy of propelling power proportionate to the length or weight of any train. Then there should be higher acceleration and quick retardation, to reduce the total time of a trip. He then discusses the question of cost and takes as an example his own railway; to make the change profitable, an increase of traffic is necessary; from the figures given by him, such an increase appears probable. If such a rapid transit scheme should come into operation, freight service would have to be performed at night, with the aid of electric locomotives.—Lond. *Elec.*, October 17.

Economical Methods for Removing Snow.—DANFORTH.—An article on the conditions in Rochester, where the snowfalls in winter are extremely heavy. The company finds it impossible to keep its tracks clear without a rotary snow plow, but for light snows the rotary plow is as undesirable as a rattan sweeper would be in 2-foot of snow. The practice is to start out the light plows and sweepers when there is no more than 2 inches, then the heavy shear plows, then the extension plows are used to level off the ridges and shovellers are sent to clean the cross walks. The work of the rotary plow commences when the banks of snow on either side of the tracks become so high that the shear plows can no longer shove them back. The cost of removing ice and snow last year in Rochester was about $90 per mile of track.—*St. R'y Jour.*, September 20, and *Int. Ed.* October.

REFERENCES.

10,000-volt, Three-Phase Locomotive.—A long, illustrated translation in abstract of the paper of Reichel, recently noticed in the Digest.—Lond. *Elec. Rev.*, October 17. (See ELECTRICAL WORLD AND ENGINEER, November 8.)

Tests of Interurban Cars.—RENSHAW.—An account of tests made by him for the Westinghouse Company, on the system of the Union Traction Company, of Indiana. This company owns about 100 miles of interurban track and about 65 miles of city track, and is now building about 130 miles of track. Fifteen cars are required for the ordinary service. There is one power station from which power is distributed at 16,000 volts. The cars have bodies about 40 feet in length, and weigh, complete, about 63,100 lbs., without passengers. Each car is equipped with two 150-hp, or four 60-hp motors. The tests were made of cars in local service, also in express service. The local-service tests are reproduced in the large engravings. The results of the tests in kilowatt hours per ton-mile for different characters of run are given. Other features discussed are the average current consumption, average voltage, tests on braking and tests with four-motor car equipments.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Test on Energy Consumption of Interurban Cars Around Detroit.—Two diagrams giving the results of two tests, both made between Detroit and Flint, a distance of 100 miles, one being for a complete round trip, the other for the run from Flint to Detroit. The results are tabulated.—*St. R'y Jour.*, October 4, and *Int. Ed.*, October.

Car Dispatching in Interurban Lines.—MITTEN.—A discussion of the practice on a line about 40 miles in length, which distance is covered in 2¼ hours. The rules governing the motorman, conductor and dispatcher are given very fully.—*St. R'y Jour.*, September 20, and *Int. Ed.*, October.

Economical Management of Repair Shops.—BANGHART.—An article giving a list of the tools and other equipment desirable for the repair shops of a line operating from 75 to 100 cars, and describing an arrangement of the equipment in the different departments; it also states the number of men required for the proper inspection of the different parts of the equipment.—*St. R'y Jour.*, September 20 and *Int. Ed.*, October.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Cut-Out.—An illustrated description of the Ferranti electrostatic voltmeter cut-out for protecting high-tension electrostatic voltmeters. This resistance cut-out is used in the new Midland power distribution system, and appears to answer all requirements in connection with underground mains. It consists of a small glass tube filled with water of a certain conductivity. A small valve is made in the glass tube near the bottom, consisting of a hole covered with a piece of rubber tubing, somewhat similar to the rubber valve of a bicycle tire. The current is led in at the top and bottom of the glass tube by means of platinum wires fused into the sides of the tube. These are connected to the outside to brass terminals, and the whole is enclosed in an outer porcelain case with plugs which fit into the terminals underneath the voltmeter. Should a spark occur for any reason, such as a short-circuit inside the instrument, the water inside the glass tube will vaporize and force itself out through the valve, thus safely breaking the circuit. The resistance of the water

is extremely great; it is so adjusted as to be only low enough to allow sufficient current to flow through to boil the water. This arrangement has been subjected to very severe tests, such as placing it directly across the terminals of a 3,000-volt alternator; in this case the circuit was broken so quickly that the tube had to be carefully examined to see whether it had blown or not.—Lond. *Elec.*, October 24.

Practical Operation of Rotary Converters.—Salter.—An illustrated article on a plant containing two 500-kw direct-current compound-wound dynamos, one 5,000-volt, 25-cycle, three-phase, double-current generator, which is either used for running as a direct-current generator in parallel with one of the direct-current dynamos, being driven by the three-phase alternator, or it is used for generating alternating current in the event of the alternator being shut down, and, furthermore, for running in parallel with the alternator at times of excessive load on the substation; this arrangement works very satisfactorily. Some notes are given on starting the converter. The method used for overcoming the instability in the speed of the rotary when driven as a direct-current motor is to excite the rotary by means of a small generator, which is driven from the rotary itself. Tappings are taken from the three-phase side of the rotary to a small induction motor, which is directly connected to a small continuous-current generator; this generator works low down on the characteristic curve, and is unsaturated at the normal e. m. f. Any change in the speed of the rotary, therefore, causes a much greater change in the e. m. f. of the exciter, and this varies the field of the rotary and keeps the alternations constant independently of the nature or amount of the load.—Lond. *Elec. Rev.*, October 17.

Electro-Physics and Magnetism.

Resistance of Metallic Sulphides.—van Aubel.—An account of experiments to find the change of electric resistance with decreasing temperatures. It is known from the researches of Dewar and Fleming and d'Arsonval that the resistivity of pure metals and of alloys diminishes considerably as their temperature approaches the absolute zero; according to the theory of electrons it means that the number of free electrons increases enormously as the heat vibrations diminish in amplitude. The case is just the reverse in chemical compounds, as is shown by the present author. He measured the resistance of a prism of iron pyrites, 1 cm. long and 4 mm. square in cross section; in this case the resistance, instead of tending towards zero as the temperature falls, tends towards infinity; this would mean that whatever free electrons exist in the sulphide at the ordinary temperature, tend to disappear entirely as the excursions of the molecules are reduced to a smaller amplitude.—*Comptes Rendus*, September 15; abstracted in Lond. *Elec.*, October 17.

Flames in Alternating Fields.—De Rossi and Stella.—A description of some experiments on the behavior of a flame in an alternating electrostatic field. Two insulated metallic discs are placed vertically and parallel to each other, and are connected with the secondary of an induction coil, the primary of which is supplied with an alternating current. A flame is placed in the space between the two discs; it is earthed through a galvanometer. In the first series of experiments the flame was displaced along the space between the discs and the current determined in the different positions; it was found to diminish very rapidly towards the center between the two plates, but the sign of the current differed greatly according to the substance burnt. A positive current was obtained with benzine, amyl acetate, illuminating gas, alcohol, acetylene, methane, cyanozen, stearine, camphor and paraffine, a negative current by phosphorus and possibly sulphur, and no current at all by flames of hydrogen, sulphuretted hydrogen, carbon bisulphide and carbonic oxide. When the flame is long and thin, it apparently spreads out into a fan when the field is excited, but when it is then examined by means of a revolving mirror, it is seen that this appearance is due to a superposition of images, the flame following every alternation of the field by bending aside.—*Nuovo Cimento*, August; abstracted in Lond. *Elec.*, October 17.

References.

Discharge of a Condenser.—Marchant.—An illustrated British Association paper, in which he describes a graphical method of determining the discharge of a condenser through a variable self-induction. It is an extension of a method of Sumpner for determining the rise of current in a circuit with a variable self-induction, to which a potential difference is suddenly applied.—Lond. *Elec. Rev.*, Oct. 17.

Magnetostriction.—Honda and Shimizu.—An account of an investigation of the influence of tension upon the Wiedemann effect in nickel, steel, iron and cobalt.—*Phys. Zeit.*, September 15; abstracted in Lond. *Elec.*, October 17.

Electro-Chemistry and Batteries.

The Prospects for a Light Storage Battery.—Norden.—He believes that the lead accumulator has been so much improved in recent years that there is little room for further development. The "light accumulator of the future," he thinks, must be a non-lead accumulator. He then discusses past trials with metals other than lead. The zinc lead peroxide cell has a higher ampere-hour capacity per lb. of weight, and its discharge voltage is higher by 25 per cent.; but the disadvantage is that during discharge the zinc goes into solution and during charge it is not so perfectly and cleanly redeposited, but is often spongy in form, causing short-circuits; local action at the zinc plate and other troubles cannot be entirely avoided, in spite of amalgamation. These disadvantages apply generally to any soluble electrode; he, therefore, claims as a principle that a soluble electrode is unsuitable for a storage battery. In the cuprous oxide, zinc accumulator, there is the same trouble with the zinc, and the copper plate also has disadvantages, as the cupric oxide goes into solution and copper is then deposited on the zinc, causing a fatal local action. Metals like zinc are never deposited upon the opposite plate; he, therefore, claims as a second principle that two different metals in an accumulator are practical only if they are either both insoluble in the electrolyte or when dissolved cannot be deposited on the opposite plates. He considers the Edison accumulator a step in the right direction, although he does not think that it represents the definite solution of the problem of the light accumulator. The mechanical construction which the active material compressed in perforated boxes is not the best construction for utilizing the total active mass, as the entering of the current into the interor of the boxes and the diffusion of the electrolyte into the pores is somewhat difficult. The capacity of the Edison cell per lb. is too much like that of the lead cell. A new principle has not been found in the invention of the Edison accumulator. He finally points out the impossibility of predicting anything on the probable future development from a purely theoretical point of view.—*Centralblatt f. Accum.*, August 15.

Graphite.—Danneel.—An account of an investigation by Borchers and Moegenburg, on the conversion of amorphous carbon into graphite in the electric furnace. If absolutely pure carbon is used, the conversion is very difficult, but the conversion is greatly accelerated if metals or metallic compounds are present which are able to form dissociable carbides. They have found that aluminum is the most convenient and effective material, the quantities required being relatively small.—*Zeit. f. Elektrochemie,* September 25.

Electric Double Layer and Absolute Potential.—Billitzer.—A Bunsen Society paper, in which he describes a method devised to determine the absolute value of a potential difference between an electrode and electrolyte. In the discussion it was pointed out that Helmholtz, Oswald and Billitzer had devised methods which give very different results, thus leaving the whole problem in doubt. Nernst proposed to consider the whole matter as hypothetical, and to use a convenient, although arbitrary, zero point by assuming the potential difference at the hydrgen electrode to be equal to zero. *Zeit. f. Elektrochemie,* August 28.

References.

Electrolysis of Alkaline Chlorides.—Foerster and Mueller.—A long account of a series of experiments with solutions of alkali hydrate, hypochlorite and chloride, electrolyzed with increasing voltage.—*Zeit. f. Elektrochemie,* August 28, September 4.

Manufacture of Aluminum.—Haber.—A Bunsen Society paper, in which he describes a series of experiments in which he tried to show on a small scale the principal points which are important for the success of the manufacture on a large scale.—*Zeit. f. Elektrochemie,* August 21.

Units, Measurements and Instruments.

Aluminum Foil Electrometer.—Grimsehl.—A description of an aluminum foil electrometer possessing certain decided advantages over the types hitherto used. The rod bearing the aluminum foil also bears a vertical plate of aluminum, against which the foil rests when the electrometer is uncharged. Another piece of aluminum foil, considerably thicker than that used for the index, is mounted

in a separate horizontal axis, and can be made to lie flat against the index foil in its zero position. This arrangement ensures portability. It also greatly increases the sensitiveness of the apparatus. If very small e. m. fs. are to be discovered, the movable thick foil or cover is brought closer to the fixed piece. Another improvement is the stopper, which is made in two pieces, each of which will independently hold the index in position while the other is being cleaned. Ebonite acquires a certain conductivity under the influence of light and dust; this is gotten rid of by a vigorous application of soap and water. The best arrangement is to keep a spare stopper in a light-tight box. It can be exchanged without removing the index. The high sensitiveness of the apparatus (2 volts) is due to the fact that aluminum foil, 90 mm. long, is used.—*Phys. Zeit.*, September 15; abstracted in Lond. *Elec.*, October 17.

Alternating-Current Meter.—Stern.—A long, illustrated article, in which he says that while the Union Electric Company, of Berlin, has up to the present time built only meters of the Thomson type, they have now put on the market an alternating-current meter of the induction type (Ferraris). It is distinguished from all other meters of the same type by the feature that it has two parallel aluminum discs mounted on the axle. Between them there are three electromagnets, side by side, the two outer ones being supplied with the main current, while the middle one is magnetized by the shunt current. The coils of the two outer ones, through which the same current flows, are oppositely wound, so that the upper ends of both have opposite polarities. For the middle electromagnet, a short-circuiting magnetic circuit is supplied, so that its lines of force pass through the aluminum discs perpendicularly to them. The lines of force from the outer magnets are perpendicular to the lines of force of the middle magnet. The theory of the meter is given at length and its construction is described.—*Elek. Zeit.*, August 28.

Reference.

Standard Cells.—Cohen.—A German Bunsen Society paper on the changes of the cadmium amalgam in Weston cells under certain conditions; also on the electromotive behavior of cadmium amalgams.—*Zeit. f. Elektrochemie*, August 28.

Telegraphy. Telephony and Signals.

Wireless Telegraphy.—Solari.—An illustrated report, supplementary to the one in the Electrical World and Engineer, October 25, on an extended series of tests of long-distance wireless telegraph transmission from Marconi's powerful station at Poldhu, Cornwall, England, to the Italian cruiser "Carlo Alberto," while the latter sailed through the North Sea and Baltic Sea to St. Petersburg and back to England, and finally returned through the Atlantic Ocean and the Mediterranean Sea to Italy. Marconi's magnetic wave detectors were used, and the results were very satisfactory, even over distances of 1,200 kw (750 miles). A complete record of the tests is given, and some of the records of signals recorded on the tape of an ordinary Morse machine are reproduced. The author sums up the results as follows: There is no limit to the distance to which electric waves can be sent over the surface of the globe as long "as the energy of transmission is proportional to the distance to be covered." The land interposed between the transmitting and receiving stations does not interrupt this communication. Sunlight has the effect of diminishing the area covered by electric waves, and, therefore, makes necessary the employment of greater amounts of energy at daytime than at night time. The influence of atmospheric discharges makes it necessary to diminish the sensitiveness of the apparatus in order to make the latter independent of them; at the same time the energy of transmission must be increased to compensate for the loss of sensitiveness. The efficiency of the magnetic detector has been shown by these positive experiments to be superior to that of any coherer, and this not only because it requires no regulation, but also on account of the absolute constancy of working, as well as the immense sensitiveness and practical value of the system. "Wireless telegraphy, according to Marconi's system, has, owing to the latest advances, entered into the field of the greatest practical applications, whether commercial or military, and without limit of distance."—Lond. *Elec.*, October 24.

Some critical editorial notes on this report, which is conceded to be undisputed evidence that wireless telegraphy has been carried on unidirectionally over a distance of 1,200 km (1,750 miles), with both land and sea intervening. It is said, however, that the report also shows that "these long-distance feats are tantalizing in their uncertainty. Messages might be received on one day and the next day, for no apparent reason, might fail to have any accurate effect on the receiving apparatus. . . . We have reason to know that these very signals transmitted from the Poldhu station were read in more than one place in England with instruments not tuned by the Marconi Company for the purpose—in fact, by instruments not in the possession of the Marconi Company at all. Thus, not only is there a lack of secrecy in the messages transmitted from the Poldhu station, but the great energy of the radiations emitted is sufficient to disturb other and independent apparatus." It is thought that long-distance experiments are useless for practical purposes.—Lond. *Elec.*, October 24.

Wireless Telegraphy.—Collins.—An illustrated description of the De Forest system.—*Elec. Rev.*, October 25.

Miscellaneous.

Manchester Technical School.—An article on the new municipal technical school of Manchester. The electric power plant contains five machines, four of 100-kw each, and one of 50-kw, the latter is a Parsons turbo-electric generator; with the purpose in view of affording facilities for research and experimental work, it was decided to have representative engines and dynamos of five different types, so that comparisons might be drawn and deductions made. There is also a storage battery of 600-amp.-hours capacity. One of the most important departments in the school is that of electrical engineering and technical physics; no fewer than 20 rooms have been entirely given up to it, including a photometer room, 60 feet in length. In this room are photometers of the Lummer-Brodhun, Steinheil and Kruess types, together with pentane, amyl-acetate (Hefner), Methven and Carcel standards; there is also a Letheby-Bunsen double-standard photometer; special photometers for arc and incandescent lamps, as well as certified English, French and German standards of light, will be provided; among the optical apparatus there will be a grating spectrum apparatus. In the electrical engineering laboratory special arrangements and instruments have been provided for the testing of all kinds of electrical plant, both continuous and alternating, and an experimental railway truck has been installed in the dynamo room; it is so constructed that a complete series of tests can be carried out under conditions approximating those obtained in actual working. Below the apparatus there is a pit; friction wheels carry the truck, and the mechanism is coupled to a large flywheel, the mass of which can be altered, it being built in segments for the purpose. The load may be varied by regulating the amount of water contained by four tanks carried on the car frames. A great variety of tests may be made, as the truck is fitted with controllers and motors, complete, while "a motor fixed outside supplies the necessary acceleration factor due to a down grade." A great number of machines have been installed for testing purposes. There is also a testing room, fitted with Addenbrooke's electrostatic instruments, for making commercial tests of generators and motors.—Lond. *Elec.*, October 17.

Magnetic Concentration.—Hassreidter.—A description of the Mechernich system of magnetic concentration. The ore passes through a chute between two magnetic poles, the upper, north, one of which is rotated, attracting the magnetic particles which are carried around by it into zones of progressively diminishing intensity until the centrifugal force imparted to the particles overcomes the magnetic attraction and they fall, being classified according to their magnetic properties. This arrangement is claimed to have the advantages of dispensing with belt carriers, and of enabling one to use small magnetic fields with very narrow air gaps, thus minimizing the loss of energy and making it possible to attract feebly magnetic particles by a very weak current. In separating blende and siderite from the Upper Harz, the grains being of 0.5 mm. size, 98.7 per cent. of the zinc has been recovered. With dolomitic Silesian blende of 2 to 8 mm. size, the recovery was 91.8 per cent., which was increased to 93.5 per cent. by reducing the grains to 2 mm. In treating ore from Broken Hill, a yield of 81 per cent. of the lead and 69 per cent. of the zinc was obtained. A plant of this type installed at Broken Hill, for the treating of middlings assaying 28 per cent. zinc, 10 per cent. lead and 9 ounces silver per ton, furnishes a product with 44 to 45 per cent. zinc and 4.5 per cent. lead.—*Jour. Soc. Chem. Ind.*, September 30; abstracted in *Eng. and Min. Jour.*, November 1.

Photo-Therapeutics.—An account of the discussion held at the Berne congress of "electrology and medical radiology," on the modern methods of applying powerful sources of light, and more especially actinic light, to the treatment of diseases. Foveau pointed out that the "electrolytic anæsthetic and microbicidal action of sunlight" was discovered by an observation of the rarity of lupus in tropical countries and accidental cures by exposure to sunlight. Kurella said that every state should possess a Finsen apparatus. Michaud reported favorably upon Foveau's apparatus with an arc lamp provided with quartz light-filters and a water circulation. Strebel described the various forms of arc lamp in use, and favored the type containing carbons with an internal water circulation. Tonta described an improved light bath, provided with a ventilator and a hygrometer. The apparatus comprises six circuits of eight incandescent lamps each. For producing blue, red or violet rays, colored screens are used. Openings in the walls of the bath enable the physician to feel the pulse and the heart without opening the bath. —*Arch. d'Elec. Med.*, September 15; abstracted in Lond. *Elec.*, October 17.

REFERENCE.

Manufacturing Plant.—An illustrated description of the new plant of the British Thomson-Houston Company, at Rugby.—Lond. *Elec.*, October 24.

New Books.

Das Selen und Seine Bedeutung fur die Elektrotechnik. By Ernst Ruhmer. Berlin: Verlag der Administration der Fachzeitschrift "Der Mechaniker." 57 pages, 49 illustrations. Price, 2.40 marks.

Mr. Ernst Ruhmer, who has for a long time been making experiments with the little known element selenium, and who has obtained excellent results by modifications of the older forms of selenium cells, has given in the present pamphlet much matter of general interest.

Selenium is so little known that a rather extended review will perhaps be in order. The material is an element belonging to the sulphur group, and like other members of that group occurs in different forms. The one in which it is primarily obtained ordinarily is the amorphous state in which it is a red powder. If this amorphous selenium is melted it assumes a different form, being then a black shellac-like substance that is so poor a conductor of electricity that it may be ranked among the insulators. If this second form is subjected to a temperature of about 200 degrees, kept there many hours and then slowly cooled the material assumes another state, becoming crystalline and of a gray color. It is this final modification that has the unique property of a decreased electrical resistance when it is exposed to light. Although this form is a conductor it is a poor one, and it is not possible to use it, say, in the form of a rod or plate. Various experimenters have made up selenium resistance elements, or "cells," as they are called, in which this difficulty is overcome by placing two conducting plates or wires close together with the selenium intervening and then winding them up into a compact form.

The author makes his cells by winding parallel to each other about a glass cylinder about ¾ inch diameter and 1¼ inches long, two platinum wires spaced about one thirty-second of an inch apart. The interstices between the wires are filled with the second modification of selenium by melting the amorphous form and pouring it on, and this is then converted into the third modification by being subjected to long continued heating, as above mentioned.

In the earlier form of cells the resistance when exposed to light was anywhere from ¼ to 1-15 of the resistance when in a perfectly dark space; the action of the cell is quite erratic, being subject to great modification by atmospheric conditions.

Mr. Ruhmer places his cell inside of a glass tube from which the air is exhausted and implies that under these conditions it is perfectly stable. The glass tubes have ordinary Edison bases secured to them, and look like "candle" type incandescent lamps. The sensibility of these cells is such that their resistance when exposed to light is only 1-80th of the resistance that they offer when they are in the dark. This increased sensibility is, however, of minor importance compared with the advance that Mr. Ruhmer has made in producing cells which respond quickly to changes in illumination. In the older types, while there was a quick and very large drop in resistance when first exposed to the light, it required several minutes or even hours for the cells to obtain a final value with a given illumination, and very much longer time—in some cases even days —for this final resistance to rise again to the original when the cell was placed in darkness.

Curves are given which show that the present form will regain its original dark resistance within less than 15 minutes, and it drops from its dark to its light resistance on exposure to light even more rapidly, these times being those required for the cell to make its maximum change in resistance. When the exposures to light and darkness succeed each other rapidly, there is still a change in the cell resistance, this being well shown by rotating before a cell a metal disc with holes in its periphery, a lamp being placed on the opposite side of the disc from the cell. If a battery and a telephone receiver are now put in the cell circuit and the disc revolved at a high rate of speed, a musical note will be heard in the telephone receiver due to the rise and fall of current in the telephone circuit because of the rise and fall of resistance of the selenium.

Mr. Ruhmer's chief object in making his investigations seems to have been the production of apparatus for wireless telephony, using a selenium cell as a receiver of light rays of varying intensity, and supplying some transmitter which would give a beam of light whose intensity would vary with words spoken into it as the strength of the current in an ordinary telephone circuit varies with the words spoken into the transmitter. As the transmitter, Mr. Ruhmer uses in place of the silvered flexible diaphragm employed by Graham Bell and Sumner Taintor, the varying convexity or concavity of which threw varying amounts of light on a selenium receiver, the so-called speaking arc in which there is superimposed on the continuous current through an electric arc the undulatory current from a telephone transmitter circuit, under which conditions the arc acts as a telephone receiver and repeats the sounds spoken into the transmitter. As this action of the arc is due to its varying heat with currents, there is an accompanying light variation, and when this is thrown on the selenium receiver it will cause the resistance of the selenium to vary so that if it is connected in a circuit with an ordinary telephone receiver and battery the telephone receiver will reproduce the sounds.

To prove that the transmission is by light, or, at all events, by actinic rays, Mr. Ruhmer placed a speaking arc before a modified cinematograph and obtained photographic records showing the varying light intensities corresponding to the undulations in the air caused by speed. When these cinematograph films were afterward placed between a selenium cell and a steadily burning arc lamp, the successive variations in the strength of the light that they allowed to pass called forth corresponding changes in the resistance of the selenium cell, and a telephone receiver connected in circuit with the cell reproduced the speech.

It is claimed that this curious and interesting form of phonograph reproduces words with extreme distinctness, the articulation being said to be even superior to that in ordinary telephonic transmission of speech. Using the speaking arc and his sensitive cells, Mr. Ruhmer has telephoned over distances as great as seven kilometers, and the only reason that tests were not made over longer distances was that there was no way in which he could further separate his stations. Curiously enough, the results seem to show that transmission is equally satisfactory, whether made in broad daylight, at night or even during rain and fog. It would seem from this that the ultra-violet rays play an important part.

Armature Windings of Direct-Current Dynamos: Extension and Application of a General Winding Rule. By E. Arnold. Translated from the German by Francis B. De Gress. New York: D. Van Nostrand Company. 124 pages, 146 illustrations. Price, $2.00.

This is a highly useful book to anyone whose work involves laying out armature windings, and it is to be regretted that its translation into English was not done years ago. All of the usual and many unusual winding schemes are described, with the aid of diagrams, and the author gives a general formula applying to all possible windings, and the value of the constants in this formula for many particular cases. About the only deficiency in the plan of the book is in the lack of comment upon the relative practical merits and disadvantages of the various windings; the discussion of impractical windings might profitably have been omitted to make room for such advisory comment. With this exception, the most

exacting reader will have hard work to find just cause for criticism. Notwithstanding that eleven years have passed since the original German edition was prepared, the book covers all fundamental windings that are used in present practice.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York.

ENGINE BUILDERS' ASSOCIATION, D. N. McBrier, Erie, Pa., Secretary. Next meeting at Sherry's, New York City, December 1 and 2, 1902.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION, Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, December 9, 10 and 11, 1902.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, Thos. R. Mercein, Milwaukee, Wis.

OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION, Secretary, John Brant, 195 Broadway, New York.

THE ELECTRICAL TRADES SOCIETY (member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Annual Convention of the Electric Storage Battery Company.

The annual convention of the Electric Storage Battery Company was held in Philadelphia on October 13, 14, 15 and 16, the sessions being held at the Colonnade Hotel. On Monday, the 13th, the managers of the sales offices throughout the United States met at the factory, and a tour through the works was made. A luncheon was served at the factory, and then the staff of the Battery Company and the visiting managers of the sales department adjourned to the Colonnade Hotel, and after an address of welcome by the president, Mr. Herbert Lloyd, papers were read by Mr. Charles Blizard, manager of the sales department; Mr. Walter G. Henderson, secretary and treasurer, and Mr. A. B. Stoughton, general counsel of the company. In the evening a reception was held by the president, at his residence, which was attended by the visiting members and officers of the company.

At the Tuesday session, papers were read by engineers of the staff. On Tuesday evening a theatre party was given at the Chestnut Street Theatre. On Wednesday, papers were read by the different members of the staff.

On Wednesday evening a banquet was given at the Germantown Cricket Club, Manhein, Philadelphia.

The banquet hall was almost completely filled by one large oval table, the surface of which was hidden beneath a mass of choicest cut flowers and beds of ferns. Three electric signs, reading, "The E. S. B. Co.," "1888"—"1902," were placed on the walls, and a menu card, having for its cover a small facsimile of the company's price-list, together with an embossed card bearing the Manheim Cricket Club's design and the guest's name were at each plate. Between the various courses, songs were rendered, and marvelous telegraphic despatches from Siam, Afghanistan, Turkey and Sandwich Islands were received on a special wire. Brief addresses by the president, vice-president, secretary and manager of the sales department were made.

Meetings continued on Thursday until noon, when the convention ended. These annual conventions of the staff of the Electric Storage Battery Company are not only most thoroughly enjoyable in bringing together the different sales managers and the corps of engineers stationed throughout the United States, but have been found to be most thoroughly instructive, and it is a feature that is looked forward to annually with growing interest, bringing in touch, as it does, the representatives, and enabling them to discuss the numerous problems which are met with in their work in different localities.

No small measure of the successful growth of the Electric Storage Battery Company can be attributed to the loyalty and earnestness of the staff in their several fields of work and their devotion to the company's interests. A graceful tribute of personal appreciation by his corps was made to Mr. Charles Blizard, manager of the sales department, in the presentation to him of a handsome watch.

New Intercommunicating Telephone.

A new switchless, automatic, intercommunicating telephone, which has now been in use sufficiently long to prove its durability, is being widely introduced by the De Veau Telephone Manufacturing Company, of New York City.

FIG. 1.—SWITCHLESS TELEPHONE—DESK TYPE.

The calling up of the station desired in this system is accomplished by one action, namely, the pressing of the button bearing that designation. This not only rings the bell at the called station, but auto-

FIG. 2.—DETAILS OF MECHANISM—DESK AND ALL-METAL WALL TYPES.

matically selects the wire of the individual desired; said connection being private, and remaining set until the receiver is hung up, when the circuits are returned to normal by the releasing of the button.

The release of the button is accomplished by means of a very ingenious apparatus, shown in Fig. 1. In this, the receiver hook engages a release which allows the button, which had hitherto remained depressed, to come back to its normal position. As will readily be seen, this does away with the switch, which had to be returned to zero before the circuits were rendered normal.

All the De Veau telephones are now equipped with the company's new transmitter, which is of the Bell solid-back type. The re-

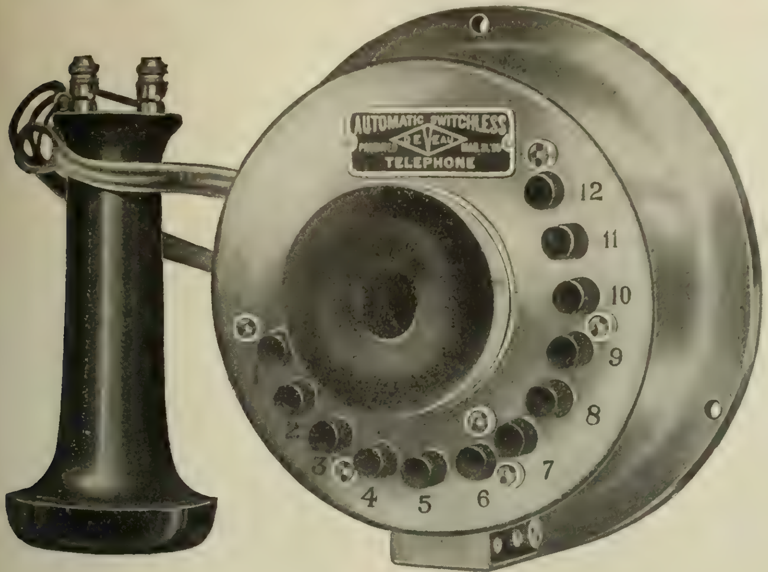


FIG. 3.—ALL-METAL SWITCHLESS RESIDENCE TELEPHONE.

ceivers are of the double-pole solid type, of which the De Veau Company make a specialty. In these receivers the outer shell is cast around the magnets so as to make a solid, permanent adjustment, which construction gives it freedom from all troubles caused by expansion and contraction. The De Veau Telephone Manufacturing Company has also put on the market a very complete line of high-grade switchboard and long-distance apparatus, made up for both

FIG. 4.—AUTOMATIC SWITCHLESS TELEPHONE—WALL TYPE.

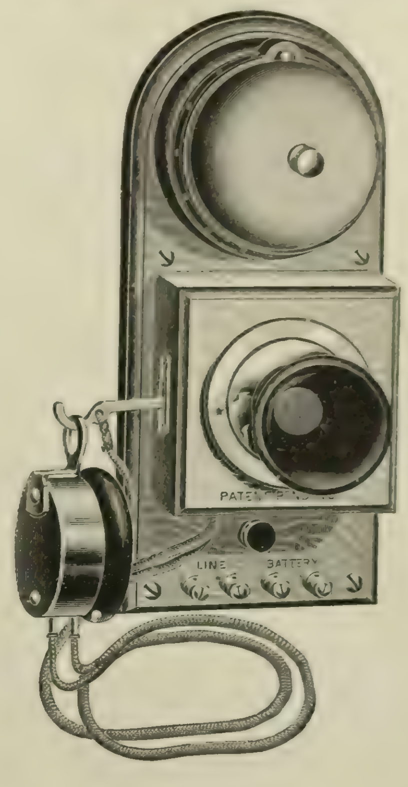
magneto and common-battery systems. These combine great simplicity of working parts with a maximum strength of construction, and a very handsome appearance.

The accompanying illustration shows also the all-metal, flush type of the De Veau automatic, switchless telephone; here the nickel-plated front is flush with the wall so as to be out of the way, and at the same time is attractive in style.

Simplified Telephone Apparatus.

An interesting new style of telephone apparatus has been put on the market by the Connecticut Telephone and Electric Company, of Meriden, Conn., employing neither an induction coil nor a permanent magnet in the receiver. This permits the instruments to be produced at a lesser cost.

These instruments are made up in either antique oak or ebony-finished cabinets. The transmitter is heavily nickel-plated, and on the back of the same are mounted the switch hook and all the necessary contacts. The transmitter is of the company's improved long-distance type, thousands of which are in use in exchange work. The receiver is made up of a steel shell, over which is forced a spun brass shell,



TELEPHONE.

heavily nickel plated. The magnet is wound with silk insulating wire, and the receiver cord is supplied with an anchor loop, which makes it impossible to run down the batteries, even although the receiver may not be placed on the hook when the parties are through talking. The instrument is also supplied with a high-grade monitor bell. The same grade of workmanship enters into this piece of apparatus as on the company's higher grades of instruments.

This apparatus is designed for use on lines of 1,000 feet or under although it is possible to operate it perfectly on any circuit over which one can ring an ordinary vibrating electric bell, or, in fact, as far as any battery-call telephone. It is also adapted for use in hotel installations, or, in fact, anywhere that a battery-call instrument can be used. It is wired up for use with but two instruments on the same circuit, but may be wired up for any special telephones desired.

Gas Engine Electrical Generating Plants.

The gas engine electrical generating plant is assuming material form in several recent projects for the utilization of gas fuel for power and lighting purposes. A complete equipment of gas generators, gas engines and direct-connected generators is now in process of installation in several important American industrial establishments—namely, the Winchester Repeating Arms Company, New Haven, Conn.; Atlantic Refining Company, Philadelphia, Pa.; Consolidated Industries Company, Batavia, N. Y., and Rockland Electric Company, Hillburn, N. Y. The first of these equipments to be put in operation will be that of the Winchester Repeating Arms Company, at New Haven. The power house has been specially designed for the new gas apparatus, and the entire power for manufacturing and lighting purposes will be furnished from this point. The engines are of Westinghouse make, of the standard vertical, three-cylinder, single-acting type, aggregating 500 hp. They are each direct-connected to 250-volt direct-current generators, and are furnished with gas fuel from Loomis-Pettibone gas generators located in the adjoining producer room. Two additional engines of the vertical type are em-

ployed as auxiliaries. Suitable gas holders are provided for insurance of continuity and uniformity of fuel supply.

The power station of the Atlantic Refining Company will be equipped with a new type of Westinghouse gas engine and one new to American practice—a horizontal, double-crank, double-acting engine. There will be two engines, each of 500 hp, and each engine will be direct-connected to a 350-kw, 25-cycle, three-phase generator, arranged for parallel operation. The engines will be supplied with a rich oil gas of approximately 1,200 B. T. U. per cubic foot.

The equipment of the Consolidated Industries Company is of particular interest, by reason of the arrangements for the most efficient utilization of the fuel supply. The plant will supply three products—metallurgical coke, fuel gas and electricity. A special process will be used, yielding metallurgical coke, and fuel gas as a by-product. The electricity for lighting and power purposes will be generated at a central power station, employing 250-hp gas engines of the new horizontal, double-acting type, direct connected to alternators operating in parallel and supplying current at 1,100 volts to the distributing net-work. A smaller generating unit will also be used for light loads. The installation is an instructive application of processes, having for their object the utilization of waste products.

Another gas power enterprise, and one capable of certain ultimate development, is the Rockland Electric Company, which together with the Ramapo Iron Works and the Ramapo Foundry Company, is comprised in the Snow interests. The installation will consist of an independent gas manufacturing plant, employing the Loomis-Pettibone process, and a power plant containing direct-connected gas engine generator units. The producer plant will supply water gas to the iron plants mentioned, for heating and metallurgical purposes, and electric power to all industrial plants in the vicinity, including the Mahwah branch of the Standard Brake Shoe Company, located about four miles distant from Hillburn. The plant will also supply current for lighting throughout the Ramapo Valley district, of some 14 miles in extent, comprised between the towns of Ridgewood, N. J., on the south and Hillburn, N. Y., on the north. The gas engines installed are also of the new Westinghouse horizontal, double-acting type, of 350 hp, each equipment aggregating 1,200 bhp, or 1,400 bhp maximum. The engines are direct connected to polyphase generators, and constructed to operate in parallel. A 128-hp vertical gas engine unit will also be employed for carrying light loads, and assisting at peak loads. A small amount of direct-current power will be furnished for a short time from one of the main units, which will be temporarily a direct-current unit, but it is the intention to ultimately replace this generator by an alternating-current generator, thus converting the entire plant into a polyphase gas engine central station. All of the machinery for these four installations will be furnished and erected by Westinghouse, Church, Kerr & Company, engineers, New York.

Fuel Feeder and Regulator.

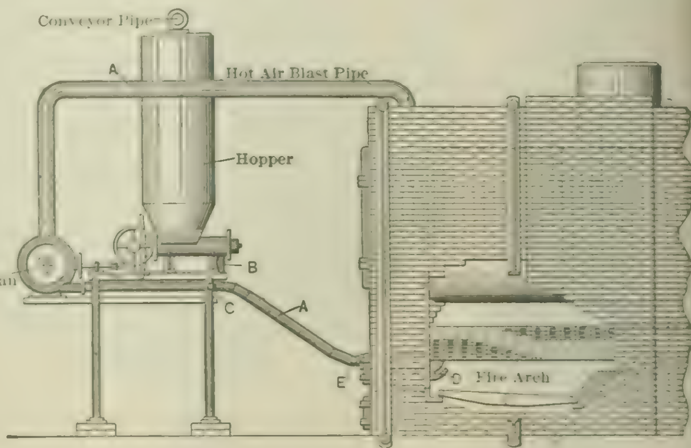
The C. O. Bartlett & Snow Company, Cleveland, Ohio, is introducing a system invented by Messrs Rowe and Bender, for burning soft coal without the production of smoke.

In designing the system, the inventors held that three principles must be considered to secure absolutely perfect combustion. First, the coal must be of uniform size—in other words, it is impossible to secure the same results from burning a lump of coal the size of a man's head and another piece the size of a pea. The coal must be made of even size before perfect combustion can be had. Second, the coal must be of equal moisture, for the same results cannot be obtained from burning coals of different moisture. "Run of mine" coal containing 5 to 6 per cent. moisture will not give the same combustion as slack coal containing 10 to 12 per cent. moisture. Third, the powdered coal must be burned in suspension. If it is swept or pushed into the furnace the heavy particles will fall to the bottom and become a solid clinker, which is objectionable, but by burning in suspension, perfect combustion is obtained.

Under the system perfected by this company, the cheapest kind of slack coal is used. It is first dried down to 2 per cent. moisture, in a dryer designed for the purpose. By a conveyor it is taken to a pulverizer, which grinds it down to 80-mesh fine, making it practically coal dust. It is then conveyed to the feeder outfit, which is the novel feature of the system. The details of construction of this outfit are shown in the accompanying drawing.

The ground coal is stored in an iron storage hopper, or tank, above or near the boiler. An air pipe, *A*, is connected with the feeder spout at the furnace, and above the boiler in the breeching or stack, a blower fan is attached to this pipe, of sufficient size to furnish the necessary air for burning the coal dust. The dust is conveyed by a special worm conveyor from the bottom of the storage bin to a spout, *B*. The speed of this conveyor controls the amount of coal used, and it can be controlled by adjusting a friction disc. From the conveyor the coal is fed direct to the air spout, *A*.

Inside of this spout there is a nozzle which concentrates the air just as it strikes the coal coming down from the conveyor, which gives a thorough mixture of the coal with the air, and at the same time prevents any danger of clogging. The coal is caught by the current of air and blown along the air spout to the furnace spout. Just before entering this there is another nozzle having a concave opening or mouth, so that the dust is sprayed upwards against the arch wall where it is at once ignited. This feed spout is bricked in and well protected so that it will not burn out. The blast of air continually passing through this feeder also has a tendency to keep it cool, so there is no danger of burning. At various places in the air pipe there are slides or valves so that the amount of air may be regulated to insure perfect combustion.



FUEL FEEDER AND REGULATOR.

Systems of conveyors take care of the coal from the time it is dumped on the overhead coal pile until it is consumed in the furnace, and it is claimed that one laborer can take charge of the entire outfit. It is also claimed that the outfit is no more expensive to install than any ordinary stoker system, and the power required to operate the various parts is a very small item compared with the saving in coal.

Toy Electric Railway.

The coming in of the electrical age has necessarily been accompanied by a demand for electrical toys, and among the most popular of these are electric locomotives and trolley cars. Pretty soon we shall see toy wireless telegraph apparatus. Meantime, the Knapp Electric and Novelty Company, of West Fifty-first Street, New York, has brought out a new electric railway and battery, appropriately ready for the holiday trade. It is neat and pretty, as will be seen. The car is painted in three colors. The motor is suspended under the car, as in the regular car, and the mechanism is sturdily built.

TOY TROLLEY CAR AND BATTERY.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 5½ per cent. for 60 to 90 days' endorsed bills receivable; 5½ to 6 per cent. for others not so well known. Lenders are firm in their ideas as to rate, yet a considerable business was transacted. In the stock market further liquidation was evident, and the election results had little effect. The pressure, however, relaxed and a covering of shorts ensued, based, to some extent, on a diminished probability of gold exports. The market was irregular and narrow. A generally favorable condition of trade and the maintenance of railroad earnings, with prospects of a further increase as soon as the movement of new corn is well under way, are cited as reasons for the maintenance of, if not the improvement in, the values of railroad securities. Manhattan was one of the features, and sharply advanced from 135⅝ to 137½, it being claimed that a very considerable increase was taking place in the earnings of the company, owing to the practical completion of the electric power equipment on all of the lines of the system. United States Steel stocks sold off rather sharply for a time, it being claimed that concessions as to prices and increasing competition in the trade were bringing out long holdings. Comparatively little attention was paid to other industrials, and no features of interest were noted. Tractions were weak and drooping. Brooklyn Rapid Transit closed at the lowest quotation—60—being a net loss of 2⅞ points. This stock reached 63⅞ at one time during the week. Metropolitan Street Railway also closed at the lowest figure, namely, 138½, being a net loss of 2¼ points. All of the electrics showed decreases; General Electric closed at 180, after reaching 187, being a net loss of 6 points, the closing quotation being also the lowest. Westinghouse closed at 212, thereby losing 1¼ points; Western Union 90¼, a loss of ¾ of a point. Commercial Cable closed at 175, a net loss of 2 points. Following are the closing quotations of November 11:

NEW YORK.

	Nov. 3.	Nov. 11.		Nov. 3.	Nov. 11.
American Tel. & Cable..	90	90	General Electric	185¼	177
American Tel. & Tel...	163	—	Hudson River Tel......	—	—
American Dist. Tel.....	38	36	Metropolitan St. Ry....	140	136⅝
Brooklyn Rapid Transit.	62¾	59⅛	N. E. Elec. Veh. Trns..	—	—
Commercial Cable	—	—	N. Y. & N. J. Tel....	—	163
Electric Boat	19	20	N. Y. E. V. T. Co....	12	10½
Electric Boat pfd.......	35	35	Tel. & Tel. Co. Am....	—	—
Electric Lead Reduc'n..	3⅝	—	Western Union Tel.....	91¼	89
Electric Vehicle	4½	4	Westinghouse Com.....	212	199
Electric Vehicle pfd.....	9	10	Westinghouse pfd......	211	201

BOSTON.

	Nov. 3.	Nov. 11.		Nov. 3.	Nov. 11.
American Tel. & Tel..	164½	161	Western Tel. & Tel. pfd	—	99
Cumberland Telephone..	—	125	Mexican Telephone	2⅛	2⅛
Edison Elec. Illum......	—	265½	New Eng. Telephone....	137½	137
General Electric	—	178	Westinghouse	—	95
Western Tel. & Tel....	—	27	Westinghouse pfd	—	95

PHILADELPHIA.

	Nov. 3.	Nov. 11.		Nov. 3.	Nov. 11.
American Railways.....	—	54½	Phila. Traction	98	98
Elec. Storage Battery...	84	81*	Phila. Electric	9	8½
Elec. Storage Bat'y prd.	—	—	Pa. Elec. Vehicle	—	—
Elec. Co. of America...	9⅝	9¼	Pa. Elec Vehicle pfd..	—	—

CHICAGO.

	Nov. 3.	Nov. 11.		Nov. 3.	Nov. 11.
Central Union Tel......	—	—	National Carbon pfd....	—	100
Chicago Edison.........	—	174	Northwest Elev. Com..	—	—
Chicago City Ry.......	212	210	Union Traction	17¼*	15
Chicago Tel. Co........	—	—	Union Traction pfd....	47	45
National Carbon	—	—			

* Asked.

DIVIDENDS.—The directors of Niles-Bemont-Pond have declared the regular quarterly dividend of 1½ per cent. on the preferred payable November 15. The directors of Pratt & Whitney have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable November 15. American Railways directors have declared a quarterly dividend of 1½ per cent. This increases the dividend basis from 5 to 6 per cent. The American Railways Company's surplus now amounts approximately to $380,000, or about 10 per cent. of the capital, without allowing for quarterly dividend of 1½ per cent. just declared. The gross earnings for the three months ending September 30 were $353,193, an increase over the same quarter of the preceding year of $90,251. The directors of Brooklyn Union Elevated have declared a regular dividend of 1½ per cent. and ½ per cent. extra on preferred stock, payable December 31, to stockholders of record December 23. The last regular dividend declared on the preferred stock was 1 per cent. Hereafter the dividend will be declared semi-annually. At the meeting of the United States and Hayti Cable Company, an annual dividend of 5¼ per cent. was voted on the preferred stock.

TELEPHONE GROWTH.—October was the best month Chicago Bell Telephone ever had. The net gain was 2,940 telephones, making the total in the city about 58,000, or a gain of 29,000 since President Sabin commenced his aggressive campaign. The Western Telephone Company is planning to spend $1,000,000 during the coming year on its southwestern property, mostly for new extensions, and it will make proportionately large expenditures on its other properties. The earnings of the company are making steady and satisfactory gains, and the outlook for the coming year is that a record-breaking revenue will be secured.

MINORITY STOCKHOLDERS OF MICHIGAN TELEPHONE.—Minority stockholders of the Michigan Telephone Company, representing about $200,000 of stock, have formed a protective committee, consisting of Charles F. Hammond, of Detroit; Samuel T. Douglas, of Detroit, and George W. Patterson, of Ann Arbor, to take such protective action as shall be considered advisable in behalf of stockholders. Depositors under this plan are assessed 25 cents per share for expenses.

ST. JOSEPH (MO.) DEAL.—E. W. Clark & Co., of Philadelphia, have bought up and consolidated the street railways and gas and electric companies of St. Joseph, Mo. They propose to spend $400,000 in improvements and extensions, and propose to sell the preferred stock, paying 5 per cent. dividends, with a handsome bonus of common stock. St. Joseph is the third city of Missouri.

GENERAL ELECTRIC ORDERS.—According to the *Wall Street Journal,* General Electric people state that there is no let-up in the contracts for new business. The company is now taking orders at the rate of between $800,000 and $900,000 per week, and are sold far ahead into 1903.

Commercial Intelligence.

THE WEEK IN TRADE.—Satisfactory trade reports continue to be received by the mercantile agencies. Jobbing trade was active, at most markets exceeding last year's. Spring sales, says *Bradstreet's,* are of good volume, indicating confidence, and enormous shipments of all classes of merchandise have congested the railroads, already fully occupied in trying to move supplies of fuel to consumers and crops to the market. Good collections are the rule, few exceptions to this being noted, and those only where rapid marketing of grain has been interfered with, or retail demand for heavy goods has been held in abeyance. The railway earnings for October were 4.8 per cent. larger than last year, and 14.2 per cent. above 1900. Iron and steel show little change. Steel rail makers are still busy, and an immense tonnage will have to be carried over into next year. Car builders are purchasing large quantities of plates for next year. Many furnaces have been compelled to bank because of the poor receipts of coke, and there is little evidence of improvement in the railway situation, motive power being utterly inadequate. The copper market was very dull, and prices continued downward. Business was light, both for home consumption and export. The following are the ruling quotations: 11.62½c. to 11.87½c. for Lake; 11.60c. to 11.70c. for electrolytic and casting stock, and 11c. for standard. The number of business failures during the week ending November 6, as reported by *Bradstreet's,* number 148, as against 194 of the previous week, and 191 the corresponding week last year.

THE SHERWIN-WILLIAMS PAINT COMPANY, of Cleveland, Ohio, is equipping all its works for electric power distribution. It recently purchased for its Cleveland works three alternating-current generators of 150-kw, 120-kw and 75-kw capacity, respectively, and about 500 horse-power in induction motors, which will be used to drive all its paint and varnish making machinery. It has also equipped its Newark, N. J., works with one 75-kw alternating-current, engine-type generator, and a number of motors, and is about to install a duplicate plant at the same works. At Pullman, Ill., it is putting in a 120-kw alternating-current generator and one of 100-kw, and about 200 hp in induction motors. The electrical apparatus for the several plants is being furnished by the Westinghouse Electric and Manufacturing Company.

THE UNITED STATES COAL COMPANY is about to equip its soft coal mines, at Dillonvale, Jefferson County, Ohio, with electrical machinery, and for that purpose has recently purchased from the Westinghouse Electric and Manufacturing Company two 150-kw, 550-volt, direct-current generators and two 10-ton mining locomotives. Electric power will be used for the operation of the locomotives and other mining machinery.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended November 1: Argentine Republic—36 pkgs. material, $1,316; 2 pkgs. machinery, $151. Antwerp—6 pkgs. machinery, $425; 38 pkgs. material, $1,800. British Possessions in Africa—87 pkgs. material, $1,274. Boulogne—8 pkgs. material, $100. Barcelona—1 pkg. material, $39. British East Indies—3 pkgs. machinery, $237; 8 pkgs. material, $270. Brazil—51 pkgs. material, $2,265; 233 pkgs. machinery, $6,966. British West Indies—1 pkg. machinery, $150; 16 pkgs. material, $254. Bremen—2 pkgs. machinery, $175. Central America—51 pkgs. material, $132. Cuba—25 pkgs. material, $790. China—12 pkgs. material, $470. Copenhagen—1 pkg. machinery, $20. Dresden—2 pkgs. material, $141. Glasgow—1 pkg. machinery, $50. Havre—44 pkgs. machinery, $775; 43 pkgs. material, $758. Hamburg—27 pkgs. material, $2,373. Japan—75 pkgs. machinery, $8,779; 43 pkgs. material, $1,381. Konigsburg—3 pkgs. material, $263. Liverpool—182 pkgs. machinery, $11,378. London—131 pkgs. machinery, $2,358; 4 pkgs. material, $265. Manchester—120 pkgs. machinery, $22,892; 21 pkgs. material, $2,332. Mexico—2 pkgs. machinery, $300; 12 pkgs. material, $467. Malta—12 pkgs. material, $125. Marseilles—25 pkgs. machinery, $175. Newcastle—1 pkg. machinery, $300. Preston—1 pkg. material, $48. Peru—2 pkgs. material, $57. Philippine Islands—34 pkgs. material, $1,689. Rotterdam—5 pkgs. material, $200. Southampton—36 pkgs. material, $3,359; 7 pkgs. machinery, $560. Stockholm—1 pkg. machinery, $700. Trieste—13 pkgs. machinery, $5,793. Uruguay—3 pkgs. machinery, $61. U. S. Colombia—11 pkgs. material, $158. Venezuela—42 pkgs. material, $297.

ORDERS FOR SUBWAY CARS.—Mr. E. P. Bryan, the general manager of the Interborough Construction Company, which has the building and operating of the Manhattan tunnel, has given the first order to a St. Louis firm for the cars that are to be used in the subway in Manhattan. Owing to the lack of time in which the fireproofed wood could be furnished, these cars are to be made fireproof by the use of asbestos. The general plan in this respect is that all electrical wires and other parts from which danger of fire might arise are to be either encased or covered within grooves of asbestos. Mr. Bryan was informed that Charles T. Yerkes had cabled to the United States from London that he had given his first order for the cars in the London subway, and there will be a good-natured rivalry between the two companies as to the excellence of the cars and the quickness with which they can be made. Mr. Yerkes stated in his cablegram that he had decided to use fire-proofed woods, treated by an electrical process. Mr. Bryan, in speaking of the cars, said: "We had intended using fire-proofed woods, as Mr. Yerkes has decided to do, but found eventually that it would be impossible. We had tests made of all sorts and conditions of woods, and practically decided to use the electric fire-proofed woods which stood the best tests of all, but then came a stumbling block in the shape of the fact that in all probability the woods could not be treated and ready for use in time for us to use them on the cars which will be needed by next October. So those the first order provides for will contain only metal covered woods and asbestos. In all probability when our second order is given we will follow Mr. Yerkes's example and have the electrically treated wood.'

ORDERS FOR CRANES AND HOISTS.—The crane and hoist demand is in excellent condtion, as reported by Pawling & Harnischfeger, Milwaukee, Wis. They advise of their recent booking of such orders, as follows: Baldwin Locomotive Works, Philadelphia, two 10-ton cranes; Manitowoc Steam Boiler Works, Manitowoc, Wis., one 35-ton crane; Consolidated Railways, Light and Power Company, Wilmington, N. C., one 10-ton crane; Pennsylvania Lines West of Pittsburg, Ft. Wayne, Ind., one 1½-ton hoist; The Lorain Steel Company, Johnstown, Pa., one 7-ton crane; American Sheet Steel Company, Cambridge, Ohio, one 5-ton crane; Berlin Machine Works, Beloit, Wis., one 1½-ton hoist; The Lorain Foundry Company, Lorain, Ohio, one 5-ton crane; Allis-Chalmers Company, Chicago (for export), one 30-ton crane with 4-ton auxiliary hoist; Colean Implement Company, Peoria, Ill., one 10-ton crane; Allis-Chalmers Company, Fraser & Chalmers' Works, Chicago, one 30-ton crane, with 8-ton auxiliary hoist; Gruson Iron Works, Eddystone, Pa., one 20-ton crane; Isaac G. Johnson & Co., Spuyten Duyvil, N. Y., one 3-ton hoist; Allis-Chalmers Company, Chicago, one 5-ton crane; Chicago, Milwaukee and St. Paul Railway, West Milwuakee shops, one 25-ton crane.

ST. LOUIS MUNICIPAL PLANT.—The city of St. Louis will shortly try an experiment in public ownership. Two electric lighting plants, owned and operated by the city, will be running. President Phillips, of the Board of Public Improvements, has prepared plans, to be approved by the board, for the plants. Bids will be let at once. One plant is to be operated at the City Hall, lighting that building, the old City Hall, the four courts, the Court House and Engine Company No. 6. The other plant, located at the insane asylum, will furnish light for that institution, the poorhouse, the female hospital and Engine Company No. 35. The construction of the two plants will cost $45,000. Heretofore the city has paid $35,000 a year for lighting the public institutions named. The usual flimsy calculations are put forward to show the saving that will be made.

AFTER AUSTRALIAN TRACTION CONTRACTS.—The electrical engineering and contracting firm of Noyes Brothers, Melbourne and Sydney, Australia, which represents the Westinghouse interests in the Antipodes, and O. Hoes, Australasian representative of the British Brush Electric Engineering Company, Limited, controlled by the British Electric Traction Company, Limited, are reported to be negotiating for the important contract for the construction of some 50 miles of electric lines in the suburbs of Melbourne. It is proposed to build a road, to be operated between Brighton and St. Kilda, and another from Newmarket to Essenden. A conference of municipalities south of the Yarra is also to be convened, for the purpose of considering a scheme of electric tramways to be carried out as municipal undertakings.

RECENT BALL ENGINE ORDERS.—A direct-connected exciter unit has been installed by the Cedar Rapids Electric Light and Power Company, Cedar Rapids, Iowa. The Ball Engine Company, Erie, Pa., furnished the engine. The Miehl Printing Press Manufacturing Company, Chicago, Ill., has recently placed in operation a 300-hp engine, built by the Ball Engine Company. The Stromberg Electric Light, Heat and Power Company, Stromberg, Neb., recently put in operation a Ball engine. The Williams Coal Company, McHenry, Ky., has recently started an electrical unit of 200 hp. The engine was furnished by the Ball Engine Company, and the generator by the General Electric Company.

HALL SIGNAL PLANT.—The Hall Signal Company will enlarge its plant, located at Garwood, N. J., in the near future. When the extension is completed the capacity for manufacturing railroad signals will be nearly doubled. The cost of the improvements contemplated will amount to at least $50,000, which sum when paid will be appropriated out of current earnings. It is officially stated that business has expanded so rapidly that the company's facilities for manufacturing have become inadequate. Deliveries have been delayed in some cases for months. It is expected that with the increased facilities less trouble will be had in making deliveries according to contract.

EXPORTS OF MANUFACTURES.—The exports of manufactures from the United States in the nine months ending with September, 1902, are larger than those in the corresponding period of any other year in the history of the country, with the single exception of 1900. The total for the nine months is $311,302,441, against $298.660.-551 in the corresponding months of last year, and $338.678,243 in the corresponding months of 1900. Comparing 1902 with 1892, the increase is nearly 200 per cent., the figures of 1892 being $111,290,024; while comparing 1902 with 1888, the growth in nine months' exportations of manufactures is from $99,840,074 to $311,302, 441.

GERMANS GET VALPARAISO TRACTION CONTRACT.—The contract for the construction and operation of the Valparaiso, Chili, electric traction system has been awarded jointly to the Allegemeine Electritaats Gesellschaft and Schuckert & Company, both of Berlin, Germany. The existing horse-car line—the Ferro Carril Urbano—is to be converted. Its length is about eight miles. A new road, about 10 miles in length, is to be constructed from the City of Valparaiso and its principal suburb, Vina del Mar.

ANOTHER LIGHT AND POWER PLANT FOR MEXICO.—Senor Vicente Viegra, an extensive land owner in the State of Jalisco, Mexico, is about to let contracts for the equipment of an electric plant which is to be constructed in the town of Tamazula de Gordiano. The plant will be used for both light and general power purposes.

MEXICAN HYDRAULIC PLANT.—Senor Felipe Rocha, of the City of Mexico, proposes to construct an hydraulic plant on the River Tepic, at a point called El Salto, about two miles from the City of Tepic, Mexico, to furnish power for lighting, and to supply current for operating various manufacturing plants in the immediate vicinity.

EQUIPMENT PENDING FOR MEXICAN TRAMWAYS.—The Mexico Electric Tramways, Limited, of the City of Mexico, of which A. E. Worswick is the chief engineer, is about to make purchases of further equipment in the United States. A portion of the road is to be laid in double track.

NEW YORK TELEPHONE COMPANY added over 5,000 new subscribers in October, making a total of over 100,000 Bell subscribers in its territory; and it also opened a commodious new exchange, "Morningside," for the benefit of its upper West Side patrons.

ST. PAUL TROLLEY SHOPS.—St. Paul dispatches states that the Twin City Rapid Transit Company has acquired title to a tract of land in that city, on which the company proposes to erect shops that will add greatly to its facilities for building and repairing cars.

General News.

THE TELEPHONE.

LITTLE ROCK, ARK.—It is announced that the Southwestern Telegraph and Telephone Company proposes to build a telephone line from Memphis, Tenn., to Jonesboro and other points.

LOS ANGELES, CALIF.—Bids will be received by the Board of Supervisors in Los Angeles, Calif., for telephone franchises in Covina, Rowland, Glendora and Lardsburg up to 2 P. M., Nov. 24. C. W. Bell is the County Clerk.

SAN FRANCISCO, CALIF.—The Commercial Pacific Cable Company has completed its 6-mile underground conduit from the ocean beach at San Francisco to the Postal Telegraph Company's main office on Market Street, whence the cable will be operated. The land wire will be at once drawn in to the conduit, which consists of a three-inch wrought iron pipe buried about two feet. The cable ship is expected during the present month and if the weather conditions are favorable for laying the cable, commercial business should be carried on before Christmas.

DENVER, COLO.—Promoters of the new telephone company will ask for a franchise in this place. H. H. Hake, of this city, is interested.

WASHINGTON, GA.—The Wilkes Telephone and Electric Company, of Washington, Ga., has just completed long distance lines to a number of nearby towns. The Southern Bell has also completed a line to this city, connecting with its long distance service.

LEWISTON, IDAHO.—The Nezperce Co-operative Telephone Company has completed its line from Mohler to Culdesac, connecting with the Lewiston line direct.

GREER, IDAHO.—The Greer-Pierce City Telephone Company has completed the construction of the line to Pierce and the line is now giving excellent service. Mr. Dulmage, the proprietor, is now extending the line from Greer to Orofino. At Orofino the line will connect with the Inland Telephone Company. The Greer-Pierce Company will soon commence construction work on four miles of line from Greer to connect with the Ramey line which taps the entire reservation.

LEROY, ILL.—The Leroy Telephone exchange and toll lines have been sold to T. L. Parks.

LOVINGTON, ILL.—The Argenta Telephone Co., has been purchased by L. Gerber, P. E. Gerber and S. O. Hilbrant.

PEARL CITY, ILL.—The Pearl City Independent Telephone Company, capital $15,000, has been incorporated.

WARSAW, ILL.—A franchise has been granted to M. T. Chenoweth on behalf of the Farmers' Telephone Company, to construct a telephone line in this place.

SPICELAND, IND.—Griffin & Ratliff will extend their telephone lines to connect Painters, Wiggs and other towns.

INDIANAPOLIS, IND.—The Home Telephone Company, of West College Corners, has been incorporated. The capital stock is $4,000. The directors are Charles Stout, J. C. Barkney and W. H. Hawley.

GAS CITY, IND.—The Home Telephone Company, of Gas City and Jonesboro, have filed articles of incorporation with the Secretary of State. The capital stock is $50,000, but this will be subsequently increased. The directors are E. H. Neal, Fred Schroeder, C. H. Holson, W. G. Woodard and K. V. Haymaker.

SHENANDOAH, IA.—The Independent Mutual Telephone Company is building a telephone line here.

BANCROFT, IA.—The Kossuth Telephone Company has purchased the Algona exchange and will connect it with the rural lines being built in the county.

ATCHISON, KAN.—A new independent telephone exchange has been incorporated at this place.

LOUISVILLE, KY.—The Marshall County Telephone Company, capital $5,000, has been organized.

NEW ORLEANS, LA.—The strike of the linemen of the Cumberland Telephone Company which has been in progress for the past three months has been settled through the efforts of Railroad Commissioner Sims. It is stated that the men accepted the company's terms.

ROCKLAND, ME.—A franchise has been granted the Knox Telephone Company to construct a telephone system here.

AUGUSTA, ME.—The Crosby Telephone Company, of Augusta, has been incorporated with a capital of $10,000. Byron Boyd is president and M. W. Crosby, treasurer.

CARLETON, MICH.—At the annual meeting of the People's Telephone Company these officers were elected: Joseph Waltz, president; F. L. Edwards, secretary and treasurer; directors: Joseph Waltz, Earl Gildsmith, Wayne; Jesse Butler, Willow; T. J. A. Milliken, New Boston, and F. L. Edwards, Carleton. The company will make some improvements.

MISSOULA, MONT.—The Rocky Mountain Bell Telephone Company has let a contract for 1,000 poles to be used in the reconstruction of the long distance line between this city, Butte and Helena. It will string two new wires, one direct to Butte and one to Helena.

YORK, NEB.—E. W. Barnes, of the American Telephone Company, is endeavoring to secure a franchise to put in an independent exchange in York.

FREMONT, NEB.—The directors of the Fremont Telephone Company will issue an additional $10,000 worth of stock to build forty miles of rural lines into Saunders County.

RENO, NEV.—Sixty new telephones have been placed in use in Reno in the past three weeks and the local exchange now numbers more instruments than the rest of the State combined.

BINGHAMTON, N. Y.—New York State Telephone is now in possession of the Binghamton Telephone Company through transfer of the stock of the latter.

CHARLOTTE, N. C.—The Southern Bell Telephone Company has ordered the necessary material for placing its wires underground.

NORWALK, OHIO.—The Local Telephone Company, of Norwalk, has increased its capital from $250,000 to $400,000.

PARKMAN, OHIO.—The Parkman Telephone Company has been incorporated with a capital of $996, by H. H. Jones, W. C. Pay, A. C. Wiggant, C. M. Bundy and Frank Owen.

AKRON, OHIO.—The Akron People's Telephone Company has paid its second quarterly dividend of one per cent. At present the company is earning 7 per cent. on its capital stock, although it has been in operation only about two years. The gross earnings for September were $6,413; operating expenses, $3,320; interest on bonds, $1,390; net for stock, $1,793.

TOLEDO, OHIO.—The plant of the Toledo Home Telephone Company was formally turned over by the Central Construction Company on November 3. At the meeting of stockholders on that day a plan was formulated for pooling the stock to prevent it from falling into the hands of a rival company. It is claimed that new contracts are coming in at the rate of 12 to 15 per day and at present the list is about 5,500.

WEST ALEXANDER, PA.—The Farmers' and Merchants' Telephone Company is being organized here.

BLOOMSBURG, PA.—The United Telephone & Telegraph Company is extending its line from Bloomsburg to Briarcreek.

CHESTERFIELD C. H., S. C.—The Chesterfield Telephone has secured subscriptions to stock, and a number of subscribers for a proposed telephone system in Cheraw, S. C. The South Carolina Long Distance Telephone Company is at present in Cheraw.

LETCHER, S. D.—The Letcher Telephone Company, capital $10,000, has been incorporated by Wm. D. Ryan, Edw. Welch and Edw. Menaugh.

WAVERLY, VA.—The Waverly Telephone Company, one of the largest rural telephone companies in the State; is rapidly extending its lines to the various centers of population in the county.

FREDERICKSBURG, VA.—A telephone system is being built between this place, Rappahannock and Tappahannock.

BRISTOL, WIS.—The Bristol Telephone Company, capital stock $4,000, has been incorporated by F. E. Stevens, J A. Rowbottom and C. L. Marsh.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—The Alabama Steel and Wire Company has purchased a large tract of land at Gadsden; the Gadsden & Attalla Electric Railway and the Gadsden Ice Factory. Nearly $5,000,000 will be expended in Gadsden.

SAN FRANCISCO, CALIF.—The Pyramid Power Company has been incorporated in San Francisco by Attorney Frank P. Deering, G. M. Sutherland, W. R. Rhoades, Allen I. Kittle and L. A. Gibbons.

SAN FRANCISCO, CALIF.—The sale of the franchise applied for by the San Francisco Electric Protective Company has been advertised by the San Francisco supervisors. An underground conduit system covering a large part of the city will carry the company's wires and the latest type of burglar alarm apparatus will be installed.

SAN FRANCISCO, CALIF.—The Sierra Electric Power & Water Company, C. H. Carter, president, will construct an electric power plant and a canal. The proposed ditch will begin at Little Sugar Pine Creek and continue to a point above Grizzly Ditch near Buchanan Crossing where the power plant will be located. The ditch will be extended to Carters, Tuolumne County, where a reservoir will be constructed.

STIRLING, COLO.—A franchise has been granted to O. P. Sells, of Pueblo, Colo., for an electric lighting plant. This franchise was given after an investigation by the town into the matter of a municipal plant. Preliminary work is now being done, and building operations will begin in thirty days.

SOUTH NORWALK, CONN.—The city has voted to appropriate $15,000 to enlarge the municipal electric lighting plant and $5,000 to equip the system with meters. The plant yielded a profit of $5,550 in 1902.

MONTPELIER, IDAHO.—An electric light proposition is absorbing the interest of citizens of this place and a home company has been formed, the stock having been all taken up. Orders for lighting are already being solicited throughout the city.

BUTLER, IND.—The Butler Arc Light Company, of Butler, Ind., has been incorporated. Capital stock, $25,000. The incorporators are Frank E. Good, Henry Grube and W. M. Barden, all of Butler.

LAURENCEBURG, KY.—A proposition to issue $20,000 water and electric light bonds will be submitted to a vote.

NEW ORLEANS, LA.—The Southern Pacific Railroad Company is supporting a $250,000 project to convert a county in Texas into a thriving center by the use of electricity to operate a 10,000-acre rice plantation in Harris County. Fuel oil will be used in the central power plant. The electric power will be used for operating rice mills, lighting the homes of the farmers, supplying heat and operating a network of trolley lines.

BANGOR, ME.—Joseph P. Bass, of Bangor, who a year ago purchased all the stock and bonds of the Oldtown Electric Light Company and the Oldtown Gaslight Company, has sold those properties to the Public Works Company, of Bangor.

WOODRUFF, S. C.—It is reported that an electric power plant will be built at Van Patton shoals, which has been bought by A. B. Groce, of Greess, S. C. An electric railway may also be built.

HIGH POINT, N. C.—The High Point, Greensboro and Winston-Salem Electric Company is preparing for business and has deposited a sum of money with the town of High Point to perpetuate and guarantee its charter.

CONCORD, N. C.—The Concord Electric Light Company has secured an extension of franchise and the owners of the property, Burton & Scott, will at once put in a new plant to cost $75,000, furnishing at least 30 arc and 100 incandescent lights.

SALISBURY, N. C.—The Salisbury Light and Power Company has been organized with a minimum capital of $50,000. J. S. Henderson, T. H. Vanderford and others are interested. J. S. McCubbins is treasurer. Work will begin on an electric railway at an early date. It is proposed to build a line four miles long to the Yadkin river next summer.

PHILADELPHIA, PA.—The ordinance giving to the Philadelphia Electric Company the right to occupy all the streets of Philadelphia is now before the Electrical Committee of the City Council. The object of the bill is to enable the company to secure directly from the council franchises which heretofore have been obtained only through subsidiary companies. The Philadelphia Electric Company was organized under a New Jersey charter, but recently has taken out a Pennsylvania charter and now desires legislation in its own name.

SPARTANBURG, S. C.—Geo. E. Ladshaw will develop a large power plant on Colorado River in Texas for a syndicate of Austin, Tex., capitalists. The power will be used in a cotton mill.

CHATTANOOGA, TENN.—Bids have been opened for lighting the city. If the price is not materially reduced the city council, it is said, may build a municipal plant.

AUSTIN, TEX.—Hon. J. W. Maxwell, of Austin, acting as the representative of Eastern capitalists, is preparing a proposition which he will submit to the city council of Austin for rebuilding the dam across the Colorado River at that place and utilize the water power thus derived for generating electric energy for private enterprises. This dam was destroyed by a flood in the Colorado river more than three years ago.

AUSTIN, TEX.—Steps have been taken looking to the purchase by the State of Texas of the old water works, electric light and power plant now owned by the city of Austin. The city has no use for the plant since it has a new and up-to-date plant situated some distance from the old plant. The latter was operated for many years by a private company and was only recently acquired by the city, the object of the latter being to do away with the opposition business of the acquired plant. If the State is successful in purchasing the plant it will be used to supply the several state eleemosynary institutions and capitol at Austin with water, light and power.

SPRINGVILLE, UTAH.—At a mass meeting held here recently it was unanimously voted to grant a franchise to Provo, Utah, capitalists to establish an electric street car line through Springville City.

LYNCHBURG, VA.—The Lynchburg Traction and Light Company has awarded a contract to the General Electric Company for complete electric equipment for the plant which the Lynchburg company proposes to establish at Reussens, on James River. The amount involved is $60,000. The company has purchased the dam and seventy acres of ground at Reussens and proposes to erect there at once a power house by which it will convert the water power of the James into electric current for the operation of plants at Reussens and in Lynchburg.

GUADALAJARA, MEX.—A merger of the holdings and interests of the Guadalajara Tramvias Company, Ltd., and the Electric Light Company, Ltd., both of the city of Guadalajara, has been effected and is to be ratified at a meeting of the stockholders of the former company to be held at Guadalajara.

CITY OF MEXICO, MEX.—German Roth and associates, all prominent mining men of Temascaltepec, Mexico, have just been granted a concession by the Mexican government to construct and install the hydraulic works necessary to utilize 2000 litres of water per second from the Rio Verde River, for power to be used in that town or to be transformed into electric energy for transmission to any points that the concessionaries may desire.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light and Power Company will spend $2,000,000 in betterments.

OPELIKA, ALA.—An electric railway line for passenger and freight purposes will be constructed from Opelika to Auburn, a distance of about 7½ miles.

SAN FRANCISCO, CALIF.—United States District Judge Welburn has decided the famous freight-franchise case of the Pacific Electric Railway Company vs. the City of Los Angeles, in favor of the city. Judge Welburn decides that the railway company is not entitled to the franchise. It is likely that the case will be appealed.

HARTFORD, CONN.—The Connecticut Railway & Lighting Company has secured rights of way for the proposed trolley line from Waterbury over Southington Mountain to Milldale. The proposed line will put Waterbury in direct trolley connection with New Haven, Hartford and Meriden.

ROME, GA.—It has been decided to extend the local trolley line to Lindale at a cost of $50,000

EVANSVILLE, IND.—The Evansville Suburban & Newburg Electric Railway Company proposes to build an extension to Rockport, a distance of 23 miles.

VINCENNES, IND.—The Southern Indiana Traction Company has been granted a fifty-year franchise to operate cars in Vincennes. The company will build an interurban line between Jasper and this city.

FT. WAYNE, IND.—The Ft. Wayne, Buffton & Richmond Traction Company has been incorporated. The capital stock is $50,000. The incorporators are Edward Manier, of Versailles, Ohio, Frank X. Schaffer, of Dayton, Ohio, Chas. Dust and Wm. F. Dinnen, of Ft. Wayne.

WARSAW, IND.—The Warsaw & Winona Electric Railway Company has been incorporated. The line has been built and is ready to be put in operation between Warsaw and Winona Assembly grounds at Winona Lake. The capital stock is $50,000. J. E. Byers, of Rochester, is president of the company; A. N. Duke, of Peru, and W. N. Smythe, of New York, are vice-presidents; S. C. Dickey, of Indianapolis, secretary.

NIAGARA FALLS, N. Y.—The Niagara Traction Automobile Company, of Niagara Falls, has been incorporated with a capital of $25,000. Directors: W. R. Campbell and F. A. Dudley, Niagara Falls; F. A. Babcock, Buffalo.

SYRACUSE, N. Y.—Capitalists identified with the Syracuse, Lakeside and Baldwinsville Railroad have purchased the Fulton Street Railway and will extend it and the Lakeside to form a trolley line between Syracuse and Oswego.

NEW YORK, N. Y.—Preparations are being made by the Long Island Railroad Company to introduce electricity on the Rockaway branch. It is the intention to widen the trestle across Jamaica Bay, and the entire Rockaway branch will be operated by electricity.

NEW YORK, N. Y.—The Manhattan Railway Company is now operating electric trains between the Battery and 155th Street, Harlem. Fifteen electric trains are now in service, but the number will be constantly increased and the number of steam locomotives correspondingly reduced.

SYRACUSE, N. Y.—The Rapid Transit Railway Company will extend its road from Liverpool to Oswego. The extension from Syracuse to Liverpool has recently been made. The total cost of the road will be $80,000. It is also probable that the Rapid Transit Company will extend south to Tully.

GLENS FALLS, N. Y.—The strike of the motormen and other employees of the Hudson Valley Railway has, after a duration of nine weeks, been settled by a compromise. The company has made concessions in the matter of advancing wages, and the employees will withdraw from the Troy Union and form one of their own. The strike has, it is said, cost the company about $200,000 in extra expenses and loss of business, and the employees over $20,000 in loss of wages. The expenses for the militia cost over $400,000 and the loss of trade in general was very large.

EAST LIVERPOOL, OHIO.—The East Liverpool & Rock Springs Railway Company has made application for a franchise to enable it to extend its line from Chester to Congo.

MEDINA, OHIO.—The village council has granted a franchise to the Cleveland & Southern Railway Company enabling it to complete its line through town and build to Wooster.

COLUMBUS, OHIO.—The Central Market Street Railway Company has placed a contract with the Electric Storage Battery Company for a storage battery outfit to consist of 290 cells.

COLUMBUS, OHIO.—A syndicate headed by Senator Foraker has taken up the financing of the Urbana, Mechanicsburg & Columbus Railway, at the head of which is Gen. Axline, of Columbus.

SANDUSKY, OHIO.—The Lake Erie, Bowling Green & Napoleon Railway, whose line from Bowling Green to Pemberville is nearly completed, is planning to extend the road to Lakeside and Marblehead next spring.

CINCINNATI, OHIO.—The Falk Company, of Milwaukee, is arranging with W. C. Compton, promoter of the Cincinnati, Milford & Goshen Traction Company for the construction of the road. It is estimated it will cost $1,000,000.

TOLEDO, OHIO.—The freight business of the Toledo interurban lines has increased so rapidly of late that it has been decided to double the facilities of the present freight station by the erection of a duplicate of the present building.

CINCINNATI, OHIO.—August Herrman, of this city, is at the head of a project to build a line from this city to Rising Sun and Dillsboro, Ind. It is the plan to enter the city over the tracks of the Cincinnati, Lawrenceburg & Aurora Railway from Sedamsville.

CLEVELAND, OHIO.—Hugh Blakely, one of the promoters of the Cleveland & New Baltimore Traction Company, states that the road will be built. It will touch Mantua and Ravenna and will connect at New Baltimore with the Akron-Alliance Connecting Railway.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Railway Company is considering the advisability of increasing its capital stock from $1,600,000 to $2,000,000. It appears that the construction of the Norwalk extension cost more money than originally estimated.

CLEVELAND, OHIO.—The majority of the steam roads throughout Ohio have announced that the competition of electric roads has made it necessary to make a rate of one fare for the round trip, during the holidays, between points where the electric line competition is the strongest.

CLEVELAND, OHIO.—J. B. Perkins, a well-known electrical engineer of Toledo, is preparing plans for the erection at Painesville, Ohio, of a large power house for the Cleveland, Painesville & Ashtabula Railway. When completed it will probably be used to supply the Cleveland, Painesville & Eastern Railway as well.

TOLEDO, OHIO.—W. B. Strang, contractor of the Detroit & Toledo Shore Line has arranged for the sale of the overhead equipment at present standing on the road, to the Toledo & Monroe Railway which will proceed as soon as possible to extend its line from Monroe to Detroit. It is now generally believed that when the line is completed it will be absorbed by the Detroit United Railway.

CLEVELAND, OHIO.—The Cleveland & Sharon Traction Company, which was originally incorporated for $10,000, will increase its capital stock to $1,000,000 and the permanent organization will be effected. At the same time a contract will be placed with the Morgan Mining & Engineering Company for the construction of the first six miles of road from Middlefield to Mesopotamia. The Osborn Engineering Company, Cleveland, will be the consulting engineers.

CLEVELAND, OHIO.—The Cleveland, Akron & Southern Fast Line Company has been incorporated by C. R. Grant, Thomas L. Childs, George W. Seiber, and Robert Hertzer. The company proposes to build an electric railway from Cleveland to Akron and Massillon, with a branch to Canton. This is a distinct project from the Cleveland, Richfield & Akron Railway Company,

which aims to build a new line from Cleveland to Akron. Both companies claim to have secured right of way.

CLEVELAND, OHIO.—The gross earnings of the Cleveland Electric Railway Company have increased $158,000 thus far this year and it is estimated that the earnings for the year will be $200,000 more than last year. At the present time the company is doing a large amount of rail welding. The addition to the Cedar Avenue power station is about completed, but the units will not be installed for about a year. In the meantime it is probable that the company will erect two and perhaps three storage battery stations.

TOLEDO, OHIO.—It is stated that Spitzer & Company, local bankers, have acquired control of the Jackson & Battle Creek Traction Company. It is proposed to issue $1,400,000 of bonds which will be offered at a fair figure with a 50 per cent. stock bonus. At present the company has a capital stock of $1,200,000 and bonds to the same amount. Of the bonded indebtedness $200,000 is put up with the Savings & Trust Company, Cleveland, as trustee, as a reserve fund. It is probable that Gen. C. M. Spitzer will be elected president and A. L. Spitzer, vice-president.

SPRINGFIELD, OHIO.—An unusual traffic arrangement has been perfected between the Erie Railway (steam) and the Dayton, Springfield & Urbana Railway (electric). The main line of the Erie passes through Durbin, several miles from Springfield. The steam road is planning to build a spur line into the city, but until it is completed the steam company will operate a special car over the electric line into the city. A new car is being built for the purpose. It will be a regular steam passenger coach so far as size and accommodations are concerned, but it will be equipped for electric propulsion and it will connect with all Erie trains.

DAYTON, OHIO.—A plan for the formation of an important traction system radiating from this city is brought to light in the recent incorporation of the Dayton Eastern Consolidated Traction Company with a nominal capital stock of $10,000, by D. King Gotwold and L. B. Corey, of Springfield, M. L. Mowser, of Dayton, and Charles Orr, of Cleveland. These gentlemen are interested in proposed lines known as the Springfield & Washington Traction Company and Xenia & Wilmington Traction Company. It is claimed that both of these projects have been financed and Eastern capitalists stand ready to build the roads. It is proposed, however, to consolidate the two projects with the Dayton & Xenia Traction Company which operates two lines from Dayton to Xenia and a branch line to Spring Valley and an option is said to have been secured on these roads. By the consolidation of these properties there would be a line from Dayton to Washington C. H., by way of Xenia and Jamestown, also a line from Springfield to Wilmington, by way of Clifton and Jamestown. It is stated that the parties interested in the proposed roads have agreed to a plan of consolidation and that if it goes through, the new lines will be built at once.

EASTON, PA.—The Easton and Nazareth Street Railway Company and the Easton, Tatamy and Bangor Street Railway Company, two of the leading trolley lines in Easton and vicinity, have been consolidated, and hereafter will be operated as the Northampton Traction Company.

NASHVILLE, TENN.—The Nashville Street Railway Company announces that it will expend $1,000,000 in improvements.

KNOXVILLE, TENN.—Philadelphia capitalists are interested in a scheme to connect the towns of Bristol and Rogersville by an electric railway which is to pass through Kingsport. At the latter place is to be built the power house and the Holston River is to be utilized to generate the electric power.

FORT WORTH, TEX.—The Northern Texas Traction Company, which operates the interurban electric line between Fort Worth and Dallas, announces that it will build an extensive system of interurban lines in that part of Texas, all of the proposed lines to radiate from Fort Worth. The new lines aggregate more than 125 miles. The cost of building and equiping these proposed new lines is estimated to exceed $3,000,000.

SALT LAKE CITY, UTAH.—Utah capitalists are about starting a new line of electric railway from Cisco to the mines at Moab, Utah, for the purpose of transporting ores from the mines, many of which have heretofore been unprofitable on account of the distance from a railway shipping point. The road will be about 100 miles long and it is estimated will cost about $1,000,000.

SALT LAKE CITY, UTAH.—The incorporators of the new power company at Shoshone Falls, Idaho, propose to build an electric railway from the town of Shoshone Falls to the Falls, a distance of 25 miles. It is also expected to eventually extend the line to the Wood River gold fields and that the mines will be operated by electric power. Mr. J. S. Fuller, of Shoshone Falls, is interested in the project.

MERIDA, MEX.—A company of Mexican capitalists has been organized in this city to construct and operate a central power station for operation of the proposed electric urban and suburban street railway lines.

CITY OF MEXICO, MEX.—Messrs. Jose Garcia and Diaz Rugama, of the City of Mexico, have a concession to construct and operate a suburban line of tramway in the Federal District. The construction of the road is now in progress.

GUADALAJARA, MEX.—The Jalisco Development Company, of Guadalajara, proposes to immediately construct an electric railway between Guadalajara and Chapala, a distance of about thirty miles. The officers of the company are: President, J. M. Chavez; vice-president, J. M. Zermeno; treasurer, Ernesto Mora, all of Guadalajara.

MONTEREY, MEX.—A general meeting of the stockholders of the Empresa Street Car Company, of Monterey, Mexico, is to be held at an early date for the purpose of considering the question of converting the lines of that company into an electric system. It is stated that either this improvement will be decided upon or the property will be sold to the syndicate of Baltimore, Md., capitalists who recently acquired the Slayden street railway system in that city.

SAN LUIS POTOSI, MEX.—An American syndicate is negotiating for the purchase of the street railway system of San Luis Potosi. The system is owned by the Compania de Tramvias, Limitada, the shares all being held by residents of that city, most of the stockholders being Spanish capitalists. All that is at present known is that the parties are in consultation and that the company has named its price which will probably be accepted. San Luis Potosi has a population of about 80,000 people and is a commercial and industrial center of much importance.

TORONTO, ONT.—The shareholders of the Toronto Street Railway Company have decided to increase the capital stock of the company from $6,000,000 to $7,000,000. It is generally understood that the new issue is for the purpose of purchasing such outside electric lines as are not now under the control of the company. It is said to be likely, however, before anything definite is done in the matter, that the company will first have electrical energy transmitted from Niagara Falls to Toronto, and it is stated that the arrangements for such transmission are near completion.

New Industrial Companies.

THE PHILADELPHIA ELECTRIC COMPANY has been chartered at Harrisburg, Pa., with a capital of $100,000.

THE HARBOTH-MITCHELL COMPANY, of Wilmington, Del., has been chartered to conduct business as electrical and mechanical engineers. Capital, $125,000.

THE KANSAS-OKLAHOMA TELEPHONE & ELECTRICAL SUPPLY CO., Sabetha, Kan., capital $10,000 has been incorporated by B. F. Herring, J. H. Judy, W. C. Buck and others.

THE EDGETON ELECTRICAL MOTOR MANUFACTURING COMPANY, of Philadelphia, has been chartered at Dover, Del., to manufacture electric motors. Capital, $300,000.

THE IMPERIAL AUTOMOBILE COMPANY, LTD., has been incorporated at Detroit, Mich. Mr. J. B. Book is chairman of the board of managers and Mr. R. O. Adams is secretary.

THE BRISTOL MOTOR CAR COMPANY, capital $10,000, has been organized in Bristol, Conn. Frederick N. Manross is president; W. L. Newbauer, treasurer; E. B. Burwell, secretary.

THE DAVIS ELECTRIC MANUFACTURING COMPANY, with a capital stock of $50,000, has been incorporated in New Jersey by Raymond Newman, Horace S. Gould and Kenneth K. McLaren.

THE CINCINNATI ELECTRICAL TOOL COMPANY, of Cincinnati, Ohio, has been incorporated with $15,000 capital stock by W. G. Benninger, J. W. Zimerer, John G. Appel, George A. Appel and Charles A. Appel.

THE O'ROURKE ENGINEERING CONSTRUCTION COMPANY, of New York, has been incorporated with a capital stock of $1,000,000. The directors are Millard F. Tompkins and Henry G. Colvin, of New York City.

THE RICHMOND ELECTRIC MANUFACTURING COMPANY, of New York, has been incorporated with a capital stock of $2,000. The directors are R. F. Sievert and Matilda Sievert, of Staten Island, and A. W. Plassman, of New York.

THE H. P. CAMERON ELECTRICAL MANUFACTURING COMPANY, of Ansonia, Conn., has been chartered, capital $50,000. David Dawson is president; H. P. Cameron, vice-president; Irving Whiting, treasurer; John Elliott, Jr., secretary.

THE CRESCENT ELECTRIC COMPANY, Utica, N. Y., has filed articles of incorporation at Albany. It has a capital stock of $30,000. The company is composed of former employees of the Utica Fire Alarm Telegraph Company who left its employ during the strike two months ago.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, has been incorporated under the laws of Delaware with $50,000 capital stock. The company takes over the partnership which for the past twelve years has manufactured a line of oil filters. The new officers are W. F. Warden, president and general manager; H. F. Maranville, vice-president; H. J. Blackburn, secretary-treasurer.

Legal.

WESTERN UNION STAYS ON ROAD.—By a decision handed down Nov. 3 by Judge Thayer of the U. S. Circuit Court of Appeals at St. Paul the Great Northern Railway Company is defeated in its suit to oust the Western Union Telegraph Company from the railroad right of way. The matter has been in litigation ten years. The court held that the contract which the telegraph company had with the railroad is for a perpetual right of way and not to be disrupted. The railroad is entitled to the cost of transporting all materials which the telegraph company uses in the construction of its lines. Should the two companies fail to agree upon the amount due for transporting construction materials, the court will appoint a master in chancery and two commissioners to take testimony and report and the court will then pass on the matter. The litigation involves 825 miles of line built prior to 1892.

Personal.

MR. W. SELLERS, an electrical engineer of Berlin, Germany, is now on a visit to this side. Last advices said he was in Pittsburg.

MR. GEORGE L. CRAGG, patent lawyer, Chicago, announces that the entrance to his offices in the Monadnock Building will be at room 1453.

MR. NORTON P. OTIS, the chairman of the board of directors of the Otis Elevator Company, has been elected to Congress on the Republican ticket.

MR. RALPH D. MERSHON now has his headquarters as consulting electrical engineer in the Columbia Building, 29 Broadway, New York City.

MR. FRANK W. HASKELL, president of the Carborundum Company, of Niagara Falls, is up for membership in the Automobile Club of America.

MR. H. F. A. KLEINSCHMIDT gave a lecture a few evenings ago before the Engineers' Club at Columbus, Ohio, on the subject "The Electric Welding of Rails."

MR. L. G. MARTIN, of the Okonite Company, is in San Francisco in connection with the installation of the San Francisco-Honolulu cable by the commercial Pacific Cable Company.

DR. OTTO C. STRECKER, of Darmstadt, Germany, is on a short visit to this country, during which he will inspect some of the more important American electrical plants and manufacturing works.

MR. FREDERICK J. NEWMAN is now chief engineer of the Woods Motor Vehicle Company, Chicago. Mr. Joseph Ledwinka has taken over his engineering practice with offices in Pittsburgh and Chicago.

MR. FRED H. POTTER, of New York, has been visiting Key West in the interest of a New York syndicate examining the property of the Key West Electric Light Company, with a view to purchasing and largely increasing the plant.

MR. CHARLES CUTTRISS, chief electrician of the Commercial Pacific Cable Company, has arrived in San Francisco, where he will have supervision of the arrangements for completing the San Francisco end of the new Honolulu cable system.

MR. CHARLES W. DOUGLASS, for thirty-seven years chief clerk in the office of the superintendent of the Western Union Telegraph Company, at Cleveland, has resigned to go into manufacturing business. Mr. Douglass is widely known in the telegraphic business.

MR. F. E. DRAKE, who for two or three years past has been the efficient manager of the Union Elektricitäts Gesellschaft, at Berlin, has definitely closed up his work there and will return to this country some time in December. It is understool he will remain here.

MR. HENRY A. LARDNER, electrical engineer with the J. G. White Co., one of the officers of the New York Electrical Society and a member of the American Institute of Electrical Engineers, was married recently at Grace Chapel, New York, to Miss Ethel Anna Elmore.

MR. A. FREDERICK COLLINS recently delivered a lecture on "Wireless Telegraphy" before the Woman's Club of Englewood, N. J., and has delivered the first of a number of lectures on the same subject in a course under the auspices of the New York City Board of Education.

MR. HENRY A. EVERETT, of Cleveland, has been elected president of the Toledo Railways & Light Company, Toledo, Ohio, to succeed Albion E. Lang, who is retiring from business. Mr. Everett recently resigned the presidencies of the Federal Telephone Company and the Cuyahoga Telephone Company, as announced in our last issue.

MR. W. H. WILEY, the well-known New York publisher and engineer, has been elected to Congress as a Republican, from one of the New Jersey districts. The House receives a valuable acquisition and a host of Mr. Wiley's friends are heartily glad to see this popular recognition of his many sterling qualities of heart and mind.

MESSRS. A. C. RAHE and M. O. SMITH, of the Smith Storage Battery Company, Binghamton, N. Y., were visitors to New York last week. The interest which their novel cell has aroused is responsible for many inquiries that have reached this company. Their energy has converted the inquiries into orders and business is very brisk.

MR. ELGIN E. STODDARD, sales manager of the engineering firm of Chas. C. Moore & Co., of San Francisco, is in the East and while in New York was a caller at the offices of ELECTRICAL WORLD AND ENGINEER. The concern has been very busy in plant installation, etc., and reports active conditions in the electrical field on the Pacific slope.

MR. A. M. LITTLE, formerly secretary of the American Electric Company, St. Paul, Minn., and traveling salesman for the Western Electric Company, Chicago, Ill., and who has, during the past year, been the New York State representative for Stuart-Howland Company, Boston, Mass., has entered the employ of Pass & Seymour, Inc., Solvay, N. Y., to represent them in the factory territory.

MR. W. H. STOCKS, who has been master mechanic of the Chicago, Rock Island & Pacific Railroad for several years, has resigned from that company to accept an appointment as representative of Gold Car Heating and Lighting Company, of New York, Chicago and London. Mr. Stocks has been associated with the mechanical departments of Minneapolis and St. Louis Railway, Great Northern Railway and Chicago, Rock Island & Pacific Railway for twenty-five years, during which time he has held the position of foreman, general foreman and master mechanic of the roads mentioned.

MR. FRANK J. SPRAGUE, who had been at the Savoy Hotel for some days, is announced by the London cablegrams to have gone to Paris. Before leaving, Mr. Sprague had something to say about the coming electrification of London. He does not think highly of present legislative conditions, which allow private persons to control London's transportation problems. In his opinion the London County Council or some strong committee should have power to execute a well ordered scheme of rapid transit, either by itslf or through private enterprise. He predicts that the day is not far distant when the steam locomotive will be unknown in and around London. At first, he says, there will be electricity for suburban lines and steam for long distance expresses and goods trains, but soon it will be found quicker and more convenient to work all railroad traffic by electricity up to a radius reaching beyond the suburban area. In Mr. Sprague's opinion the general adoption of electricity by English railways is coming much more quickly than most people realize. This will introduce a new condition of life, and one which will make for the health and happiness of the millions who earn their living in the big cities of the United Kingdom.

NEW INSTITUTE MEMBERS.—At the last meeting of the directors of the American Institute of Electrical Engineers, the following new associates were elected: Beattie, Mark Brewer, General Electric Co., 706 Phœnix Building, Minneapolis, Minn. Bainton, John Richard, Consulting Engineer, Edge and Edge, 250 Pitt St., Sydney, New South Wales. Collins, Curtis C., Electrical Engineer, S. A. Luz Electrica, Box 244, San Juan, P. R. Copp, Frank Toulmen, Jr., Testing Department, General Electric Co., Schenectady, N. Y. Davis, William Griffith, Power and Mining Eng. Department, General Electric Co., Schenectady, N. Y. Dudley, Eugene Elmer, Chief Electrician, American Steel and Wire Co., Georgetown, Worcester, Mass. Fairchild, Walter Lowe, Sales Engineer, Stanley Electric Mfg. Co., 29 Broadway, New York City. Godbe, Murray Charles, Department Engineer, Utah Light and Power Co., Salt Lake City, Utah. Goody, Coral Payne, Assistant Engineer, The Telluride Power Co., Logan, Utah. Gray, Guthrie, Assistant Mechanical Engineer, Department of Works, World's Fair, St. Louis, Mo. Hall, Frank Wells, Office Engineer, The Sprague Electric Co., Fisher Building, Chicago, Ill. Hamilton, James Henry, Electrical Signaling Engineer. The Cape Government Railways, Cape Town, South Africa. Haselden, Harry Ariel, Electrical Engineer, The Whitin Machine Works, Whitinsville, Mass. Henderson, John Samuel, Superintendent and Electrician, City Electric Light Plant, Brewton, Ala. Herbert, Edward, Western Electric Co., 259 South Clinton St., Chicago, Ill. Hoxie, Hall Farrington, Electrical Engineer, Board of Patent Control, residence 96½ Hicks St., Brooklyn, N. Y. Jacobson, Julius R., Special Employee General Electric Co., Schenectady, N. Y. Johnston, Richard Harry, Assistant, R. D. Lillibridge, 170 Broadway, N. Y. Jolly, John MacCallum, Electrical Engineer, Noyes Bros., 109 Pitt St., Sydney, N. S. W. Jones, Benjamin Needham, Electrician, Marine Eng. and Machine Co., Harrison, N. J. Jones, Robert Clay, Turnbull & Jones, Electrical Engineers and Contractors, Box 362, Dunedin, New Zeal. Joslin, Arba Vanderburg, Transformer Inspector, Ind. Electric Light and Power Co., San Francisco, Calif., Kappella, Adolph Somers, Head of Induction Motor Tests, General Electric Co., Schenectady, N. Y. Livers, John Leo, Electrical Contractor, Martinsburg, W. Va. Lodyguine, Alexander, Electrical Engineer, National Battery Co., 359 Normal Ave., Buffalo, N. Y. MacKeen, Rupert Thomas, Assistant Superintendent of Construction, The Canadian General Electric Co., Toronto, Ont. Medbury, S. C., Jr., Electrical Engineer of Stations, Va., Passenger and Power Co., 116 N. 3d St., Richmond, Va. Nesbit William, Salesman Westinghouse E. & M. Co., 902 University Block, Syracuse, N. Y. Replogle, James Gillespie Blaine, Superintendent, The South Fork Electric Light Co., Box 164, South Fork, Pa. Scott, Robert Julian, Professor of Engineering and Electricity, New Zealand University, Canterbury College, Christchurch, New Zealand. Stone, Charles Leroy, Power and Mining Department, General Electric Co., Schenectady, N. Y. Waters, William Lawrence, Chief Engineer, Christensen Eng. Co., Milwaukee, Wis. Williamson, Robert Baird, Principal of School of Electrical Engineering, The International Correspondence Schools, Scranton, Pa. Woolford, William Allen, Testing Department, General Electric Co., Schenectady, N. Y. Mr. G. W. Greenwood was transferred to full membership.

EDUCATIONAL.

LOWELL LECTURE COURSES.—In the Lowell free lecture courses at the Massachusetts Institute of Technology, twelve lectures on general electrical testing are to be delivered by Asst. Prof. F. A. Laws and twelve on polyphase currents by Prof. H. E. Clifford.

GROWTH OF CORNELL UNIVERSITY.—President Schurman, of Cornell University, has announced the results of the deliberations of the annual Fall meeting of the Board of Trustees of the university. An increase in facilities for instruction, in which are included gifts from the late Dean Sage, of Albany, Hiram W. Sibley, of Rochester, the late James B. Guilford, of Utica, and Cornelius N. Bliss, Henry R. Ickelheimer, George C. Boldt, Jacob H. Schiff, John D. Rockefeller, and Oliver H. Payne, of New York, were announced. The location of the Rockefeller Hall of Physics, which will cost $250,000, was decided upon, and the building will be placed on a line running east and west between the present Lincoln and McGraw Halls. President Schurman's recommendation of immediate erection of a hall for arts and humanities, to cost $250,000, was adopted, and the building was located on the plot of ground now occupied by houses of profs. Wait, Law, and Hewett. The plan for the expansion of Cornell University on most magnificent lines was adopted, and for this purpose the president was authorized to purchase immediately sixteen acres of land to the west of the library building. It is proposed to erect six new costly buildings on this plot immediately, and eight more in the remote future. A scheme for the superannuation of all professors at the age of seventy was adopted, the details to be arranged later. It is probable that all professors so retired will be pensioned.

Trade Notes.

MR. HENRY D. SEARS has moved his office in Boston to the Board of Trade Building, 131 State Street.

THE CROUSE-TREMAINE CARBON COMPANY has moved its general offices from Fostoria to Cleveland, Ohio.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has recently issued a new general catalogue dated 1903, and is distributing the same to the trade throughout the country.

WHITEHEAD MACHINERY COMPANY, of Davenport, Ia., is making a specialty of the purchase and sale of second-hand Corliss engines, automatic engines, boilers, etc., and will be glad to receive inquiries on the subject.

A GOLD MEDAL.—At the Dusseldorf Exhibition, which has just terminated, the highest award of merit, the gold medal, was awarded the "Hunt" conveyor. This conveyor is manufactured by the C. W. Hunt Company, West New Brighton, New York.

DISTRIBUTION OF LIGHT.—A dainty and altogether admirable little pamphlet on the distribution of light from the Nernst lamp has just been put in circulation by the Nernst Lamp Company, of Pittsburg. The "talking points" of the Nernst are well brought out

THE TELEPHONE MAGAZINE, according to the latest announcement of its editor, C. E. Kammeyer, will in the future be published by the Telephone Magazine Publishing Company, with John R. Dare as president. It is announced that no one connected with manufacture of telephone apparatus now has any financial interest in the paper.

ELECTRIC BLUE PRINTING.—The Pittsburg Blue Print Company, 1501 Park Building, Pittsburg, Pa., has issued a pamphlet describing its system of apparatus for blue printing with aid of the electric arc. This company has devised what appears to be a very efficient and convenient arrangement for utilizing the electric arc for this purpose.

OIL FILTERS FOR BATTLESHIPS.—The Burt Manufacturing Company, of Akron, Ohio, has just closed a contract for four large special style Cross oil filters to be used on four new battleships now being built for the Government. In this connection the Burt Company calls attention to the fact that its filters have now been adopted by ten different governments.

THE ECONOMICAL ELECTRIC LAMP COMPANY, 123 Liberty St., New York, reports the sales for its turn-down incandescent electric lamps to be most encouraging; up to date the demand having far exceeded the supply. Recent additions to its facilities, however, enable it to fill orders more promptly. Orders have been received from all parts of the world, some reaching as high as 25,000 lamps. This company recently placed a contract with the Bryan Marsh Company for 175,000 lamps.

SEDERHOLM BOILERS.—The Sederholm boilers are made for high pressures and in large units, by the Allis-Chalmers Company, Chicago, Ill. It is stated that the Sederholm boiler combines the advantages of the horizontal tubular and the French types without possessing their defects. The principal features claimed for this boiler are economy, durability and concentration of power. The Allis-Chalmers Company has recently sent out some literature on the subject of this boiler, including a report of a test made last year. The company will be glad to send this matter to any address upon application.

ELECTRICAL SUPPLIES.—In some trade catalogues one finds illustrated many devices that are of little practical value. A catalogue gotten up with the idea of quality of contents rather than quantity is therefore likely to prove of especial interest. The Vallee Bros. Electrical Company, 625 Arch Street, Philadelphia, has adopted this plan in the production of two late catalogues, Nos. 4 and 5, the first of which relates to electrical house goods and the second to telephone apparatus. Only articles of approved value are listed and even they make catalogues of large size. The articles illustrated are up-to-date, and there is a satisfaction in feeling that in looking the catalogues over no time is wasted in noting records of obsolete or useless goods. All of the apparatus listed in these catalogues are standard. The company deals in everything electrical and does not confine itself to the two departments above mentioned.

THE VILTER MANUFACTURING COMPANY, Milwaukee, Wis., builder of improved Corliss engines, has recently received a letter from one of its customers which reads as follows: "Mr. Banes tells me that you have completed the installation of the tandem compound Corliss engine, which I purchased from your people, and I have great pleasure in handing you herewith my check to cover your services in full. The opinions of all of the engineers and electrical people who have inspected my plant have been that the engine is a splendid piece of work, admirably adapted to my requirements in every respect and my engineer, Mr. Banes, tells me that it performs perfectly. I have no doubt at all that it will prove most satisfactory, and assure you that I am indebted to you for the very capable manner in which you have conducted the installation. Tom J. Gardner, Las Animas, Colo."

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 4, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

712,477. BRUSH HOLDER; N. C. Bassett, Lynn, Mass. App. filed March 24, 1902. The brush lies against a flange inclined to the radius of the commutator and a coil spring has one end in engagement with the brush and the other with the brush holder.

712,513. OUTLET BUSHING FOR CONDUITS; F. W. Erickson, Boston, Mass. App. filed March 15, 1902. A two-part bushing having external and internal screw-threads, the former for a nut and the latter for the end of the conduit.

712,514. INTERIOR CONDUIT OUTLET BOX; F. W. Erickson, Boston, Mass. App. filed March 26, 1902. The box is cast around the bushings through which the conduit enters.

712,521. REGULATOR FOR ALTERNATING SERIES ARC LIGHT SYSTEMS; J. H. Hallberg, New York, N. Y. App. filed Nov. 27, 1901. An elastically suspended magnet coil and a balanced core; the coil being in series with the line, so that when one or more lamps are cut out, the movement of the core will introduce impedance in the circuit.

712,522. REGULATOR FOR ALTERNATING SERIES ARC LIGHT SYSTEMS; J. H. Hallberg, New York, N. Y. App. filed Jan. 29, 1902. A device for automatically changing the ratio of the current transformation, whereby the power factor of the system will be maintained practically constant from zero to full load.

712,523. REGULATOR FOR ALTERNATING SERIES ARC LIGHT SYSTEMS; J. H. Hallberg, New York, N. Y. App. filed Jan. 29, 1902. Comprises a device, a portion of which is responsive to any increase in current upon the line within predetermined limits and a portion of which is only responsive to a current in excess of such limit, which device will act when energized to introduce an impedance upon the line proportional to any decrease in load.

712,524. REGULATOR FOR ALTERNATING SERIES ARC LIGHT SYSTEMS; J. H. Hallberg, New York, N. Y. App. filed Jan. 29, 1902. A modification of the preceding patent.

712,525. FIRE ALARM SIGNALING APPARATUS; J. Hamer, Buffalo, N. Y. App. filed Nov. 11, 1901. The wrist of the person sending in the alarm is caught and can be released only when someone else arrives with a releasing device.

712,535. METHOD OF CONSTRUCTING ELECTRIC SWITCHES; G. H. Hill, Glenridge, N. J. App. filed Aug. 10, 1901. The contact segments are coated with porcelain or an insulating paint before they are embedded in a base insulation.

712,539. TROLLEY; N. Nublinger, Barberton, Ohio. App. filed July 3, 1902. The wheel is mounted on a short vertical axis, so that it will yield laterally when passing curves.

712,549. MOTOR CONTROLLER; G. E. Krause and A. L. Bolen, Indianapolis, Ind. App. filed Oct. 7, 1901. A set of resistances and means for changing bridging connections between their terminals whereby they may be placed in series or any number in parallel with the remainder in series.

712,561. REGULATION OF DYNAMO-ELECTRIC MACHINES; Alexander D. Lunt, Schenectady, N. Y. App. filed January 17, 1900. (See Current News and Notes.)

712,568. CABLE JOINT; W. M. Murphey, New York, N. Y. App. filed Jan. 13, 1902. A sleeve carrying its own cementing material and applicable to the joint.

712,584. WINDING FOR ELECTRICAL TRANSFORMERS; J. S. Peck, Pittsburg, Pa. App. filed March 21, 1902. A parallel winding for transformers comprising a number of coils severally sub-divided and mutually cross-connected so as to insure the same inductive relation for all of the parallel circuits.

712,589. SYSTEM OF MOTOR CONTROL; William B. Potter, Schenectady, N. Y. App. filed Nov. 1, 1900. Both the motor field and armature are revolvable; one is geared to the car axle and the other is controllable from any point of a car or train by means of a brake actuated by pneumatic or hydraulic means.

712,590. END PLAY DEVICE FOR ROTARY MACHINES; W. B. Potter and E. M. Hewlett, Schenectady, N. Y. App. filed March 27, 1901. Means for regulating end play in rotary machines, comprising a shaft, means for effecting end-thrust and means for maintaining a slow speed of movement during the end-thrust compared with the speed of the shaft.

712,591. COMMUTATOR BRUSH; W. B. Potter, Schenectady, N. Y. App. filed Sept. 9, 1901. The contact end of the brush is reduced in lateral dimensions.

712,600. SWITCHBOARD SOCKET; H. R. Sargent, Schenectady, N. Y. App. filed March 5, 1901. Details.

712,613. ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINE AND SYSTEM OF DISTRIBUTION; William Stanley, Great Barrington and John F. Kelly, of Pittsfield, Mass. App. filed April 5, 1902. (See Current News and Notes.)

712,614. ELECTRICAL GENERATION AND DISTRIBUTION; William Stanley, of Great Barrington, and John F. Kelly, of Pittsfield, Mass. App. filed June 25, 1902. (See Current News and Notes.)

712,618. PROTECTING DEVICE FOR ELECTRIC CIRCUITS; P. H. Thomas, Pittsburg, Pa App. filed Nov. 27, 1899. Comprises one or more series gaps, one or more gaps shunting one or more infusible and non-polarizable current-limiting bodies and a non-polarizable current-limiting body in series with all the gaps .

712,619. ELECTRICAL RELAY; A. T. M. Thomson, Middlesex, England. App. filed Feb. 4, 1901. Details.

712,620. ELECTRIC METER; E. Thomson, Swampscott, Mass. App. filed July 27, 1898. A motor generator and devices controlled by the current generated thereby for opening the supply circuit of the motor generator when its armature reaches a rate of rotation corresponding to the energy to be measured.

712,630. HIGH OR LOW WATER ALARM; C. E. Zimmermann, Syracuse, N. Y. App. filed Dec. 5, 1901. A float carrying a pointer and circuit terminals adapted to be closed at the critical point.

712,634. EXERCISING APPARATUS; R. Aronstein, Goldfield, Colo. App. filed June 18, 1902. An apparatus for drill-striking practice in which a circuit is closed through the body of the person using the hammer, at each blow.

712,639. REGULATING ROTARY CONVERTERS; Ernst J. Berg, Schenectady, N. Y. App. filed March 20, 1899. (See Current News and Notes.)

712,650. BRAKE SHOE; F. E. Case, Schenectady, N. Y. App. filed June 30, 1897. Electrically operated brake shoes provided with means for proportioning the braking effect to the co-efficient of track friction.

712,652. INTERCHANGEABLE HOOD SUPPORT FOR HIGH TENSION ELECTRIC LAMP SERVICE; J. H. B. Conger and C. J. Eichhorn, Newark, N. J. App. filed Jan. 24, 1902. Details.

712,668. GRAVITY BATTERY; W. N. Gove, Philadelphia, Pa. App. filed Jan. 16, 1902. Babbitt metal is used in place of copper in an ordinary gravity battery.

712,673. PROCESS OF OPERATING ELECTRIC MOTORS; J. Harris, Rensselaer, N. Y. App. filed Jan. 23, 1902. Consists in passing a current through a fluid conductor and then through recurring paths to a second

fluid conductor and to line and in using a revolving device whose ends dip into the conducting fluid at intervals in succession, cutting as they revolve the magnetic flux produced by the current in the field circuit.

712,685. SOCKET FOR INCANDESCENT LAMPS; O. E. Kenney, Toledo, Ohio. App. filed May 31, 1902. Details.

712,686. SOCKET FOR INCANDESCENT LAMPS; O. E. Kenney, Toledo, Ohio, App. filed May 31, 1902. Details.

712,715. ELECTROMEDICAL APPARATUS; L. Petich, New York, N. Y. App. filed March 11, 1901. The apparatus including battery, induction coil, etc., is inclosed in a two-part casing which forms the two electrodes or handles.

712,717. ELECTRIC MOTOR; O. H. Pieper, Rochester, N. Y. App. filed Dec. 4, 1901. The primary of a transformer is connected in series with the field windings and the secondary in series with the armature of the motor, so that the magnetic and electric circuits can be so proportioned that the field and armature current are practically in phase.

712,737. COMPOUNDING-ALTERNATOR; Charles P. Steinmetz, Schenectady, N. Y. App. filed August 20, 1897. (See Current News and Notes.)

712,739. ELECTRIC SPARK GENERATOR; J. Struthers, Des Moines, Ia. App. filed March 10, 1902. Details.

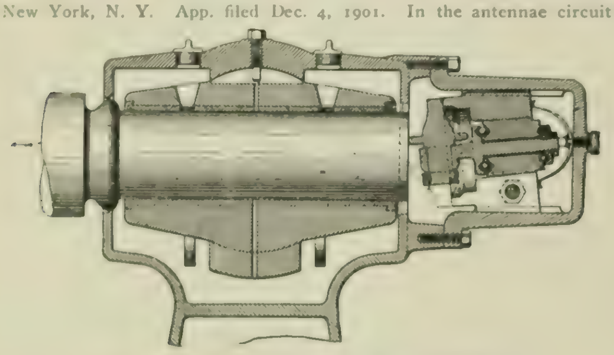
712,741. APPARATUS FOR TRANSFERRING ELECTRIC ENERGY; E. Thomson, Swampscott, Mass. App. filed Feb. 27, 1897. The mode of operation in energizing a core by a winding traversed for a period by the current, then interrupting the current flow by a contact maker at the end of a given time, during which the core has reached a considerable degree of magnetization and at or about the same time closing a circuit secondary to the first winding, to obtain therein a current which may be utilized in any desired way.

712,742. ALTERNATING CURRENT METER; E. Thomson, Swampscott, Mass. App. filed April 10, 1901. A field magnet system provided with a single closed winding connected and arranged to serve at the same time as the series and the potential winding of the meter.

712,749. RHEOSTAT; G. H. Whittingham, New York, N. Y. App. filed Jan. 21, 1902. A tubular insulating body having the resistance coil therein, all terminals of which lead out to one end of the tube.

712,754. RAILWAY SIGNAL; R. A. Baldwin, South Norwalk, Conn. App. filed Dec. 9, 1901. A signaling system in which more than one car or train can pass into a block and yet be protected.

712,764. RECEIVER FOR WIRELESS TELEGRAPHY; Angel De Castro, New York, N. Y. App. filed Dec. 4, 1901. In the antennae circuit is a stretched fine steel wire between the poles of a magnet, surrounded by iron filings and in contact with a sounding box. When the antennae is influenced by electric waves, the device emits a sound, or a galvanometer connected to turns about the magnet is affected. The coherer consists of titanium particles in an exhausted tube, the particles being contained in a cup at the end of one of the tube electrodes, the end of the other electrode bearing on top of the particles.



712,590.—End-play Device for Rotary Machines.

712,814. BATTERY INSTALLATION FOR SUBMARINE BOATS; S. Lake, Bridgeport, Conn. App. filed March 4, 1902. Cement tanks constructed in metal submarine boats to receive storage batteries.

712,839. SECTIONAL CONDUIT; W. L. McGowan, Philadelphia, Pa. App. filed March 20, 1902. The ends of the sections are united by rods extending into each.

712,845. ELECTRIC SWITCH ACTUATOR; J. Y. Porter, Detroit, Mich. App. filed Aug. 14, 1901. Details.

712,847. DRIVING CENTRIFUGAL OR OTHER MACHINES BY MEANS OF ELECTRIC MOTORS; G. Pott and R. Williamson, Motherwell, Scotland. App. filed Jan. 15, 1902. A stationary spindle, a loose sleeve thereon, to which the armature is fixed, a clutch carried by the sleeve and a disk with which the clutch gradually engages by centrifugal action on starting the motor.

712,871. GRINDING MACHINE; O. S. Walker, Worcester, Mass. App. filed Aug. 12, 1901. An automatic grinding machine in which the circuit of the motor is controlled by the movement of a platen.

712,882. ELECTRICAL CONTROLLER CONTACT ARM; E. H. Wise, Westmont, Pa. App. filed May 20, 1902. Means are provided in the arm for utilizing the current to create a magnetic field to destroy arcs which may be formed on the breaking of the current.

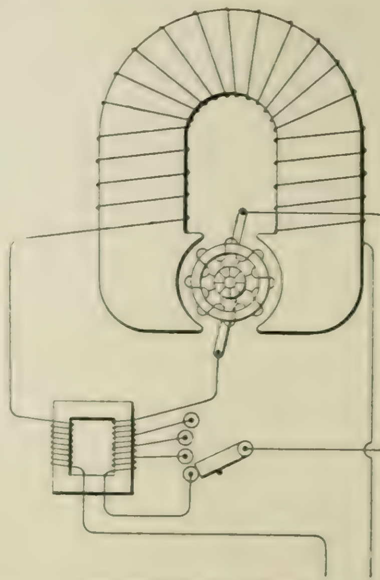
712,910. PRINTING TELEGRAPH; O. T. Kieber, Pittsburg, Pa. App. filed Sept. 10, 1900. Various improvements in printing telegraph apparatus.

712,917. ELECTRIC ARC LAMP; L. C. H. Mersing, London, Eng. App. filed June 30, 1902. Details.

712,961. ELECTRIC RAILWAY SYSTEM; W. B. Potter, Schenectady, N. Y. App. filed March 5, 1900. A transformer adapted to normally supply a current of low potential to the working conductors, a second transformer and a switch actuated by the low potential transformer upon the passage of a car to connect the second transformer so that a current of higher potential will be supplied to the conductor.

712,989. ELECTRIC CAUTERY; W. E. Washburn, Cedar Rapids, Iowa. App. filed Sept. 8, 1902. The device is especially constructed to remove the tonsils.

712,991. REGULATING ROTARY CONVERTERS; Ernst J. Berg, Schenectady, N. Y. App. filed March 20, 1899. (See Current News and Notes.)



712,717.—Electric Motor.

712,994. METHOD OF OPERATING ELECTRIC BRAKES; F. E. Case, Schenectady, N. Y. App. filed June 30, 1897. Electrically actuated brake shoes provided with means whereby any one can be released whenever the speed of rotation of its axle is substantially less than that of another axle.

712,995. PROCESS OF PEROXIDIZING STORAGE BATTERY PLATES; R. N. Chamberlain, Depew, N. Y. App. filed Aug. 23, 1900. The plates are subjected as anodes to electrolysis in a solution of sulphuric acid and nitrate of lead.

712,999. STORAGE BATTERY; B. Ford, Philadelphia, Pa. App. filed Aug. 28, 1900. A flat plate having its edge turned over to form a tubular bead, constituting a support for the active material.

713,005. PENHOLDER; G. B. Hunt, New York, N. Y. App. filed April 7, 1902. The "grip" of the penholder is made up of alternate zinc and copper sections, to afford a galvanic action when it is held between the fingers.

713,010. REGULATING DYNAMO-ELECTRIC MACHINES; Alexander D. Lunt, Schenectady, N. Y. App. filed January 7, 1900. (See Current News and Notes.)

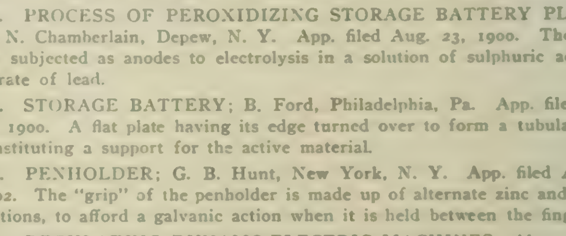
713,015. SURFACE CONTACT STRUCTURE; W. B. Potter, Schenectady, N. Y. App. filed Oct 11, 1897. The contact button can be lifted out of its solid support and easily replaced, there being a conducting socket into which the lower end fits.

713,016. ELECTRIC RAILWAY SYSTEM; W. B. Potter, Schenectady, N. Y. App. filed March 5, 1900. A specific form of apparatus by which the low potential secondary of a transformer is prevented from being short-circuited when the high potential secondary is cut into circuit.

713,020. PROCESS OF MANUFACTURING ELEMENTS FOR STORAGE BATTERIES; E. A. Sperry, Cleveland, Ohio. App. filed Feb. 20, 1902. Process consists in mixing together while dry and in a finely divided condition, lead, lead oxide and an alkali-metal salt and then moistening the mixture with an alkaline hydroxide.

713,022. COMPOUNDING ALTERNATORS; C. P. Steinmetz, Schenectady, N. Y. App. filed August 20, 1897. (See Current News and Notes.)

713,023. ELECTRIC METER; E. Thomson, Swampscott, Mass. App. filed July 27, 1898. A motor, the speed of which is varied by intermittently applying energy thereto at such intervals as to maintain its speed proportional to the quantity to be measured.



712,754.—Railway Signal.

713,044. METHOD OF PRODUCING ASYMMETRICAL CURRENTS FROM SYMMETRICAL ALTERNATING E. M. F.; Michael I. Pupin, Yonkers, N. Y. App. filed Jan. 4, 1898. The capacity reactance of an electrolytic cell is proportioned to the other reactance in circuit such that when an alternating E. M. F. is impressed on it, one-half of the wave will be suppressed.

713,045. APPARATUS FOR PRODUCING ASYMMETRICAL CURRENTS FROM SYMMETRICAL ALTERNATING E. M. F.; Michael I. Pupin, Yonkers, N. Y. App. filed Jan. 4, 1898. Details for carrying out above method.

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NEW YORK. SATURDAY, NOVEMBER 22, 1902.

CONTENTS.

Electricity on the Elevated.

It is a bit too early to expect electricity to justify fully its adoption on the Manhattan elev ted system in New York City. Necessarily a longer time must elapse before all the changes in equipment can be carried out and everything can be made to work smoothly. There will certainly be delays, and troubles due to the unexperienced handling of a new system, but lready some of the benefits are beginning to emerge. The annual report just presented by President Gould must be regarded as a remarkable illustration of what electric traction can do in the way of stimulating and revivifying an old property, and it really looks as though some of the great gains made on street railways in the early trolley days will be paralleled by the leaps and bounds in traffic on the Manhattan. It appears that even with the limited electrical equipment there was an increase in passengers of about 29,000,000 in the past twelve months; while in the last quarter the electrified east side has shown 25 per cent. increase against the 10 per cent. on the west side, where electric cars are still very much of a novelty. Moreover the operating ratio for the year has been cut from 55.38 per cent. down to 50.10; and there should be possible something better, although that is a point in regard to which one must wait for the facts and results.

Incidentally, altogether aside from what the company has gained, the public is very greatly a beneficiary by the change of motive power. After traveling on one of the clean, bright electrics, it is a burden and vexation to the flesh to go back to the steam trains, especially if windows or doors are open, or if one has to stand on a platform. Inside the cars, the mere change in the lighting has been an infinite betterment. Not alone are the old oil or other lamps bad, but anybody standing in the aisle shuts out the light from everyone else around, so that reading becomes an impossibility. The electric lights are so placed and distributed that all parts of the car are well lit, and no one's light can be intercepted. Better yet, there is a distinct saving in time. The schedule has certainly been cut 25 per cent.; in fact a half-hour trip, old style, can apparently now be made in about twenty minutes; although we note friction and stoppages due to the inexperience alike of trainmen and passengers.

We note a tendency to boom Manhattan stock on all these points, but before money is paid out in dividends we venture to hope that the company will follow up the present change by making other improvements that should and must come as an inevitable sequel. The very increase of travel is rendering the station and terminal facilities quite inadequate; and in fact, despite the change to electricity, one hears many complaints about the crushing and crowding on the Elevated; while pickpockets are apparently enjoying "the time of their lives," on account of the helplessness of their victims in the melee. It does little good also to gain time in transit and then waste more than the gain in the press on some blockaded platform or narrow stairway. In short, the adoption of electricity is a great boon, but there are many others due in its train.

Self-Help.

Whether or not he meant it as a reply to Senator Hill's campaign proposal for State ownership of the coal mines, President Roosevelt said a mighty strong and pertinent thing on paternalism in government at the Chamber of Commerce banquet in New York City last week. We quote it in full as follows: "At a time when the growing complexity of our social and industrial life has rendered inevitable the intrusion of the State into spheres of work wherein

it formerly took no part, and when there is also a growing tendency to demand the illegitimate and unwise transfer to the government of much of the work that should be done by private persons, singly or associated together, it is a pleasure to address a body whose members possess to an eminent degree the traditional American self-reliance of spirit which makes them scorn to ask from the government, whether of State or of Nation, anything but a fair field and no favor—who confide, not in being helped by others, but in their own skill, energy, and business capacity to achieve success." Those of us who believe in self-help and in the minimization of governmental management could not ask a better presentation of their views than this. A curious feature is that such a declaration should come from the leading spokesman of the Republican party, which is popularly credited with a desire to magnify the office and function of the central power, and that the doctrine attacked was put forward by one whose proudest boast is that he is a Democrat, and who speaks for the party that has always opposed tooth and nail such centralized aggrandizement in national policy. All that the industries of the country need—mines, telegraphs, railroads, lighting plants—is that they shall be left to the development of private enterprise by those "who confide, not in being helped by others, but in their own skill, energy and business capacity to achieve success."

Train-Dispatching.

If report be true—and we are not in a position to contradict it—the present month witnesses the fiftieth anniversary of the first attempts to use telegraphy in train dispatching. The claim for priority is made for Mr. Albert H. Copeland, of Chenoa, Ill., and another pioneer who asserts that he moved trains by telegraph about the same time is Mr. D. H. Conklin, of Decatur, Ill. Mr. Copeland made his essay on the Burlington and Rutland road during a snow storm, in the fall of 1852, when he was in the postal service; while Mr. Conklin was engaged in the development of the method in the same year, as a telegraph operator, in the earlier days of the Erie system.

When we consider what an important adjunct the telegraph has become to the railroads, it is hard to get one's self back to the time of the Baltimore and Ohio experiments of 1844, and to take seriously Professor Morse's suggestion that if a break were found in the telegraph wire, the train should stop long enough to repair it. But this is what he said: "Very little interruption would take place if the train that discovered a break would stop not more than five minutes, and, being furnished with pieces of wire already prepared for the purpose, anyone could simply unwrap and scrape the broken ends and unite them by twisting the ends of the pieces of wire to them." Repairing a telegraph circuit while the train waits would hardly commend itself to the hurried commuter or the passenger by the Twentieth Century Flyer; but those were idyllic, romantic days, when probably the railroad traveler would prefer to be detained in order that he might see some of the mysterious workings of the newfangled telegraph.

The association of railroad and telegraph has indeed always been very close, and we do not wonder that the Western Union objects strenuously to being cut adrift from its old railroad bases. Telegraphy has been of infinite value in expediting and improving train service, and it would not be right to let this "jubilee" go by without remembrance, even though the telephone has come in to play so important a part in dispatching of late years.

Electric Heating.

Not long since, we took occasion to discuss the economic future of electric heating on a considerable scale. Quite apropos, therefore, is a recent paper in *l'Electricien* on a carefully formulated plan for the electric heating of the famous Davos-Platz region in Switzerland. This, as our readers will doubtless recollect, is perhaps the most noted winter resort for consumptive patients in all Europe, and to its sanatoriums two or three thousand invalids resort for treatment each season. The remedial value of pure, cold air is now well recognized in such cases, both here and abroad, and in this instance the primary purpose of electric heating is the preservation of pure air. To this end the plan includes a complete electric heating system for the whole community so as to eliminate the use of fuel as completely as possible. There is ample water power a dozen miles or so away, and it is proposed to install a polyphase plant of about 15,000 hp to do the work. This output is computed to be ample for the requirements, and when the project is carried out we shall be treated to the remarkable spectacle of a settlement containing a total population of about 5,000 entirely rid of fires and the concomitant contamination of the air. It is estimated that the total cost of the energy delivered, including all items of fixed charges and depreciation, will amount to about two-thirds of a cent per kilowatt-hour. There seems to be no reason why such a figure may not be reached in a hydraulic plant economically installed and administered, and it is evident enough that so low a cost puts electric heating in an entirely new light. We are so wonted to consider the cost of electrical energy in the light of ordinary central station prices that it is hard to realize the significance of the situation. In this instance, to be sure, the main object of the innovation is sanitary rather than economic, but it will be none the less an invaluable lesson to the world. When we consider that energy could be supplied at a similar cost in working on a colossal scale from low-grade coal at the mine, we are tempted to dream of cities without smoke. At least, the Davos-Platz experiment will proclaim the way.

Transmission Lines on the Sea coast.

In another column an account is given of a difficulty which has arisen in the operation of high-voltage transmission lines, located near the seashore where heavy sea fogs are prevalent. The trouble comes at a season of the year when there is also likely to be considerable dust flying at times when the fog is not present. This difficulty, as experienced on the Pacific Coast near Los Angeles has, we understand, also made itself manifest on at least one other line located near the seashore. Fortunately, at the same time that we record the difficulties which have arisen, we are enabled to describe a cure which has been applied, and under a test of something over a year, has given very satisfactory results. It is somewhat strange that so much trouble should be experienced directly on the sea coast, near Los Angeles, while, at the same time, the sea fogs which frequently drift up the valleys in that region, do not seem to have troubled the transmission lines a few miles inland. Just how much of the trouble is due to the salt held in suspension in the fog itself, and how much is caused by the character of the dust which is deposited on the insulators in dry times, has not, we believe, been thoroughly determined. It is now a well-known fact that aluminum cannot be used on or near the sea coast, because of the corroding effects of the salt mist.

It seems peculiar that sea fog should contain as much salt in mechanical suspension as it frequently does. When it exists in fog, it is, of course, the result of spray being carried up into the air, and finally assuming the form of a fog along with the condensed moisture from the atmosphere. Otherwise sea fog would, of course, consist of nothing but vapor condensed from the atmosphere. Whether heavy sea fog alone, without the presence of dust previously deposited on the insulator, would cause leakage sufficient to burn the pins, is something which has not been determined, but the presence of the coating of dust

previous to the appearance of the fog seems to be a very important factor in the trouble. Of course, the fog itself, if partially composed of sea spray, will deposit a certain amount of salt under the insulators, but this might not be sufficient in itself to produce a break-down across the surface of the insulator, unless some dry dust had been deposited there previously by the wind. The information at hand does not indicate whether the Santa Monica transmission plant, which has experienced this trouble, has had its lines alive during the whole twenty-four hours. There would probably be more deposits upon the insulators if the lines were dead part of the day than if they were kept alive all the time, as the tendency of the high voltage is to statically charge all particles near each conductor and repel them. Indeed, it has been noticed many times in connection with high-tension insulators that moisture is driven away by this static effect. However, it is of more practical value to know the way the trouble can be overcome than to know the exact cause of it, and it is a satisfaction to record the remedy.

THE PERMEABILITY OF MAGNETIC LIQUIDS.

We publish this week, on page 811, the description of some measurements of permeability in magnetic liquids. The method employed is interesting as being analogous to that suggested by Hughes for his sonometer. Whereas, however, sonometer induction coils are usually flat and axially short, those employed in this investigation were relatively thin and axially long, so as to secure a close approximation to a uniform magnetic field in their interiors. The method seems to be swift in application and promises a wide field of adaptation. Alloys of iron, nickel and cobalt, with other metals, often displaying remarkable and anomalous magnetic behavior and possibly solutions of magnetic substances, tested in this way, might also evince peculiarities. If such were found to be the case, the method would be valuable, because solutions are so readily prepared and exchanged by contrast with solid cores of alloy. The maximum permeability observed was less than one tenth of one per cent. greater than the permeability of vacuum. This was for ferric chloride. When the permeability of pure iron may be as high as 2,000, the feeble permeability of aqueous solutions of the salts of iron stands in marked contrast.

The observations were carried out up to intensities of magnetic force approximating 200 gausses, a relatively high value. According to the results shown in Fig. 5, cobalt and iron behave nearly with equal power in solution and give an increase of permeability over vacuum of 45 parts in a million for each per cent. of pure metal in solution; whereas nickel in the solutions of its salts is feebler and only gives about one third of that amount. This reverses the order of relative magnetic power in the metals, since solid nickel is superior to solid cobalt in permeability, at low intensities of exciting magnetic field. The general results obtained seem to be in fair agreement with the few and scanty data hitherto available on this subject. Thus, taking ferric chloride of specific gravity 1.52, the permeability of this solution was observed to be approximately 1.00085. Referring this to susceptibility, the corresponding value would be about 68×10^{-6}, while the value of Quincke, quoted for the solution of that density (1.508), is 65×10^{-6}. It is to be hoped that the investigation will be extended to other densities of solution, and to various other compounds and mixtures. The results so obtained might prove very valuable from a theoretical standpoint, although it must be confessed that with such feeble permeabilities there is not much hope of immediate practical application.

THE SIZE OF ATOMS.

A paper recently read before the Physical Society of London on this subject by Mr. H. V. Ridout, purports to compute the size of atoms with unprecedented accuracy, based on certain convenient hypotheses. Some of these hypotheses are, perhaps, more convenient than reliable; such, for instance, as that atoms are spherical in form, and that in water, hydroxyl and hydrogen atoms occupy equal volumes; or are marbles of the same size in contact with each other. This view of the atomic structure of water gives a mental picture of the substance resembling piled cannon balls. It is then, virtually, demonstrated in the usual manner that a sphere which in free space would hold by virtue of its electrostatic capacity the same total quantity of electricity as the hydrogen atoms in a gramme of water, would have a diameter about one thousand times greater than that of the sun. In other words a cubic centimetre of water apparently stows away on its hydrogen atoms as much electricity as would be held by a sphere in free space a thousand times bigger than the sun and charged to the same potential. As, however, the capacity of a free sphere varies as its radius while its mass varies as the cube of the radius; the charge per unit of mass varies inversely as the square of the diameter. Consequently, a simple calculation leads to the result that if the fine-grainedness of water is sufficiently great to permit of eleven millions of these lilliputian marbles to line up in a millimetre, their electrostatic storage capacity in one centimetre cube of water would be equal to that of a single marble of a thousand sun diameters.

Since the thousandth of a millimetre is commonly called a micron (millionth metre), the millionth of a millimetre (billionth metre) may be conveniently called a bicron, and the result of the calculation is, therefore, that a linear series of 11.4 of these hydrogen marbles would fit in a bicron. Or, since a linear dimension of about one hundred bicrons is near the limit of visibility attained by the microscope, the diameter of a hydrogen atom would be about one thousandth times smaller than the microscope could render visible to the eye. Lord Kelvin's classical estimate of the size of atoms lay between a bicron and the tenth of a bicron; so that the lower limit of Kelvin's estimated range is about the same as that deduced in the paper here referred to. Of course the present limitations of knowledge in regard to the structure of matter prohibit any such computations from entering the regions of precision. All we can perhaps be permitted to say at present is that atoms of hydrogen approach a bicron in size.

In our last issue, we printed an article by Dr. S. N. Taylor, dealing with the measurements of corpuscles or chips of atoms. According to the results of the various measurements there described, a corpuscle is a much smaller quantity of matter than an atom, and whereas atoms of different chemical substances have different masses and occupy different volumes, the masses of corpuscles of different chemical substances appear to be the same. A chip of a hydrogen atom cannot be distinguished in its behavior from the chip of an aluminum or oxygen atom. In particular, the mass of a hydrogen corpuscle comes out only about one thousandth part of the mass of a hydrogen atom, and this is derived not from a single experiment conducted in a particular manner, but from numerous experiments made in very different directions. Consequently, if the size of an atom may conveniently be expressed as a fraction of a bicron, it would seem that the size of a corpuscle may conveniently find expression in *bicrons*. And mayhap the end is not yet. At all events, it must be confessed that the end is not in sight.

Stanley Transformer Patent Decision.

Judge Lacombe, of the United States Circuit Court of the Southern District of New York, on November 17 handed down an important decision denying a motion for a preliminary injunction applied for under a decision written by the same judge in the case of the Saranac Electric Light Company, handed down from the Court of Appeals, Second Circuit, January 14, 1902.

In the last-mentioned decision, the defendent maintained that the Stanley claims indicated no invention, but the court held that if these claims were read in the light of explanatory matter included in the specifications and denominated the "Stanley rule," the patent did cover an invention. The court's statement of the Stanley rule was as follows: "It says you may determine the proper length of the primary coil by connecting the transformer in circuit with the dynamo with which it is to be used, and then winding on wire until the loss indicated by the formula $C^2 R$, with the secondary circuit open, equals a certain loss of energy."

On July 1 Judge Colt, of the United States Circuit of the District of Massachusetts, denied a motion for a preliminary injunction based upon the above decision, the statement being made that the complainant should show, first, what the Stanley patent covers; and second, that the transformer in suit comes within the Stanley invention as thus defined.

Judge Lacombe, in his present opinion, holds that while in the Saranac Lake case there was no proof that the defendant's transformer was so constructed as actually to use the so-called Stanley rule in determining the length of wire in the primary coil, it did appear that the length used was substantially the length that would have determined had the rule been used. The evidence in the present case, however, is much more specific as to the length of wire in the primary coil; and in view of the repeated and concurrent testimony of the many experts called by the defendent, it cannot be held that the length of wire in the primary coil is substantially the same as it would be if such length were determined by the Stanley rule. Judge Lacombe concluded by saying that if the length be not substantially the same we seem to have the very exception suggested in the opinion of the Court of Appeals: "Some other length covered by the language of the claim but not of the rule, would fall outside of the claim." The decision is that infringement is not shown, and the motion for injunction was denied. The decision is to be appealed.

November Meeting of American Institute of Electrical Engineers.

The topic considered at the meeting of the American Institute of Electrical Engineers, held November 21, was "Electric Variable Speed Control," which was represented by seven papers. Abstracts of these papers, together with the accompanying discussion, will be printed next week. The titles and scopes of the papers are as follows:

1. "A Series-Parallel System of Speed Control," by George W. Fowler. A description of the parts of a system, including a double commutator motor, switchboard-controller, automatic switches and emergency switches.

2. "The Storage Battery as a Factor in Speed Control," by H. B. Coho. A description of the use of storage batteries in connection with operation of printing presses and the multiple voltage system.

3. "Electrically Operated Coal Hoist," by P. O. Keilholtz. A description and data concerning the operation of a coal hoist.

4. "Motors for Machine Tools," by F. O. Blackwell. A description of the characteristics of the different classes of metal-working tools, of the requirements of motors for operating them, of the conditions limiting the range of speed variation and some of the methods of obtaining it with continuous current motors.

5. "Multiple Unit Voltage Speed Control for Trunk Line Service," by H. Ward Leonard. A description of a single-phase, high-tension, alternating-current system for operating trunk line railways.

6. "The Three-Wire System in Variable Speed Motor Work," by N. W. Storer. A description of the operation of variable speed d.c. motors on the three-wire system.

7. "The Operation of Machine Shops by Individual Electric Motors," by R. T. Lozier. Data concerning the load factor and operation of machine shops, and a description of the advantages derived from the use of individual electric motors.

Pittsburg Local Section of American Institute of Electrical Engineers.

The November meeting of the Pittsburg Local Section of the American Institute of Electrical Engineers was held November 10 at the Electric Club of that city. The following committee was appointed to have charge of the preparation of programmes, calling of meetings, etc.: P. M. Lincoln, chairman; J. S. Peck, secretary; Messrs. H. W. Fisher, J. M. Kintner and Calvin W. Rice. Thirty institute members and about 175 visitors were present at the meeting.

President Scott gave a resumé of the discussion at the New York meeting and a brief account of the John Fritz dinner and medal. Mr. A. J. Wurts read his communication to the Institute Transactions, abstracted elsewhere in this issue, and added some further remarks. Attention was called to the fact that no illuminant has ever been discarded; candles, oil lamps, gas and incandescent lamps are all in extensive use. The custom of rating lamps according to spherical candle power instead of by effective illumination was severely criticized. The great flexibility in the size of the Nernst lamp was pointed out. It was predicted that the Nernst lamp will have a great influence on street as well as interior illumination.

Mr. Henderson gave a description of the Bremer flame arc lamp. Attention was called to the fact that the arc lamp was the earliest form of the electric lamp, and that a great amount of experimental work has been done on methods for holding carbons in proper position. The Bremer lamp is strictly a German invention, and no American improvements have been made upon it. The carbons are manufactured according to a secret process, and only in Germany. The most striking features of the Bremer lamp are the compo of the carbons, their position in the lamp, and the fact that the arc is drawn out fan-shaped by means of a magnet placed around the arc. When the carbons are heated, mineral vapors are given off, which become luminous, and give the arc the peculiar flaming appearance as well as its yellow color. The two carbons are nearly parallel, converging at an angle of about 20°. The arc is started by means of a starting device, which short-circuits the ends of the two carbons. The arc is prevented from traveling up between the carbons by means of the magnets which surround the carbon points and hold the arc in position, as well as spreading it out fan-shaped. Tests have shown the Bremer lamp to be over three times as economical as the ordinary arc lamp.

Dr. von Recklinghausen read a paper, descriptive of the Cooper-Hewitt lamp. Several lamps were shown in operation, and were frequently referred to by the speaker.

The cost of producing acetylene gas was briefly discussed. The values given are approximately as follows: One kw-hour will produce 250 cp-hours by incandescent lamp, 500 candle-power by Nernst lamp, 1,000 candle-power by arc lamp, 2,000 candle-power by Cooper-Hewitt lamps, and 110 candle-power by acetylene. In the production of calcium carbides, however, an electric plant may be operated at full load for 24 hours per day, while the ordinary lighting station does not ordinarily deliver more power than is equivalent to full load for two hours per day. A 25-cp acetylene lamp was exhibited, and it was stated that the cost of operating this lamp was not more than one cent per hour.

A discussion on the Cooper-Hewitt lamp followed, during which it was stated that the lamp can be operated in any position if designed for that given position. The pressure in the lamp when operating is 2 mm. of mercury. The smallest size lamp made up to the present time is approximately 20 inches long, giving about 180 candle-power. The longest about 20 feet, giving approximately 3,000 candle-power.

Mr. Storer referred to Mr. Wurts' contention against mean spherical candle-power as a unit of measure, and said he was conducting a similar campaign with reference to the one-hour-horse-power rating of street car motors; but as a horse-power rating is demanded by the commercial conditions, so a candle-power rating would also be demanded. Mr. Wurts stated that the candle-power rating does not fill the commercial want, as it is not a unit of measure of effective illumination. Mr. Jones stated that from a large experience in lighting buildings he was convinced that mean spherical candle-power rating was in no way satisfactory, but that effective illumination was the thing demanded. An animated discussion then took place between Messrs. Wurts, Kintner and Storer, with respect to the necessity of maintaining the candle-power rating.

Leeds, England, Central Station.

IN 1891, power was granted to a private company to supply public electrical service within Leeds, England, and two years later the service was commenced, the lighting tariff being 16 cents per kw-hour, which was later reduced to 10 cents. In 1898 the plant was taken over by the municipality, and at the present time current is being supplied at the rate of 8 cents per kw-hour for lighting and 3 to 4 cents for power service.

With reduction in price for current the demand increased, and though considerable extensions and additions were made to the original plant, a supplementary station finally became necessary, which has recently been put in operation. With the new plant two-phase generation was adopted, and it is now contemplated to change over the older plant to two-phase.

The dimensions of the new station are 290 ft. by 181 ft. The engine room is a lofty erection 220 ft. in length and 65 ft. in width. From the floor line to the crane rail measures 33 ft., and from floor line to the under side of the roof binders 44 ft., thus allowing 11 ft. clear for the movements of the crane. Accommodation has been provided for step-up transformers for feeding the outlying districts of the city at extra high pressure, should such a proceeding be necessary. The switch room is no less than 170 ft. in length by 28 ft. in width and 16 ft. in height.

Ample room has been provided for leading out the cables from the works to the different parts of the town, and for running the various leads from the switchboard to the dynamos For this purpose there is a cable cellar (Fig. 2) which occupies the whole of the space beneath the switch room, and which also leads to the subway running from the works to Queen Street. The stores occupy a room above the switch room, with which it is identical in size.

The boiler house is rather larger than the engine room, being 231 ft. in length, 82 ft. in width, and 210 ft. in height from the floor line to the under side of the coal stores. The amount of coal which it is estimated will be consumed in a month is 4,000 tons, and the coal bunker, which is over the boiler house, is capable of holding just this quantity. The chimney is 210 ft. high, with an inside diameter at the bottom of 12 ft. 6 in.

Up to the present there are but two units installed in the engine room, but their combined capacity dwarfs the units in the older plant. The alternators were made by the Electric Construction Company, and are coupled, one to a McLaren engine and the other to a Belliss engine. Each has a capacity of 1,500 kw and each engine is capable of developing 2,400 hp. Both engines are of the triple expansion enclosed type, with forced lubrication. The dimensions of the McLaren engine are, high-pressure cylinder, 27½ in. diameter; intermediate-pressure cylinder, 39½ in. diameter; low-pressure cylinder, 64½ in. diameter; stroke, 24 in.; speed, 200 revolutions per minute. The valves are trick-ported slide valves, balanced horizontally and vertically, and the floor space covered by the set is 38 ft. by 18 ft. 6 in. The engine alone covers 24 ft. by 9 ft. and is 20 ft. high. It is fitted with a governor of the automatic expansion type.

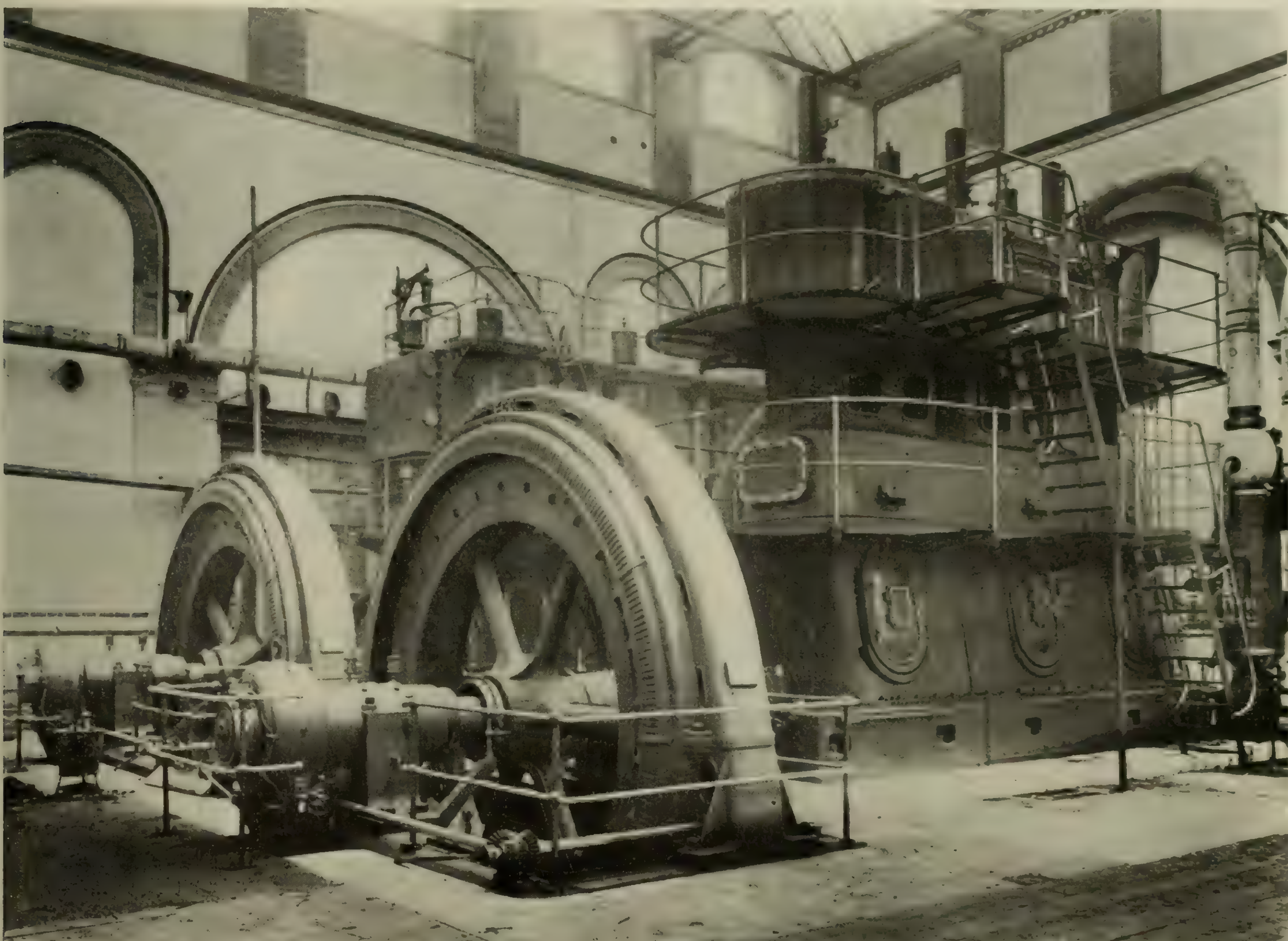


Fig. 1.—Generating Units, Leeds, Eng., Central Station.

The dimensions of the Belliss engine are, high-pressure cylinder, 22½ in. diameter; intermediate-pressure cylinder, 35 in. diameter; low-pressure cylinder, 55 in. diameter; stroke, 30 in. diameter; speed, 200 revolutions per minute. The engine has piston valves, and the governor acts on the throttle. The total floor space occupied by this set is exactly the same as that occupied by the McLaren set, but the engine alone occupies 25 ft. 3 in. by 8 ft., and is 22 ft. high.

The alternators, as stated before, generate two-phase currents. They are of the revolving field type with 30 poles, and the maximum output of each machine is 1,750 kilo-volt-amperes at 2,200 volts on a load having a power-factor of 0.8. The flywheel effect is such as to reduce the fluctuation in velocity during a revolution to less than one-twentieth of 1 per cent. from the mean velocity, and the paralleling force is so great that the synchronizing current is hardly perceptible.

The guaranteed commercial efficiency is 95 per cent. at half load.

Close regulation of voltage being so essential with two-phase machines required to work on a combined motor and lighting load, the specification calls for a maximum drop in voltage from no load to full non-inductive load of 4 per cent., and of 12 per cent. on a load having a power-factor of 0.8. It is further guaranteed that when one phase is carrying full non-inductive load, the other being on open circuit, the difference in the voltages of the two phases will not exceed 3½ per cent. The frequency is 50 cycles per sec., and the voltage 2,000 on each phase. The weight of the magnets and wheel and shaft is 28 tons, the total diameter over the field magnets being 13 ft. 6 in. A cast-steel ring fits over a cast-steel spider, and it is to this that

FIG. 2.—CABLE SUBWAY.

the magnet poles are bolted. The slot type of winding has been employed in the manufacture of the armatures. On the alternator shaft of each set is mounted an exciter of 8 kw capacity.

Each sub-station transformer has an output of 60 kw, the primary current being supplied at 3,000 volts, 50 periods; the secondaries are wound to give either 305 or 410 volts. The special feature of these transformers is the use of circular stampings, having only one joint, thus giving the lowest possible magnetic resistance for a given coil area. The tests show an open circuit loss of 460 watts, and a guarantee is given that the magnetizing watts will not increase after the transformers are put to work. The drop in voltage from no-load to full non-inductive load is 1 per cent., while on a load having a power-factor of 0.75 the drop is still under 2 per cent.

The condensing plant consists of two surface condensers, each having 3,400 sq. ft. of heating surface, one for each engine. In connection with those condensers are two centrifugal pumps by Messrs. Belliss and Morcom. There are 2,245 tubes in each condenser of ¾ in. internal bore and 7 ft. 9 in. in length. Both condensers are situated in the celar below the engines.

For the purpose of extracting oil from the exhaust steam before it passes into the condenser there has been fitted in the exhaust pipe, between the condenser and its condenser, an oil separator, while the feed tanks, situated in the pump house, receive the discharge water from the air pump for the condensers. The engine room is provided with a 30-ton overhead traveling crane, equipped with a two-phase motor. Messrs. Ferranti have supplied the new switchboard, which is of the high-tension type, consisting of six sets of two-phase oil break switches on the dynamo board, with the necessary 'bus bars, synchronizing apparatus, etc., and 30 circuit panels of the usual spring break type. A glazed brick wall supports this board, the dynamo section being on one side and the feeder section on the other. On quite a distinct and separate board at the back of the controlling table are placed the exciting circuit instruments, and the exciter controllers are placed on a table away from the board. The existing switchboards have been coupled up to the new board by means of three sets of feeders. As previously mentioned, the cable cellar is immediately beneath the switch room, and is so arranged that the cables leaving the board are carried down direct on to shelves supported by brackets carried on iron pillars, and they then pass away into the cable subway, a distance of 350 yards. It is thus possible to gain access, with great ease, to any cable, whenever desirable, as there is a space of 2 ft. 6 in. between the tiers of shelves through which the attendant can walk. The subway itself is 11 ft. wide and 7 ft. high, the roof girders being supported by a line of pillars. A line of shelves is formed on each side by means of brackets which are fastened to the side walls, and there are additional brackets supported by the center pillars. Accommodation is provided in the subway for 200 cables, and there are outlets at each street crossing which permit of the exit of cables. The whole of the subway is enclosed in waterproof course.

The boiler house has been designed to accommodate 24 boilers with 4,300 sq. ft. heating surface each, but up to the present there are only eight Babcock and Wilcox water-tube boilers installed, all being fitted with superheaters and purifiers. The tubes are arranged in 17 sections, with 12 best solid-drawn steel tubes to each section. The boilers are fitted with Meldrum's coking stoker and forced draught.

A Green economizer, consisting of 960 tubes, is situated over the boilers between the coal store and the western wall of the engine house. Provision has also been made in the boiler house for three other economizers of the same size, one to each set of six boilers. The conveying plant and mechanical stokers are driven by means of two-phase motors.

At the south end of the boiler house is the pump house, capable of holding seven feed pumps, which would feed all the 24 boilers, but up to the present it contains only two with a capacity of 4,000 gallons per hour each and one with a capacity of 8,000 gallons per hour. In addition to these there are two Worthington pumps (one capable of pumping 12,500 gallons per hour and the other just double this quantity), which discharge the water into the overhead storage tank after drawing it from the river and passing it through a battery of filters.

The coal-conveying plant consists of elevators and conveyors for the coal, and ash-conveying plant for the ashes. The coal is brought

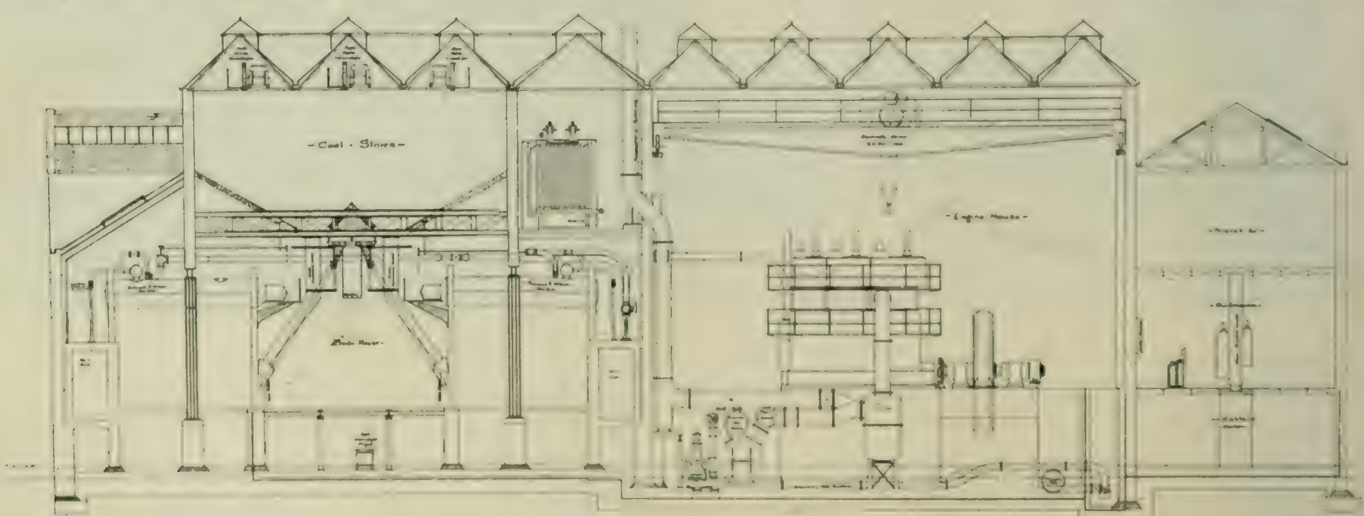


FIG. 3.—CROSS-SECTION OF GENERATING STATION.

down to the works in the Corporation's own boats and will be discharged by means of a crane mounted on an elevated structure 15 ft. above the wharf level. This crane will be capable of traveling over a distance of about 60 ft. on this structure, and will be fitted with a grab to enable the coal to be handled as quickly as possible. Immediately under the crane rails will be placed a plate conveyor running under the whole length of the elevated structure for the crane. The plate conveyor is 3 ft. wide, and sheet-iron sides, fitted immediately above it and placed on an angle, will direct the coal, when discharged from the grab, direct on to the conveyor. The coal is then taken to a hopper immediately outside the boiler house entrance, is there elevated by means of two conveyors to the coal stores, and is transmitted through the coal stores on three push-plate conveyors, one in the middle and one on either side of the bunkers. The coal can

FIG. 4.—TRANSFORMER AND COILS.

thus be discharged at any point in the stores as required. The plant will be able to deal with 40 tons of coal per hour. The ash conveyor is of the plate-conveyor type, and carries all the ashes to the north end of the boiler house. A bucket elevator then receives the ashes, which are carried up and discharged into an overhead ash-bin, from which they are released and dropped into carts by means of opening a shoot at the bottom of the bunker.

The workshops are at the north end of the buildings, and include mechanics' shop, smiths' shop and joiners' shop, all repairs being done on the premises, except in the case of very large work. The workshops will be fitted with all the necessary machine tools to do the repairs. Mr. Charles France has been responsible for the architectural design of the buildings, and the engineering work, both mechanical and electrical, has been arranged and superintended by Mr. H. Dickinson, the Corporation's engineer.

The Quirinal Tunnel.

A cable dispatch from Rome to a New York daily newspaper says: Quite the most popular place in Rome to-day is the tunnel under the Quirinal, which was opened last week. The admittance of the public was the occasion of much ceremonious display. It was chiefly a municipal function, for the Syndic and all the city authorities were there, as well as deputies, senators and the directors of various useful and artistic societies. The tunnel, which is considered a triumph of the Roman Street Railway Society, is 1,150 feet long. The walls, which are being covered with white majolica, are illuminated with eight large electric lamps. On the opening day all the cars entering the tunnel were adorned with flags, and on issuing refreshments were served to all those who took part in the inauguration. Half the fares of the first two days went to the sufferers from the recent cyclone in Sicily.

The Permeability of Magnetic Liquids.

By FITZHUGH TOWNSEND, S. DIAMANT AND L. S. THURSTON.

THERE are at present to be found in the literature of physics a considerable number of researches relating to the magnetic properties of the salts of iron, cobalt and nickel, and their relative susceptibilities at different magnetic densities. Wiedemann, Schumeister, Eaton and Von Ettingshausen found K for $Fe\ Cl_3$ to be constant, while Silow and Quincke found it to vary. Quincke furthermore, was the only one of the investigators just mentioned who conducted experiments at high-field strengths, ranging from 6,380 to 12,510 gausses. The others used values of $\mathcal{H}D$ varying from 0.2 to 250. The following table shows to what extent some of the determinations of K for $Fe\ Cl_3$ compare with one another:

	Specific Gravity	$K \times 10^6$
Quincke	1.508	[illegible]
Arndtsen	1.495	[illegible]
Von Ettinghausen	[illegible]	[illegible]
Silow	1.520	[illegible]
Borgmann	1.487	[illegible]
	1.520	36.5
Henrichsen	1.36	42.7
Wähner	1.435	37
Schumeister	1.395	[illegible]

The measurements which are to be described are the result of a suggestion by Prof. F. B. Crocker that it would probably be possible

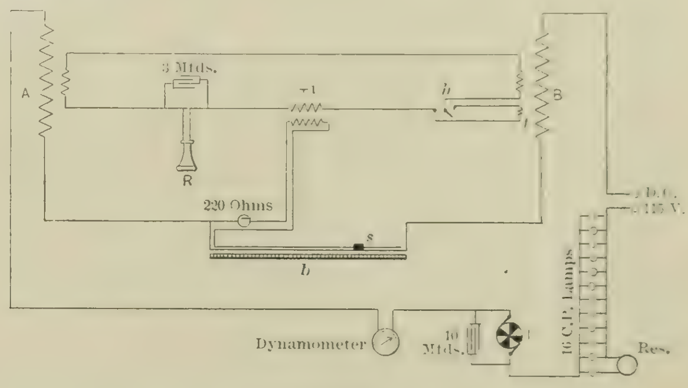


FIG. 1.—ARRANGEMENT OF APPARATUS.

to investigate the subject in a more direct way, by making determinations of permeability instead of susceptibility. It was found difficult to carry out this idea in the ordinary manner, using a ballistic galvanometer, on account of the extremely small difference between the permeability of the liquid and that of air; a zero method involving the use of an interrupted current, and a telephone receiver was, therefore, resorted to.

The exact arrangement of the apparatus is shown in Fig. 1.

The explanation of the symbols in Fig. 1 is as follows:

I.—Interrupter giving a frequency of 138 p. p. s.

b.—Meter bridge, with slider *S.*

T'.—Auxiliary transformer of few turns.

r.—Ohmic resistance, large enough to cause the e. m. f. of *T'* to be directly proportional to the distance through which the slider *S* is moved.

R.—Telephone receiver.

h.—Switch used to insert or cut out the calibrating turns, *t.*

A, B.—Glass tubes, each wound with a primary and a secondary winding. The section of *A* and *B* is shown in Fig. 2; primary winding, 1,015 turns; secondary winding, 1,000 turns.

In making a determination, both glass tubes were filled with water, and the slider *S* adjusted until silence was obtained in the telephone

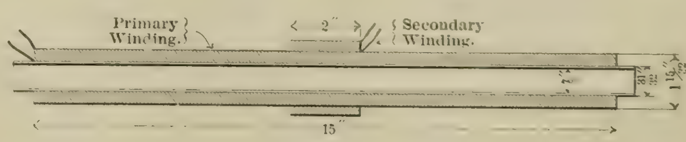


FIG. 2.—SECTION OF PRIMARY AND SECONDARY WINDING.

receiver. The switch, *h*, was then thrown to the right, so as to insert in the telephone circuit the three extra turns, *t*, and the bridge again balanced. One-third of the difference in cm. between these two positions of the slider *S* is, therefore, the distance through which

the slider would have to be moved to balance an increase of $\frac{1}{1000}$ in the secondary e. m. f. of B. Let y represent the number of cm. per turn obtained in this way.

With the switch, h, again thrown to the left, the liquid to be tested was then substituted for the water in tube A, and a balance again obtained. Let x denote the difference in cm. between this position

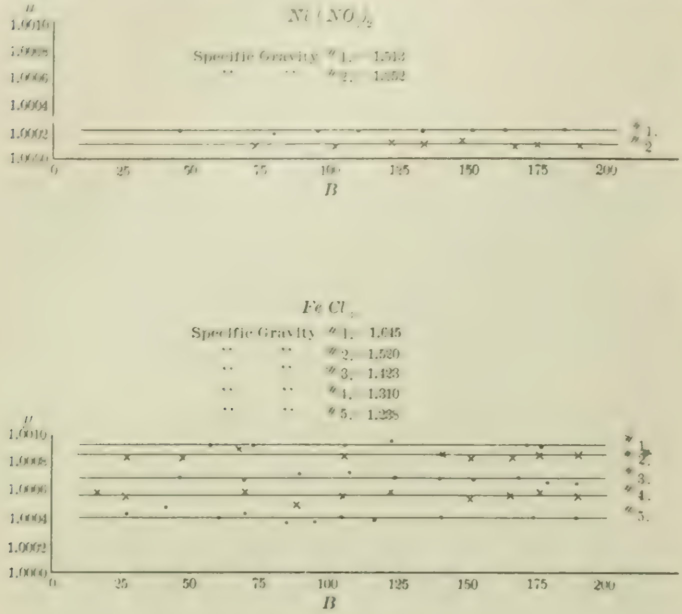


FIG. 3.—VALUES OF PERMEABILITY.

and that found in the first place, when the tube A contained water. We may then write,

$$\mu^1 = 1 + \frac{x}{y} \times 0.001. \tag{1}$$

μ^1 is not, however, the true permeability, because the thickness of the walls of the tube and of the primary winding must be taken into account.

Let R denote the radius of the outside of the tube plus one-half of the thickness of the primary winding, and r the radius of the inside of the tube. The total magnetic flux with the inside filled with water would then be very nearly given by the equation,

$$\Phi a = \frac{4 \pi n i \times \pi R^2}{l} \tag{2}$$

in which n = number of primary turns, i = current in amperes, l

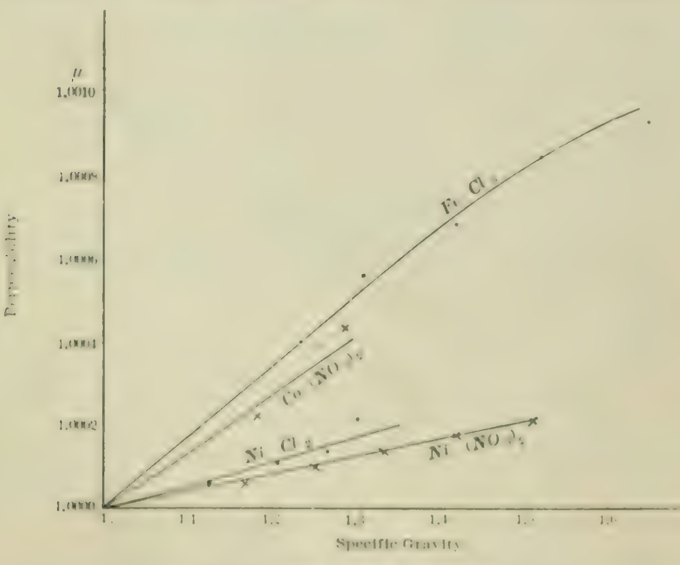


FIG. 4.—PERMEABILITY CURVES.

= length of the tube. When the tube is filled with the liquid to be tested, the flux becomes,

$$\Phi\mu = \frac{4 \pi n i \times \pi r^2 \mu}{l} + \frac{4 \pi n i [\pi (R^2 - r^2)]}{l} \tag{3}$$

This equation is only true when the permeability of the liquid is very nearly equal to unity; the whole method, in fact, depends upon the same assumption.

Now, the apparent permeability which is experimentally determined is $\mu^1 = \frac{\Phi_\mu}{\Phi_a}$ therefore, from equations (1), (2) and (3),

$$\mu = 1 - \frac{R^2}{r^2}(\mu^1 - 1) = 1 - \frac{R^2}{r^2}\left(\frac{x}{y} \times 0.001\right) \tag{4}$$

The value $\frac{R^2}{r^2}$ was carefully determined, and found equal to 1.94.

All the values of permeability given in Figs. 3, 4 and 5 were, therefore, obtained from the formula.

$$\mu = 1.00194\,\frac{x}{y}. \tag{5}$$

In performing the experiments, great care was taken to keep the temperatures of tubes A and B equal, in order to prevent the introduction of an error, due to a difference in expansion in the two sets of windings.

It will be seen that, in the case of all the liquids tested, the permeability was found to be independent of the magnetic induction. This is probably due to the fact that the observations correspond to points which are on the straight portion of the magnetization curve. Whether this is true or not, however, remains to a great extent a subject of speculation. The difficulty in carrying the induction higher lies in the rise in temperature due to the large i^2r loss in the primary windings

Figs. 4 and 5 are interesting in that they show practically a straight line relation between permeability and both specific gravity and per

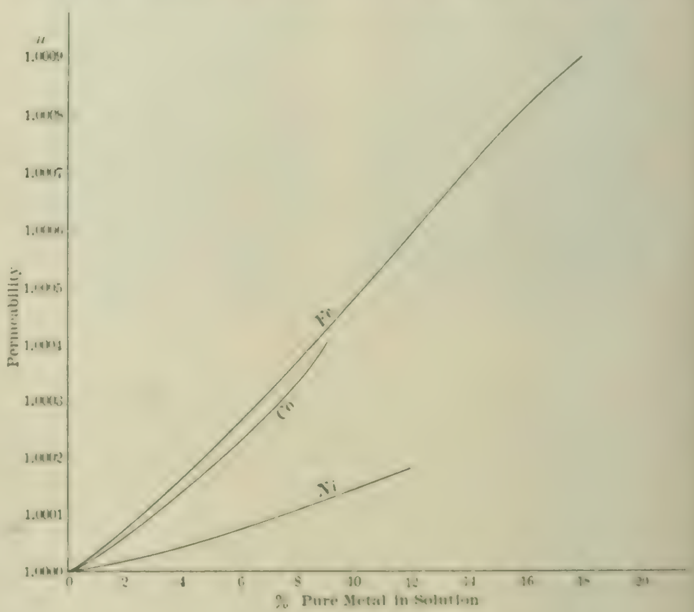


FIG. 5.—PERMEABILITY CURVES.

cent. of metal in solution. This result is one that would be expected from Ewing's theory, in that an increase in the number of elementary magnets per cubic cm. would involve a corresponding increase in the number pulled into line for a given value of $\mathfrak{H}$.

The method described involves practically the same idea as the Hughes' balance, and is both direct and easy of operation compared with other methods when brought to the same degree of sensitiveness.

"The Eye of God."

According to the London *Globe*, of a recent issue, a good story is told of how the Mullah, who is at present giving so much trouble in Somaliland, worked one of those "miracles" which drew many waverers to his banner. An English man-of-war was sent to demonstrate off the coast, and at night threw a searchlight onto the jungle-covered mountains. Abdullah was in hiding there, and knowing from his visits to Aden what it was which his followers hailed as a new star, had the wit to use the circumstances to his own end. He told them that the light was seeking him, and when the electric rays actually flooded his encampment, he cried in triumph, "Will you deny now that I am under the eye of God?" a claim which was admitted with prostrations by the Somali.

The Determination of Central Station Rates.

BY C. J. SPENCER.

DURING some recent work on the installation of isolated plants, occasion arose to make a great many calculations as to whether the plants would pay for themselves. These instances became so numerous that a system was evolved by which the relative costs could be compared and shown graphically. The loads in these cases were of such an even character that, when compared with the best rates obtainable from outside companies, the plants would show a saving. This is a matter of interest to all those engaged in the selling of electric light and power, and it is of advantage to such persons to know wherein their rates are at a disadvantage.

At the present time there are several systems of charging for current, among which are the following:

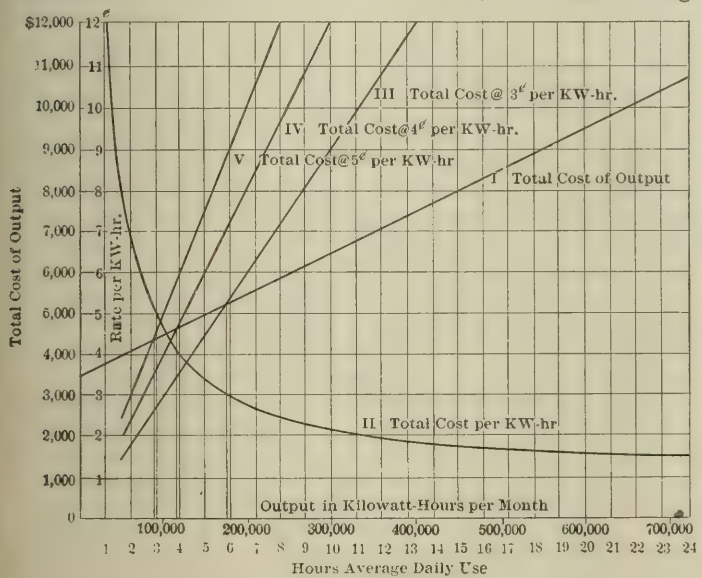
I. An amount per lamp and per horse-power installed per month.

II. An amount per kilowatt-hour.

III. An amount per lamp and per horse-power installed, and an additional amount per kilowatt-hour.

IV. An amount per kilowatt-hour, which varies as an inverse factor of the use of the current.

System I. is evidently unfair, for those persons who burn their lamps and run their motors continuously would pay no more than those who use their equipment a short time. Under system II. a manufacturer, or any one else for that matter, could install a large



CURVES FOR DETERMINING RATES.

motor and run it only a few minutes each day, thus requiring a large capacity in generators with an equivalent return. An ideal system from the producers' point of view would be one in which the rate charged depended on the load on the power plant at the time of the use of the current. This may be approximated in an assumed case of a power plant, without means of regulating the voltage, by charging by the ampere-hour. Then, at times of heavy load, the voltage would be low, and an ampere-hour would not represent as much energy as at times of light load and high voltage. This system cannot be satisfactory, since the required change of voltage would be too great to allow of satisfactory service. Watt-hour meters may be employed, containing clock work with a changeable gear and set to register a higher amount at those hours at which the heaviest loads occur.

As an alternative to the above the proposition can be attacked from the consumer's point of view. He is not interested in what the electric energy costs the supplying company. What he does want is electric energy at a cheaper rate than that at which he can produce it. The producer now selects his rates so as to compete with the cost to the consumer of operating an isolated plant, and bases his charges on system III., charging a fixed amount to cover the fixed charges for power-station equipment, and an amount for coal, water and supplies depending on the energy delivered; or else employs system IV., basing his charges on the use of the current.

The following is a systematic method of determining the rates to be charged under system IV. Take, for example, a station with a maximum capacity of 1,000 kw, and costing $200,000. Let us assume the following costs as including a fair profit: Attendance, $500 per month; coal, water and supplies, one cent per kw-hour; fixed charges, including depreciation and repairs, insurance, taxes and interest on the investment, $3,000 per month. Then the constant cost per month amounts to $3,500. This amount must be spent in order to secure a capacity of 1,000 kilowatts, no matter what the output may be. Curve I. is plotted, starting with a cost of $3,500 per month and at an angle corresponding to one cent per kw-hour, thus representing the total cost of output. Curve II. is obtained by dividing the output into the total cost, as shown on Curve I., and thus shows the cost per kw-hour for any output. Curves III., IV. and V. are given for comparison, being the cost of output at the 3-cent, 4-cent and 5-cent rates. A fact, which is at once apparent, is that these curves cross Curve I. at the same output at which Curve II. intersests the corresponding rate. The maximum output is gotten when running continuously, and is equal to 1,000 kilowatts, 24 hours per day and 30 days per month, or 720,000 kw-hours, at which output the rate is but one and one-half cents per kw-hour; therefore, this would be the rate for a continuous use of the entire installation. Furthermore, this maximum output can be divided into 24 equal parts, each one of which represents one-hour average daily use per month. The rate for this power station would then be 3 cents per kw-hour for six hours average daily use, 4 cents for four hours, 5 cents for three hours, 7 cents for two hours, etc.

The hours average daily use of current is obtained by dividing the kw-hours consumed per month by 30 times the maximum requirements. It is not correct to take the maximum requirements in kilowatts in the case of an alternating current, for the capacity of the generators depends on the voltage and current. After obtaining the hours average daily use, as above, look along the curve and find the price per kw-hour for this use. The result is an equitable charge, and is easily understood. It also has the advantage of preventing customers from installing twice as much light or power as they need, and which they rarely use, thus requiring a larger station, and consequently larger investment without a fair return.

Development of the Paris Underground.

The original line of the Paris Metropolitan runs through Paris from east to west, from the Vincennes to the Neuilly barrier, and merely required tunnels under the Fauborg St. Antoine, the Rue de Rivoli, the Champs Elysées, and the Avenue de la Grande Armée. The branches from the Place de l'Etoile to the Trocadéro and the Porte Dauphine were also easy operations. But the line from the Place de l'Etoile to the Place de la Bastille, a section of which was recently opened, is of a different character. The line had to pass over or under three trunk railways, for level crossings were out of the question with lines by each of which hundreds of trains daily entered or left Paris. The Metropolitan line accordingly tunnels under the Western Railway in the Boulevard des Batignolles, 100 yards from St. Lazare station, but that line is not very wide, nor is it much below ground. Not so with the northern and eastern lines, which are both wide and deep where they pass under the boulevard. The Metropolitan, therefore, emerges from underground, and at a very sharp gradient becomes a viaduct passing along the middle of the boulevard.

Still more noteworthy is the work going on under the Place de l'Opéra. Three stories, so to speak, of railways are there being constructed. One line from Auteuil to the Opéra, another from the Place du Danube at the northeastern extremity of Paris to the Palais Royal, and a third from Courcelles to Ménilmontant all reach or pass this spot, which will therefore be the great center of traffic, and there will be a station serving all three lines, yet almost imperceptible from the surface. Just as the Crédit Lyonnais has three stories of vaults, there will be three stories of lines, with stairs so arranged as to make ingress or egress easy. A projected line from Montmartre to Montparnasse, cutting Paris from north to south and tunnelling under the Seine has not yet been commenced.

One result of the lines already opened is that several omnibus and tramway lines have been given up for want of traffic, and that the companies have instituted an action against the municipality for allowing the break-up of a monopoly for which they pay a considerable sum.

Measurement of Light.

In introducing the papers at the recent meeting of the American Institute of Electrical Engineers, President Scott set forth some general considerations on the efficiency of sources of light and their measurement. It is difficult, he said, for us, whose streets and houses are illuminated almost as well by night as by day to realize that it was only a trifle over a century ago when inventors began to make improvements upon the primitive lamp which had done service for many thousands of years. The fuel for lamps was principally solid or fixed oils until the advent of mineral oils within the past fifty years. The general change from candle sticks to lamp chimneys was in the days of our fathers and mothers. Gas lighting became common in London in 1816. The electric lighting on a commercial scale has come about with the easy recollection of all of us. It was the demand for illumination and the development of electric lighting which gave the electrical industry its great impetus and it is still one of the most important branches of electrical work. If time permitted, it would be interesting to study the influence of artificial illumination as a factor in civilization, to note its effect upon domestic affairs, social customs and industrial activity.

Light as a commercial product must be measured. Although it is one of the most common commodities and has been for years sold daily to millions of customers, yet there is scarcely any commodity in which the standards and methods of measurement are so inadequate. Gas is sold by volume and not by the quantity of illumination produced. Electricity is sold by the quantity of current or of energy, which is probably quite satisfactory to the central station. When, however, the measurement of the light itself is considered, the methods and the standards are inadequate and often illogical; for example, the candle power of an arc lamp has been so unscientifically stated that as a makeshift it is often designated by the watts consumed irrespective of the actual quantity of light or of the difference in the quality of light from various lamps.

Although the measurement of the invisible, intangible, subtle flow of electricity is effected with the greatest degree of refinement and precision by instruments which are the embodiment of simplicity in design, construction and operation and the electrical units of measurement are among the most definite physical standards, yet the measurement of light and of illumination is one for which the standards are not simple and convenient and for which the methods of measurement are difficult and inconvenient, and unsatisfactory and inadequate. Peculiar difficulties are inherent in the problem, as it involves physiological as well as physical elements. The only purpose of illumination is the production of a certain effect upon the nerves of the retina, and popularly speaking, it is the amount of this effect which is termed the intensity of the illumination. The color and character of the light, as well as its quantity, are elements of the first importance both objectively when considered in a physical and in a scientific sense and also subjectively in their relation to vision. These effects are by no means the same with different individuals nor are they constant with the same individual.

In discussing the operation of incandescent lamps on low frequency alternating current, the late Prof. Rowland once remarked that the proper test would be to have an old lady use the light for reading and see whether it hurt her eyes. At first this suggestion seemed rather out of place, but I rather think that the leading physicist of America was not far wrong when he proposed the physiological rather than the physical test to determine the suitability of a source of light.

In a scientific sense the quantity of the energy which is luminous and which is capable of affecting the retina is the important element when determining the efficiency of a source of light. This luminous energy is quite small compared to the heat energy which is wasted energy so far as the eye is concerned. In a physical measurement of the efficiency of illumination the total quantity of light emitted is the only quantity to be considered. In determining this it is necessary to obtain the total radiation and it is for this purpose that the mean spherical or the average candle power in all directions is measured. In general, it is not total illumination which is of practical consequence; it is effectiveness in illumination which is wanted, and not so many total candle power or so many watts consumed. Effective illumination involves quantity of light, color of light, distribution of light and the canons of adequate and acceptable illumination are physiological as well as physical. Two sources of illumination which emit the same aggregate quantity of light cannot be placed upon a commercial parity if one of them throws a greater proportion of its light up when the illumination should be downward or vice versa; nor if one gives yellow light which is less effective than the white light of the other; nor if one emits its light from a single intense source, whereas the other may send its light forth from numerous points or an extended area.

It is well to study carefully and make intelligent use of the physical methods of measurement. Such methods are certainly useful in comparing different lights of the same kind or order and they greatly assist one who is experimenting to increase the efficiency of a given type of lamp. But in our study of the standards to be used in the measurement of light and the methods and apparatus which are suitable it is fitting that we should have in mind the general problem of illumination. We must recognize that although electric lighting is of prime importance in contributing to the general welfare and in its commercial aspects, nevertheless, all of our present methods of producing electric illumination require an exorbitant expenditure of energy for the production of a given quantity of light on account of the large amount of waste heat; also that the present methods of supplying light usually give a distribution which is uneven, ineffective and unsatisfactory; and also that the present methods of measurement, although susceptible of a fair degree of physical precision do not adequately measure what is of first importance, namely, the effectiveness of illumination.

To the discussion of the papers read at this meeting Mr. A. J. Wurts has communicated a criticism on the value of the mean spherical candle power as a standard expressing the flux of light. Taking for illustration the various well-known electric lights—the incandescent, the arc, the Nernst, the Hewitt and the Bremer—Mr. Wurts states that these all differ widely in both quality and effective illuminating powers for a given set of conditions, and cannot consistently be compared by the standard of mean spherical candle power.

In years gone by, when the incandescent lamp was practically the only electric lamp in commercial use, and later, even after the arc lamp had been introduced, the photometric determination of candle power served a purpose and gave a nominal rating to these lamps, but the great difference in candle power between the arc and incandescent was such that comparison between them on a basis of mean spherical candle power was of small consequence. With the advent, however, of new illuminants, the question of fair comparison becomes at once a matter of considerable practical importance.

In the laboratory, the photometer has proved itself a valuable guide in determining the relative life and efficiency of illuminants under varying conditions, and if there were only one kind of illuminant to be considered, then units differing slightly in candle power could be easily and satisfactorily compared with this instrument, either by direct measurement or by the mean spherical candle power method, but with illuminants differing widely in candle power, quality and distribution of light, neither the direct measurement on the photometer nor the mean spherical candle measurement offer a fair basis of comparison because two lights having the same mean spherical candle power might differ widely in quality and distribution of light or effective illuminatng power; for example, let us consider two lights exactly the same in every respect except that one throws all its light upward, whereas the other throws it all downward. Both have the same mean spherical candle power, but obviously not the same effective illuminating power for a given purpose.

Mr. Wurts says that it follows logically and as a matter of fact that a user of light never, it may be said, inquires about the mean spherical candle power of an illuminant; the only use he makes of a photometer is to test with it some guarantee of candle power which may have been furnished with his lamps. The practical user in negotiating for this or that illuminant is more interested in the effective illuminating power of the lamp in queston than he is in the mean spherical candle power, and by effective illumination is meant that amount of light which is reflected to the eye from the objects it is desired to see. The total light flux is of no consequence to the dry goods man or his customers, to the hotel keeper or his guests, except in as far as upward or horizontal rays may be reflected from ceiling and walls. Interest centers rather in (1) the quality of the light; (2) the effective illuminating power; and (3) cost of maintaining the illumination. If this last statement be correct, may not the comparison of various illuminants as to the three points involved be more practically and satisfactorily determined in some other way than by the mean spherical candle power method: that is, by a method which does not place on an equal footing a sphere of soft white

light and a search light, assuming that both have the same mean spherical candle power?

Mr. Wurts in his communication also gives a description of means for comparing different illuminants which, though old, seems to be worthy of more attention than it has yet received and one which also seems to be capable of considerable development. The photometer in question provides a means for comparing the effective illuminating powers of various illuminants and involves every characteristic, advantage and disadvantage which may be found in any particular class of illuminants. This method has been used from time to time in a crude way, by placing different kinds of illuminants in the same room and noting the illumination, but could not this idea be carried out on a more practical and elaborate scale by providing two rooms exactly alike in every respect, that is, in dimensions, color and furniture, and then by locating standardized units of light; such as 16 c. p. incandescent lamps, in one room, comparing the effective illuminating power of these lamps as a standard with the effective illuminating power of any other lamp or lamps arranged in the other room in any manner whatsoever which will produce the best results—the most effective illumination with this particular kind of lamp; for example, suppose it be desired to illuminate a dry goods store, the chief points to be considered being the illumination of goods on the counters and on the shelves back of the counters, also boxes and their labels above the shelves to a height of eight feet above the floor. For a given expenditure of energy, can this illumination be obtained more effectively with this or that lamp? In making such comparison of effective illumination, it would seem proper not to make any restrictions whatever as to the position or distribution of the units. Both the lamps to be used as standard and the lamps to be compared with the standard should be located and distributed to the best possible advantage with reference to effective illumination.

With the two-room photometer above described, it would be a simple matter for the observer to place himself in a position commanding a good view of the two rooms for purposes of comparison. The illumination of the standard room might be easily varied by using a considerable number of small units and the wattmeter readings would of course give the relative efficiencies for equal effective illuminating power. If the various illuminants now in the field could be thus authoritatively compared with reference to effective illuminating power and the results tabulated and given to the public, users of artificial light would have before them a reasonable and practicable means of determining the best illuminant for a given set of conditions.

"Fog Boxes" for High-Voltage Insulators.

Mr. J. J. Davis, superintendent of the United Electric Gas and Power Company, which owns a number of plants on the Pacific Coast, and has one generating station at Santa Monica, about 20 miles west of Los Angeles, offers some interesting information regarding experiences with the effect of dust and sea-fog on high-tension insulators. The power house at Santa Monica is located directly on the sea beach, and from there a 22,000-volt line supplies a number of small towns with electric light and power. The pole line for several miles of its distance is either directly on the coast or but a short distance back from it. Ever since the installation of this high-tension line, the company has experienced the greatest difficulty from current leaking over the surface of the insulators and burning off the pins. This was caused by fogs, which are very thick along this coast. It was found that the line worked perfectly in wet weather, but in dry weather dust would accumulate under the bell of the insulator, and in time of fog, the moist atmosphere would pass under the insulators depositing moisture on the dust, which would form a sort of paste, and so establish a sufficiently low resistance path so that the high-voltage current would flash across. In a short time, the pins would burn off, with the natural result that the wire dropping on the cross-arm would burn the cross-arm off, and ultimately swing against the pole, burning it off. Mr. Davis states that the company tried many schemes to overcome this serious difficulty before he hit upon the novel device of fencing in the pins and glass. This new arrangement, he reports, has been shown by practical tests to have completely overcome the leakage, and so prevent the burning off of the pins.

The fog box, which is illustrated herewith, is made of one-inch redwood, 12 inches square, and 4½ inches deep. The box has in its top a round hole 10 inches in diameter, which leaves about 1½ inches all around the outer edge of the insulators. The boxes come up within two inches of the wire, and are mounted on the cross-arm. Previous to the adoption of this scheme, there was one section of five miles of line paralleling the beach which had to be patrolled day and night. The boxes have not been in use, on part of the line, about one year.

The insulators used are the type known as No. 1 Provo, and also Locke 60,000-volts glass. The leakage was clearly not due to the fault of the insulators, because these types have been successfully used on higher voltages in other places, and in wet weather there was no trouble on this line. The trouble came with the fog after a period of dry weather. The company has experimented with insulators made for 80,000 volts working pressure, and the same trouble was experienced as with other insulators. Apparently, the boxes keep the dust and fog from drifting in under the bells of the insulators.

"FOG BOXES" ON SANTA MONICA TRANSMISSION LINE.

Mr. Davis does not consider that a transmission line at very high voltage will ever be successfully operated along a sea coast where there are fogs. To illustrate how trying the conditions are, Mr. Davis cites one case where the company had a 2,300-volt line on Locke glass insulators, made for 30,000 volts working pressure, and in a heavy sea-fog, when the insulators would get a trifle dusty, the 2,300-volt current would leak over and burn the pins. The same thing held true with Provo No. 1 insulators. When this happens with only 2,300 volts, it can easily be imagined what difficulty the company would have in operating without fog boxes on its 22,000-volt line.

The Wilkinsburg, Pa., Electric Club.

As an illustration of the excellent policy of the Wilkinsburg, Pa., Electric Club in providing instruction for its members, we give below the programme up to the holidays. The membership consists principally of employes of the Westinghouse works at East Pittsburg, the officers being as follows: President, E. M. Olin, superintendent of testing department; vice-president, E. Townsend, apprentice; treasurer, L. A. Osborne, works' manager; secretary, C. E. Downton, foreman of apprentices—all of the Westinghouse Works.

Sunday.—Reading-room open afternoon and evening.

Monday.—General or technical lecture.

Tuesday.—Class *A* in elementary electricity: Direct-current apparatus, R. D. De Wolf, instructor. Section 1, direct-current apparatus, C. H. Darrall, chairman. Section 8, switchboards, B. Rowe, chairman. Section 4, railway work, L. Watts, chairman.

Wednesday.—Lecture to East Pittsburg drawing class, D. F. Rogers, chairman; testing, E. M. Olin, chairman.

Thursday.—General or technical lecture.

Friday.—Class *B* in elementary electricity: Alternating Currents, W. D. Cassin, instructor: Section 3, transformers, W. P. Woodward, chairman. Section 6, detail apparatus, T. S. Perkins, chairman. Section 7, road engineering, J. W. Fraser, chairman.

Saturday.—Club rooms open afternoon and evening. Excursions, third Saturday of each month, F. D. Newbury, chairman.

The Armature Reaction of Alternators—III.

By C. F. G[illegible].

COMPENSATING M. M. F.

THE armature m. m. f. equivalent to the direct reaction being determined, it does not suffice to add to the inducing ampere-turns an equal value to maintain the same flux in the armature. This would be admissible only if there were no magnetic leakage; in reality, the field ampere-turns to compensate for the direct reaction increases the magnetic leakage and necessitates the addition of supplementary turns on the field to compensate for the drop of magnetic potential which such increase of leakage occasions.

The ampere-turns corresponding to direct action should, therefore, be multiplied by a coefficient greater than unity. The value of this coefficient is simple of determination. It suffices to apply Kirchoff's law to the field and armature magnetic circuits for the condition of no load, and condition of load with a wattless current I.

Let F be on-load field m. m. f.

$F + F'$ the m. m. f. with load.

F_i = armature m. m. f.

r = reluctance of field poles and frame.

R_i = reluctance of armature (gap, armature iron and pole piece).

R_a = reluctance of field leakage circuit.

ϕ_i = armature flux, assumed to be constant.

ϕ = field flux at no-load for an armature flux ϕ_i.

ϕ^1 = field flux at load for the armature flux ϕ_i.

φ_a = field leakage for field flux ϕ at no-load.

ϕ_a^1 = leakage flux at load.

We have (Fig. 2) for no load.

$$F - r(\phi_i + \phi_a) = R_i\,\phi_i = R_a\,\phi_a \qquad (14)$$

and for condition of load,

$$F + F^1 - r(\phi_i + \phi_a^1) = R_i\,\phi_i + F_i = R_a\,\phi_a^1 \qquad (15)$$

By subtraction we obtain

$$F^1 - r(\phi_a^1 - \phi_a) = F_i = R_a(\phi_a^1 - \phi_a);$$

eliminating $\phi_a^1 - \phi_a$

$$F^1 = F_i\,\frac{r + R_a}{R_a} = F_i\left(1 + \frac{r}{R_a}\right) \qquad (16)$$

The desired factor is thus the latter value, and in general is comprised between 1.0 and 1.1, but in certain cases may exceed 1.5. The calculation assumes that the reluctance, r, remains is the same at no load and at load with a wattless current, I, in the armature. In general, this hypothesis is only realized in the case of short-circuit calculations, to which in preference the author applies the expression. If the reluctance, r, increases by an increment Δr in passing from no load to load, the expression becomes

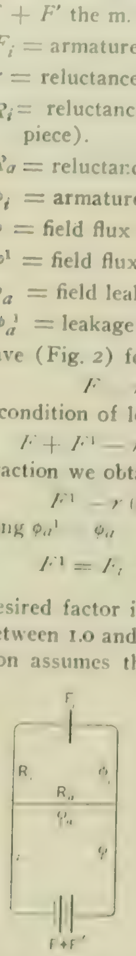


FIG. 2.—MAGNETIC CIRCUITS.

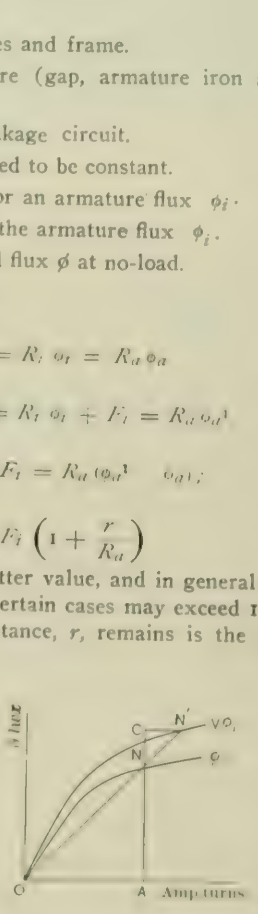


FIG. 3.—NO-LOAD CURVES.

$$F^1 = F_i\left(1 + \frac{r + \Delta r}{R}\right) + \frac{\Delta r\;F}{r + \dfrac{R_a\,R_i}{R_a + R_i}} \qquad (17)$$

This formula presents some interest, for the corresponding correction can be easily obtained by determining Δr or $r + \Delta r$ by means of the no-load characteristic.

The only unknown quantity is, in fact, Δr or $r + \Delta r$. It suffices to remark that the increase of field flux is $\phi_a^1 - \phi_a = \frac{F_i}{R_a}$, which leads to the determination of the value of $r + \Delta r$. To do so, trace (Fig. 3) the no-load characteristic and the curve of no-load field flux, obtained by multiplying the ordinates of the first by v. From the point N, corresponding to the no-load ampere-turns, $OA = F$, a length, NC, equal to $\frac{F_i}{R_a}$ is marked off, and from C a line drawn parallel to OA until it meets the curve at N'. The angle $N'OA$ has for its tangent

$$\frac{1}{r + \Delta r + \dfrac{R_i\,R_a}{R_i + R_a}}$$

The problem can naturally be attacked from the other end. In particular, we can, as Messrs. Giles and Picou have done, determine the increased ampere-turns to maintain with the direct reaction the same flux in the field for no-load.

If Φ' is the flux in the armature at load, we have for the condition of load the two equations

$$F + F^1 - r(\phi_i^1 + \phi_a^1) = R_i\,\phi_i^1 + F_i = R_a\,\phi_a^1 \qquad (18)$$

with the condition that $\phi_i^1 + \phi_a^1 = \varphi_i + \phi_a$.

Combining with equation (14), we obtain

$$F^1 = R_i(\phi_i^1 - \phi_i) + F_i$$

On the other hand, the equation (18) solved for ϕ_i^1 and ϕ_a^1 give

$$\phi_i^1 = \frac{R_a(F + F^1) - (R_a + r)F_i}{(R_a + R_i)r + R_i\,R_a}$$

$$\phi_a^1 = \frac{R_i(F + F^1) + r\,F_i}{(R_a + R_i)r + R_i\,R_a}$$

From the first is deduced

$$\phi_i^1 - \phi_i = \frac{R_a\,F^1 - (R_a + r)F_1}{(R_i + R_a)r + R_i\,R_a}$$

which gives

$$F^1 = \frac{R_i\,R_a\,F^1 - R_i(R_a + r)F_i}{(R_i + R_a)r + R_i\,R_a} + F_i \qquad (19)$$

whence $F^1 = \dfrac{R_a\,F_i}{R_i + R_a} = \dfrac{F_i}{v}$

it being understood that the ratio

$$\frac{R_a + R_i}{R_a} = \frac{\phi_a + \phi_i}{\phi_i}$$

defines the Hopkinson coefficient for no-load.

The expression $\phi_i^1 - \varphi_i$ becomes

$$\phi_i^1 - \phi_i = -\frac{F_i}{R_i + R_a} \qquad (20)$$

The presence of a current I in the armature thus necessitates for the maintenance of constant flux in the field, an increase of ampere-turns denoted by $\frac{F_i}{v}$, and occasions a diminution of armature flux of

$$\frac{F_i}{R_i + R_a} = \frac{F_i}{v}\cdot\frac{1}{R_a}$$

and consequently an increase of field leakage of $\frac{F_i}{v} \times \frac{1}{R_a}$.

This manner of viewing the problem, though less convenient than that which has been indicated above for the case of short-circuiting, is, nevertheless very interesting, as will be seen later, for the conditions of load, for it *alone* possesses the advantage of involving the same induction in the field, and, consequently the same value of r. It can further be assumed that the excitation remains constant, and the reduction then determined of the m. m. f. that will involve the presence of a current, I, in the armature. The calculation will not be made for this case, the result only being indicated.

The reduction of the total field flux is equivalent always to the diminution of the m. m. f. by a quantity $\frac{F_i}{v}$, but the expressions for diminution of the armature flux and the increase of field leakage, which are

$$\phi_i^1 - \phi_i = \frac{\dfrac{F_i}{v}\left(1 + \dfrac{r}{R_a}\right)}{r + \dfrac{R_i\,R_a}{R_i + R_a}} \qquad (21)$$

$$\phi_a^1 - \phi_a = \frac{\dfrac{F_i}{v}\cdot\dfrac{r}{R_a}}{r + \dfrac{R_i\,R_a}{R_i + R_a}} \qquad (22)$$

are somewhat more complicated than the preceding ones, but yet admit of simple application. As in the first case, it will be necessary to make a correction, taking account of the fact that the reluctance does not remain constant, which correction, however, is simple of determination.

The Heyland Single-Phase Motor.

From time to time accounts have appeared in the Digest of the Heyland Motor and of the controversies of which it has been the subject abroad, particularly is connection with questions of priority of invention. It will be recalled that the important feature of this motor is that it starts under load without the use of clutches and special devices of any kind. During the past year the motor has been passed into considerable use abroad, about 3,000 hp now being installed. We illustrate herewith a line drawing of a 150-hp machine recently installed in the London Metropolitan Electrical Supply Station, together with a diagram of connections and performance curves of a 15-hp and 30-hp motor, each of which are direct-connected to a pump.

Referring to Fig. 1, the stator has the usual running and starting winding, the former being (drum) wound in half open slots, and the latter (drum) wound in large square holes. The rotor has a three-phase star-connected drum winding, carried out in half-closed slots, the three free ends being connected to three overhung slip-rings on the shaft; the bearings are self-oiling asd carried upon end shields bolted to the stator case.

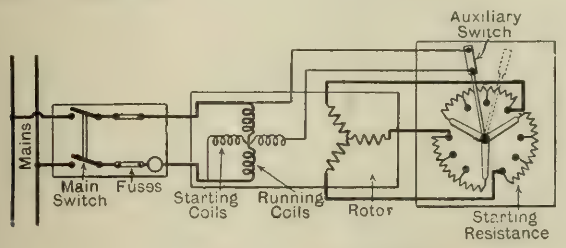


FIG. 2.—DIAGRAM OF CONNECTIONS.

At starting, the two sets of coils are put in parallel across the mains, and a three-legged resistance inserted into the rotor circuit by means of the brushes on the slip rings (see Fig. 2). As soon as the motor has reached a certain speed the starting coils and the resistances are cut out—the latter, of course, gradually. This is the whole operation, and is performed by one movement of the hand-wheel of the starter. For lift work the starter takes the form of a special controller, quite self-contained, with dash pots, etc., it being operated by a rope in the usual manner. For crane work, a controller very similar to a direct-current tramcar controller is used.

Fig. 3 shows the curves of output, current, speed efficiency, power-factor and starting torque of a 15-hp heavy-duty single-phase motors. This motor is directly belted to a deep well pump, making 18 strokes per minute, and is rated at 15 horse-power, 100 volts, 50 periods, and 1,000 revs. per min.; it has run continuously (often day and night) for two years in West Ham, England, under trying conditions, with the greatest success.

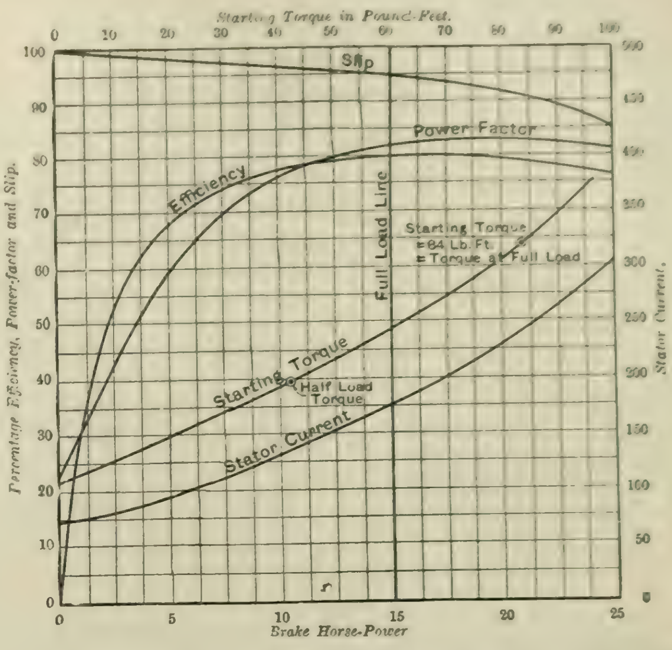


FIG. 3.—STARTING AND RUNNING PERFORMANCE OF 15 B.H.P. HEYLAND MOTOR DIRECT COUPLED TO PUMP.

The 150-hp Heyland motor is probably the largest single-phase motor yet made—at any rate, for such a high frequency as 100 cycles. This motor, which has been running for some time in the Manchester-square sub-station of the Metropolitan Electricity Supply Company, and is used for converting either single-phase current at 100 cycles and 1,100 volts, or, two-phase current at 60 cycles and 1,100 volts, into continuous current at 220 volts.

Tests have shown its most economical output to be 260 hp, while

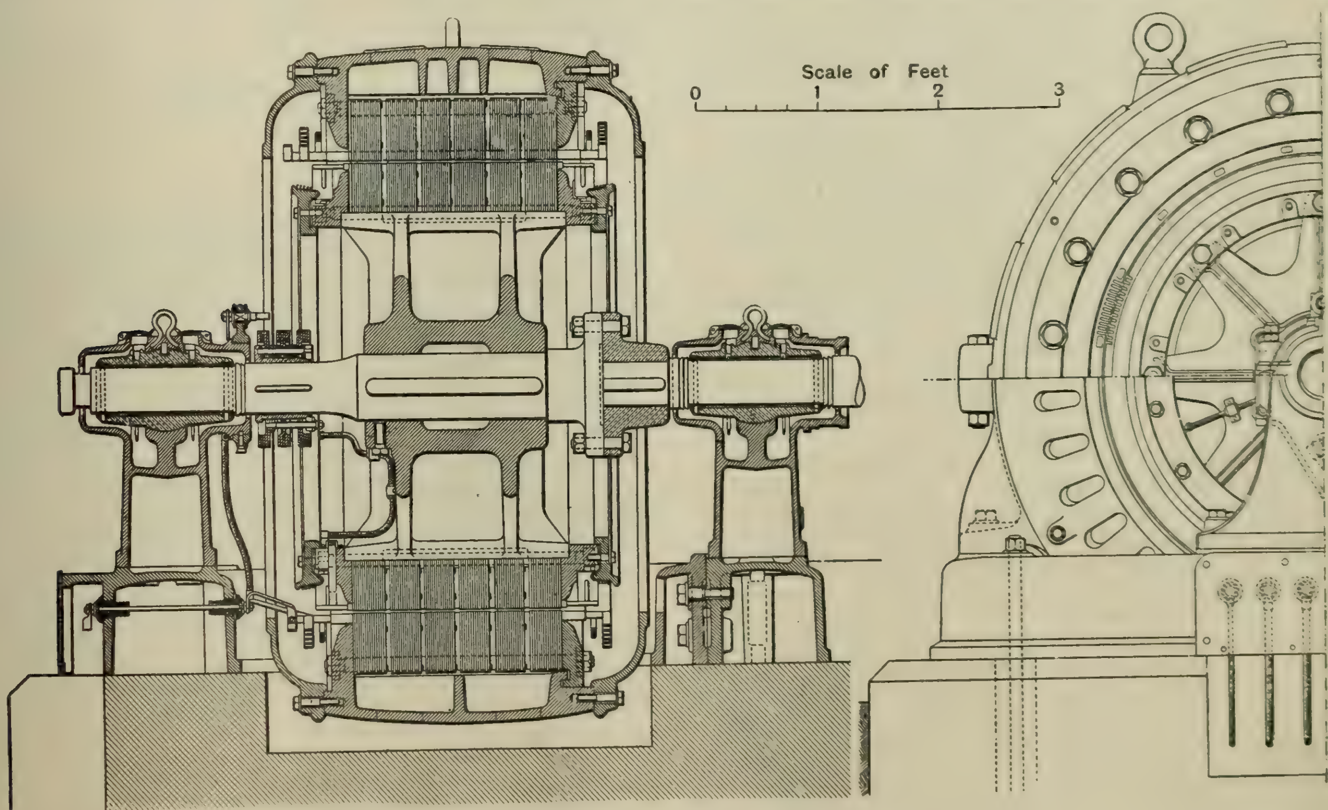


FIG. 1.—SECTION AND ELEVATION OF 150-HP HEYLAND SINGLE-PHASE MOTOR.

its overload capacity was 480 hp before falling out of step, and 350 hp for four hours.

Fig. 4 illustrates the starting and running performance of a 30-hp motor coupled to one of two pumping sets installed for the Hammersmith Vestry.

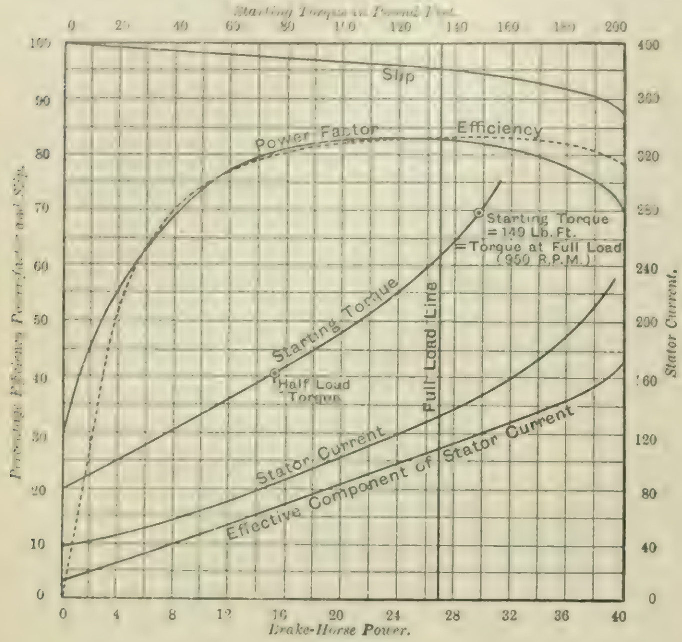


FIG. 4.—STARTING AND RUNNING PERFORMANCE OF 30-B.H.P. MOTOR COUPLED TO A PUMP.

mersmith Vestry. These motors are typical standard motors designed for starting with a maximum torque equal to the full-load running torque.

New Washington Water-Power Transmission Plant.

A water-power electrical generating plant, similar to that at Snoqualmie Falls, is to be installed in the same section of the State at an early date. The company incorporated for this purpose has been merged with the Snoqualmie Company, the new organization being known as the Snoqualmie Falls and White River Power Company. The new development will be on the White River, utilizing Lake Tapps for storage purposes. The accompanying map indicates the course of the transmission lines and the location of the generating and sub-stations.

The general plan on the White River power development is to divert the water of White River at a point in Pierce County, State of Washington, and to convey the waters thus diverted through an excavated canal, a distance of about eight miles, to Lake Tapps. The level of this lake will be raised until it occupies an area of about 5,000 acres and will serve as a storage reservoir and settling basin. The outlet of the lake will be a short canal and tunnel, connecting with a penstock on the brow of the hill overlooking the Stuck Valley. Steel pipes leading from the penstock will convey the water under a head of 450 feet to the waterwheels in the power house at the foot of the hill; and from the waterwheels the water will escape through a short tail-race into Stuck River. The power-house circuit will be connected with the present Snoqualmie Falls transmission system by circuits about five miles in length.

The intake at the point of diversion will be constructed of concrete masonry. The level of the river will be raised at this point in order to effect a full entrance of the water into the intake by the construction of a submerged dam across the river, which will be continued to the intake in the shape of an earthen embankment designed to be higher than the river at any stage. There will also be constructed at the intake and in connection therewith, a set of gates for the purpose of discharging the water back into the river and in shutting the same off from the canal at any time it may be desired to do so for inspection or repair purposes.

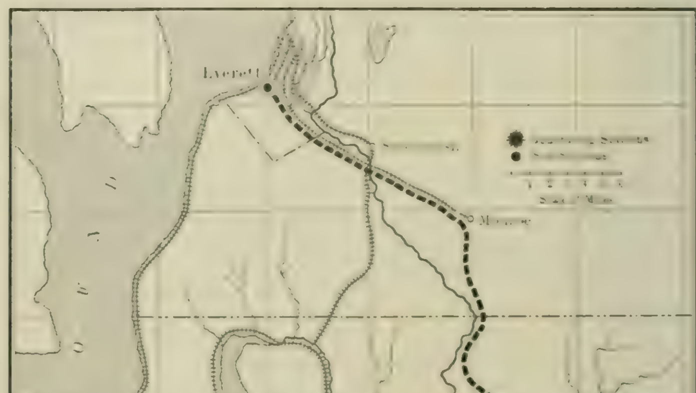
The inlet canal throughout its entire length will be a cut through earth and cement gravel. The canal will be 25 feet wide on the bottom, with side slopes of 1½ to 1 below the water line, and 1 to 1 above the water line, and will flow 6 feet deep. The canal and intake are designed to discharge a volume of water equivalent to 60,000 hp, under 450 feet head.

The contour of Lake Tapps is such that the raising of its level would overflow the lake at eight different points; this, however, is to be prevented by the construction of earthen dams at these particular points. Aside from these dams the only work to be done in connection with the reservoir is to clear about 1,000 acres of land around the lake, and to build a ditch to connect Church Lake with this storage reservoir.

The outlet canal will consist of a channel having the same design as the inlet canal, and the construction of a tunnel which is a prolongation of the outlet canal.

The penstock is designed to receive the full discharge of the canal, and which will be constructed of concrete masonry. The penstock will have five outlets, through which will be discharged the water to the different pipe lines.

The present development contemplates the installation of one pipe line at present, sufficient in size to deliver 10,000 hp. More pipe lines



MAP OF TRANSMISSION SYSTEM.

will be added later, as additional waterwheels are installed. The pipe lines will be of rolled-steel plates, riveted together and supported by concrete piers and anchored firmly to the earth from point to point.

The power house is designed to accommodate a 50,000-hp installation of waterwheels, generators and accessories. The building will be erected in common red brick, although at present it will be erected in part only—sufficient to house a 10,000-hp installation of waterwheels and generators. As an adjunct, there will be a machine shop equipped with a lathe, drill press, shaper and blacksmith forge, with the necessary accessories. There will be installed in the power house two 3,000-kw generators and two exciters of the Westinghouse type, direct connected to impact waterwheels of sufficient capacity to drive the generators under full load.

There will also be erected either separately or in connection with

the power house a transformer house, in common red brick, in which will be installed 10,000 hp of raising transformers.

A frame building will also be constructed near the power house for the purpose of housing the men who will operate the plant, and which will also contain a dining room, kitchen and laundry, and rooms for office, store and drafting purposes.

The incorporators of the new organization are Charles H. Baker, Thomas B. Hardin, Lester Turner, O. D. Colvin and Colonel G. Simpson. Mr. Baker is president and chief engineer of the Snoqualmie company. It is understood that there will be no further extensions at Snoqualmie Falls for a year or more, as it is Mr. Baker's plan to reach Portland, Ore., with the new lines, which the White River power will enable to be done with a saving of 50 miles of transmission. The Snoqualmie and White River plants will be run together, and each will serve as a reserve for the other, the idea being for the former plant to carry the load in Whatcom and the northern cities, while the White River plant will supply Portland and the intervening cities lying to the south.

Owing to the short distance of Tacoma from this great development, that city will be greatly benefitted. The new industries established in Tacoma and Seattle during the last twelve months are declared to have absorbed the entire spare power of the Snoqualmie plant, so that the company has recently had to decline applications aggregating 3,500-hp in excess of its capacity until the new power is ready.

It is reported locally that an industrial enterprise larger than any now existing in the Northwest will soon locate at a point somewhere between Seattle and Tacoma, and that Mr. Baker's new company will furnish several thousand horse-power for its operation. The capital stock of the new company is placed at $2,000,000, divided into 20,000 shares of $100 each.

Thawing of Water Pipes by Electricity.

By William Smith Horry.

It may be interesting to some of your readers to know that the thawing of water pipes in the winter forms regularly an occupation for our electrical force at Sault Ste. Marie. The accompanying illustration shows the equipment used last year, which was in charge of our electrician, Mr. William Gorby. Mr. Gorby has carried on this work every winter for the last six years. He read an article written about six years ago by a college professor pointing

APPARATUS FOR THAWING WATER PIPES.

out that water pipes can be thawed out very simply by causing an electric current to traverse that part which is frozen. He tried it at the first opportunity and found that he very soon had the pipe in service. Since that time he has thawed out all sorts and sizes of water pipes at a large saving in money to the owners. The largest pipe thawed out was a 4-inch cast iron pipe, which was frozen more or less for 200 ft. It took at least half an hour to get water running in this.

The illustration shows a 250-kw transformer mounted on a sleigh. I may explain that Mr. Gorby used this because at the time we had no smaller transformer available. Generally all the pipes in the town can be thawed out by a 500-light transformer, but two of these are ample to thaw out any pipes likely to get frozen. We generally find that at the first appearance of our pipe-thawing apparatus in the winter the rig is besieged with customers all wanting their house pipes thawed out. These people generally claim that it is the company's mains and not their own pipes that prevent the water from flowing, so a bargain is struck generally at about $3.00, payable immediately the water flows, provided it is proved that heir pipes are frozen and not the mains. I may mention that the saving to the citizens of Sault Ste. Marie, Ontario, by the use of this device is very large.

The primary wires (2,200 volts) are bared and the current led through a water rheostat to the transformer. An ammeter shown in the engraving indicates the load on the transformer primary. The secondary is connected to the frozen pipe at two places and the current switched on. In the ordinary house service pipes the water begins to flow very quickly, frequently within a minute.

It may seem a bit dangerous handling the primary current in the way our men do, but I may say that in the very cold weather the snow is an insulator like glass, and although the rig here shown has been employed very largely, no accidents have occurred and the apparatus has never yet failed in getting a frozen pipe working. This application constitutes another evidence of the extreme value of the technical journals to those who read.

Cost of Operating Automobiles.

Some interesting figures and estimates as to cost of automobile operation have lately been made public by Mr. A. Elliott Ranney, who has compared automobiles with horse vehicles. He says that the cost of a fashionable driving outfit used during the winter and spring for shopping, calling, park use, etc., is found to range from $3,030 to $6,610, as follows: Brougham, $1,200 to $2,000; victoria, $800 to $1,800; two horses, $600 to $2,000; double harness, $300 to $500; single harness, $100 to $250; stable clothing, stable tools, halters, etc., $30 to $60. Total cost, $3,030 to $6,610. The expense of maintenance for stable, feed, etc., but not including hire of coachman, would be about $100 a month. A similar motor outfit will cost from $3,800 to $7,500, as follows: Electric brougham, $2,000 to $4,000; electric victoria, $1,800 to $3,500. Total cost, $3,800 to $7,500.

The monthly cost of maintenance, however, not including coachman, should not exceed $70, and in addition the electric outfit is capable of four times the daily mileage of which the best horses would be capable. In other words, a lady could have her carriage at the door every day after breakfast to convey her children to school and her husband to his office, back to the house before 10 A. M. for her to shop, back (after the mistress and coachman have lunched) for calling, receptions, and a park drive, back (after the owner's family and coachman have dined) to go to the theatre, supper, and return home about 12 P. M., and yet no exhaustion of the power, no lame horses, and an ability to repeat the performance day in and day out.

The coachman, moreover, has no horses to clean or feed, no harness to wash, no necessity for going constantly to the farrier and wasting the precious time of his mistress while the horses are being shod, and no good excuse to offer why he should not always be on hand at the request of his employer.

He cannot keep for himself, as his little perquisites, his monthly commissions on feed, stabling or shoeing, nor can he get his percentage on all new horses bought to replace lame or sick ones. He cannot buy sponges, soap, currycombs, brushes, etc., by the score, nor keep his employer's bank account constantly depleted with bills for new harness, new blankets, repairs, etc.

In the case of a light driving outfit for park or suburban use the advantage of the motor vehicle is much greater. The horse outfit will cost from $660 to $1,630, as follows: Buggy or runabout, $250 to $400; horse, $300 to $1,000; harness, $100 to $200; whip, $5 to $10; stable clothing, halter, etc., $5 to $20; total cost, $660 to 1,630. The monthly cost of maintenance would be about $40. A steam carriage capable of covering several times the daily mileage of the horse would cost from $600 to $950 or a gasoline runabout from $650 to $1,300, and the monthly cost of maintenance should not exceed $25, giving a considerable advantage in favor of the motor vehicle, not only in operating expenses, but in initial cost as well.

The Use and Advantages of the Alternating Current for Land Telegraphy—III.

By Edwin F. Northrup.

In Fig. 12 is shown another method of cutting out half-waves. Here the alternating-current circuit is broken at *n* by means of a transmitter, *M*. The trailer *t* moves synchronously around the sunflowers *S*, as before, and by depressing keys K_1, K_2, etc., a circuit is completed through *M*, during the time that *t* passes over the segment which is put in contact with the negative pole of the battery.

A better and more ingenious method of cutting out and reversing

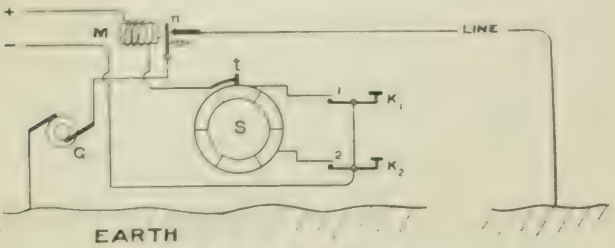


FIG. 12.—CUTTING OUT HALF WAVES.

the half waves is to employ a transformer. The primary idea of this method is due to one of the engineers of the Rowland Company.

A converter *C* is supplied with one secondary winding *S* and two primary windings, S_1 and S_2, S_1 being wound in the opposite direction to S_2. The terminals of the generator *G* are connected across the terminals of one primary winding. The circuit of the other primary winding can be closed through the sunflower device S'_1, by the keys K_1, K_2, etc., as shown. Normally the primary S_1 induces an alternating current in the secondary *S*, which is connected to the telegraph line. If, for example, K_1 is depressed when *t* reaches segment No. 1 a momentary current passes through S_2, and the inductive effect upon *S* is made null by having S_2 wound oppositely to S_1. Again, matters may be so arranged that twice the current will flow through S_2, that flows through S_1, in which case the wave on the line will be reversed instead of cut out.

The modified single half waves when received may be translated, in some ways to be described, into telegraphic signals of any variety. Thus the modified semicycles may be recorded chemically upon tape, or be received as Morse characters on sounders or tapes, or they may be automatically converted by local apparatus into printed characters. To each half wave in a group of waves may be assigned a particular meaning or character. Thus a group of thirty-five (35) half waves may be used to transmit the alphabet and the nine digits, the first wave in the group being *A*, the second

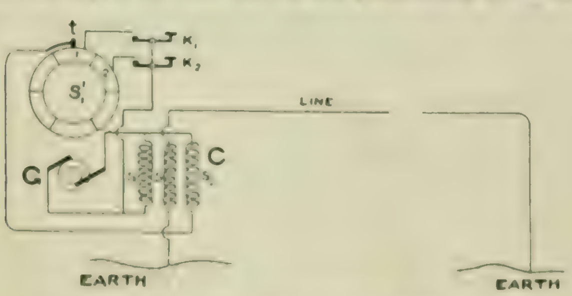


FIG. 13.—CUTTING OUT AND REVERSING HALF WAVES.

C, the third *D*, etc. Thus any one of 35 characters may be transmitted every time that the group of 35 half waves recurs, which in the case of 210 alternations of the current per second means six (6) letters per second, or about 60 words per minute in one direction. Again a modified single half wave may serve in the Morse alphabet as a dot, and two or more modified half waves occurring near together may serve as a short or long dash.

As stated above, another method of impressing signals upon the alternating line current is to modify, for each particular signal, a combination of half waves in a group of half waves. The method now to be described, of making a single telegraphic signal to consist of a combination of two or more modified half waves in a group of half waves, is the important broad principle in alternating current, multiplex telegraphy discovered by Professor Rowland. Others have used the alternating current to transmit telegraphic signals, but to Professor Rowland is wholly due the principle of modifying the waves in combinations.

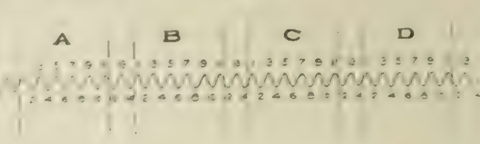


FIG. 14.—GROUPING OF WAVES.

Let *A, B, C, D* represent four groups of 11 waves each of the alternating current. The groups are shown separated from each other by three (3) half waves. Let there be four operators at one end of the line. To each operator is assigned the exclusive use of the line for approximately ¼th of the time, or during the period that a particular group of waves passes over the line. Thus any operator may modify the waves in his own group with affecting the waves in the groups belonging to the other three operators. The half waves between the groups are left for special signals.

Now, if an operator modifies the waves in his group in combinations of two, and never modifies adjacent half waves, he can, out of a group of eleven (11) half waves, make 45 possible combinations.

These combinations are:

1—3,	1—4,	1—5,	1—6,	1—7,	1—8,	1—9,	1—10,	1—11
	2—4,	2—5,	2—6,	2—7,	2—8,	2—9,	2—10,	2—11
		3—5,	3—6,	3—7,	3—8,	3—9,	3—10,	3—11
			4—6,	4—7,	4—8,	4—9,	4—10,	4—11
				5—7,	5—8,	5—9,	5—10,	5—11
					6—8,	6—9,	6—10,	6—11
						7—9,	7—10,	7—11
							8—10,	8—11
								9—11

A telegraphic signal can be made to correspond to each one of these different combinations, and hence four different signals may be transmitted over the line during the time that the four groups of half waves *A, B, C* and *D* are on the line.

If the current has 224 half periods a second then 16 groups of 11 waves each will have passed over the line in one second, which means that 16 telegraphic signals can be sent per second in one direction, or, as methods have been invented by which each signal as received is automatically translated into a printed letter, 160 words per minute can be sent in one direction with a current of 224 half periods per second. The line may be duplexed which will double this capacity.

The practical methods for modifying the waves in combinations are very numerous and cannot be described here to any extent. The following diagrammatic illustration of the best method known to the writer may, however, be of interest. The method is due in part to Professor Rowland and in part to his former assistant engineers including the writer.

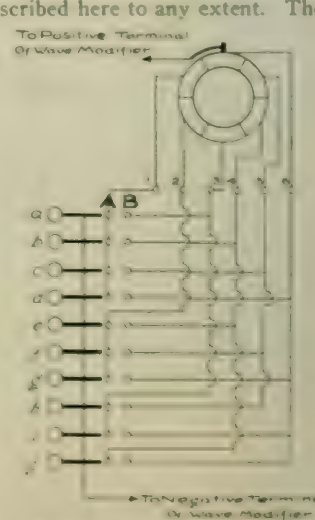


FIG. 15.—MODIFYING WAVES IN COMBINATION.

For the sake of simplification, the diagram is made to show but two waves in a group and only two groups are shown. We will first show that circuits may be electrically combined as follows:

In Fig. 15 the circuits 1, 2, 3, 4, 5 and 6 go to a sunflower and a wave-modifying apparatus. Then let *a, b, c, d*, etc., represent the metallic keys joined together and to the negative terminal of the wave-modifying device, and *A* and *B*, two rows of contacts connected to the circuits, as shown. Depressing a key joins to the negative terminal of the wave modifier the two contacts in rows *A* and *B*, opposite to the key depressed, thus permitting current to flow in two of the 6 circuits, 1 to 6. Thus depressing *h*, combines the circuits 3 and 5, depressing *b*, the circuits 1 and 4, etc. Combining this method with

the principles explained in connection with Fig. 13 we have the arrangement illustrated in the following figure:

F is a sunflower, here shown with 12 insulated segments. The trailer *t* turns synchronously with the alternator or other source of alternating e. m. f., *G*, so that *t*, passes over one segment for each

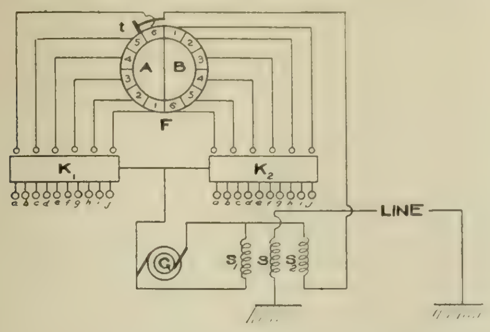


FIG. 16.—WAVE-MODIFYING APPARATUS.

semicycle of the current. K_1 and K_2 are two-circuit combining devices or keyboards tlike that shown in Fig. 15. The remaining parts of the diagram are the same as shown in Fig. 13.

A person depressing any one of the keys of K_1 will modify two waves from group A, but will in nowise interfere with the operator on K_2, who, by depressing a single key will modify two waves of group B. The method is made perfect and complete by employing a mechanical arrangement which locks the keys at intervals, so that they can only be depressed while the trailer *t* is passing over some other group of segments than the group connected to the keyboard being operated, and, if a key is depressed, leaves it locked down while the trailer is passing over the group of segments belonging to the same keyboard.

By the method just described, the alternating current can be divided up into any number of groups of waves, and any combination of waves may be modified in each group, so that 4 or 6, or more, different messages may be transmitted over the line, as if at the same time; that is, the line may be multiplexed to any extent. The number of groups to employ will depend, in any particular case, upon the requirements to be filled, of speed, of transmitting, etc. The total signaling capacity of any line being fixed, it follows that the greater is the number employed of groups of waves, and waves in each group, the slower is the speed of transmission, but the greater is the number of messages and characters that may be transmitted at the same time.

Before discussing further the various possibilities of the alternating current for telegraphy, and before showing how the modified semicycles may be translated at the receiving end into intelligible signals, it will be necessary to describe synchronism. We will show how the use of the alternating current on the line enables one to maintain perfect synchronism between the moving apparatus at the two extremities of the line. This perfect synchronism being secured it is possible to duplicate at the end of a long line any mechanical operation performed at the other end of the line. Hence the methods of synchronism here described have considerable value in other fields than telegraphy.

The earliest practical device for maintaining one or more pieces of rotating mechanism in synchronism with a periodic current, with which the writer is acquainted, is the "Phonic Wheel" described in *Nature* May 28, 1878. Its essential principles are also described as follows in Lord Rayleigh's "Theory of Sound," Vol I, page 67.

"An intermittant electric current may also be applied to regulate the speed of a revolving body. The *phonic wheel,* invented independently by M. La Cour and by the author of this work, is of great service in acoustical investigations. It may take various forms; but the essential feature is the approximate closing of the magnetic circuit of an electromagnet, fed with an intermittent current, by one or more soft iron armatures carried by the wheel and disposed symmetrically round the circumference. If in the revolution of the wheel the closest passage of the armature synchronizes with the middle of the time of excitation, the electromagnetic forces operating upon the armature during its advance and its retreat balance one another. If, however, the wheel be a little in arrear, the forces promoting advance gain an advantage over those hindering the retreat of the armature, and thus upon the whole the magnetic forces encourage the rotation. In like manner if the phase of the wheel be in advance of that first specificed, forces are called into play which retard the motion. By a self-acting adjustment the rotation settles down into such a phase that the driving forces exactly balance the resistances. When the wheel runs lightly, and the electric appliances are moderately powerful, independent driving may not be needed. In this case, of course, the phase of closest passage must *follow* that which marks the middle of the time of magnetization. If, as is sometimes advisable, there be an independent driving power, the phase of closest passage may either precede or follow that of magnetization.

"In some cases the oscillations of the motion about the phase into which it should settle down are very persistent and interfere with the applications of the instrument. A remedy may be found in a ring containing water or mercury, revolving concentrically. When the rotation is uniform, the fluid revolves like a solid body and then exercises no influence. But when from any cause the speed changes the fluid persists for a time in the former motion, and thus brings into play forces tending to damp out oscillations."

The methods of synchronism devised by Professor Rowland for his printing telegraph system are based essentially upon the principles above described. Important modification, however, of details make his methods of special value. An essential principle, first put into practice by Professor Rowland, is to use the same alternating current on the same line both for transmitting signals and for maintaining synchronism. In maintaining synchronous motion for alternating-current telegraphy, there is first the problem of running a small rotating device, or primary synchronizer, in synchronism with the alternations of the line current, and, second, the problem of maintaining by electrical means, larger apparatus in synchronous rotation with the primary synchronizer. Many distinct methods are known to the writer and have been tried by him, of producing both primary and secondary synchronism. Three methods of producing primary synchronism which have been tried and found to operate perfectly, will be described.

Method I.—The alternating current received at station B, over the line from the generator *G* at station A, maintains in vibration the tongues of two polarized relays, R_1 and R_2. These two relays may, if desired, be combined in one relay having two tongues. The tongue of relay R_2 serves for receiving the signals and the tongue

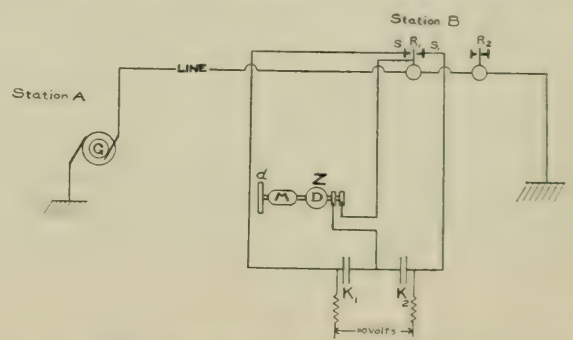


FIG. 17.—PRODUCING PRIMARY AND SECONDARY SYNCHRONISM.

of relay R_1, serves for maintaining the synchronism. K_1 and K_2 are two condensers of about 3 m. f. capacity each. They are connected up as shown in Fig. 17. Is circuit with the wire joining the insulated tongue of relay R_1, and the middle point of the two condensers is the synchronizer *Z*. As the tongue of R_1 vibrates between its contacts, *S* and S_1, an alternating current flows in the synchronizer circuit which has the same period as the current of the line. The synchronizer *Z* consists of three essential parts *D*, a small, light, single-phase alternating-current motor, or a device like the phonic wheel, a small direct-current motor *M*, which takes the load off the alternator and tends to run it at approximately the speed of synchronism, and a mercury damper *d*, like that described in connection with the phonic wheel, to damp out "pumping" or the small oscillations of the synchronizing motor.

This contrivance will run in almost perfect synchronism with the line current. Having this small synchronizer running in synchronism with the lie current, it is a simple matter to run any number of other motors of large size in perfect synchronism with the small synchronizer, and hence, with the line current. The above method of synchronism is the one that was most generally used by Professor Rowland.

Method II.—In this method the tongue of the relay R at station B (the tongue of the signal-receiving relay not being shown) vibrates from the current received from the generator G at station A. M is an alternating-current generator driven, preferably by a direct-connected series-wound motor (not shown) approximately at the speed of synchronism. It is wound with two sets of coils. One set, connected to the slip rings r_1, serves to furnish current for the duplex line, the other set, connected to the slip rings r_2, serves for

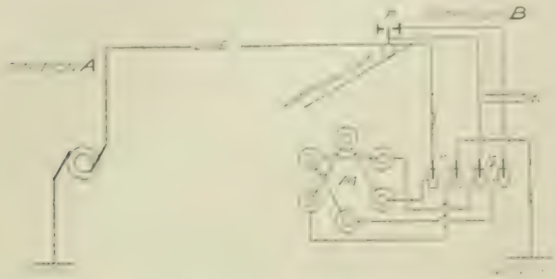


FIG. 18.—PRODUCING PRIMARY AND SECONDARY SYNCHRONISM.

maintaining the synchronism. It was experimentally found by the writer, to whom this method is due, that powerful synchronism is obtained, using a ¼-hp generator, if a condenser K of about 10 m. f. capacity is connected between one slip ring belonging to the synchronizing coils, and one relay contact, the tongue of the relay being connected to the other ring.

Synchronism is due to the variations of load which are thrown upon the alternator, according as the waves of the alternator tend to reach a maximum or minimum value at the moment when the tongue of the relay is touching its contacts. This method gives strong synchronism and is recommended by its simplicity.

Method III.—By the following method, the primary idea of which is due to one of the engineers of the Rowland company, a series wound direct-current motor of any size may be run in perfect synchronism with any regularly periodic electric current. The method may be briefly described as follows:

In Fig. 19, A is the armature, and F the field of a series wound direct-current motor. T is the vibrating tongue of a receiving relay, and is maintained in continuous vibration, by a periodic current received from the telegraph line. (The intermittent or alternating current which may be obtained by means of a vibrating standard tuning fork, could be used to secure a rotary motion of standard and perfectly uniform velocity.)

K is a cylindrical commutating device shown in the diagram developed. That is the surface of the commutator is shown as if cut in a line parallel with its axis and laid out flat. K is mounted upon the axis of the motor M to be synchronized. b_1, b_2, b_3 are three stationary brushes which slide over the surface of K, as it

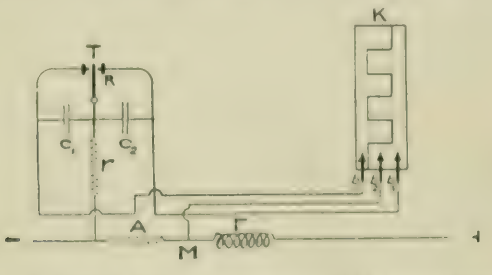


FIG. 19.—PRODUCING PRIMARY AND SECONDARY SYNCHRONISM.

rotates with the motor. The two outside brushes are connected to the relay contacts. The middle brush is connected to one end of the motor armature. The other end of the motor armature is connected through a suitable resistance, r, to the tongue of the relay. C_1 and C_2 are two small condensers which entirely eliminate sparking at the relay contacts. The arrangement operates by throwing, at rapidly recurring intervals, a short circuit of varying duration upon the armature of the direct current motor which tends, normally, to run too fast. It will be seen, by studying the diagram, that the moments when the armature is short circuited, follow each other in rapid succession and that the length of the intervals that a short circuit lasts, is proportional to the phase displacement of the motor from perfect synchronous rotation.

It would be very interesting to follow in detail the numerous features of synchronous rotation, to describe the many ways of obtaining secondary synchronism, to show how synchronous motion may be studied by means of the telephone and optically, to investigate the theoretically best dimensions of the apparatus for obtaining the most perfect synchronism, and to indicate the numerous valuable applications that can be made of synchronous motion. But the original purpose and intended limits of the present article must prevent us from touching upon the above matters.

A single illustration of a simple general application of synchronism will, however, be given on account of the bearing which it has upon the general theory of alternating current telegraphy.

Let R represent the tongue and contact points of a polarized relay. Let it be supposed that the tongue of this relay vibrates synchronously with a periodic current. If the current is alternating, each plus half wave will carry the tongue T against the contact S_1, and each negative half wave will carry the tongue against the contact S. Let K represent a sunflower of six segments and t a trailer. Let R_1 to R_6 represent six polarized relays. Let one terminal of the coils of each of these relays be joined to a common wire C, and the other terminal of each coil to a segment of the sunflower. The common wire C is joined to b, the middle wire of a three-wire circuit, or the centre of a divided resistance, as indicated in P. The contacts S and S_1, of the relay, are joined to the outside wires of the three-wire circuit or to the ends of a divided resistance. The tongue of the relay is joined to the trailer t. Suppose now that by a suitable method of synchronism, the trailer t is made to revolve around the sunflower K, so that each time the tongue T is against the contact S_1

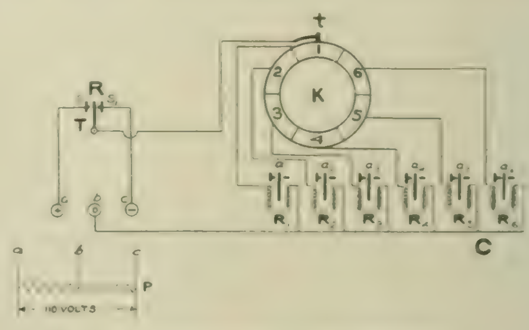


FIG. 20.—APPLICATION OF SYNCHRONISM.

the trailer is on an odd numbered segment of the sunflower, and when the tongue T is against S the trailer is on an even numbered segment. Suppose the relays R_2 R_4 R_6 are wound in one direction and the relays R_1 R_3 R_5 are wound in the opposite direction, then the local alternating current, which by the vibration of the tongue of the relay, is made to traverse the wire connected to the trailer, will supply current in the positive direction to the odd numbered relays, and current in the negative direction to the even numbered relays, but as the odd and even numbered relays have their windings in opposite directions the tongues of all of them will receive impulses in the same direction.

This direction may be chosen to carry the tongues away from their contacts, a_1 to a_6. Suppose now that a wave of the current which is keeping the tongue T of the relay R in vibration is cut-out or reversed. Suppose this wave to be No. 2. Then when the trailer arrives on segment 2, the tongue of R will be against the contact S_1, instead of the contact S, to which it would have been carried by wave No. 2 if it had not been cut-out or reversed. The relay R_2 will now receive, when the trailer reaches segment 2, a current in the opposite direction to that which it normally receives when no wave has been modified. The tongue of R_2 will, therefore, receive an impulse which will carry it against its contact, a_2, where it will remain until the trailer has again returned to segment 2, when, if the wave No. 2 has not been modified a second time, it will return to its back stop.

Now, as any number of half waves may be cut out or otherwise modified, and in all manner of combinations, the tongues of any number of local relays may be controlled at a distance so as to go over in any order or on any desired combinations against their contacts and then be later automatically returned to their back stops. Now the tongues of the local relays by closing contacts, that electrically control local apparatus of any kind or size, make it possible by means of the alternating current and synchronism, to

transmit Morse signals, printed messages, diagrams, or duplicate mechanical motions, or perform most any desired operation at the distant end of any telegraph line through which a current of a few milliamperes may be forced.

Water Power Development for Atlanta, Ga.

An important Southern hydro-electrical power transmission enterprise projected by Eastern capitalists involves the immediate construction of a concrete dam across the Chattahoochee River at the Bull Sluice Shoals about fifteen miles from Atlanta, Ga., and the erection of a generating station at the dam. The plant will have an ultimate capacity of 14,000-hp at the generator terminals, of which but 6,000-hp will be available at the present time. The remaining 8,000-hp will be installed as rapidly as is warranted by the local demands for power.

The development of this undertaking involves an expenditure of over $1,500,000, all of which has already been subscribed by the promoting interests comprised in the Atlanta Water & Electric Power Company. This corporation has been formed under the laws of Georgia and is officered by men prominent in hydraulic and electric power enterprises, viz.: S. Morgan Smith, York, Pa., president; Forest Adair, Atlanta, Ga., vice-president; J. J. Spaulding, Atlanta, Ga., secretary and treasurer. The board of directors comprise the above gentlemen together with C. Elmer Smith, of York, Pa., and George C. Smith, of the Westinghouse companies. The entire hydraulic work, including the erection of dam and power house and the furnishing of the hydraulic machinery will be carried out by the S. Morgan Smith Company, of York, Pa. The electrical work will be designed and executed by Westinghouse, Church, Kerr & Company, engineers and auditors for the Atlanta Water and Electric Power Company. The electrical equipment will be furnished by the Westinghouse Electric & Manufacturing Company.

Previous to the final organization of the power company, a commission of eminent hydraulic engineers was appointed to investigate the proposed location of the dam, together with the possibility of interference with the Atlanta City water supply plant, located a few miles below Bull Sluice Shoals, and to make such recommendations as would insure the success of the enterprise, and avert such catastrophes as have occurred in Southern territory within recent years. This commission comprised Mr. John Bogart, engineer of the St. Lawrence Power Company, Massena, New York, and Mr. William De La Barre, engineer of the St. Anthony's Falls Power Company, both of whom have been intimately connected with many important hydraulic undertakings in this country. The report of this commission was entirely favorable to the enterprise as originally promoted, and the work is proceeding with all possible speed in entire accordance with its recommendations.

The dam will be constructed of cyclopean masonry with concrete facings and will be approximately 1100 feet in length, 50 feet high, and 65 feet wide at the base. The geological formation of the river bed, which is hard gneiss rock, is peculiarly favorable to the hydraulic work.

At each end of the dam will be located a concrete bulkhead, each extending 10 feet above the crest of the dam proper into one of which are anchored the turbine penstocks. The power house will be located immediately in the rear of the main bulkhead and built upon the river bed. Seven steel penstocks, each 12 feet in diameter, extend from their anchorage in the base of the bulkheads to the wheel casings, a distance of fifty feet. These penstocks will be controlled by vertical sliding headgates operated through gearing from the crest of the bulkhead and protected by steel trash racks, provision for repairs being made by a series of steel frames for stop logs, should these be necessary. Anchored sluiceways at the base of the bulkhead will be provided for taking care of water during construction of the dam.

The turbines are to be of the horizontal twin inward flow type, manuafctured by the S. Morgan Smith Company. There will ultimately be seven pairs of 2,500-hp each, in addition to two single exciter turbines of 250-hp each. The turbines are encased within a steel casing placed within the penstocks, with the steel draft tubes extending 20 feet below the power house floor, into the tail-race. The shafts extend into the generator compartment, being direct coupled to 1500-kw Westinghouse revolving field alternating current generators. A similar arrangement is employed with the exciter units each of which is 150-kw capacity and capable of carrying indefinitely the entire excitation load.

The generators furnish current at 2200 volts and 60 cycles direct to the station switchboard which is of the Westinghouse No. 11 type, embodying the most recent and approved forms of current metering and controlling appliances. A considerable amount of power will be furnished to local concerns directly from the station bus, thus avoiding transformation losses, but provision has been made for a complete equipment of 1500-kw Westinghouse water cooled transformers which will raise the pressure to 22,000 volts for transmission, should this be decided upon. The present installation will consist of three 1500-kw units with exciters and the necessary controlling apparatus, but the entire power house and equipment has been designed with a view to immediate extension when warranted by the demand for power.

CURRENT NEWS AND NOTES.

LIGHTING THE ST. LOUIS FAIR.—The Bureau of Publicity of the St. Louis World's Fair announces that Chief Rustin, of the Electrical Department, is experimenting with various illuminants to produce the best effects at the Fair. Among the lamps being experimented with is the Cooper-Hewitt mercury vapor lamp. In referring to this light the bureau points out jocularly that Chief Rustin's red mustache assumes a vivid green hue under its rays, and draws various inferences.

STATE ELECTRICAL COMMISSION.—Last winter the Legislature of New York State appointed a commission consisting of C. P. Steinmetz, H. W. Buck and State Engineer Edward A. Bond, to investigate and report upon the advisability of New York State establishing an electrical laboratory at some suitable point in the State. The commission has held several meetings, and on Thursday, November 13, it held a meeting at Niagara Falls, the three commissioners being in attendance. It is intimated that the commission will report in favor of establishing the institution referred to, which will also serve as a standardization bureau. Among other things it is reported that the commission has learned that the amount of capital in New York State directly interested in the development and use of electricity is $1,680,590,290, made up of $217,974,695 representing the capitalization of the companies engaged in the manufacture of electrical apparatus, and $1,462,615,595, the capitalization of the companies involving the use of electricity. These figures practically show the use of electricity in New York State alone.

ALTERNATOR AUTOMATIC REGULATION.—A very interesting system for the automatic regulation of alternators is the subject of a patent granted November 4th to William Stanley and John F. Kelly, the object being to maintain a constant potential at the alternator terminals, whatever may be the demands of the load as to lagging or leading current. The method depends upon an application of the transformer principle to field excitation. The fields are excited by polyphase currents of low frequency—say four cycles when the frequency of the current generated is 60 cycles. When there is a lagging current in the armature, the relative phase of the armature and field currents will be such as to give rise to a reaction reducing the inductance of the field circuit, thus causing more exciting current to flow and thereby maintaining the voltage of the alternator. In case of a leading current, reaction in the opposite sense occurs, which reduces the strength of the field, thus again maintaining the voltage constant. The conditions require that the circuit of the constant-potential exciter and field shall be of low resistance as compared with the field inductance, the amount of current flowing being then practically a function of the field inductance as modified by the reaction of the armature currents. By thus rendering an alternator automatically regulating for lagging and leading currents, the character of the load with respect to these factors ceases to have particular significance with respect to the generating plant, the importance of which consideration is obvious.

INFORMATION WANTED.—We have received the following inquiry from abroad, to answer which we beg our readers' assistance: "Please send us the address of manufacturers of automobiles and cars to be used on mountainous streets which are driven by means of a lateral trolley system and a strain arm fastened on the roof of the carriage which connects the power-transmitting line to the motor by a combined current."

THE SILLIMAN LECTURES.—As announced last week, the Silliman lectures at Yale are to be delivered next year by Prof. J. J. Thomson, of England. These lectures are to be given annually and will consist of a series of about six lectures each year. Prof. Thomson has the honor of starting them off. The lecturer is appointed annually, and it is likely that a new choice will be made each year.

CANADIAN CABLES.—The government cable steamer "Tyrian" is laying a cable in the Gulf of St. Lawrence from Grosse Island to Bryan Island, and from the latter island to Heath Point, Anticosti. This cable will be 114 miles in length. The wireless telegraph stations at Belle Isle Street are, it is stated, doing satisfactory work. All the government signal stations in the Gulf will soon be equipped with wireless telegraph apparatus.

TURBINE GOVERNORS AT SAULT STE. MARIE.—In the article on the "Soo" plant recently appearing in these columns, the statement was omitted that all of the turbine governors, which are of the Lombard type, will be run from one central pressure and vacuum system, instead of each governor having its individual tank and pump. This in connection with the arrangement for controlling the speed of all the numerous units for the generator switchboard panel makes the governing feature of this plant unique.

STEEL ROADWAYS.—It has been definitely decided to begin this week the work of laying a section of steel wagon road on Murray Street from Broadway to Church Street, New York City. The job will be finished in about a week or ten days. Only a single road will be laid in the center of the street, asd loaded trucks coming up the grade from the North River piers will be given the right of way. Gen. Roy Stone, of the Bureau of Road Inquiry, Department of Agriculture, who has the work in charge, states that St. Nicholas Avenue, above 126th Street, would probably be selected as the location for the laying of an up-town stretch of steel road, instead of Seventh Avenue. The mile of steel to be used for the purpose has been given by Mr. Charles M. Schwab. The only steel track road in existence runs from Valencia to Grao, in Spain, a distance of two miles. It cost $9,506 to build, of which $6,890 was for steel. It is used daily by more than three thousand vehicles. The cost of maintenance is $380 a year, as against $5,470 a year spent to keep the road in condition before the steel tracks were laid.

LONDON UNDERGROUND ROADS.—A cable dispatch from London of November 11 says: Prime Minister Balfour announced in the House of Commons this evening that the government was considering the appointment of a commission which shall be empowered to hold a complete inquiry into the subject of underground railways. The appointment of such a commission, according to the view of the solicitor of Messrs. Perks and Yerkes and the chairman of the District Railway, will involve the hanging up of Mr. Morgan's and other schemes yet unsanctioned for two or three years, as a commission is not likely to report in less than that time. Meanwhile the Yerkes and Speyer schemes will go ahead. The matter was discussed to-day at a meeting of the London County Council. Mr. John Burns declared that the tube system was already obsolete. The people did not want to travel in the bowels of the earth. The solution of traffic congestion lay in electric surface lines connected with congested points by shallow underground tracks. The present indications point to the eventual establishment of central control of all the lines, which will have an important influence in the pending schemes.

AMERICAN ELECTROCHEMICAL SOCIETY.—At the November meeting of the council of the American Electrochemical Society, the following new members were elected: George W. Patterson, Jr., Ann Arbor, Mich.; Erik W. Tillberg, Worcester, Mass.; A. A. Knudson, New York; Arthur E. Kennelly, Cambridge, Mass.; C. S. Bradley, New York; Walter T. Taggart, Philadelphia, Pa.; Barthold E. Schlesinger, Boston, Mass.; Max Mauran, Niagara Falls, N. Y.; W. E. Goldsborough, Lafayette, Ind.; C. C. Speiden, Summit, N. J.; F. B. Crocker, New York; Charles J. Greenstreet, Ford City, Pa.; Ashmead G. Rodgers, Niagara Falls, N. Y.; F. J. A. McKittrick, Schenectady, N. Y.; Wm. O. Mathews, Dover Bay, Ohio; E. A. Deeds, Niagara Falls, N. Y.; Dr. A. T. Lincoln, Urbana, Ill.; J. G. Zimmerman, Madison, Wis.; James L. Ewin, Washington, D. C.; Geo. O. Knapp, Chicago, Ill.; C. E. Freeman, Chicago, Ill.; Charles F. Vaughn, Niagara Falls, N. Y.; Harold Childs Pease, Schenectady, N. Y.; Prof. Dr. Fritz Haber, Karlsruhe, Germany. At the same meeting it was voted to hold the annual meeting of the society in New York on Thursday, Friday and Saturday of the week following Easter Sunday. A committee was appointed to arrange with the American Institute of Electrical Engineers for a contemporary meeting to be held in September at Sault Ste. Marie.

SUBMARINE BOAT TESTS.—It is stated from Greenport, Long Island, that the United States to-day possesses the fastest submarine boat afloat in the Moccasin. It was thought to be quite an advance in submarine warfare when the contract for the new boats stipulated that they should make seven knots submerged, especially as this was one and one-half knots above the speed shown by the Holland. The official figures show that the Moccasin made a maximum speed of seven and twenty-eight hundredths knots on its submerged trials. This unlooked for speed was made under the electric batteries and motor, without any assistance from the gas engine. The Moccasin made eight runs submerged, four with and four against the tide, and developed a speed of five one-hundredths of a knot more than that of the Adder. One of the allegations made by those who oppose submarines is that they can be easily picked up by a battleship. This would appear to be refuted by the experience to-day of observers on the shore stationed there to take the time of the boat, who were absolutely unable to pick up the Moccasin on its first run, although she carried a guide mast with a red flag at the head. This happened once before during the trial of the Adder. In the afternoon the Adder and Moccasin made their ten knots awash. This is considered one of the most severe trials. The machinery worked well on both boats. The speed of the Adder during the standardizing trials was announced to-day as seven and one-halt knots for the awash condition, eight and one-half for the surface condition, and seven and twenty-three-hundredths knots for the submerged runs. All are much in excess of the contract requirements.

WIRELESS TELEGRAPHY IN THE NAVY.—Admiral Bradford reports, in regard to wireless telegraphy in the U. S. Navy, as follows: "The bureau regrets that it has been unable to reach any satisfactory arrangement with the Marconi Wireless Telegraph Company for the purchase of its appliances, should it be desired, after testing the same. The company has offered a duplicate set for test, to be returned after the trials have been completed. This company requires, however, the payment of a given sum for each set upon delivery, and a royalty for each year during the life of the patents. The aggregate cost of a set under such an agreement would be very great. In addition, it is illegal to obligate the payment of money beyond a single fiscal year. The bureau regrets that it has been unable to reach a satisfactory basis for the possible acquisition of appliances which have such a good reputation as those of the Marconi Wireless Telegraph Company. It is further proposed to establish wireless telegraph stations for the purpose of instructing officers and men at such stations as Newport, New York, San Francisco and possibly other naval stations. In order to ascertain the effect of heat, which is said to be injurious to the successful working of wireless apparatus, a station will be established at Key West. Most naval powers are far in advance of the United States in the installation of wireless telegraph appliances on board of naval ships. It is the opinion of the bureau, however, that thus far no ground has been lost by reason of the conservative progress of this country in adopting some particular system and supplying it to vessels of the navy. The latter are being prepared, so far as the necessary changes in their masts are concerned, as opportunity offers, and many are ready for the installation of the apparatus, whenever supplied. This may be done without the appliances of a dock yard." Admiral Bradford calls attention to the fact that very few American naval officers are available for the study of wireless telegraphy, while in foreign navies distinguished officers are engaged solely on this important service.

GUTTA PERCHA SUPPLY.—A cable dispatch from Berlin states that the Secretary of the Imperial Posts has granted a large sum of money for the purpose of examining gutta percha found in German New Guinea and deciding as to its fitness for use in telegraph cables.

AN ABSURD BOYCOTT.—Essentially a bad thing, the attempted boycott of the Schenectady Street Railway Company by the local trades assembly seems the worst of the kind. It appears that as the men on the road did not wish to form a union, the General Electric Company owning the road declined to bring pressure on them, as requested by the assembly, whereupon a boycott was declared. The intelligent labor sentiment of Schenectady is, however, overwhelmingly against this absurd proceeding, and everybody is riding on the cars. The traffic has not fallen off five per cent., and it is said that the boycott will soon be declared off.

NEW YORK ELECTRICAL SOCIETY.—The 228th meeting of the society will be held in the large lecture room of the American Institute at the Berkeley Lyceum Building, 19 West Forty-fourth Street, Tuesday evening, November 25th, at 8 o'clock. Mr. A. Frederick Collins will lecture on "Operative Systems of Wireless Telegraphy." The lecture will comprise a brief review of the evolution of the art; current theories as to cause and effect; an analysis of the different systems; and a discussion of the commercial practicability of wireless telegraphy and telephony. This treatment of the subject will be illustrated by diagrams and by apparatus in operation.

STARTING SYNCHRONOUS MOTOR.—A patent granted November 11 to Thomas J. Johnson, on an application filed April 8, 1899, relates to a method of starting alternating current motors of the synchronous type, including rotary converters. In the case of the ordinary synchronous motor, in starting a switch is thrown which short-circuits the armature and sends alternating current through the field; the machine then gets up to speed as an induction machine, when the switch is thrown into another position, which establishes the normal running circuit. A preferable method noted consists in having such connections in starting that the field has only half the normal poles; in this case the switch is thrown in its final position after synchronism has been exceeded, and then the speed drops until at synchronism the armature locks into step. In starting rotary converters by this method, the armature is closed on itself by a ring which short-circuits the commutator.

WIRELESS TELEGRAPHY IN THE PACIFIC.—The Marconi Wireless Telegraph Company of America has a plan for a Pacific and Alaska service. All the important points of the coast will be connected, with a base at San Francisco. For this purpose a complete installation is necessary, and a station like that at Glace Bay, on the Atlantic, will be erected. Options have already been secured on land sites. With the great central station at San Francisco, it is the intention to establish communication with the Sandwich Islands, where the company already has stations. It is also in the general plan to take in Guam and other points necessary to reach the Philippines. Propositions have been received by the Marconi Wireless Telegraphy Company of America to connect, by an all-American line, Alaska and the United States. This will supplement the line already established in the Territory. The projected line from Western Alaska will connect the Yukon River country with Seattle, and its advantage to the people of the coast is apparent. Propositions have also been received to connect Siberia with this line, so that we return to the Collins regimé and the events that just preceded the first success of the Atlantic cable.

AUTOMOBILE CLUB OF AMERICA.—At the annual election of the Automobile Club of America, held at the club house, Fifty-eighth Street and Fifth Avenue, last night, the regular ticket was elected without opposition, as follows: President, Albert R. Shattuck; first vice-president, Winthrop E. Scarritt; second vice-president, James Stillman; third vice-president, W. K. Vanderbilt, Jr.; treasurer, Jefferson Seligman; governors (to serve three years, class of 1905), Col. John Jacob Astor, George F. Chamberlin, and Peter Cooper Hewitt; governor (to serve one year, class of 1903), Harlan W. Whipple. The Contest Committee submitted its report on the recent 500-mile reliability test to Boston and return, and made twenty recommendations regarding the conditions of future contests. The principal suggestions are that the award of certificates be discontinued, that medals instead of cups be offered, that observers be changed daily, that competition among contestants for first arrival at destinations be discouraged, that no time allowances be permitted, that the emphasizing of no stops be avoided and conditions meeting the average touring conditions be made, that after the contest the cars be exhibited for four days in the condition in which they arrive, and that the prices of the cars be taken into consideration in future systems of classification. The balance sheet shows that the club has cash in hand of $5,397, and has $13,240 in dividend-paying securities of high grade.

Letter to the Editors.

Electrochemical Units.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of October 18th you printed a communication from me, wherein I pointed out that a 100-ampere current in one sidereal day, is capable of liberating to within .07 of one per cent. of a cubic metre of hydrogen under standard conditions, by electrolysis. I also called attention to certain numerical agreements between the weight in absolute units, or dynes, of one litre of hydrogen, the number of seconds in a day, and the mean value of gravity, and I suggested that if a demonstration could be made, showing that these relationships were fundamental and absolute in their agreement, such demonstration would be of very far-reaching theoretical importance.

I have read the communication of Prof. Reginald A. Fessenden in your issue of November 8th, wherein he points out that the above coincidences are not physical agreements for the reason that the atmospheric pressure is temporary, varying in its magnitude at different periods in the world's history. He mentions that during the carboniferous age, the atmospheric pressure was probably much greater than now, "consequently the relations must be merely coincidences, and not the expression of any physical law, and cannot, therefore, serve as a proper basis of a system of units." I have to acknowledge that this point is well taken. The pressure of the atmosphere would have to be constant through all time in order that the agreements which I pointed out should be fundamental. As such constancy in pressure would be contrary to the teachings of the nebular hypothesis, it is undoubtedly true that the relationship to the day of time cannot be fundamental.

Inasmuch as, by Faraday's law, equal currents in equal times, liberate electrochemical equivalents of the elements, there is a fundamental relationship between masses of matter and electric quantities. The ideal absolute unit of electrical quantity would be that quantity of electricity which an hydrogen ion carries at the moment of its liberation in electrolysis. The quantity of electricity that frees a litre of hydrogen is related to this latter mass of matter. Its magnitude is as many times greater than the ideal unit just mentioned, as there are atoms in a litre. While it is true that in the course of geologic ages the atmospheric pressure might alter and thereby a litre alter its capacity for hydrogen, still, if its capacity be defined by that which it possesses under 760 millimetres pressure of mercury, provision is made against any such variation. The quantity of electricity involved in the liberation of a litre of hydrogen is a quantity convenient to handle in electrochemical experiments and calculations. There is no fundamental relationship now known between the electrostatic unit of quantity and the charge on a hydrogen ion at the moment of its liberation, nor would there be one between the crith col, or that quantity which liberates a litre of hydrogen and an electrostatic unit. There is here a breach that must be arbitrarily bridged by the actual numeral that establishes the connection. Time is not an essential element in the definition of derived units of electrical quantity. If we avail ourselves of the very close agreements I have pointed out, and define the new units of electric quantity by the day in connection with certain ampere flows of current, while the definitions would not be exact, they would still be so close as to be of great aid to the memory, and of far-reaching service in electrochemical work. This may be appreciated from the following table:

Pound Avoir. Col. = [illegible] ampere days and liberates 1 pound Avoir.—.59%
Grain Col. = .072 ampere days and liberates 1 grain + .2 %
Kilogram Col. = 1110 ampere days and liberates 1 kilogram + .1%
Gram Col. = 1.11 ampere days and liberates 1 gram + .1%
Kilocrith Col. = 100 ampere days and liberates 1 kilocrith + .34%
Crith Col. = .1 ampere days and liberates 1 crith + .34%

A col unit quantity of electricity is a quantity which co-ordinates with a unit of weight, and such unit of weight is used as a prefix to designate such co-ordination. To define the metric coil units exactly in their equivalency to ampere-seconds, we may resort to a number of mean solar seconds that is closely related to the day of time, in which case the numeral, ignoring the decimal point which expresses the number of amperes that must flow for this time in order to equal a kilogram col, or a gram col, becomes naturally the same numeral that also expresses the specific gravity of water with hydrogen as unity of specific gravity. This is shown in the following table:

Kilogram Col. 1112.7 amperes for 86,103 seconds to free one kilogram.
Gram Col. 1.1127 amperes for 86,103 seconds to free one gram.
Kilocrith Col. 100 amperes for 86,103 seconds to free one kilocrith.
Crith Col. .1 amperes for 86,103 seconds to free one crith.

In connection with this last table, it may be added that a crith is the weight of a litre or cubic decimetre of hydrogen, and it equals .089873 grams; also that the gram col liberates 11.127 criths and the kilogram col liberates 11127 criths. This latter figure also expresses exactly the specific gravity of water with hydrogen as unity of specific gravity. These figures are based upon Dr. Edward W. Morley's determination of the weight of a litre of hydrogen, and Lord Rayleigh's electrochemical equivalent of silver, viz., .001118 grams per coulomb. Under these premises, with hydrogen taken as unity of atomic weight, we must attribute 107.11 as being the atomic weight of silver. Dividing the former figure by the latter, we secure the electrochemical equivalent of hydrogen as .000010437867 grams per coulomb. Without dealing further with an intricate fraction like this for hydrogen, we have in the above tables means of telling the electrochemical equivalent of any element, in round numbers, when we merely divide that element's atomic weight by its valency and weigh out the equivalent so secured in terms of any of the weights given.

The results would be the same were the atomic weight of hydrogen taken as more than unity to agree with oxygen as 16.

CLEVELAND, OHIO. ALFRED H. COWLES.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Polyphase Generator.—GRATZMULLER.—An illustrated article on his non-synchronous polyphase alternator. He mentions the alternator of Leblanc, in which the magnetizing currents are furnished by the network to which the generator supplies energy currents; such a generator becomes self-exciting if condensers are inserted in the polyphase circuits of the rotor; it then no longer takes such wattless currents from the network. The present author obtains the same result by different means, with the use of a direct-current armature. He first considers a polyphase alternator with projecting poles, the rotor of which is a direct-current armature with commutators; if the rotor is revolved and the brushes are also revolved but independently of the rotation of the rotor, then the alternator is self-exciting, if condensers or self-inductors are inserted between the brushes according to whether the rotor and the brushes revolve in the same or in opposite directions. He proves the following theorem: let a direct-current armature be traversed by a certain flux, and let self-inductance coils be inserted between the brushes; if the brushes and the armature revolve in inverse sense with respect to the resulting flux, a flux of armature reaction is obtained, which makes an angle smaller than 90 degrees with the resulting flux, and has, therefore, a component in the direction and the sense of the flux. He compares this self-excitation by reaction, with the self-excitation of a shunt dynamo by means of the shifting of the brushes against the direction of rotation. He then discusses the case in which there is a stator of an induction motor, while its rotor is replaced by a direct-current armature with commutator, the brushes which are symmetrically distributed around the commutator, being connected together by means of inductance coils. He discusses this problem by means of dynamos, and shows that in this way a self-exciting alternate is obtained, the stator and rotor having no point of contact, the rotor circuits being closed through self-inductance coils and the stator circuits through inductive or non-inductive resistances. He has confirmed his theoretical results with an experimental machine of this type.—*L'Ind. Elec.*, October 10.

REFERENCE.

Induction Motor.—ZIEGENBERG.—A communication in which he continues the discussion on the definition of conduction motors and induction motors.—*Elek. Zeit.*, September 11.

LIGHTS AND LIGHTING.

Alternating-Current Arc at High Voltage.—MONASCH.—An account of an experimental investigation of the alternating-current arc at "higher" voltages. The use of a higher voltage has the advantage that immediately after closing the circuit the arc is obtained, without first bringing the electrodes together. Moreover, as the current is comparatively small, nearly all metals may be used as electrodes. With a current of 0.02 to 0.068 amperes, the only metals he could not use were bismuth, lead and antimony. For obtaining the high voltage, he has formed single-phase, alternating current of 125 volts and 47 periods "in transformer with open magnetic circuit" (the secondary voltage is not stated). He first studied the relation between the power and the distance between the electrodes for constant current, copper electrodes being used; he found that this relation is represented graphically by straight lines, the watt consumption increasing with increasing distance between the electrodes. The power factor, *i. e.*, the relation of the watts to the volt amperes increases with the length of the arc. With a current of 0.041 ampere, it is 0.58 for an arc of 3 mm. and 0.63 for an arc of 10 mm. In all his experiments the power factor was of the same order of magnitude. He also studied the real watts at constant arc length, as a function of the air pressure, for copper electrodes; the watts increase slightly for increasing pressures; for a current of 0.041 ampere the consumption of watts is about 13 at 100 mm. mercury, and 18 at 750 mm. mercury for an arc length of 4 mm.; for greater arc lengths the increase of watts seems to be greater.—*Elek. Zeit.*, October 30.

Incandescent Lamps.—An article on a method of Siemens & Halske for lengthening the economical life of electric incandescent lamps. The life depends upon two things: the first is the burning out of the incandescent filament, the second is the blackening of the globe, due to pulverization of the filament. The best economy is obtained when both of these limits are reached at about the same time. This is accomplished by placing the filament in a globe of proper size. They have found that this relation exists when a filament of 10 candles, with an energy consumption of 2 watts per candle, is placed in a spherical globe with a diameter of 100 mm.—*Zeit. f. Beleucht.*, October 30.

POWER.

French Hydroelectric Electrolytic Power Plant.—An illustrated description of the Clavaux plant of the Societe d'Electrochemie. There is 5,000 hp. available during eight months, while at low-water level the available hydraulic power decreases to 3,000 hp. The horizontal axle turbines have a capacity of 550 hp, the normal speed being 250 r. p. m. There are five 375-kw direct-current generators, direct coupled to the turbine. A small 80-kw generator furnishes the current for light and for various motors in the plant. Each of the 375-kw direct-current generators is provided with two independent commutators, each giving 2,500 amperes at 75 volts. Only three generators are at work at present. The purely electrolytic processes

are mainly for the production of sodium and peroxide of sodium by the Castner & Hulin method.—*L'Ind. Elec.*, October 10.

Power Transmission in Switzerland.—An illustrated description of the hydroelectric power plant of Beznau, Switzerland. Three-phase alternating current, with a frequency of 50 periods per second, is transmitted at two different voltages: at 8,000 volts, to distances below 15 km. and at 25,000 volts to greater distances; the 25,000-volt currents are transformed down to 8,000 volts in substations. The supply network furnishes current for lighting and motors, the lamps being installed on a three-wire system, with 250 volts between the outers. The 8,000-volt line supplies a district near Aarau, while the 25,000-volt line approaches Zurich and supplies a large industrial district where steam is now in general use.—*L'Ind. Elec.*, October 10.

REFERENCES.

Electrical Engineering in Agriculture.—HAAS.—The paper in full, of which a long abstract was noticed in the Digest.—*Elek. Zeit.*, August 28.

Development of Power Plants.—The twenty-fifth anniversary number contains numerous illustrated articles, among which are the following: A retrospect of a quarter-century of progress by Thurston; the development of power plants by Low; on electrical progress from 1877 to 1902 by Martin.—*Am. Mach.*, November 6.

TRACTION.

Single-Phase Railway Systems.—A long editorial, in which it is said that there are three possible single-phase systems fulfilling the necessary conditions of good starting and speed variation when running: the single-phase repulsion motor, the single-phase series motor, and the Ward-Leonard converter system. Repulsion motors have been constructed of from 10 to 15 hp; "it remains to be seen whether it is possible to develop this motor on the scale necessary for traction purposes with a good efficiency and power factor; at the present time it is of no value for traction." The converter system was recently advocated by Mordey and Jenkin, and a railway on this system is now being equipped in Switzerland by the Oerlikon Company; there is an addition of about 40 per cent. to the weight of the trains. Where water power is available, "this simply means a larger consumption of that which costs next to nothing; but, granting this, and granting also that the saving in power fluctuation might offset the increased cost of plant required to haul the additional weight, still the substitution of a locomotive for direct-motor driving would be a high price to pay for the advantages of speed control which this system affords. The usefulness of the converter system appears to be confined to railways where the variation of load due to grades is excessive, and where the traffic consists of heavy trains that would in any case have to be hauled by locomotives." Concerning the single-phase series motor, reference is made to the recent A. I. E. E. paper by Lamme; the most noticeable feature outside of the motors is said to be the method of control. "If this motor fulfills in practice the expectations formed from its behavior at Pittsburg, it will give a complete solution of the problem of single-phase railways, and a notable advance will have been made in electric traction."—Lond. *Elec.*, October 31.

Removal of Sleet from a Third Rail.—HANCHETT.—An article in which he says that sleet causes more trouble than anything else in third-rail operation. It forms when a light rain is falling immediately after a cold snap, and when the rail is below 32° F., but when the air is above that temperature. He suggests two methods for removing the sleet from a third rail. The first is to switch over the outgoing feeders so that they reinforce the ground return, thus making the third-rail carry the full current. This will heat up the third-rail and will remove the sleet. The writer figures the amount of heat required to raise a 60-lb. rail 10° F., and finds that 50 hp for 10 minutes will suffice per mile of rail. The second method suggested is the use of a transformer car, taking current from the third-rail, and by means of a rotary converter and transformer, passing 2,000 amperes or more of alternating current through the third-rail. The transformer is to be equipped with heavy shoes, capable of making substantial contact with the rail, and located as far apart as it is convenient to place them, but not with too large shoes, as it is desirable that the shoes should become warm in order that they may melt through to a contact surface. The method has not been tried.—*St. R'y Jour.*, November 1, and *Ind. Ed.*, November.

Brakes on Interurban Cars.—An editorial, stating that the rate of braking on electric cars is considerably higher than on steam trains, which is due partly to the reasons that rapid retardation has been felt to be more important in electric work and partly because a motorman has better control of the braking apparatus on a single car than a steam engineer on a steam train. It has been known for a long time that the friction between brake shoes and car wheels with a given brake-shoe pressure is considerably less at high speed than at low. As a result, the best braking effort is obtained by giving a maximum pressure to the brake shoes at high speeds and reducing this pressure as the speed falls off, so as to keep it under the point at which the wheels will slide. In order to do this, it is necessary to carry in the storage reservoir a pressure which will slide the wheels when going at low speed. This practice in itself is not desirable, because with careless use of the brakes there is a chance for flat wheels, but it is justified when very high speeds of over 50 miles per hour must be obtained. Automatic devices have been suggested for varying the maximum brake-shoe pressure according to the speed, but so far they have been too complicated to secure adoption. The air brake in regular service on electric cars differs from the vacuum brake used on steam cars, but is more desirable for the purpose, as the pressure can be more easily regulated and the apparatus is much simpler.—*St. R'y Jour.*, November 1, and *Ind. Ed.*, November.

Grand Rapids Street Railway.—An illustrated article on mechanical novelties on this system. A home-made cast welding outfit is described. The principal difference in the cast welded joints at Grand Rapids is that a certain amount of melted iron is allowed to pass through the mold to heat it up before the joint is actually cast. About 40 lbs. of metal is used for this purpose, after which the joint is cast with about 140 lbs. of metal; the union between the iron and steel is then very good. A cast-iron plate is shown, which is used against the lip of the rail in paved streets, and it has been found to reduce greatly the chipping of the granite paving block, which formerly butted close against the edge of the rail. In the trolley wheel used, oil is introduced into the interior of the hub, and first passes along the interior of the hollow axle of the wheel and afterwards along the outside. A very broad bearing is obtained, which gives a long life to the wheel. The sand box used can be rotated 120 degrees around an axle by means of a button pressed by the conductor's foot, and located near the controller. The track drill employed is operated by a 1-hp motor, and the speed is reduced by a worm gear in the head of the drilling device, the ratio of reduction being 27 to 1, so that the drill runs at 40 r. p. m. The bonds on the road are made of old field wire, from which the insulation has been removed. The ends of the bonds are provided with thimbles, which are inserted in the holes in the web of the rail and riveted. The gear on the axle instead of being made in two halves, as usual, is made of one piece, and is pressed on the car axle before pressing on the wheel. The company believes that most of the trouble with gears and pinions is caused by the gear becoming loose on the axle, and the present practice is intended to obviate this trouble.—*St. R'y Jour.*, November 1, and *Int. Ed.*, November.

Zurich.—A well-illustrated article on the street railway system of Zurich. The track is laid with a meter gauge, and is practically double. A set of sections is given of the track construction. The rail weighs 99 lbs. per yard, and is of Thomas steel with a tensile strength of 99,000 lbs. per square inch. The Falk cast welded joint was carefully considered for use on the entire system, but only a short section of track was equipped with it, to determine the results with Thomas steel rails. A short section of track has also been laid with Demerbe rail. The system has three car houses, which are described in detail. The company has a power station, which it inherited from the former owners, and also purchases power from the city at 2½ cents per kw-hour. Full particulars are given of the overhead construction and rolling stock.—*St. R'y Jour.*, November 1, and *Int. Ed.*, November.

REFERENCE.

Testing Railway Armatures.—An article on transformers for testing railway apparatus. The most troublesome fault in a railway armature in a short-circuited coil. This is often due to careless soldering or carelessness in insulating leads, and is difficult to test in the ordinary way, as the normal resistance between adjacent commutator bars is so low. A process is described in detail, in which a railway armature can be easily tested with the aid of a transformer, if alternating current is available.—*St. R'y Jour.*, November 1, and *Int. Ed.*, November.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

REFERENCE.

Circuit Breakers.—VOGELSANG.—An illustrated description of new automatic circuit breakers of the Voigh & Haeffner Co.—*Elek. Zeit.*, September 18.

ELECTRO-PHYSICS AND MAGNETISM.

Contact Difference of Potential.—BOLEY.—A description of a new method of determining contact potentials between metals. It is based upon the measurement of the e. m. f. of a special class of cell. The saturated amalgams of two metals are associated with two suitable electrolytes, and the chain consists of the first amalgam, the first liquid, the second liquid and the second amalgam. The total e. m. f. is the sum of the potential differences at the various junctions, and if that between the two liquids is negligible, then the one between the two amalgams equals the total e. m. f. of the cell minus the potential difference between the first amalgam and the first liquid minus that between the second amalgam and the second liquid. He has applied this method provisionally to determine the contact difference of potential between silver and lead, which was found to be 0.001 volt, which value lies below the limit of experimental error; the method must, therefore, be rendered more sensitive.—*Comptes Rendus*, September 15; abstracted in Lond. *Elec.*, October 24.

Pressure of Radiation.—LEBEDEW.—An article on the Maxwell-Bartoli pressure of radiation, the existence of which has been experimentally proved by Nichols and Hull, and by Lebedew, and which is assumed to explain the apparent repulsion of comets' tails by the sun, that notable exception to the law of gravitational attraction. According to Lebedew, the pressure acting upon a body exposed to sunlight is a certain fraction of the gravitational attraction, and this fraction is unity minus the reciprocal value of 10,000 times the product of the radius of the body in centimeters and its density with respect to water. The larger and denser the body is, the less will it be affected by the pressure of light. If its diameter is 1 meter and its density that of water, the attraction will be diminished by one-millionth, and our instruments will be unable to discover any effect. When the diameter is about 0.001 mm., or of the order of the light waves, the attraction will be just balanced by the repulsion. The actual repulsion observed in comets will give a means of measuring the diameter of the meteorites of which they consist. His formula cannot be directly applied to molecules, since certain resonance phenomena intervene in this case.—*Phys. Zeit.*, October 1; abstracted in Lond. *Elec.*, October 24.

Energy of Oscillating Discharge.—MARESCA.—An account of measurements of the energy developed by the oscillatory discharge in a vacuum tube, by means of a calorimetric method. About 40 results are quoted, and in each of them the energy dissipated in the tube is sensibly proportional to the square of the discharge potential. The maximum dissipation of energy takes place when the pressure in the tube amounts to 24 mm. of mercury.—*Phys. Zeit.*, October 1; abstracted in Lond. *Elec.*, October 24.

REFERENCES.

Conductivity of Gases.—HARMS.—An account of experiments in which he extends the observations of Geitel and Wilson concerning a residual conductivity of air, and describes a new method for studying the ionization and conductivity of gases.—*Phys. Zeit.*, October 1; abstracted in Lond. *Elec.*, October 24.

Phase Difference.—KOHLRAUSCH.—An illustrated description of a simple lecture-room method for demonstrating the phase difference between current and voltage in an alternating-current circuit.—*Elek. Zeit.*, September 11.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Rectifier.—GUTHE.—A contribution to the theory of the aluminium rectifier. The explanation given by the author for its behavior is that with the aluminium as anode the oxygen gas formed is kept in the meshes of the solid oxide film, and thus prevents the passing of the ions until the potential difference at the terminals of the cell is raised sufficiently to enable the ions to break through the gaseous film. On the other hand, the hydrogen produced by the current when flowing in the opposite direction is not held back in the solid network, but escapes freely; consequently, there is no high resistance when the aluminium plate is the cathode. This view is confirmed by the following experiment: he brought a plate which had been anode, and on which a high resistance had been produced, into a vacuum and found that a large number of minute gas bubbles appeared at the plate, showing the presence of a gaseous film; removing this, at least partially under the air pump, the resistance of the plate was greatly reduced. Some other experiments corroborate this theory. Anions, such as chlorine, do not produce the high resistance, as they act in the same manner as hydrogen and escape freely. He compares this film with a semi-permeable membrane, and constructs a cell consisting of copper, copper sulphate solution, a semi-permeable membrane of copper ferrocyanide, a ferrocyanide of potassium solution, and platinum; he found that only a small current could be obtained in the direction from the copper to the platinum, the counter e. m. f. of polarization rising as high as 20 volts, while the current would pass unobstructed in the opposite direction. He suggests that ordinary polarization may be explained by the assumption of a liquid high-resistance film, possibly of pure water, between an electrode and the electrolyte; this explanation would also facilitate the understanding of the peculiar fact that hydrogen polarization appears to have very different values, according to whether it is liberated on platinum, on lead or on mercury.—*Electrochem. Ind.*, October.

Zinc-Reducing Processes.—DANNEEL.—A description of several processes worked out at the metallurgical laboratory of the Institute of Technology of Aix-la-Chapelle, Germany. The first, devised by Borchers and Dorsemagen, consists in chlorinating raw ore in the presence of salt-solutions in revolving iron drums, by means of free chlorine, obtained at during another step of the process. The chlorides of lead, zinc and silver are then leached out with hot water or hot dilute lyes, obtained during the process; the dehydrated mixture of chlorides is then electrolyzed in a fused state, producing chlorine gas and a mixture of molten lead and zinc. A large experimental plant for studying this process on an industrial scale is being installed by F. Krupp. The second process described was devised by Borchers and von Kuegelgen for treating the waste products of zinc galvanizers. They are dissolved in hydrochloric acid to saturation, the iron is removed, they are evaporated to dryness in iron crucibles lined with lead, the pulverized zinc chloride is mixed with metal oxides, for instance copper oxide and calcium carbide, and is then melted to zinc alloys such as brass. The third process was devised by Dorsemagen for the treatment of siliceous zinc ore to produce zinc and silicon carbide (carborundum). An electric furnace is used; a mixture of carbon and siliceous zinc ore is heated in the furnace by a carbon rod; the zinc is distilled off and there remains silicon carbide. The reduction temperature of the silica is only slightly above the distillation temperature of zinc. The fourth process described is by Borchers and Dorsemagen, and is quite analogous to the last one described. It is used for the treatment of ores containing iron and zinc, in order to get ferrosilicon and iron. The process differs from the last one only in so far as ferrosilicon instead of silicon carbide is obtained.—*Zeit. f. Elektrochemie*, Sept. 25.

Ozone.—LUTHER.—A German Bunsen Soc'y paper on experiments made by Inglis on the electromotive behavior of ozone. He also remarks that an ozone electrode (*i. e.*, a platinized platinum electrode in an ozone solution) assumes a higher oxidation potential if the electrode was previously charged with hydrogen and a lower one if it was previously saturated with oxygen. He also describes an experiment in which there is apparently reduction at both electrodes; the reduction at the anode is explained as a secondary action, due to a primary oxidation with a formation of a higher oxide, which is at the same time an energetic reducing agent. —*Zeit. f. Elektrochemie*, Aug. 28.

Electrolysis of Fused Sodium Hydroxide.—LE BLANC AND BRODE. —A long account of an experimental investigation, the principal results of which are that fused sodium hydroxide containing water has two decomposition voltages, 1.3 and 2.2 volts: in baths free from water the lower decomposition voltage disappears; a 1.3 volts hydrogen and oxygen are formed, and at 2.2 volts sodium and oxygen; in a bath, free from water, sodium alone is formed as the cathode at a voltage above 2.2. It is certain that pure fused sodium hydroxide contains no H or O ions but only Na and O H ions. The phenomena of the electrolytic production of sodium with the Castner process at a large scale, are discussed.—*Zeit. f. Elektrochemie*, Sept. 11, 18.

REFERENCES.

Niagara Falls.—J. W. RICHARDS.—The conclusion of his very long and well illustrated article on the electrochemical industries of Niagara Falls. In this part the following plans, with the processes used, are described: Pittsburg Reduction Company, the Carborun-

dum Company, the International Acheson Graphite Company, and the Acker Process Company.—*Electrochemical Ind.*, Oct.

Conductivity and Freezing Points.—TOWER.—An account of an experimental investigation of the conductivity and freezing points of aqueous solutions of certain metallic salts of tartaric, malic and succinic acids. A peculiar exceptional behavior of nickel and cobalt tartrates and malates, is pointed out.—*Electrochem. Ind.*, Oct.

Silver Salts.—LEY.—An article on the application of electrochemical methods for the determination of the structural formulas of silver salts.—*Zeit. f. Elektrochemie*, Sept. 4.

Colloids.—ZSIGMONDY.—A Bunsen Society paper on colloidal solutions, chiefly on the order of magnitude of the dimensions of the particles, especially of gold.—*Zeit. f. Elektrochemie*, Sept. 4.

Analysis of Food Stuffs.—MEDICUS.—An article giving an account of experiments, made by Mebold, on the electrolytic determination of traces of metals in food stuffs.—*Zeit. f. Elektrochemie*, Sept. 4.

Apparatus.—JORDIS.—An illustrated description of a mercury bath for lecture-room purposes for demonstrating the laws of the vapor tensions of solvents and solutions, by means of a series of barometer tubes.—*Zeit. f. Elektrochemie*, Sept. 4.

Dusseldorf Exposition.—Continuations of the descriptions of the accumulator exhibits at the Dusseldorf exposition by the following German firms: E. Schulz, of Witten; the Pollak Accumulator Works, of Frankfort; also an exhibit by the "Accumulatoren Fabrik A. G., Hagen," on sanitary arrangements in storage battery factories. —*Centralblatt f. Accum.*, Sept. 1, 15, Oct. 1.

American Electrochemical Society.—A very full report of the proceedings of the Niagara meeting of this society, with long abstracts of the papers, all of which have been noticed briefly in the ELECTRICAL WORLD AND ENGINEER.—*Electrochem. Ind.*, Oct.

Pioneers of Electrochemistry.—The beginning of a series of biographical sketches, with portraits. The first is a sketch of the life and work of Charles M. Hall, the second of Alfred H. Cowles.—*Electrochem. Ind.*, Sept., Oct.

UNITS, MEASUREMENTS AND INSTRUMENTS.

A New Measuring Instrument.—DIETZE.—An illustrated description of a new measuring instrument for locating faults, determining the alternating current strength at any point of a line, etc. The instrument is essentially a transformer, the primary of which is the line wire to be tested, while the secondary contains a telephone; an iron ring which can be closed and opened so as to embrace the line wire, forms the magnetic circuit. He was enabled to detect with his instrument an alternating current of 0.005 amp. and 42.5 periods per second; the instrument (without the telephone) weighs only 0.8 kgr. For locating insulation faults it is used as follows. To find a low-resistance fault in a house installation for instance, one may use the supply current of 100 volts, by connecting one pole of the current supply to earth and the other to the circuit to be tested; then a current will flow through the fault to the earth. The instrument is then moved along the circuit to be tested, the line wire being embraced by the iron ring core of the transformer, until one reaches the fault where the current passes from the circuit to the earth; at that point the sound in the telephone ceases. Of course, an alternating current is required for this purpose, and if the current supply is direct current, it is necessary to insert an interrupter in the circuit. The instrument may also be used for quick and easy measurements of the current strength at any point of an alternating current system, if the telephone is replaced by an alternating current measuring instrument. In this way it may also be used for tests of transformers, motors, arc lamps, etc.—*Elek. Zeit.*, Sept. 18.

Ballistic Galvanometer with Movable Coil.—DIESSELHORST.—A summary of the principles which should underlie the construction of a good ballistic galvanometer with a movable coil, such as has recently been introduced on account of its independence of external disturbances. It should be possible to observe accurately the point of reversal; the reversal should therefore not take place in less than five seconds after the impulse; the galvanometer should be sensitive and should soon return to rest; the time of the impulse should not perceptibly influence the deflection, or, if it does, that influence should be easy to calculate. As regards the time distribution of the current impulse, the author shows that the form of the current is quite without influence, provided its duration is short; it certainly has no effect upon the damping. If a d'Arsonval galvanometer is to be used for ballistic measurements, which do not admit of a multiplication method, the best instrument is that which is aperiodic with the external resistance used, and in which the period of undamped oscillation is about 15 seconds. If the damping factor lies between 30 and infinity, it may be so arranged that reversal takes place in five seconds, and that the deflection has gone back to one five-thousandth of the original amount in less than one minute. At the same time, it is possible to arrange it so that of the greatest possible sensitiveness less than 5 per cent. will be lost.—*Ann. d. Phys.*, No. 10; abstracted in Lond. *Elec.*, Oct. 31.

REFERENCES.

Capacity of Polyphase Cables.—DELLA RICCA.—An illustrated article on cable tests. In practice the frequency is low enough to allow electrostatic equilibrium to set in at any instant of the cycle, and the ordinary law of electrostatics for a number of charged bodies holds. There are eight possible tests of capacity with a three-core lead-covered cable, which are discussed in detail and with illustrations.—*Soc. Belge. Elec.*, Bull, 19, May; abstracted in *Science Abstracts*, Oct. 25.

Potentiometer.—A long illustrated description of the latest form of the Crompton potentiometer.—Lond. *Elec.*, Oct. 31.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Signals.—PRASCH.—An illustrated article on the latest form of the electric block signal system of Krizik, as tried on an experimental road of the Austrian railways.—*Zeit. d. Oest. Ing. & Arch. Ver.*, Oct. 31.

Telephone Rates.—DE LAND.—An article discussing "how and why the original increase in telephone rates came about."—*Tel. Mag.*, Oct.

New Books.

THE ELECTRO-PLATING AND ELECTRO-REFINING OF METALS. Being a new edition of Alexander Watt's "Electro-Deposition." Revised and Largely Re-written by Arnold Philip. New York: D. Van Nostrand Company. 680 pages, 160 illustrations, 14 tables. Price, $4.50.

Watt's classical book on electro-plating was recently put into the hands of Mr. A. Philip for revision and the present volume is the outcome. The original is well enough known to those interested in this art to render a review of the new issue as a whole unnecessary, so that mention will be made only of the parts that are new or re-arranged.

After reading Chapters I and II one begins to think that he will find the whole book changed, as these bear but a slim resemblance to the opening chapters in the earlier edition. The archaic machines and batteries for current generation are dropped and their place taken by modern apparatus, motor-dynamos, storage batteries, etc., and modern cell-testing devices are shown. Strange to say, the author has seen fit to devote ten or a dozen pages to thermopiles in spite of the fact that while these for years held out glittering promises, no one has ever succeeded in placing on the market a type that would give commercial service, and the best of them are far from suitable to be placed in the hands of the average electroplating attendant.

Beginning with Chapter II the enthusiasm of the reviser apparently slackened, as from there on the next four hundred pages seem to be exactly like those in the preceding edition, cuts, matter and all. There is probably good reason for this as the art of electroplating reached a stage where further advance was difficult some time since, and the old work of Watt's covered the various processes fully; it might, however, have been desirable to show some of the more modern machinery for planing, sawing and trimming.

In the appendix on electroplating Mr. Philips' hand becomes apparent again, particularly in a brief but interesting section on the manufacture of search-light mirrors, taken from Cowper-Coles paper read before the British I. E. E., and some remarks on the electro-deposition of aluminum where, to parody Charles Lamb, Mr. Philip seems to be of the opinion that "you cannot plate with aluminum."

By far the most interesting part of this edition refers to a subject that does not come under electroplating at all, but under electro-refining, and it was because of this that the old title was changed to the present one. The section referred to is on

the electrolytic refinement of copper, and is handled in a most complete and thoroughly satisfactory manner. Mr. Philip has analyzed with much care the cost of such refining and figured out formulae which are, to say the least, plausible, from which the current density, ground area for buildings, capital outlay and probable return from a refining plant may be calculated.

His formula for the best current density and curves worked out therefrom show the interesting result, that maximum economy is reached, not with a maximum current density in the vats as would at first appear to be the case, but with a density of about 15 amperes per square foot of electrode at the average selling price of refined copper, falling off after that density is exceeded almost as rapidly as it rises up to that point. Further on in the explanation and discussion of various processes for making directly by electrolysis such forms as tubes and sheets of tough homogenous copper, he shows that the higher selling price of the product makes increased current strength economical.

The electrolytic refinement of gold and silver also receives considerable attention, and the recovery of tin from tin plate both by electrical and chemical processes is treated of in some detail, although the author reaches the conclusion that it is only under the most exceptionally favorable circumstances that the recovery can be made at a profit.

These and other additions to the previous edition have added over one hundred closely printed pages and still more firmly establish the right of the book to be considered as the best all-around authority in its field

BOOKS RECEIVED.

The Elements of Electrical Engineering. A First Year's Course for Students. By Thomas Sewell, A. I. E. E. New York: D. Van Nostrand. 332 pages, 204 illustrations. Price, $3.00.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

The Electrical Trades Society (member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Engine Builders' Association, D. N. McBrier, Erie, Pa., Secretary. Next meeting at Sherry's, New York City, December 1 and 2, 1902.

Interstate Independent Telephone Association, Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, December 9, 10 and 11, 1902.

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

New York Electrical Society, Secretary, G. H. Guy, 114 Liberty Street, New York. Next meeting 8 P. M., November 25, at 19 West Forty-fourth Street. Lecture by A. Frederick Collins, on "Operative Systems of Wireless Telegraphy."

Northwestern Electrical Association, Secretary, Thos. R. Mercein, Milwaukee, Wis.

Old-Time Telegraphers' and Historical Association, Secretary, John Brant, 195 Broadway, New York.

Pennsylvania State Street Railway Association, Secretary, John Ruth.

Vermont Electrical Association, Secretary, C. C. Wells, Middlebury, Vt.

U. S. Military Telegraph Corps, Secretary J. E. Pettit, Postal Telegraph Company, Chicago, Ill.

Test of the Clare Storage Battery.

An interesting and successful trial of electric storage batteries was made recently at Quincy, Mass., where the Consolidated Storage Batteries Company of New Jersey conducted tests on the new Clare battery, invented by James P. Clare. The tests on the Clare cell were made in running a 25-foot electric launch of the standard type, furnished by the Electric Launch Company, and were conducted for Mr. Wallace Downey, of the Townsend & Downey Ship Building & Repair Company, of Shooter's Island, N. Y., under the direction of Dr. Louis Bell, Prof. Louis Duncan, who recently took charge of the department of electrical engineering at the Massachusetts Institute of Technology, and Mr. J. H. Hampton, of the Downey Company.

The battery, weighing 1,870 pounds, drove the launch 41.74 miles at the rate of 5.59 miles per hour. In order to compare the Clare cells with a standard cell on the market to-day, the launch was first taken out on August 28th with such a battery, furnished with the launch when purchased. This battery consisted of 44 nine-plate cells, weighing in the aggregate, 1,320 pounds, and drove the launch 24.8 miles at an average rate of 4.88 miles per hour. When the launch finished her run, the battery was practically "dry," and the cells were delivering current at the rate of 1.63 volts each.

The test with the Clare cells were made under practically the same weather conditions and with the identical passengers. The Clare battery consisted of 44 cells weighing 1,870 pounds, an addition in the launch's load of 550 pounds, which was responsible for a corresponding increase of the wetted surface. But in spite of the added weight and increased wetted surface the launch covered 41.74 miles in 7 hours and 27 minutes, an average rate of 5.59 miles per hour; and when the run was finished the cells were delivering the current under 1.75 volts each, which means that the launch would have run several miles farther before the voltage in the cells was brought down to 1.63 volts.

The result of the test showed that the weight per mile of endurance was about 44 pounds for the Clare cell as against about 54 pounds for the competing cell. The representatives of the Consolidated Storage Batteries Company stated that the test was in no sense made against any particular cell, but they claim that the weight of the Clare cell per ampere-hour is less than half that of the best lead grid cells now on the market.

The electric launch on which these trials were made was 23 feet and 5 feet 8 inches beam on the waterline, with about 3 feet draft. She was fitted with a 3-hp standard launch motor, driving a 3-bladed bronze screw, of 7 inches radius and composite pitch, at about 700 r. p. m. When the launch was purchased for the tests she had made less than 100 miles in all with the battery with which she was equipped, and prior to the first trial the battery was carefully worked up to good condition electrically, and was in excellent general order. The launch had rather coarse lines, which accounts for the moderate general speed in both trials.

The Clare battery was tested after 13 regular discharges, subsequent to the forming run, and was not considered to be up to its ultimate capacity.

The weather in the two trials was favorable, with fairly smooth sea and with conditions of wind and tide closely uniform. In each test the boat was driven twice through severe adverse tides in Hull Gut, a spot notorious all along the New England coast. The fundamental purpose of the experiments was to demonstrate that the Clare cell with a construction especially planned to avoid deterioration through service, could still more than hold its own in weight efficiency as compared with even the lightest standard forms of lead grid battery. Hence the same boat motor, screw and general equipment was retained intact in both trials, the battery alone being charged.

Gantry Traveling Crane Equipment at the Sandy Hook Proving Grounds.

A Gantry traveling crane equipment, installed at the U. S. Ordnance Proving Grounds, at Sandy Hook, N. J., for lifting and transporting the heavy guns stationed there from point to point with rapidity, safety and ease, has heretofore been operated by hand, requiring at times as many as twelve men for this purpose. As this was a slow and expensive means of operation, it was decided to

equip the crane and car with electric motors, and the work was intrusted to Mr. E. R. Knowles, to whom we are indebted for the following particulars concerning this installation:

The former electrical generating plant, which had been used exclusively for lighting the various buildings, was remodelled and apparatus added to bring it up to the requirements of the new installation. The two old fire-tube boilers have been retained and an additional one of 50-hp capacity has been installed by Blake & Williams, New York, who also furnished and installed all of the steam piping and other auxiliary steam appliances. Both of the old engines will shortly be removed, as the machine shop power will be supplied by electric motors, and the dynamo used in charging

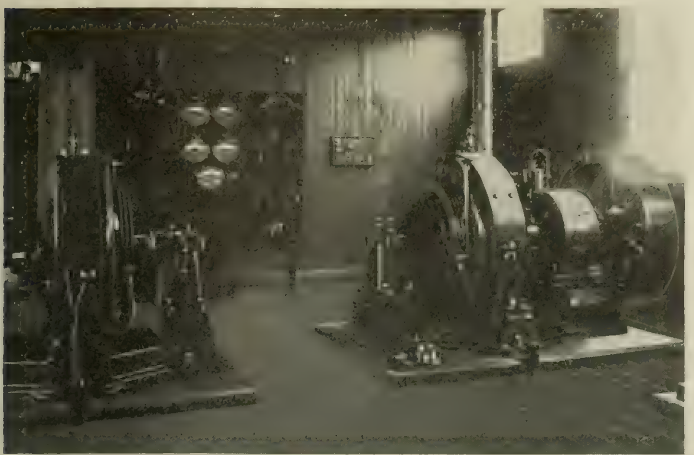


FIG. 1.—GENERATING PLANT, SANDY HOOK PROVING GROUNDS.

the storage battery will be either replaced by a modern motor generator or will be direct connected to a motor.

Two new 40-hp Payne automatic engines supply power for two new direct-connected generators. These engines are supplied with steam at 80 lbs. pressure, and run at 230 r. p. m., the variation between no load and full load being less than two per cent.

The generators, which were furnished by the C. & C. Electric Company, are each of 25-kw capacity, 250 volts, over-compounded for a drop of 3 per cent., and provided with an equalizing connection for parallel working. They operate sparklessly at all loads, and require no shifting of the brushes for any change in current consumption. The same company also supplied and installed all of the motors referred to hereafter.

Fig. 1 gives a good idea of the appearance of the generating plant. The 200,000-cm. generator leads are lead-covered and carried in ducts under the floor to the switchboard, shown in the background, which was manufactured by the Walker Electric Company, of Philadelphia, Pa., after designs prepared by Mr. Knowles. It is arranged in three panels, one each for the generators, lighting and power. The lighting panel is yet to be connected to the battery-charging set, but the power panel distributes current to the pole line running to the crane.

The pole line consists of two feeders, each of 200,000 cm. cross-section, supported 20 inches apart on chestnut poles, 30 feet long. Precaution had to be taken to set the poles extra deep, and at several places guying was necessary to guard against trouble, due to shifting of the sands.

The general operation of the crane equipment proper will be explained with reference to Figs. 2 and 3. At one side of the picture are the bomb-proof embankments, and at the other, gun emplacements.

Between these two elevations the tracks are located, on which the car runs which carries the Gantry crane. Certain distances apart, transverse tracks are laid on top of the two embankments, and the crane can move along these in either direction after it has been run off the main car, when it is desired to transport a gun from one point of the embankment to another.

The feeder junction box, is located at the forward end of the gun emplacement, and from that point two No. 0000 trolley wires, having a figure eight cross-section, are run in a recess about 5 in. x 7 in., cut into the side of the emplacement.

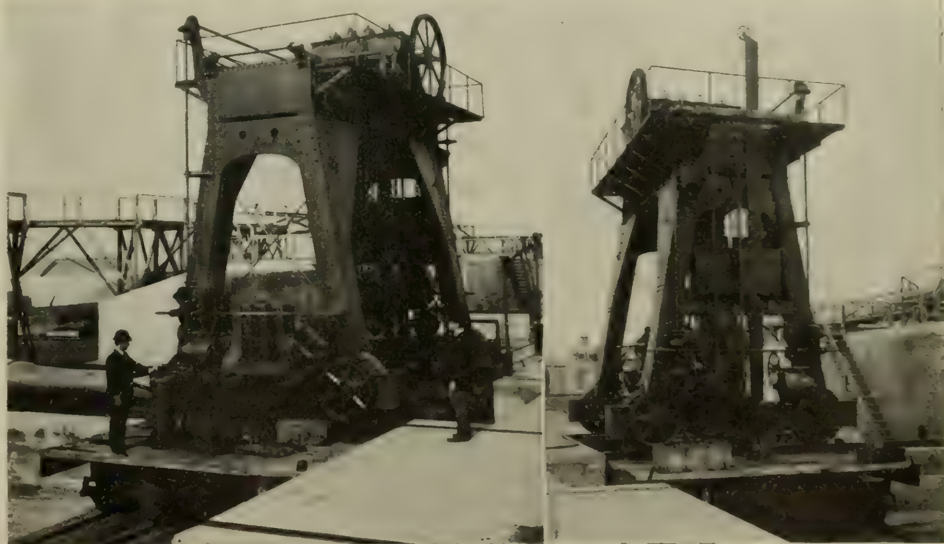
The car carrying the crane is equipped with two trucks, each carrying a 7½-hp C. & C. series motor, wound for 112 volts and a speed of 900 r. p. m. These two motors are connected in series, and are operated by a Cutler-Hammer controller, shown on the front part of the car platform. The controller cylinder carries the forward and reverse contacts, there being no separate reversing cylinder. When the handle is in a central position, the current is off and there are the same number of speeds available in either direction. This feature is embodied in all controllers in use on the equipment.

The current is collected from the trolley wires by two sets of trolleys, one at each end of the car, connected in multiple so as to prevent the possibility of the car being without current at a time when it passes a crossing. The distance across the latter is always less than the distance between the two sets of trolleys, so that before one trolley leaves the trolley wire on one side of the crossing, the other trolley has made contact with the wire on the other side. To enable this to be done and also to permit of the car being run in either direction without having to reverse the position of the trolleys, the latter are supported in a horizontal position, perpendicular to the side of the car between two heavy springs which permit them to take a position to either side of the perpendicular. This method, devised by Mr. Knowles, has proved a pronounced success. No mechanical brakes are provided on the car, as it can be stopped almost instantly by bringing the controller handle to the first reverse position.

The crane proper, which has a capacity of 80 tons, and was built by the Shaw Electric Crane Company, of Muskegon, Mich., is mounted on tracks running across the car platform. It is operated by two 7½-hp motors, connected in series. Double speed reduction by means of gear wheels allows the motors to be run at a high speed, which in turn insures light motor frames. The hoisting apparatus is operated by two 7½-hp motors, connected in series, and mounted on the frame of the Gantry crane, as shown.

The controllers for operating these motors, as well as the one for a 1½-hp, 225-volt motor of 400 r. p. m., mounted on the crane frame and operating the over-head traveler by means of chain gearing, are all mounted on the crane platform next to the car controller, so that it requires only one man to operate the entire equipment. This greatly cheapens and simplifies the operation and assures rapid action, the saving of time by this method over the manual method formerly employed being about 75 per cent.

An ingenious method has been devised for electrically connecting the crane with the car and to prevent the cable from becoming slack when the crane is run off the car to either side of it. One end of a two-strand elliptical cable is firmly attached to a single sheave drum, located on the frame of the crane; the other end passes between two curved guides in the floor of the car, and is connected to the main feeder circuit below the car platform. The drum is provided with two contact rings, to which the two conductors are



FIGS. 2 AND 3.—TRAVELING CRANE.

connected, and two carbon brushes lead the current from the rings to the crane controllers. The drum is so counterweighted that all slack in the cable is taken up as the crane moves off or back to its position on the car from either direction. The counterweight cable is wound on a pulley external to the cable drum, and passes up to the top of the counterweight guide. This device enables the cable to lie flat on the car platform and embankments when the crane is run off in either direction.

In order to prevent the crane from being run off the embankment, reversing switches are mounted on the lower part of the crane frame, and are tripped by track clamps fastened to the rails at a safe distance from the end.

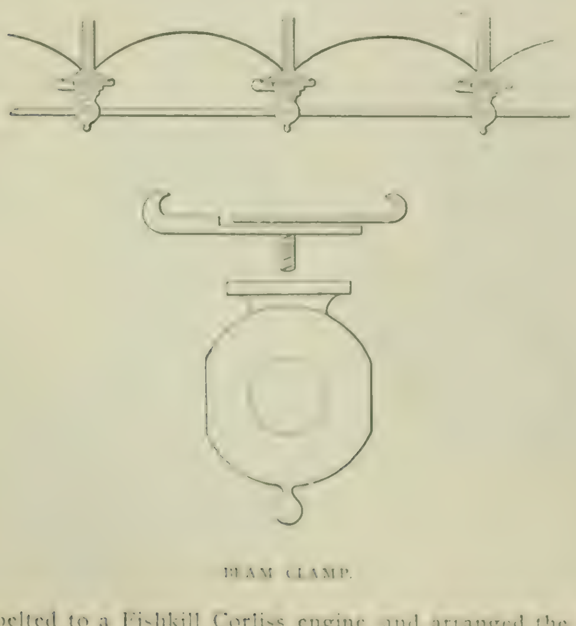
Electric Light Plant in Department Store.

A new electric light plant has just been completed at the Koch department store, West 125th St., New York City, under the supervision of Mr. George Nissenson, chief engineer of the H. C. F. Koch & Co., who both designed and supervised the construction of the plant.

In view of the fact that the building is thoroughly fireproof, being constructed of iron beams and corrugated steel arches, and that all wiring was to be exposed, a problem was presented in securing the conduit pipes to the ceiling in such a manner as to form both a safe and ornamental construction, which latter quality is almost a necessity in the wiring of a department store. The same difficulty was encountered in laying out piping, as any clumsy or awkward arrangement would mar the appearance of the store. This was overcome by arranging the pipes in symmetrically ornamental figures, thus in reality adding to the good appearance of the ceiling.

To meet the case, Mr. Nissenson designed a ball-shaped casting and beam clamp, shown in the accompanying illustration. It is provided with four openings at right angles to each other, and large enough for a half-inch conduit pipe to pass through. At the top is an opening drilled and tapped for a quarter-inch bolt, which serves as a tightening screw to the clamp. From the accompanying sketch it will be seen that the construction is one both satisfactory and ornamental.

A new switchboard has also been installed with all modern appliances. The plant formerly consisted of a number of small units driven by high-speed engines. In his design for the new plant, Mr. Nissenson substituted for these groups a single large



BEAM CLAMP.

unit belted to a Fishkill Corliss engine, and arranged the plant to run partly condensing and partly non-condensing in order to obtain the feed water at a high temperature and secure greater economy.

An innovation introduced into the store by Mr. Nissenson is the Continental arc lamp manufactured by the Helios-Upton Company, of Philadelphia, which was adopted only after a severe test. Mr. Nissenson considers that the main floor, which is equipped with the Continental arc lamps, is far superior as to lighting to any store in the city. The light is well distributed and diffused, which are important considerations in an establishment of this character.

Lathe Grinding Attachment.

The accompanying illustrations show two different styles of a grinding attachment for lathes, made by L. S. Heard & Son, Barre, Mass. This attachment, in connection with the lathe, forms, in fact, a universal cutter and reamer grinder, and is exceptionally handy machine for use in keeping such tools in perfect condition.

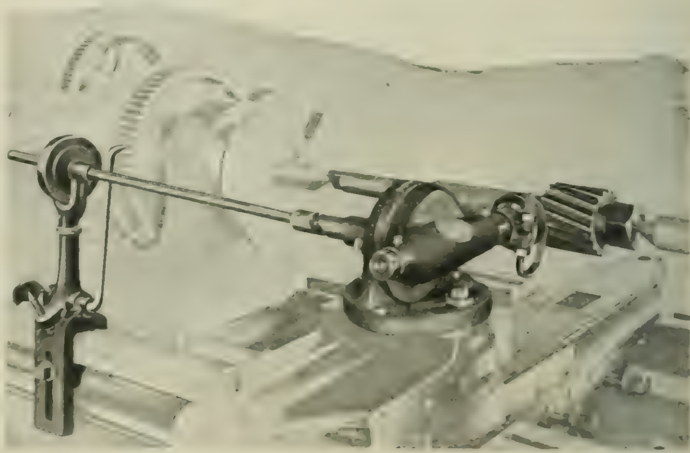


FIG. 1.—GRINDING ATTACHMENT.

One style is friction driven by means of a friction roll running on the large step of a cone, and the other style is electrically driven. This attachment, as will be seen, is mounted on the tool block of the lathe and can be swivelled in any direction in a horizontal plane. The grinding spindle can also be swung to various angles in a vertical plane so that the wheel can be presented to the work at practically any desired angle. An extension may be fitted to carry a small wheel for

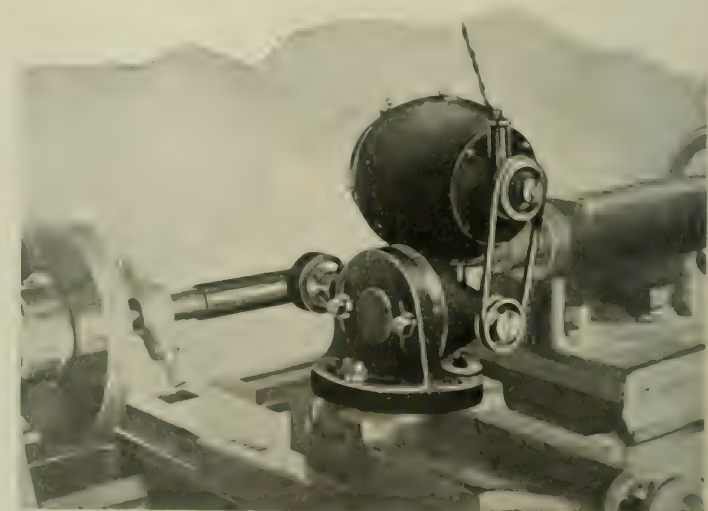


FIG. 2.—GRINDING ATTACHMENT.

internal grinding. The machine is simple to adjust, and accurate in results. In the arrangement for electric driving, the motor is mounted over the grinding spindle and swivels with it. This method of mounting the motor over the spindle rather than building it around the grinding spindle gives four bearings for the work that two would otherwise have to do and makes the machine much more universal in its range.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a good demand for money, the closing rates being 6 per cent. for 60 days, and 5½a6 per cent. for four, five and six months. Owing to uncertainty about the financial outlook, and liquidation by large speculators, the stock market was nervous and depressed. Bear operators were also active and all stocks shared in the downward tendency. Among the industrials, Amalgamated Copper was conspicuous, but a greater effect was produced on the general market by the heaviness of the United States Steel stocks. The "curb" showed a continued sagging tendency, with sharp breaks at times, and closing prices at about the lowest. Tractions and electrics shared in the general weakness of the market, all, however, with the exception of the two Westinghouse issues, closing at figures above the lowest. Brooklyn Rapid Transit closed at 58, being a net loss of 2 points, but 3¼ points above the lowest figure. Metropolitan Street Railway lost 1¾ points, closing at 136¾, the price during the week ranging between 135½ and 138. General Electric touched 175 at one time, but recovered, and closed at 181½, representing a net gain of 1½ points. Westinghouse common closed at 190, and preferred at 200½, representing net losses of 22 and 19½ points, respectively. Western Union lost 1¾ points, closing at 88½. Commercial Cable closed at 178, a net loss of 2 points. Following are the closing quotations of November 18:

NEW YORK.

	Nov. 11.	Nov. 18.		Nov. 11.	Nov. 18.
American Tel. & Cable..	90	89	General Electric	177	178
American Tel. & Tel...	—	160	Hudson River Tel......	—	—
American Dist. Tel.....	36	34	Metropolitan St. Ry....	136⅝	137⅛
Brooklyn Rapid Transit.	59⅛	58½	N. E. Elec. Veh. Trns..	—	3/16
Commercial Cable	—	—	N. Y. & N. J. Tel....	163	—
Electric Boat	20	20	N. Y. E. V. T. Co....	10½	11
Electric Boat pfd.......	35	35	Tel. & Tel. Co. Am....	—	—
Electric Lead Reduc'n..	—	2⅜	Western Union Tel.....	89	88¾
Electric Vehicle	4	4	Westinghouse Com.....	199	197
Electric Vehicle pfd....	10	10	Westinghouse pfd......	201	200

BOSTON.

	Nov. 11.	Nov. 18.		Nov. 11.	Nov. 18.
American Tel. & Tel..	161	161½	Western Tel. & Tel. pfd	99	99
Cumberland Telephone..	125	—	Mexican Telephone	2⅛	2
Edison Elec. Illum......	265½	—	New Eng. Telephone....	137	135½
General Electric	178	—	Westinghouse	95	97
Western Tel. & Tel....	27	25	Westinghouse pfd	95	103

PHILADELPHIA.

	Nov. 11.	Nov. 18.		Nov. 11.	Nov. 18.
American Railways.....	54½	53¾	Phila. Traction	98	98
Elec. Storage Battery...	81*	80	Phila. Electric	8½	8½
Elec. Storage Bat'y pfd	—	—	Pa. Elec. Vehicle	—	—
Elec. Co. of America...	9¼	9⅛	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	Nov. 11.	Nov. 18.		Nov. 11.	Nov. 18.
Central Union Tel......	—	—	National Carbon pfd....	100	—
Chicago Edison	174	—	Northwest Elev. Com..	—	—
Chicago City Ry......	210	210	Union Traction	15	15
Chicago Tel. Co.......	—	—	Union Traction pfd...	45	45
National Carbon	—	—			

* Asked.

KANSAS CITY INDEPENDENT TELEPHONE.—The Germania Trust Company, of St. Louis, has completed a deal by which it will finance the Kansas City Home Telephone Company, incorporated under the laws of Missouri for $3,000,000. The new telephone company will enter the field as an independent concern and will probably occupy the same prominence in Kansas City as does the Kinloch Company in St. Louis. Of the authorized capital, $1,700,000 will be issued and $1,700,000 of an authorized issue of 5 per-cent., twenty-year gold bonds will be given in payment for the completion of the system. Construction work on the telephone system has commenced, but the principal work up to date has been the soliciting of contracts. The company is actively engaged in securing subscriptions for its service on a basis of three-year contracts, to date from the commencement of the service. Up to September 26 it had secured bona fide subscription contracts, business and residence, to the number of 5,549, representing a business of about $264,860 per annum. The officers of the company are Joseph J. Helm, of Kansas City, president; Henry Koehler, Jr., Kansas City, first vice-president; E. L. Barber, of Wauseon, Ohio, second vice-president; O. C. Snider, of Kansas City, secretary. The management of the affairs of the concern will be largely in the hands of Messrs. Koehler, Heim and Barber, the voting trustees.

SNOQUALMIE POWER.—The Snoqualmie Falls and White River Power Company, which has been incorporated in the State of Washington, with a capital stock of $2,000,000, proposes to transmit electric power to cities extending from the British line to Portland, Ore. The present plant at Snoqualmie Falls will supply power for the northern part of the district, and the new water power plant to be installed near Tacoma, Wash., will supply power for Tacoma, Portland and intermediate points. Chas. H. Baker and his associates in the Snoqualmie Falls Power Company will control the entire system. They have purchased the water rights that have been held for some years by the White River Power Company. These rights were originally acquired by persons connected with the Westinghouse Electric and Manufacturing Company, and the Snoqualmie Power people have held an option on the property ever since they bought the machinery for their original plant. Water will be diverted from White River and conducted to Lake Tapps, where an immense storage reservoir will be located. Thence a canal will carry the water to a high bluff near Sumner, which is about nine miles from Tacoma. With the available head of water obtained 12,500 hp. can be developed for transmission.

ALLIS-CHALMERS COMPANY.—Bunnell, Buchanan & Company have prepared the following statement relating to Allis-Chalmers Company: "For the five months from May 1 to September 30, 1902, the net profit, after deducting all expenses for manufacture and selling, and after making full provision for depreciation of buildings, plant and machinery and for possible bad debts, have been about $700,000. The surplus over the 7 per cent. dividends that have been paid quarterly since the organization of the company, and that have accrued to September 30, 1902, amounts to about $525,000. The results were obtained notwithstanding that the plants of the company in Chicago were seriously affected by the strike of the machinists that prevailed during all that period of operation, except the month of September last. The removal of this difficulty and the gradual commencement of work in the new shops at West Allis, affords facilities for an important increase of business and promises additional profits for the stockholders."

PENNSYLVANIA ELECTRIC VEHICLE.—Frank C. Lewin secretary of the Pennsylvania Electric Vehicle Company, says "The sale of electrical vehicles will show a very substantial increase over last year, and as some of our latest carriages are higher priced than those which we have been selling, the cash receipts from sales for 1902 will show a greater increase over 1901 than the number of sales. The surplus of one or two thousand dollars, which we hope to announce in our next annual report, will mean more than the mere figures since this year we have marked down, according to present conditions, portions of our property which have been depreciating for some time but which were carried in the last report at considerably higher figures. We are well satisfied with the showing this year so far, since although we have fully recovered our actual money loss from the fire, it considerably injured our business."

DENVER GAS AND ELECTRIC.—Holders of a large amount of stock and consolidated bonds of the Denver Gas and Electric Company have requested Ashbel P. Fitch, Warren W. Foster, Anton G. Hodenpyl, Philip Lehman, Claude Meeker, E. W. Rollins, Dennis Sullivan, George P. Sheldon and Junius M. Stevens to act as a protective committee in their interests. The Trust Company of America, New York; Michigan Trust Company, Grand Rapids, and Ohio Trust Company, Columbus, have been designated as depositaries who will receive deposits of stock and consolidated bonds, in negotiable form, until December 1, and will issue therefor negotiable receipts.

BIRMINGHAM, ALA. ELECTRICS.—Since the Birmingham Railway, Light & Power Company was organized, in August, 1901, it has spent $1,500,000 in extensions and betterments, and will spend $500,000 more before the work laid out is completed. The street railway company has relaid its tracks with heavy rails, and has increased its mileage from 90 to 105 miles. The company has received during the year 47 new cars. In the single article of copper wire the company has expended $300,000, and in the item of gas main extensions about $250,000 has been expended.

ST. JOSEPH ELECTRIC EARNINGS.—The earnings of St. Joseph Railway, Light, Heat and Power Company for two calendar years (1902 partly estimated), follow:

	1902.	1901.	Changes.
Gross	$531,233	$461,254	Inc. $69,979
Expenses	280,508	238,815	Inc. 41,693
Net......................	$250,725	$222,439	Inc. $28,286

DIVIDEND.—The directors of the Kings County Electric Light, Heat & Power Company have declared the regular quarterly dividend of 1½ per cent., payable December 1.

MANHATTAN ELEVATED.—The Manhattan Railway Company last week made public its annual report for the year ended September 30 last. The year was a very prosperous one. The number of passengers carried was 223,427,283, an increase of 29,274,967 for the year.

The financial statement shows:

	1902.	1901.
Earnings from operation	$11,067,746.33	$9,620,563.98
Operating expenses	5,545,395.24	5,328,649.04
Net earnings	$5,522,351.09	$4,291,914.94
Other income	515,800.00	835,308.32
Gross income	$6,038,151.09	$5,127,223.26
Interest on bonds	1,809,680.92	1,809,680.92
Taxes	902,408.14	873,451.23
Total interest and taxes	$2,712,089.06	$2,683,132.15
Net income	3,326,062.03	2,444,091.11
Dividends, 4% on $48,000,000	1,920,000.00	1,920,000.00
Surplus for year	$1,406,062.03	$524,091.11
Surplus balance, profit and loss, Septemper 30, '00	....	4,442,265.41
Surplus balance, profit and loss, September 30, '01	4,966,356.52	....
Surplus balance, profit and loss account	$6,372,418.55	$4,966,356.52

Speaking of the affairs of the company, the report of President Gould says: "The statement of operations for the past year, showing an increase of over 29,000,000 in the number of passengers carried, and a decrease in the operating ratio, is an encouraging indication that the results which were predicted when the stockholders decided to equip the system with electricity will be more than realized, particularly as only one-half the lines have been under full electric operation since September 15 last, and that the high cost of fuel has materially increased the expenses. Since the last annual meeting substantial progress has been made with the new equipment. The Second and Third Avenue lines have been completed, with 608 cars in operation. The Sixth and Ninth Avenue lines, on which eighty cars are now running, should be finished not later than April 1, 1903."

SUSQUEHANNA POWER.—The purchase of the $2,000,000 of common stock of the United Electric Light & Power Company, of Baltimore, from the United Railways and Electric Company by a syndicate acting through the Continental Trust Company was completed last week. For the stock, which constitutes the entire issue, $900,000 is to be paid on or before January 15, 1903. The purchase of the control of the light and power company practically assures the launching of the great Susquehanna River electric power development project by the syndicate. There are to be three developments, that will cost between $10,000,000 and $12,000,000, and two years will be required to complete the work, the purpose being to supply motive power for the street railway system of Baltimore, to supply electricity for lighting the streets, and for general power and heating purposes.

Commercial Intelligence.

THE WEEK IN TRADE.—A more satisfactory state of trade can hardly be imagined, according to reports received by the mercantile agencies. *Bradstreet's* says: "Trade, industry and transportation continue active despite the drawbacks caused by the warm weather, scarcity of fuel and car and motive power shortages." Cold weather is needed to stimulate consumption of heavy winter goods from retailers' hands, whatever complaint there is heard regarding collections being attributed to this cause. Holiday goods are in exceptionally active demand, the outlook being that distribution, far in excess of any previous year, will be realized. More than usual activity is, however, noted in spring goods, which are being ordered more freely than in average years. This is taken to indicate widespread confidence in a prosperous condition next year. Little or no improvement is noted in the fuel situation, which greatly affects iron and steel manufacturers, many of whom are reported discouraged by their inability to fill orders now on their books. The scarcity of fuel keeps many furnaces idle, and the pig iron demand is in excess of production. Structural material mills are very active, being sold five or six months ahead, and the country's rail production is said to be practically sold up to September, 1903. The lumber trade is quite active, notwithstanding the advanced stage of the season, and the only complaint is as to the backward deliveries. From all over the country come complaints of congestions in railroad tonnage, affecting the movement of crops eastward and of merchandise to the West. Gross railway earnings naturally show increases over a year ago, those for the full month of October indicating a gain of over 6 per cent. on the corresponding month last year, which was a record-breaker in this respect. The disturbed condition of the stock market exercised an adverse influence on the copper market, and buyers were reluctant to enter into any obligations. Transactions were few and prices showed a decline. The closing quotations were 11½a11⅝ cents for Lake, 11¼a11⅜ cents for electrolytic in cakes, wire bars or ingots, 11a11⅛ cents for cathodes, and 11¼a11⅜ cents for casting stock. The number of business failures for the week ending November 13, as reported by *Bradstreet's*, aggregated 205 as against 148 the previous week, and 213 the same week last year.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended November 8: Azores—1 pkg. material, $119. Antwerp—19 pkgs. material, $2,427; 182 pkgs. machinery, $2,575. Argentine Republic—19 pkgs. machinery, $340. Bristol—4 pkgs. material, $290. Bremen—2 pkgs. material, $2,000. British Australia—2 pkgs. machinery, $156; 38 pkgs. material, $832. British East Indies—15 pkgs. material, $1,172. Brazil—6 pkgs. material, $122. British Possessions in Africa—148 pkgs. material, $7,245. British West Indies—9 pkgs. material, $130; 31 pkgs. machinery, $2,581. China—107 pkgs. material, $797. Constantinople—2 pkgs. machinery, $1,000. Cuba—6 pkgs. machinery, $502; 14 pkgs. material, $583. Central America—2 pkgs. material, $22; 23 pkgs. machinery, $1,357. Colchester—7 pkgs. machinery, $452. Dutch West Indies—8 pkgs. machinery, $170. Ecuador—2 pkgs. machinery, $65. Egypt—6 pkgs. material, $63. Glasgow—77 pkgs. machinery, $7,440; 3 pkgs. material, $222. Hong Kong—13 pkgs. material, $502; 4 pkgs. machinery, $217. Havre—4 pkgs. material, $248. Japan—24 pkgs. machinery, $18,239; 9 pkgs. material, $257. Liverpool—443 pkgs. machinery, $23,920; 32 pkgs. material, $1,344. London—146 pkgs. machinery, $5,981; 80 pkgs. material, $5,388. Lisbon—1 pkg. material, $55. Marseilles—25 pkgs. machinery, $1,260. Mexico—41 pkgs. material, $3,026; 10 pkgs. machinery, $1,469. New Zealand—1 pkg. machinery, $75; 36 pkgs. material, $1,062. Nova Scotia—18 pkgs. material, $595; 7 pkgs. machinery, $600. Newfoundland—5 pkgs. material, $51. Odessa—1 pkg. machinery, $101. Peru—72 pkgs. machinery, $1,682. Philippine Islands—13 pkgs. material, $265. Southampton—16 pkgs. machinery, $1,250; 5 pkgs. material, $420. Stettin—20 pkgs. material, $3,500. Uruguay—3 pkgs. machinery, $88. U. S. Colombia—26 pkgs. material, $720.

ENGINES FOR LIGHTING.—The American Sugar Refining Company, Jersey City, N. J., has recently put into operation a direct-connected electrical unit, consisting of a 250 hp engine and alternating dynamo. The generator was furnished by the Westinghouse Electric & Manufacturing Company, Pittsburg, and the engine by the Ball Engine Company, Erie, Pa. The Bishop & Babcock Company, Cleveland, has recently installed an electrical unit, consisting of a Westinghouse alternator direct-connected to an engine built by the Ball Engine Company. The Pennsylvania Railroad Company has recently started at its Altoona, Pa., shops, a 450-hp engine, built by the Ball Engine Company, being the fifth engine furnished by the Ball Company for this plant. The same company has recently put into operation at its Meadows, N. J., shop, a direct-connected unit of 250 hp, the generator being furnished by the Westinghouse Electric & Manufacturing Company, Pittsburg, and the engines by the Ball Engine Company. The Western Packing Company, of Denver, Colo., has recently installed two 100-kw Crocker-Wheeler generators, direct-connected to Ball engines, built by the Ball Engine Company, which furnish power for both light and elevator service.

BOILERS FOR ST. LOUIS FAIR.—An order for twenty-six large boilers for use on the World's Fair grounds has been placed with the Springfield Boiler & Manufacturing Company of that city. This is said to be the largest order for steam boilers ever secured by an inland firm in this country. The boilers now in process of construction are to be of 700 hp each, and are intended for the Union Electric Light & Power Company, which concern will install them in the lighting plant on the exposition site. The boilers will be 12 ft. in diameter and 24 ft. long, with outer shells of steel 1 3-32 inches thick. They will be of the marine type with three interior fire boxes.

AMERICAN JESSOP WORKS.—A telegram from Washington, Pa., of November 15 says: The big American plant of the William Jessop & Sons' Steel Company, of Sheffield, England, which has been in the course of construction for over a year, was put in operation last night for the first time. As a test of the big furnaces about 3,600 pounds of crucible steel was made, and it was declared by the officers to be of the finest quality.

COMBINED STEAM AND ELECTRIC ROAD.—The North Shore Railroad Company, California, which is reconstructing the southern portion of its lines as an electric road, has decided to locate its new 2,000-hp electric power station at Alto, near the centre of the electrical division. The plans have been completed for a one-story brick structure with a three-story tower, for taking in the high tension leads from the Bay Counties Power Company's system. The greater part of the steam plant will be held in reserve, while motor generators operated from the transmission line will supply direct current for the cars. In case of interruption of the current the steam plant will take care of the electric railway lines and also the lighting and power circuits of the California Central Gas and Electric Company, extending from San Quentin Prison to Sausalito, the terminus of the railroad on San Francisco Bay. Contracts have been closed with the St. Louis Car Company for nine motor cars and 12 trailers, all of large size, to conform with the standard passenger coaches of the railroad. General Electric car equipments have been ordered, with quadruple motors. Westinghouse air-brakes will be used, and a modern block signal system, will furnish protection on the lines where both steam and electric trains are to be operated. A novel feature will be introduced at one of the tunnels, in which 450 electric lights will be installed at intervals of 10 feet. They are to be so arranged that as the train passes through the tunnel it automatically switches on the lights. As they will be placed at the level of the windows they will light the cars brilliantly.

ANDES ELECTRIC RAILWAY PROJECT.—The construction of an electric railroad across the Andes is again projected, there being unlimited water power available. It is proposed that the line be built from Los Andes and run some 30 miles to the foot of the mountains; then ascend to Cumbre, located at an altitude of 13,500 feet. From Cumbre, the road would gradually descend on the Argentine side and connect with a steam railroad running to Buenos Ayres. There are no American bidders for the construction of the road, but there are an English company, a French syndicate and a Chilian group, each of whom have different projects, but public sentiment, according to private advices from Chili, is now in favor of the Government undertaking the work on its own account. The English company, known as the Transandine Company, holds the old Clark concession, and is represented by Grace Bros., in London, which concern is closely affiliated with W. R. Grace & Company, Hanover Square, New York. They, however, ask f r an amendment in the concession, namely, that the subvention offered by the Chilian Government should be payable as sections of the road are completed. If the work is ultimately undertaken by the Chilian Government, the contracts for equipment, etc., will most likely be placed through Beeche, Duval & Company, whose New York offices are in the Broad Exchange Building, 25 Broad Street. It is figured that the cost of construction and equipping an electric road will mean an expenditure of about $2,250,000, gold.

ELBLIGHT COMPANY OF AMERICA.—During the past summer Mr. Russell Spaulding, who has been very active in the concern from the start, caused to be incorporated under the laws of the State of New York, the Elblight Company of America, which company has purchased from the National Electric Improvement Company, all its good will, patents and assets, of every nature. Since the formation of the Elblight Company of America, there have been formed various sub-companies, viz.: The Elblight Company, of Pittsburg; the Cincinnati Elblight Company, the Elblight Company, of Chicago, and the Elblight Company, of California. Besides this there are in process of formation the Elblight Company, of Philadelphia; the St. Louis Elblight Company, the Elblight Company, of Boston; the Elblight Company, of Denver; the Elblight Company, of Oregon, and the Elblight Company, of Canada. The remaining territory in the United States has been allotted to over fifty agents, whose contracts are subject to the formation of sub-companies in their district. The Elblight material is in great demand for decorative lighting, temporary work, etc., and Mr. Spaulding reports that the company has been from six weeks to two months behind orders, owing to the call for its lamps and cable in all parts of the country.

IMPORTATION OF MATERIALS.—The September report of the Treasury Bureau of Statistics shows that the importations of manufacturers' materials in the nine months ending with September, 1902, were not only larger than in the corresponding period of any preceding year, but formed a larger percentage of the total imports than on any preceding occasion. The total importation of manufacturers' materials in the nine months ending with September, 1902, amounted to $325,771,211, and formed 46.39 per cent. of the total imports. A comparison of these figures with those for the corresponding period of 1890, shows an increase of 60 per cent. in the importations of manufacturers' materials during that time, the total importation of manufacturers' materials in the nine months of 1890 having been $206,724,960. The share which manufacturers' materials formed of the total imports in 1890 was only 33.03 per cent., as against $46.39 per cent. in the corresponding months of 1902.

CONTRACTS PENDING FOR SYDNEY.—Contracts are expected to be placed almost immediately for additional equipment to be installed in the central power station of the Sydney City & Suburban Tramways, Sydney, New South Wales. The existing capacity is fully employed by the lines now in operation and further machinery is required in connection with the lines nearing completion and to furnish power to work considerable extensions which have been decided upon. The present plant consists of Allis engines and General Electric generators. The value of the contract was about $800,000. The lines at present running are over 100 miles in length. It is expected that over $1,000,000 will be expended in additional power house equipment, trolley poles, car equipments, etc.

INDIAN CONTRACTS PENDING.—Mr. J. Tata, of Bombay, one of the richest and most influential men in British India, who has been on a visit to the United States for the past six weeks, sailed Tuesday for India. While he has not placed any definite contracts in this country for the equipment necessary to be installed in the two large water-power plants which he and his friends are projecting, and to which some reference has already been made in these columns, it is anticipated that shortly after his return to India he will purchase considerable American machinery. The contract for a 4,000-light plant, which is to be installed in the large hotel Mr. Tata is to build in Bombay has been awarded to German concerns. The dynamos will be built by the Lahmeyer Company, of Frankfort.

THE STANDARD POLE & TIE COMPANY, 44 Broad Street, New York City, advise that within the next week they will move their North Carolina office from Maxton to Wilmington. They have had their office in Maxton for the last two years, but it now appears that it will be more to their advantage to have this office located in Wilmington. Mr. J. W. Davis, who is the manager of that office, has personal charge of the shipment of the "Octagonal" and "Juniper" poles from that section and has supervision also over the inspectors who inspect personally every carload of material before it is shipped. All communications relative to the purchasing of material should be addressed to the New York office of the company in the future as in the past.

STORAGE BATTERY FOR CLEVELAND, O.—A battery of chloride accumulators consisting of 264 elements capable of discharging at the rate of 1,200 amperes in regulating the fluctuations, has been contracted for by the Cleveland Electric Railway Company. The Electric Storage Battery Company will install this battery at Windermere, a point five miles from the power house. The battery is designed not only to care for the fluctuations on the line at this point, but to maintain the voltage during the hours of peak load. It is also intended to assist in carrying the load on the Euclid Beach line, which is very heavy during summer months.

TELEPHONY FOR ST. PETERSBURG.—The Journal of St. Petersburg, of October 26, announces that the city has decided to equip a central telephone exchange for 12,000 subscribers. The Antwerp Telephone and Electrical Works has received the contract in competition with several others, and will furnish 30 sections of Kellogg telephone switchboard of the central energy system. The apparatus is to be built at Antwerp and Chicago, and the installation work will be done by V. Saveliew & Co., of St. Petersburg. The cost of the apparatus is given at 380,390 roubles.

SCHOEN, AUSTIN & COMPANY have established themselves as manufacturers' agents at 1218 Empire Building, Atlanta, Ga. They will act as representatives for the Safety Insulated Wire & Cable Company, of New York, and as special sales agents for the Wotton Electric & Manufacturing Company. The firm comprises Major H. B. Austin, who has long been prominent in Southern trade, and another member has been active in the telegraph and telephone business. They will include practically everything except dynamo electric machinery.

MORE ELECTRIC TRACTION FOR CUBA.—The interests which are identified with the Havana Electric Railway Company, of which Mr. C. F. Greenwood, formerly of the Consolidated Traction Company, of Pittsburg, is the general manager, are reported to have obtained franchises for the construction of about 100 miles of new lines in the neighborhood of Havana.

WESTINGHOUSE ORDERS.—It is stated that the British Westinghouse Company has booked contracts, aggregating $1,000,000, for electrical equipment of British collieries, where the mine masters have heretofore demurred at the introduction of machinery.

VARIOUS EQUIPMENT WANTED IN SPAIN.—F. H. Bagge, 14 Ronda Universidad, Barcelona, Spain, is in the market for electrical equipment—particularly street railway plant. He is the contractor for the Barcelona & San Andres Railway.

EQUIPMENT WANTED IN CHINA.—Takahashi & Company, of Chefoo, China, are reported to be in the market for boilers, engines, etc., to be installed in electrical plants.

General News.

THE TELEPHONE.

ANNISTON, ALA.—The [illegible] Bell Telephone & Telegraph Company, will build a new line from Anniston to Montgomery.

BIRMINGHAM, ALA.—The Alabama and Georgia Long Distance Telephone Company has been bought by the Southern Bell Telephone Company for $12,000. The lines included in the deal extend from Gadsden to Sylacauga; from Ironaton to Oxford; Jacksonville to Cave Springs; Oxford to Dearmandville; [illegible] to [illegible]; [illegible] to [illegible]; Dearmandville to Delat; also the exchanges at Oxford and Piedmont.

DOUGLAS, ARIZ.—The Texas & Western Telegraph & Telephone Company, capital stock $200,000, was granted a permit to do business in Texas.

PARAGOULD, ARK.—O. Morseman is securing subscriptions for the stock of the Paragould Telephone Company, whose capital stock will probably be $20,000. The company intends to build a line into Cardwell and Jonesboro.

ARROYO GRANDE, CALIF.—The Sunset Telephone Company is building a line from this place to Oceano.

SAN FRANCISCO, CALIF.—It is said that options have been secured on property near the ocean beach at San Francisco for the location of a large wireless telegraph plant by the Marconi Wireless Telegraph Company, of America. It is hoped that communication will be established with the Hawaiian Islands and possibly with Alaska.

JACKSONVILLE, FLA.—A 4,000-foot cable has been laid across the channel to South Jacksonville to connect the Southern Bell Telephone lines with St. Augustine and Palatka. The St. Augustine-Palatka line has recently been completed.

ATLANTA, GA.—The Southern Bell Telephone Company has completed a line to Clinton, S. C., via Athens and Elberton, Ga., on towards Columbia, S. C.

AUGUSTA, GA.—The City Council has granted a fifty-year franchise to the Southern Bell Telephone Company to erect poles and lay underground conduits for wires in this city. The Bell Company is also preparing to erect a building in Augusta for an exchange.

OWANECO, ILL.—Owaneco is to have a new telephone system to be known as the Eaton Bros.' Telephone Company.

NEWTON, ILL.—The Jasper County Telephone Company, of this place, has certified to an increase of capital stock from $5,000 to $20,000.

DANVILLE, ILL.—The Danville Telephone Company has been granted a franchise to construct and maintain a complete conduit system in this place.

ROCKFORD, ILL.—The Home Telephone Company, of Rockford, now has 1,000 telephones installed, and is thus up to the number required by its franchise as called for by the city ordinance before compensation can be charged.

ANGOLA, IND.—A telephone franchise has been granted the Farmers' Telephone Company.

MANSON, IND.—The directors of the Manson Co-operative Telephone Company, of this place, will construct a new trunk line to Mechanicsburg and Cyclone.

NEWCASTLE, IND.—The Central Union Telephone Company has added a new fifty-drop section to its switchboard now giving it a 350-drop board. It has about 480 telephones in use at the present time.

MISHAWAKA, IND.—The telephone system and service between this city and a score or more of towns and cities in northern Indiana was completed on Nov. 5, thus making complete the telephone loop from central Indiana cities to near the Michigan line.

INDIANAPOLIS, IND.—The services of the telephones were largely depended on throughout Indiana during the week in the gathering of election returns and other matters relating to the recent election. It is estimated that the receipts of the telegraph companies were from one half to two thirds less than during the election two years ago.

MUNCIE, IND.—Three linemen, employed in the construction of a new telephone line into Muncie and a junk dealer are under arrest, charged with stealing large quantities of copper wire. They confess that they have made it a business of stealing copper wire from telephone and traction companies. In their possession was found upwards of $200 worth of copper wire.

LAFAYETTE, IND.—The Lafayette Telephone Company has filed a mortgage of $150,000, covering its plant, system and franchise, for the purpose of making extensive improvements and extensions. A complete common battery multiple system will be installed and other improvements made. The Lafayette Loan and Trust Company will act as receiver for the bond holders, the mortgage being executed by the company in favor of the bond holders.

EMMETSBURG, IA.—The Palo Alto Telephone Company has been incorporated at Emmetsburg to build a county system.

COON RAPIDS, IA.—The Harris-Jewell Telephone Co., of Coon Rapids, has changed its name to Coon Rapids Telephone and Electrical Company.

BOXHOLM, IA.—The farmers and business men of this place have organized a telephone company to be known as the Grant Center Telephone Company.

HUMBOLDT, IA.—The Humboldt Mutual Telephone Company has consolidated with the Rural Union Telephone Company, of Ottosen, Bradgate and Livermore.

GUTHRIE CENTRE, IA.—The Iowa Telephone Company has secured an exchange at Guthrie Centre with an independent telephone company, and is said to be doing the same thing elsewhere, with a view to strengthening its toll line service.

MOLINE, KAN.—Dr. J. H. Close has formed the Elk County Telephone Company, with a capital of $100,000. J. H. Close, C. F. Plowman, S. C. Hanna and others are interested.

TURNER, ME.—The Hebron's Home Telephone Company, of Turner, has been chartered, capital $1,800. President, J. L. Bumpus, Hebron; treasurer, W. H. Berry, East Hebron, Me.

FREDERICK, MD.—The United Telephone Company, which recently absorbed the Maryland Telephone Company, of Hagerstown, will build a new line from Boonsboro to Frederick.

ATTLEBORO, MASS.—The Taunton Telephone Company is making arrangements to extend its line from Taunton through Norton, Mansfield and Attleboro, and intends to combine these four places into one big district, which will be managed like the Providence district of the Providence Telephone Company.

MENOMINEE, MICH.—The Michigan Telephone Company will expend between $4,000 and $5,000 improving the telephone service in Menominee.

ALMA, MICH.—A contract has been closed by the Valley Telephone Company of this place to build a line south from Flint to Holly and ultimately to Detroit.

JEFFERS, MINN.—The Amo Telephone Company will extend its line into Jeffers and Windom.

CANTON, MO.—The Bell Telephone Company is building a line from Edina to Canton.

KANSAS CITY, MO.—The Pittsburg Home Telephone Company, capital $75,000, has been incorporated by E. N. Reaser, Jas. A. Plattner, E. Chapman and others.

KANSAS CITY, MO.—The Home Telephone Company, which was organized here recently, increased its capital stock from $50,000 to $3,000,000. Gentlemen representing the St. Louis Trust Company, which will finance the new concern, are here in the interest of the company. The Home Telephone Company got its franchise by agreeing to reduce rates something like 50 per cent. In the last three months the company has spent $250,000 in constructing the lines. There is great interest in the rivalry that is expected to follow when the new company is in the field against the present telephone company.

BOZEMAN, MONT.—The Rocky Mountain Bell Telephone Company has let the contract for the erection of a telephone line from Bozeman to Salesville.

SOUTH OMAHA, NEB.—A franchise has been granted to the Interstate Independent Company to construct a telephone system in this place.

GRANT, NEB.—A. S. Clark, A. Van Wegene and J. L. Putnam, Omaha parties, have organized the Nebraska Clark Automatic Telephone Company. It was recently incorporated to manufacture and operate telephone systems.

CANTERBURY DEPOT, N. H.—The Citizens' Telephone Company is building a line between East Canterbury and Belmont.

TILTON, N. H.—A telephone line is being built between Canterbury and Belmont to connect the Boscawen and Canterbury line with the Citizens' system.

BRANCHVILLE, N. J.—The Farmers' Telephone Company is about to build a line from Beemerville to Branchville and probably to Newton.

CAMDEN, N. J.—The Globe Automatic Telephone Company has been incorporated, with a capital stock of $500,000, by J. E. Norling, J. D. Lynch and F. A. Lindiquist.

GLENS FALLS, N. Y.—The Hudson River Telephone Company is constructing a telephone line in the village of Warrensburg.

CHARLOTTE, N. C.—The Southern Bell Telephone Company has bought the independent line to Monroe, 25 miles in length. The Bell Company has also completed a line between Raleigh and Wilmington. A line has also been completed from Wilmington to Southport.

GASTONIA, N. C.—The Piedmont Telephone and Telegraph Company has been organized here with a capital of $30,000, as the successor of the Gastonia Telephone Company. W. T. Love was elected president and R. B. Babington, superintendent of the new concern. The new company also absorbed the exchanges at King's Mountain, Bessemer City, Lincolnton, Shelby and Cheneyville N. C. The company has contracted with the Bell Company to connect with the long distance service of the latter.

ROSEWOOD, OHIO.—The Champaign Telephone Company, of Rosewood, has incorporated, with $15,000, to install a local telephone system.

HAMILTON, OHIO.—The plant of the Hamilton Home Telephone Company is about completed. The conduits are all laid and cable is being run.

BOWLING GREEN, OHIO.—The United States Telephone Company is stringing additional wires between Lima, Findlay, Bowling Green and Toledo.

SOUTH CHARLESTON, OHIO.—A. B. Bell has been elected secretary of the Madison-Clark Telephone Company, succeeding J. C. McMillan, resigned.

TOLEDO, OHIO.—The Toledo Home Telephone Company has opened its East Toledo exchange with 300 subscribers. The exchange will accommodate 1,500 subscribers.

MANSFIELD, OHIO.—The Mansfield Telephone Company will expend $30,000 in the extension and improvement of the system within a short time. Lines will be extended to all parts of the county and the Mansfield exchange will be enlarged.

MIDDLETOWN, OHIO.—The Miami & Erie Transportation Company is at work putting in a system of telephones. Every part of the route is to be equipped with telephones, and an operator will be in constant communication with the electric boats.

CRESTLINE, OHIO.—The council has granted the Crestline Telephone Company a new 20-year franchise, repealing the old franchise which would have expired in four years. The company is in a prosperous condition and improvements are to be made.

CLEVELAND, OHIO.—The franchise of the Detroit People's Telephone Company will soon become inoperative through failure to commence service on time, and the officials of the Federal Telephone Company are making every effort to get matters in shape so that the franchise may be extended and the exchange completed without delay. President Dickson, of the Federal Telephone Company, denies positively the truth of the report that it is figuring with the Bell Company with a view of disposing of the various Federal properties.

CLEVELAND, OHIO.—Officials of the Cuyahoga Telephone Company are preparing to enter upon an active campaign to induce the city council to permit the company to increase rates. The Cuyahoga Company has a total of 10,072 subscribers. When the present rates of $36 and $48 were announced, it was thought that the exchange would not go above 5,000 in a number of years and with the increased number of subscribers it is claimed that the receipts hardly pay the cost of operation. President Dickson, of the Federal Company, is quoted as saying that no money will be spent on the Cuyahoga plant until the council grants the desired permission to increase rates.

GUTHRIE, OKLA.—Fifteen of the independent telephone companies of Oklahoma have combined under the name of the Pioneer Telephone Company with a capital stock of $500,000.

CHARTIERS, PA.—The Chartiers Telephone Company, having a trunk line from Carnegie to McDonald, and other valuable franchises, has passed under control of the West Penn Company, with lines in Washington, Greene and Allegheny counties. The latter is preparing to issue $25,000 in bonds to develop the new acquisition. A line will be built to Wheeling and a large exchange put in at Washington, Pa.

SPARTANSBURG, S. C.—The Southern Bell Telephone Company has bought the consolidated telephone system of Spartansburg, also the independent systems in Greenville, Newbury, Union, Clinton and other places. These exchanges were all controlled by Philadelphia capitalists represented by L. W. Floyd, of Newbury, S. C., who will become manager of the Bell interests in Newbury, and at the other places mentioned.

COLTON, S. D.—The farmers northwest of here have decided to build another telephone line.

MARION, S. D.—J. A. Steninger, of Patker, has been granted a franchise to establish a local telephone system at this place.

KNOXVILLE, TENN.—Telephone lines are being built in every direction to the farms near Knoxville by the local companies and it is said that every progressive farmer within ten miles of Knoxville will soon be supplied with a telephone.

DALLAS, TEX.—The Quanah-Mangum Telephone Company, of Quanah, capital stock $5,000, has been incorporated by M. M. Hankins, J. E. Woolbright and M. R. Smith.

DENISON, TEX.—The Grayson County Telephone Company is constructing a line through the Indian Territory, via Denison and will extend it to Kansas City and St. Louis.

RICHMOND, VA.—The Richmond Telephone Company has begun the work of placing its wires underground. An order has been placed for 200,000 feet of conduit material.

PETERSBURG, VA.—It is proposed to complete by December 15, the transfer of the wires of the Southern Bell and the Mutual Telephone companies to one exchange. These interests were recently consolidated.

DANVILLE, VA.—The Southern Bell Telephone Company announces that it will soon put in operation long distance telephone lines to Martinsville and South Boston. The concession was gained through the efforts of the Business Men's Association.

PARKERSBURG, W. VA.—As the result of the recent doubling of rates, the Bell Telephone Company has lost a large number of subscribers at this point, and the business of the West Virginia Western Telephone Company has increased proportionately.

JANESVILLE, WIS.—Directors of the Badger State Long Distance Telephone Company met here a few days ago. Papers of foreclosure have been served on the directors by the German-American Bank, of Milwaukee. The directors decided to waive the right of redemption and the property will probably be sold within two months. The stockholders have decided on making an effort to bid in the property and will be present at the sale.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—Frank D. Sweeten, treasurer of the Vallee Bros. Electrical Company, of Philadelphia, is organizing a syndicate to buy the Alabama Light and Power Company, at Opelika, Ala., and to build an electric railway from Opelika to Auburn, 7½ miles. The new concern will have a capital of $200,000. An option has been secured by the new company.

SAN FRANCISCO, CALIF.—The Richmond Light and Power Company, which has been incorporated with W. A. Bissell, of Alameda, and Walter P. Treat, N. T. Messer, Jr., Edwin Schwab and W. C. Webb, of San Francisco, as directors, has a capital stock of $150,000.

SAN FRANCISCO, CALIF.—The Klickitat Power & Electric Company, George Canfield, president, which was recently organized, will install a water power electric plant on the Little Klickitat River, just below the falls. The city of Goldendale, Wash., will be lighted under a franchise recently granted to J. T. Moffett.

SAN FRANCISCO, CALIF.—The Edison Electric Co., of Evanston, Wyo., and Los Angeles, Calif., has filed a deed of trust in San Bernardino, Calif., to all of its franchises, pole lines, power houses and electric power systems, which are located in nearly every county south of the Tehachapi. The 60-mile power transmission line between the Santa Ana Canyon and Los Angeles is included. The Edison Company deeded its property in trust to the Los Angeles Trust Company and the United States Mortgage & Trust Company, of New York, in order to secure $10,000,000 for the carrying on of its business. It proposes to issue 10,000 one-thousand-dollar bonds, drawing 5 per cent. interest and payable semi-annually. The bonds become due Sept. 1st, 1922. Among the improvements thus provided for is the construction of a water power electric transmission plant in the Kern River Canyon that will be the largest in Southern California. The current is to be transmitted over one hundred miles to Los Angeles. Machinery contracts will be let in the near future and the hydraulic work is already well advanced.

SAN FRANCISCO, CALIF.—The United Gas & Electric Company, which distributes the electric power from the Standard Electric Company's transmission lines, is completing a large steam power auxiliary station in San Jose, Calif. A large addition has been built at the old San Jose Light & Power plant and a 400-kw General Electric engine type generator has been installed. A General Electric 300-kw three-phase generator has been shipped from the East for the new station. A contract has been closed—with the General Electric Company—to build a 1,000-kw revolving-field generator direct connected to a Corliss automatic engine making 100 r. p. m. All of the above generators for the new plant are three-phase, 60 cycle. Nearly all of this machinery will be held in reserve in case of trouble on the transmission line. Constant current transformers have been installed to supply series alternating arc lamps on street lighting circuits in San Jose. J. E. Green is general manager of the company and C. H. Pennoyer is the local superintendent in San Jose. The company's electric distributing lines and gas mains are being extended in Santa Clara and San Mateo counties.

KEY WEST, FLA.—F. H. Porter, of New York, has been here examining, with a view to possibly purchasing, the Key West Electric Company. The deal will likely be consummated and will mean extensive improvements in the electric railway as well as the lighting systems.

VILLA RICA, GA.—The Villa Rica Light and Power Company has been organized. The following officers have been elected: C. M. Griffin, president; F. C. Wilson, vice-president; E. R. Ayers, secretary and treasurer.

JACKSON, GA.—Capt. Seaton Grantland, of Griffin, is planning to put in an immense electric plant at High Falls, 10 miles south of here that will generate between 30,000 and 40,000 horse power. The electric power will be conveyed to Griffin principally and to such other towns or places as will need it for ginning, cotton factories, oil mills or other manufactories and lighting purposes. It will cost, when completed, $200,000 or more.

ALTON, ILL.—The new 600-hp engine which will operate the new electric power plant at the glass works has been completed and will be put in operation immediately. The new power plant, which is the most complete private plant of its kind in the vicinity of Alton, has been operated the past few days by a smaller 200-hp engine. The Illinois glass company is making preparations to increase its lighting capacity whenever it is desired. The whole plant, including the yards and all departments of the factories, are thoroughly illuminated at night and power fans have been installed to improve the comfort of the men.

SUMMITVILLE, IND.—The Summitville Electric Light Company has put in operation a new electric light plant, which is to be bought by the city at a cost of $50,000.

DEERFIELD, ME.—The Electric Light and Power Company is at work at West Deerfield. The power house will be erected substantially as originally planned, and the location of the dam will be changed. The company is seriously considering the erection of a dam by its own men rather than under a contract.

BOSTON, MASS.—The Edison Illuminating Company has been given permission by the Chelsea aldermen to run wires through certain streets in that place to supply East Boston with light and power.

OWOSSO, MICH.—The common council has declared in favor of a public lighting plant, and a committee was appointed to look into the matter.

DULUTH, MINN.—The Highland Canal & Water Power Company has secured an option of the Jay Cooke property, surrounding the St. Louis River, the purchase price being set at $1,000,000. This company was organized to establish a water power plant, having a capacity of 500,000 horse power. The plan is to connect the chain of lakes back of Duluth with Lake Superior by a canal, thus securing a waterfall from which to derive the power.

MONROE CITY, MO.—The electric light plant, costing $15,000, is completed and for the first time the lights were turned on November 8.

FARMINGTON, MO.—The electric light plant has passed into the hands of Loftcutler & Bendit, of St. Louis. They have been granted a twenty years' franchise by the city council, and the town is to be rewired and the number of street lights increased from fifty-eight to eighty. Several thousand dollars will be spent in improving the plant.

ST. LOUIS, MO.—Bids for the purchase of the United States Incandescent Company's plant at Jefferson Avenue and Walnut Street were opened November 5 in Judge Fischer's division of the circuit court. The National Lamp Company submitted the highest bid, $15,500, and it is probable that it will be accepted. Some time ago there was a dispute between J. M. Davey and H. G. Ferguson, owners of the United States Incandescent Lamp Company, and it was decided to have a receiver appointed and dissolve the partnership and sell the property.

NEWPORT, N. H.—The Newport Electric Light Company has increased its capital stock to $25,000.

BROOKLYN, N. Y.—The Queretaro Power Company, of Brooklyn, has been incorporated to construct electric and water works in Queretaro, Mexico; capital $300,000.

ALTAMONT, N. Y.—The Altamont Illuminating Company has been incorporated to supply gas and electricity in Guilderland, Knox, and Altamont. The capital is $5,000. The directors are E. G. Crannell, Frederick Crounse, Lewis E. Fowler, Hiram Griggs, James Keenholts, Frank S. Lape, Albert J. Manchester, Emmett Mynderse, Eugene Sand, Robert C. Simmons, Edward C. Sturges, Dayton H. Whipple and John D. White, of Altamont.

PROSPECT, OHIO.—The village has placed a contract with the Prospect Electric Light Company for furnishing light for public use. The company will make extensive repairs to its equipment.

YORK, PA.—The light committee of the York councils by awarding the contract for city lighting to the Edison Electric Light Company and rejecting the bid of the recently established Merchants' Electric Light Company has provoked a storm of public criticism. The committee, on the pretext that councils are about to consider a proposition for the establishing of a municipal lighting plant, awarded the contract to the old established company. The new company's bid was for a period of either three or five years and would have meant a saving of $18,000 to the city treasury. So great is the disapproval of the citizens that the awarding of the contract may be reconsidered at the next meeting of the city councils.

HURON, S. D.—The Gladys Electric Light, Water and Power Company, of this city, with a capital stock of $100,000, was granted a permit to do business in Texas.

NASHVILLE, TENN.—The Louisville and Nashville Railway is considering a plan to equip all its coaches with electric lights.

STAUNTON, VA.—Edgar M. Funkhouser and associates will purchase the plant of the Staunton Light and Power Company, now in the hands of R. D. Anderson, the receiver of the company.

THE ELECTRIC RAILWAY.

ATLANTA, GA.—The Atlanta Railway and Electric Company on December 1, will inaugurate an increased scale of wages. Extra pay is also promised men serving a stated term of years.

ELKTON, MD.—The Elkton & Chesapeake City Electric Railway Company has changed hands, M. P. O'Brien and Ambrose Higgins selling out their interest to G. W. Buinbaker, W. W. Hess and G. E. Schlegelmalch, all of Philadelphia. The company was re-organized with Mr. Buinbaker as president. The new owners will commence at once the building of their line from Elkton to Stanton, at which point they will connect with the line to Wilmington, Del.

SALAMANCA, N. Y.—The Berney Traction Company has been incorporated here, with a capital of $10,000. The directors are S. A. Holbrook and A. J. Edgett, of Bradford, Pa., and W. K. Harrison, of Salamanca.

NEW YORK, N. Y.—The Staten Island Rapid Transit Railway Company is erecting a large freight shed and office at Tompkinsville, Staten Island, to take the place of the one now located at Stapleton. The building will be on the property recently filled in by the company.

SYRACUSE, N. Y.—The wages of all of the employees of the Syracuse Rapid Transit Company have been advanced by the company voluntarily. The wages were formerly $1.35 to $1.60 per day; now they are $1.60 to $2. This affects over three hundred men. General Manager E. G. Connette intends to pursue the policy of having the employees share in the success of the company.

DAYTON, OHIO.—The Dayton & Western Traction Company, which is building an extension from Eaton to Richmond, Ind., will also build a spur line from Westville to New Paris.

COLUMBUS, OHIO.—A certificate of consolidation has been filed by the Cincinnati & Eastern Traction and the Cincinnati Suburban Traction Company. They are not competing lines. The capital stock is $2,500,000.

FOSTORIA, OHIO.—The directors of the Toledo, Fostoria & Findlay Railway announce that construction work on the extension from Fostoria to Toledo, will start early next Spring. Additional capital has been interested.

MARYSVILLE, OHIO.—Dr. H. C. Diamond, of Springfield, and W. D. Riddell, of Xenia, are looking over the territory between Springfield and Delaware with a view of building an electric railway between these points. Considerable isolated territory would be opened up by such a line.

SANDUSKY, OHIO.—The Sandusky & Southwestern Railway Company, with headquarters at Wapakoneta, Ohio, has been incorporated by F. O. Olsen, S. W. McFarland, S. P. Douglass, Wm. H. Wyke and Itharmer E. Yarnell. The capital stock is $1,000,000 and the company proposes to build from Sandusky to Wapakoneta through Erie, Sandusky, Seneca, Wyandot, Hardin, Logan, Allen and Auglaize counties.

LEXINGTON, S. C.—The surveys have been completed for an electric railway to Columbia. Col. Graham, of Columbia, is interested. A company was organized recently to push the work.

COLUMBIA, TENN.—The Interurban Railway Ordinance has been passed by the city council, with a proviso that the work of construction shall be completed within two years.

RICHMOND, VA.—The Amalgamated Association of Street Railway Employees has begun a series of meetings for the purpose of educating the members regarding their obligations to employers, the union and the public.

RICHMOND, VA.—The Virginia Passenger and Power Company on November 14 took formal possession of the line of the Richmond and Petersburg Electric Railway. The Virginia Company has also practically decided to unite the two power houses in Richmond with the new power house being erected in Petersburg. When the plants are completed it is likely that coal will be dispensed with, water power being used entirely. The Virginia Company's plant in Dinwiddie County will develop [illegible] horse-power. The company will also occupy a new building in Richmond after January 1.

LEGAL.

STEAM PUMP LITIGATION.—The International Steam Pump Company has brought suit in the New York Supreme Court to recover from Henry R. Worthington a large number of patents issued in foreign countries and others pending here and abroad. The company is also seeking to recover from Worthington about $1,200,000 worth of its stock, which, it alleges, was issued to him without consideration. The company demands the return of the stock on the ground that the patents for which the stock was given in payment were rightfully the property of the company. Mr. Worthington replies that the patents contested for are his personal property and not those of the Worthington Corporation or of the International Steam Pump Company. The company lays claim to 226 patents and applications for patents, most of which are in foreign countries. Lawyers Jenner and Wetmore represent Mr. Worthington. The counsel for the company are Guggenheimer, Untermyer & Marshall.

NEW INDUSTRIAL COMPANIES.

THE PITTSBURG LIGHT AND MANUFACTURING COMPANY has been incorporated at Harrisburg, Pa., with a capital stock of $10,000.

THE NATIONAL CAR TRUCK & BRAKE COMPANY has been incorporated with $100,000 capital in West Virginia to engage in the manufacture of trucks and brakes in Cleveland.

THE TOGGLE RAIL BRAKE COMPANY has been incorporated at Camden, N. J., with a capital stock of $250,000. The incorporators are John W. Avery, Samuel R. Bullock and William N. McInnis.

THE MOLONEY ELECTRIC COMPANY has filed letters of incorporation at St. Louis, Mo., with a capital stock of $40,000 paid up. The incorporators are T. O. Moloney, H. Wurdack and L. L. Mullen.

THE NATIONAL INCANDESCENT LAMP COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $5,000. The shareholders are Geo. W. Wadlow, Jones H. Parker and Henry M. Munn.

THE UNITED STATES INCANDESCENT LAMP COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $10,000. Messrs. G. W. Wadlow, J. H. Parker and H. M. Mumm are the shareholders.

THE MISSOURI ELECTRICAL CONSTRUCTION COMPANY, St. Louis, Mo., has filed articles of incorporation, with a capital stock of $2,000, one-half paid up. The shareholders are Samuel G. Payne, Barton J. Parker and Hickman P. Rodgers.

THE UNITED STATES ELECTRIC MAIL BOX COMPANY, of Stanwick, N. J., has been incorporated to manufacture electric mail boxes. Capital $100,000. The incorporators are N. O. Walters, Isaac N. Walters, Uriah N. Funk and others.

THE REED-SQUIRE ELECTRIC COMPANY, of Kansas City, Mo., has been incorporated for the manufacture, purchase and sale of electrical appliances of all kinds and the construction and operation of electric light and power plants. It has a capital stock of $40,000, one-half paid. The incorporators are E. M. Reed, William Squire, Lewis Crocker and H. M. Squire.

PERSONAL.

MR. GEORGE F. McCULLOCH, president of the Union Traction Company, Indianapolis, Ind., has returned home from Europe.

MR. W. F. GUNN has been appointed to take charge of advertising and publicity for the Kellogg Switchboard & Supply Company, of Chicago.

MR. R. B. BRAMWELL has resigned his position as advertising manager of the International Motor Car Company, of Toledo, Ohio, to engage in other lines of work.

MR. JOSEPH E. LOCKWOOD, of the Michigan Electric Company, and representative of the Stanley interests at Detroit, has been visiting the East during the past week.

MR. W. C. WARD, until recently mayor of Warren, Ohio, has become executive head of the Peerless Electric Company, recently formed in that city to manufacture electrical goods.

MM. CHARTON and FAIRELEY, prominent engineers of the Paris Metropolitan Railway, are now here to study electric traction methods. They are staying at the Hotel Lafayette, University Place.

MR. D. E. GOE has left the Northern Electrical Manufacturing Company, of Madison, Wis., and will, it is understood, devote his energies to general advertising in which field he has had a large and successful experience.

MR. J. B. PERKINS, of Toledo, Ohio, has completed plans for the power house of the Cleveland, Painesville & Ashtabula Electric Railway to be erected at Painesville, Ohio. It will be of the alternating current type and will supply several sub-stations.

MR. EDWIN O. WAYMIRE, treasurer of the Dayton Fan & Motor Company, was in New York last week taking orders for his company's fans for both domestic and foreign shipment. Mr. Waymire reports business unusually good, and is very enthusiastic about the outlook for next season.

MR. A. MEYER, president of the Crescent Company, of Chicago, was a visitor to New York the latter part of last week. Mr. Meyer has been in the East for the purpose of introducing his soldering stick and paste, and a new cord spool and socket handle which have recently been put on the market.

MR. ARTHUR STANLEY, well known in the electrical trade of New York, takes charge, on December 1, of the New York office of Robbins & Myers, of Springfield, Ohio, and will represent their well-known fan motors, power motors, etc., with headquarters in the Maiden Lane Building, Broadway.

MR. S. W. WARE, ex-mayor of the City of Adelaide, South Australia, has arrived in the United States for the purpose of studying American electric traction methods and electrical plants, it having been decided to convert the existing horse-car system in Adelaide into an electric system. Mr. Ware is at present in New York. He is a guest at the Fifth Avenue Hotel.

MR. F. L. MARTIN, who has been for some time past in charge of the publication department, etc., of the Kellogg Company, has now joined the forces of the Stromberg-Carlson Telephone Mfg. Co., of Chicago, and will have charge of its advertising, etc. Mr. Martin has done excellent work and has a great many friends in the telephone field.

MR. ARTHUR WARREN, the head of the publication department of the Westinghouse Companies, who has been visiting this side for some weeks, sailed for England last Tuesday. The ramifications of the Westinghouse interests in Europe are now so large and widespread as to require Mr. Warren's constant attention on the other side.

MR. ESHABRAU HATA, telephone engineer of the Japanese government, is visiting telephone exchanges in the West, studying modern telephone practice. He is accompanied by Mr. C. Owoyama, a Japanese electrical engineer. They visited the exchange of the Home Telephone Company in Toledo, Ohio, last week, and were favorably impressed with its completeness.

MR. BELISARDO RODRIGUEZ, of Caracas, Venezuela, representing a syndicate of capitalists, is now in the United States for the purpose of purchasing the equipment for a gravity electric road, which is intended to be constructed from the city of Caracas to a point in the vicinity of La Guayra, the principal port of Venezuela. The line will be about six miles in length. Mr. Rodriguez is making his headquarters at the Export Club of America, 82-88 Wall Street, New York.

MR. LUTHER STIERINGER has been recommended by the Committee on Science and Arts of the Franklin Institute, Philadelphia, for the John Scott Legacy premium and medal for his "worthy contributions to the art of electric illumination." This award does credit to the Institute by its recognition of the pioneer utilitarian work and later asthetic results of this engineer, who has taught his age how to use light as an artist uses color. Mr. Stieringer has been seriously ill of late and is wintering on the Mexican border and in Southern California.

NEW YORK ELECTRICAL SOCIETY.—The following named gentlemen were elected members of the New York Electrical Society at its last meeting: George L. Patterson, Brice A. Frey, Harry Alexander, Gustave A. Brackly, John L. Streever, R. Halliday Nexsen, Geo. Greenwood, Henry A. Sheuplein, A. H. Ackerman, Frank F. Thompson, Orosco C. Woolson, E. W. Hazazer, C. R. Newman, John H. Dale, Charles H. Sinnett, Olin Beecher Greene, A. F. Stanley, G. T. Luckett, Severn D. Sprong, William T. Dempsey, F. Moreton Jack and E. A. Harley.

MESSRS. J. J. BELLMAN and HENRY SANFORD, 2nd, have opened offices at No. 14 Church Street, New York, to transact a general engineering and contracting business. The business is started under the most favorable auspices, as both Mr. Bellman and Mr. Sanford are practical men. The former is a graduate electrical engineer of Columbia University, and has been connected with a number of prominent concerns, among them the New York Edison Company, the Crocker-Wheeler Company and Westinghouse, Church, Kerr and Company. Mr. Sanford has been connected with the General Electric Company and the Metropolitan Street Railway Company. They will make a specialty of power plant work and take complete contracts for the entire equipment of central stations and isolated plants. As they are both active young men and have ample financial resources, their prospects of success are very bright.

OBITUARY.

MR. H. D. KAMPMAN.—The death is noted of Mr. Herman D. Kampman, formerly president of the San Antonio, Tex., Gas and Electric Company when its properties were purchased by the McMillin syndicate. He was in his forty-sixth year.

MR. CHARLES MOEHLMAN, foreman of the iron foundry of the General Electric Company, Schenectady, N. Y., died suddenly at his home in Schenectady on Friday, October 31st. He was born in Nittlestadt, Westphalia, in 1856, and after attending common schools until he was 14 years of age, started in his father's foundry to learn the molder's trade. At the age of 21 he had the usual term of three years' service in the German army. In 1882 he emigrated to America and worked for four years in an iron foundry at Amsterdam, N. Y., and also in several other foundries until January, 1888, when he secured employment as molder with the Edison General Electric Company. He continued in its employ until his death. He was appointed foreman of the iron foundry in 1895. A widow and six children survive him.

MR. GEORGE HARDING, one of the oldest and best known patent lawyers in this country, died in New York City this week, aged 76. He graduated from the University of Pennsylvania in 1846 and after reading law with John Caldwalader was admitted to the bar in 1849. He was connected with the McCormick reaper case in which Lincoln and Stanton figured and in which he showed a miniature grain field to illustrate the process of reaping by machinery. When he was arguing the telegraph case of S. F. B. Morse against O'Reilly in the United States Supreme Court he operated a miniature telegraph system to illustrate his points, and in a hat-body case made a complete hat in the court room. What is said to have been his most successful case was the Tilghman glycerine case, in which he induced the Supreme Court to reverse its first decision on the question. Mr. Harding leaves two children, a son and a daughter, the former, George J. Harding, well known as a member of the Philadelphia bar.

PROF. O. N. ROOD.—We regret to note the death of Prof. O. N. Rood, of Columbia University, in New York City, last week, of pneumonia. He was born in Danbury, Conn., 71 years ago, and entered Yale at 18, but after completing his sophomore year went to Princeton, taking his A. B. with the class of '53. For two years after graduation he was instructor in chemistry at Yale. Then he went abroad and worked for three years under Liebig at Munich, returning here in 1858 to take the chair of physics in Troy University. At the same time he filled the post of professor of rhetoric and logic. Troy University disbanded soon after the breaking out of the Civil War and Prof. Rood went into retirement for a while at his country place, Peacedale, R. I. In 1864 he became professor of physics at Columbia. Much of Prof. Rood's scientific fame is based on his original investigations into color. In later years the Rontgen ray engaged his attention, and in the early '90s he was one of the prominent investigators in this field. One of the many pieces of apparatus devised by Prof. Rood was an instrument now known as the flicker photometer, which he used in investigating color blindness. By it the measurement of light independent of color was made possible. Up to the day of his illness he was experimenting with the electrical conductivity of insulating materials. To carry on this investigation more delicate methods of measurement were necessary, and last year Prof. Rood devised a new method of measuring electrical resistances capable of dealing with some 10,000 times greater than had ever been possible before. By it he was able to measure the electrical resistance of glass, ebonite and other insulators hitherto ranked as non-conductors. As a teacher Prof. Rood was thorough and painstaking. His habits of abstraction and quaint eccentricities made him dear to the heart of the undergraduate. Prof. Rood was a painter of some reputation. Several of his water colors have been exhibited at the annual exhibitions of the American Water Color Society. He is survived by a widow and five adult children. The funeral took place on Friday morning, the pallbearers being members of the department of physics.

Trade Notes.

THE MANUFACTURING & SELLING CO. OF AMERICA announces that it has acquired from the Strobel & Wilkin Company, 591 Broadway, the sole agency for the O. K. dry batteries and has removed its offices and factory to 129-131 Crosby Street.

THE ELECTRIC APPLIANCE COMPANY, Chicago, refers to Packard incandescent lamps as "Quality Lamps." It claims that extra quality lies in the Packard and that fact is being discovered by users generally. The increasing output is pointed to as evidence of this.

LARGE FILTER.—A very large filter for lubricating oil has recently been furnished by the Burt Manufacturing Company, Akron, Ohio, for the plant of the Savannah Electric Company, Savannah, Ga. The Burt Company has also lately shipped a large oil filter for use by an electric plant in Brazil.

ELECTRICAL MERCHANDISE.—The Liberty Electrical Supply Company, 136 Liberty Street, New York, carries a full line of house goods, telephones, construction material, etc. These goods are illustrated and listed in a 48-page catalogue of recent issue. About everything in the electrical supply line is shown.

ALPHADUCT, the new fireproof flexible interior conduit, is now being placed on the market. Much time and money have been spent on this product to make it a success and wherever installations have been made it has given satisfaction. The Eastern selling branch of this business is at 39 and 41 Cortlandt Street, New York. Mr. W. S. Brown being the representative.

FORT WAYNE BULLETINS.—The Fort Wayne Electric Works, Fort Wayne, Ind., in bulletins Nos. 1027, 1035 and 1036 illustrate and describe respectively alternating current arc lamps; electrostatic ground detectors and small direct-current motors. These various types of apparatus are very completely illustrated with views of detailed parts and finished machines.

THE BILLINGS & SPENCER COMPANY, Hartford, Conn., has just issued a new list of drop-forge lathe dogs. Dimensions and prices of the dogs are given, and a variety of these devices are illustrated. The same company has recently issued a circular on its automobile forgings. These parts are illustrated in perspective and dimensional diagrams. They comprise all of the metal parts of the automobiles.

ARC LIGHT BLUE-PRINTING MACHINE.—The Eugene Dietzen Company, 181 Monroe St., Chicago, has issued a circular describing and illustrating its automatic revolving cylindrical electric blue-printing machine. The machine consists of a cylindrical printing frame composed of two semi-cylindrical plates of heavy glass on the exterior of which are placed the tracings and printing paper and an automatic arrangement whereby an arc lamp is alternately lowered and raised within the interior of the cylinder.

THE SHULTZ BELTING COMPANY, St. Louis, Mo., has just completed the work of remodelling and enlarging its factory. The new buildings increase the company's capacity two and one-half times, and the equipment includes a full line of new and modern machinery. The company states that it uses the heaviest packer-steer hides in the manufacture of its belting, and prepares the leather by its own special process. By a new stretching device all the stretch is taken out of the belting. The company states that its tannery and belt factory are thoroughly up to date and unexcelled.

COAL-HANDLING STATION.—The John A. Mead Manufacturing Company, 11 Broadway, New York, has just issued a pamphlet giving an interesting description of the United States naval coaling station at Frenchman's Bay, Me. It contains half-tone views of the station and apparatus. This plant has a capacity of unloading from colliers or barges of 160 tons per hour for each of the two towers, and can take coal from the storage building to the pier, for supplying war vessels or colliers, at a rate of 250 tons per hour. This capacity can be increased by the use of additional cable cars.

MESSRS. CHARLES H. BESLY & CO., 10-12 North Canal St., Chicago, Ill., report their general business very good. They call particular attention to their large and varied assortment of seamless brass and copper tubing. Three hundred sizes of tubing are carried in stock, varying from one sixty-fourth-inch outside diameter to eight and one-half inch outside diameter. Brass rod, sheet, wire and brazed tubing; braziers sheet copper, soft and cold rolled copper anodes; brush copper for electrical purposes; german silver sheet, rod and wire are also carried in stock. Their new store building on Clinton Street is progressing rapidly and will give them over double the space of their present five-story building, 10-12 North Canal Street. Their three hundred-page catalogue will be mailed free on application.

MECHANICAL STOKERS.—The Rhode Island & Suburban Railway has contracted for a large equipment of Roney mechanical stokers for its new boiler plant. The plant will have an ultimate boiler capacity of 8,300-hp. The above stokers will be used throughout. Another large concern, the Narra-

[illegible] Electric Lighting Company is also installing a complete equipment of [illegible] stokers, [illegible] of the [illegible] type operating under [illegible] & Wilcox boilers of [illegible] capacity. A third industrial plant employing these stokers is the Brown & Sharpe Mfg. Co., where [illegible] stokers under two batteries of Babcock and Wilcox boilers have been in use for some time with excellent results. The success of this installation undoubtedly furnished the incentive toward the smoke prevention movement now active in Rhode Island.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 11, 1902.

[illegible] N. Y.]

713,122. METHOD OF MAKING ELECTRIC CONDUITS; A. M. Lougee, Boston, Mass. App. filed Dec. 2, 1901. The method consists in lining the conduit with a vulcanizable insulating material and then applying a vulcanizing heat.

713,123. ELECTRIC CONDUIT; A. M. Lougee, Boston, Mass. App. filed Dec. 2, 1901. The product covered by the preceding method.

713,133. ELECTRIC SWITCH; T. Muller, New York, N. Y. App. filed March 13, 1902. A tilting weight is attached to the movable electrode and a second tilting weight movable independently to operate the movable electrodes is caused to act by means of a fluid actuated member.

713,140. PROCESS OF DISTANTLY REPRODUCING PICTURES; H. R. Palmer, Cleveland, Ohio. App. filed Jan. 21, 1901. (See Current News and Notes.)

713,174. VOLTAIC CELL; H. B. Taylor, Newark, N. J. App. filed April 2, 1902. Details of construction and mounting facilitating assembling and renewing of the parts.

713,186. SECONDARY BATTERY; R. Welford, Sunderland, Eng. App. filed Nov. 21, 1899. The corrugations of the plate are occupied by tablets of active material through which coils of conducting wire run.

713,190. MANUFACTURE OF INSULATING OR PROTECTIVE COMPOUNDS; C. L. V. Zimmer, Hamburg, Germany. App. filed May 13, 1901. A damp-proof insulating material obtained from fat, a saponifying agent, oxygen to thicken the composition and bituminous matter.

713,223. MOTOR CONTROL; J. D. Hilder, Yonkers, N. Y. App. filed Jan. 3, 1902. The electrical means for controlling the starting of the motor are automatically de-energized after the motor has started, to avoid consumption of current and heating.

713,251. PRESSURE REGULATOR; C. F. Spery, Rockland, Ill. App. filed Jan. 25, 1902. Details.

713,257. RECORDING ELECTRICAL MEASURING INSTRUMENT; E. Weston, Newark, and A. O. Benecke, Vailsburg, N. J. App. filed Feb. 10, 1902. Means whereby the stylus may be driven by a rotary armature capable of making either a fractional part of a revolution, or a number of revolutions in either direction in such manner as to give to the stylus wide ranges of movement over the record-receiving surface.

713,258. RECORDING ELECTRICAL MEASURING INSTRUMENT; E. Weston, Newark, and A. O. Benecke, Vailsburg, N. J. App. filed Feb. 10, 1902. An electrically controlled recording instrument intended to give a correct record as to nature and duration of any physical change acting upon a movable agent.

713,259. RECORDING ELECTRICAL MEASURING INSTRUMENT; E. Weston, Newark, and A. O. Benecke, Vailsburg, N. J. App. filed Feb. 10, 1902. An instrument wherein the index needle is caused to return to zero after any change has been imparted to it by the force to be measured.

713,277. ELECTROLYTIC REFINING OF LEAD AND LEAD ALLOYS; A. G. Betts, Lansingburg, N. Y. App. filed Jan. 9, 1902. Process of electro-depositing lead consisting in subjecting to electrolysis and electrolyte containing in solution a lead compound and a reducing agent capable of restraining the crystallization of the lead deposit.

713,278. ELECTRO-DEPOSITED LEAD; A. G. Betts, Lansingburg, N. Y. App. filed Oct. 9, 1902. The product produced by the preceding process.

713,284. RECTIFIER; Harold W. Buck, Schenectady, N. Y. App. filed Oct. 17, 1898. Two sources of alternating current of the same phase are alternately connected to a work-circuit, and one disconnected after the other is connected thereto. One e.m.f. is thus in circuit during approximately a half-period and the unbalanced e.m.f. existing at the instant of commutation is neutralized by opposing to it an independent periodic e.m.f.

713,305. ELECTRICAL IGNITING DEVICE; C. A. Holdbridge, Chicago, Ill. App. filed Sept. 16, 1901. A metallic tube having a wick projecting from its end and forming one terminal of a circuit, is drawn across a roughened plate forming the other terminal, to produce sparks and ignite the wick.

713,307. OPERATING DYNAMO-ELECTRIC MACHINES; F. H. Jeannin, Schenectady, N. Y. App. filed Oct. 28, 1901. (See Current News and Notes.)

713,[illegible]. MAINTAINING SYNCHRONOUS ROTATION OF DYNAMO-ELECTRIC MACHINES; E. W. Mix, Paris, France. App. filed Oct. 25, 1899. (See Current News and Notes.)

713,327. TRANSFORMER; W. S. Moody, Schenectady, N. Y. App. filed March [illegible]. [illegible]

713,346. GROUND DETECTOR; W. H. [illegible], Lynn, Mass. App. filed March 19, [illegible]. A ground detector comprising a plurality of segments related severally to the different wires of a distributing system, a common ground electrostatically related to all of the segments and a number of index needles each jointly controlled by a pair of distributing wires.

713,356. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed March 6, 1899. (See Current News and Notes.)

713,365. ELECTROMAGNETIC MEDICAL APPLIANCE; F. H. Vollery, Allegheny, Pa. App. filed May 7, 1902. The action of an induction coil is designed to be improved by using a vibrating diaphragm across which conducting wires are stretched, to control the current.

713,380. CONTROLLING MOTORS FROM DISTANT POINTS; N. C. Bassett, Lynn, Mass. App. filed March 24, 1902. The arm of the rheostat is automatically returned to the off-position after the motor has closed the main valve of an engine, thus permitting the engineer to stop the engine by simply throwing a switch and leaving the apparatus to effect its usual functions.

713,386. INTERIOR CONDUIT OUTLET BOX; H. D. Betts, Englewood and R. M. Thomas, Elizabeth, N. J. App. filed June 25, 1902. Details.

713,445. STARTING ALTERNATING CURRENT MOTORS; T. J. Johnston, New York, N. Y. App. filed April 8, 1899. (See Current News and Notes.)

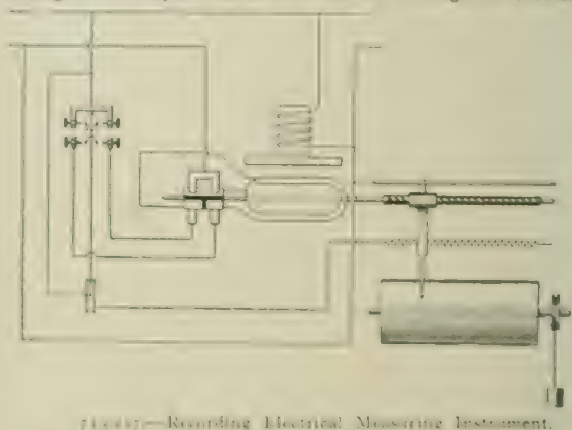
713,463. GOVERNOR; J. A. Lightpipe, San Francisco, Cal. App. filed Aug. 26, 1898. An important feature of the invention consists in combining with a water wheel governor, a device so arranged that a change of load has the same effect upon the governor as a change of speed.

713,464. ELECTRIC LOCOMOTIVE; E. C. Lindsay, Philadelphia, Pa. App. filed May 28, 1902. To accommodate a large motor on a narrow gauge locomotive, the motor is hung on a countershaft and gears first with the countershaft and then with the axle.

713,479. RECORDING ELECTRIC-WAVE FORMS; E. J. Murphy, Lynn, Mass. App. filed Nov. 23, 1901. (See Current News and Notes.)

713,486. ELECTROMAGNETIC TOOL; R. R. Nicely, Denver, Colo. App. filed March 8, 1901. Details.

713,497. TELEGRAPHY; H. A. Rowland, Baltimore, Md. App. filed June 4, 1900. The invention embodies a system of telegraphy in which the messages are transmitted by impressing an electromotive force rising and falling in value upon a main line wire and cutting out or otherwise mod-



[illegible]—Recording Electrical Measuring Instrument.

ifying a pre-selected number and combination of the wave impulses of the current produced by the electromotive force for each character and locating at the receiving points printers adapted to print the characters represented by the combination of suppressed and unsuppressed current impulses.

713,503. FUSE CARRIER; H. R. Sargent, Schenectady, N. Y. App. filed March 5, 1901. Comprises two clamping members having grooves for the reception of the fuses.

713,523. ADJUSTING COMPOUND-WOUND GENERATOR; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 24, 1898. (See Current News and Notes.)

713,555. RECTIFIER; Harold W. Buck, Niagara Falls, N. Y. App. filed Oct. 17, 1898. Two sources of alternating e.m.f. are alternately connected to the work circuit at overlapping time intervals, a reactive device being included in the work circuit to smooth out the rectified circuit and prevent [illegible] fluctuations therein.

713,564. ELECTRIC METER; J. Harris, Rensselaer, N. Y. App. filed Jan. 24, [illegible]. Details.

713,[illegible]. STARTING ALTERNATING-CURRENT MOTORS; T. J. Johnston, New York, N. Y. App. filed April 8, 1899. (See Current News and Notes.)

713,568. NON-ACTIVE METAL FOR USE IN STORAGE BATTERIES; H. H. Lloyd, Germantown, Pa. App. filed June 29, 1900. Lead and a twelve per cent. alloy of antimony rolled in a cold state.

713,574. ADJUSTING COMPOUND-WOUND GENERATOR; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 24, 1898. (See Current News and Notes.)

713,583. CONNECTION FOR MEASURING INSTRUMENTS; J. E. Woodbridge, Albany, N. Y. App. filed March 26, 1902. To reduce the number of connections and transformers the measuring instruments are inserted in inter-connected leads extending from the secondaries of the transformers.

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ELECTRICAL WORLD AND ENGINEER.

SPECIAL ANNOUNCEMENT TO ADVERTISERS.

The attention of advertisers is directed to an important announcement appearing on page xviii of the advertising section of this issue, on the subject of the new schedule of advertising rates taking effect January 1, 1903.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue, New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

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In requesting your address changed give OLD as well as new address.

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NEW YORK, SATURDAY, NOVEMBER 29, 1902.

CONTENTS.

"ALL FAILURES."

Sometimes the truth in regard to municipal ownership slips out unawares from its advocates. In the New South Wales Parliament a month or two ago, the question was up of municipalizing the Australian Gas Light Company, and one member was quite urgent on the subject, moving a long resolution against the gas corporation. He then pointed out the fine financial results in England from municipal gas work, but, "With regard to electricity, he believed it would never supersede gas as an illuminant. While 17 municipalities in New South Wales had gas works, 7 had electric lighting plants, and the latter were all failures." We can readily believe it, and we desire to call attention to the fact that it was a rabid "municipalite" who insisted on the fact. Why in doing so he should expect to strengthen his general municipal argument, we will not attempt to explain or understand, nor are we particularly concerned at the seven failures, for there are plenty of electric light successes under private management. All we wish to point out is that every municipal lighting plant in the growing and prosperous colony of New South Wales is a failure, on the unchallenged statement of a devout believer in municipal ownership.

GREAT UNKNOWN MEN.

At the time of the breakfast given to Prince Henry of Prussia, to enable him to meet the American "Captains of Industry," surprise was expressed in many quarters at the inclusion of men, whose names were unknown to the public, but whose merit was at once conceded by their brethren best able to express an opinion as to their worthiness. Of such modest workers there were happily not a few, adding dignity to the occasion that mere wealth could not have done, however great the aggregate. In like manner, the honors paid recently to Mr. John Fritz have elicited comment, and one leading journal, the New York *Sun*, has given space to an article entitled "Little-Known Men of Genius," which has John Fritz, and the new medal signalized by the recent big banquet, as its theme. Our contemporary's article remarks: "In this age a little man's bigness often is limited only by his ability to keep himself before the public. On the other hand, many of the achievements that have contributed to this nation's greatness and the world's progress have been wrought out in quiet corners and byways, and the world has known little of their authors until long after the achievement made the world richer and better, or until after the worker has been dead long enough to get into the cyclopædias."

This is well put, and the fact that recognition does come after a time ought to encourage younger men who may feel that they are likely long to toil in the chill desert air of obscurity. If any real stuff lies in them, the work will be done just the same, absolutely for the sake of doing it. But there are degrees of recognition, and we doubt if the recent affair has made Mr. Fritz any better known than before in the field where his ability has really counted. As a matter of fact, a man who has received the highest honors that Europe can give him in his art has not been altogether overlooked. Perhaps the arts and sciences have suffered more from the undue sensational attention given to some of their practitioners by the public than from any neglect of genuinely deserving discoverers and inventors. We imagine and hope that after all the best result that will attend the foundation of the Fritz medal will be gained in bringing together for other common objects and purposes the great engineering societies of the country, enabling them to wield for good all the enormous influence of which they are capable.

THE DECLINE IN COPPER

A marked indication of the decline in copper and of its results is given by the statistics of some nineteen copper stocks quoted on the Boston market. From the highest record price down to the recent lowest, these stocks show a shrinkage of $253,800,000. Perhaps the most marked decline is that in Calumet & Hecla, from 895 to 450, although Amalgamated Copper has flopped from 130 down to 53; while Tamarack has plunged from 363 to 146. These prices are, however, only in keeping with the drop in the price of copper from 18 or 19 cents to 11 or 12. It is needless to say that the electrical industry views with complacency the lower quotation for copper, which it would be glad to have continue, and which it believes to yield a fair margin of profit in mines of ordinary richness. Probably the price will not stay permanently at its present low level, but it will be interesting to note the effect of 12-cent copper on the production of aluminum. If electrical manufacturers could be assured of steady 12-cent copper they might not be so determined to exploit mines for their own supply. Another effect might be less insistence on high voltages for power transmission. The development of high pressures has been closely coincident with the upward curve of copper prices. This might be regarded as one of the compensations of the case.

INSTITUTE PAPERS.

An announcement made at a recent meeting of the Institute that the *Transactions* for the past year will, owing to the bulk of matter, have to be issued in two volumes, each of about 800 pages, brings up the question if a policy as to papers that thus so severely taxes the resources of the Institute is a wise one. Until quite a recent period, but one paper, or at most two, was read at an ordinary meeting, a more elaborate programme being appropriately reserved for the annual general meeting extending over several days, and the attendance at which is quite representative in its character. But aside from the financial aspect, it is a matter of much doubt in the minds of many if the departure from the former practice has been productive of results in harmony with the objects of the Institute. Of the great number of papers presented under the changed policy, perhaps a majority can be classified as of merely an instructive as distinguished from an engineering character, the latter term applying to contributions in which the subject is considered in its broadest possible relations, or illustrating the application of judgment to the solution of engineering problems, or recording data of intrinsic value—in short, giving information of the kind sought by engineers, who are either instructed in purely technical details, or know the sources whence such information may be readily drawn. To further illustrate the distinction, we may refer to the excellent remarks of Mr. Day in the discussion of the recent papers. A paper prepared along the line of these remarks would not only have been representative in the broadest sense of the topic of the meeting, but if read alone would have in all probability drawn out in the discussion the substance of most of the papers actually read, and in proper relation and subordination to the topic as a whole.

But even if a half dozen or more papers of a real engineering character might at present be gathered monthly without great effort, it is doubtful if the best interests of the Institute would be served by taking advantage of the opportunity. The amount of material for papers of a high quality is necessarily limited in a field so comparatively restricted as that of electrical engineering, and in a continuing body like the Institute the future should not be sacrificed to the present. So keen, indeed, has been the endeavor to expand the programme of meetings, that in one case a paper was accepted from a non-member in direct violation of the constitution; and in another case it was necessary to have a paper that had been accepted rewritten after it left the author's hands in order to render it at all presentable. In a young and vigorous body like the Institute, it is but natural there should exist a spirit of innovation, and it is well that such is the case. We believe, however, that the experiment here considered has been fraught with dubious results, and that a return to the more conservative and safer practice of the past is plainly indicated.

THE GROWTH OF CENTRAL STATION PRACTICE.

The article on recent developments of the Chicago Edison system, which we publish this week, is a most striking reminder of the far-reaching changes in central station working. The distribution of energy to the heart of a great city is always a formidable problem, and in Chicago its difficulties are fully developed. The mere matter of bigness is an important factor in modifying methods. Up to certain magnitudes certain plans of operation work admirably, but beyond these points inconveniences develop faster than advantages. Perhaps telephone engineering involves these problems of magnitude more fully than any other branch of applied electricity, but even in central station work they enter as disturbing factors. So it has come to pass that the old and beautifully simple idea of distribution from a single generating plant at or near its center of load has come to be greatly modified. The huge loads to be carried in the center of a large city have grown unwieldy and demand stations of dimensions not permissible for economic reasons in the midst of the concentrated load. Hence there has been very general recourse taken to the methods of power transmission, and in most large cities there is a combination of alternating-current generation and direct-current distribution from rotaries. Sub-stations for rotaries can obviously be stowed away in spaces altogether impossible for generating stations and can be worked with a very moderate amount of attendance.

The Randolph Street Sub-station of the Chicago Edison Company is of unusual interest in several respects. In the first place, it is of no mean dimensions, containing a round dozen 500-kw rotaries when fully equipped. And its location in the basement of a colossal modern office building is altogether out of the usual. It is enough to make an old-fashioned central station man rub his eyes and wonder if he is awake. The equipment is thoroughly up to date and gives a wonderfully compact, convenient and efficient station. We cannot help wondering, however, why, as in several other recent installations, so low a frequency as 25 cycles was selected for the polyphase side of the equipment. It almost seems as if the old guard of low-tension men had feared to trust themselves in presence of the temptation to distribute alternating current, and had put it from them by selecting a frequency just too low to use comfortably in incandescent lamps. There are indubitably some excellent reasons for continuing the distribution of direct current even when alternating current is at hand, notably the extensive use of low-tension arc lamps and a heavy existing motor load; but it seems a bit short-sighted to go just below, instead of just above, the critical frequency for incandescents. Except in this particular there is very little in the installation to criticise, and assuredly the Chicago Edison Company has no prejudice against the polyphase distribution, since it uses it freely in outlying districts.

Even more interesting than this striking sub-station is the project for a colossal new generating plant at Center Avenue and Twenty-second Street. This must be regarded as a power transmission plant pure and simple, since its entire outputs will be three-phase current at 9,000 volts. Here again the frequency is 25 cycles to match that of the older station, and in the alternating current distribution motor-generator frequency changers, 25 to 60 cycles, will

be used. It is interesting to note that the distribution in these cases will be 3-phase, 4-wire, the generators being Y-connected. We cannot help wondering what will be the relative outputs of alternating and direct current ten years hence. At present the latter has decidedly the advantage. A point of great interest to engineers in the new station is the reported determination to use steam turbines as the prime movers. This will assuredly be a most instructive innovation in working on this large scale, and the results will be watched with the most intense interest. Certain it is that the steam turbine is steadily forcing its way into use, and that it has been acquiring an excellent reputation for economy. We must applaud in this connection the wise conservatism of the turbine manufacturers who have through several years worked up the machines with the greatest care, not putting them out until they stood on solid ground and even then only where they were well adapted for the work in hand. In this huge Chicago station, if rumor be true, they will have a fair field on a most convincing scale. In the immense area to be covered, the rapid growth of population and the very large manufacturing interests to be served, the territory of the Chicago Edison Company is unique. We ought also to add that it has been very skillfully served, and the business has certainly been managed and engineered with remarkable ability. Its service has grown with the rapidity of a boom mining camp, and somehow or other the plant has contrived to keep abreast of the load and a little ahead of the times.

SPEED CONTROL OF DIRECT-CURRENT MOTORS.

While a majority of the papers read at the recent meeting of the American Institute of Electrical Engineers are rather commercial than engineering in their scope and treatment, and do not throw much more light upon the methods of variable speed control than can be obtained from the trade publications relating to the several systems described, yet those not in close touch with the subject will find instruction in their reading. The unique advantages of the electric motor in power distribution have led to its rapid displacement of the mechanical drive, but as pointed out by President Scott, its entry into this field is also leading to a revolution in tool practice through the adaptability of the direct-current motor for variable speeds. This development has brought to the front all known forms of motor speed regulation. Rheostatic control, magnetic field control, series-parallel control and variable impressed voltage control, are all in use, and in some cases two or three of these methods are invoked conjointly for the operation of one and the same motor.

The simplest and earliest method in historical order of development is the rheostatic control, or the insertion of adjustable resistance into the circuit of a motor to lower its speed. This method when relied upon exclusively through a wide range of speed variation, is very clumsy, because it requires such bulky rheostats, often larger than the motor. It is wasteful, because of the heat liberated in the resistance. In some cases it is very irregular, because of variations in load when a relatively large amount of resistance is included in the circuit. The magnetic field control, usually a shunt field rheostat control, is the next simplest, and the next in order of development. It is economical, simple and effective, but its range of effectiveness is unfortunately limited. Series-parallel control is in very extensive use in electric traction, and forms the basis of electric car speed control; but it involves some complication. It requires either two separate motors or two motor armatures in one magnetic field, which is virtually rolling two motors into one. Variable-impressed-voltage control is also in fairly extensive use. This also calls for some complication, but the complication is transferred in this case from the motor to some part of the supply system. In the three-wire system, the generator is either double or at least is specially constructed so as to present a neutral point, and an extra wire has to be carried from the generator to the motor. In the four-wire system, with multiple voltages either boosters or separator generators have to be used, each for its own voltage of supply. In some cases the Ward-Leonard system is used with its extra and intermediate motor-generator installed near the working motor for the purpose of supplying to the latter the exact pressure desired. All of the above methods are available, and each has its special field of usefulness, either singly or in combination with some of the others. The result is that the direct-current motor is one of the most flexible machines in commercial use, and is capable of meeting all reasonable demands for variation at will of speed or of torque.

The much-vexed question of independent or individual motor driving was also discussed in the Institute papers. If a number of different lathes or tools are driven by one and the same motor, the condition reverts to that of countershafting in a modified form or on a reduced scale, so that instead of having a long continuous line of overhead shafting, with belts depending therefrom to the successive tools, there are a number of short lengths of shafting, each driven by its own motor, and each driving a limited number of tools. By suitably grouping the tools in this manner considerable economy of power may be effected by stopping the motors connected to tools out of use. But in almost all cases of group-driving the speed of the motor is kept constant to suit the average requirement of the whole group it drives. Only in the case of individual driving can the speed of the motor be conveniently adjusted and varied to suit the work. Of course, it is possible to vary the speed of a tool by mechanical means when group driving is employed; as, for example, by means of the well-known cone pulleys. But in nearly all cases the mechanical means for varying the speed of tools require some little attention and time for their operation, whereas neither time nor effort of mind are appreciably called for in varying the speed of a direct-connected motor in turning the controller handle. It is largely for the convenience of operation that the individual motor in tool driving is so popular. The workman can give his entire thought and attention to the job, and the controller-handle of the motor is manipulated by him almost unconsciously to suit the best requirements of his tool; whereas if mechanical changes of speed are required the workman will not take the time and trouble to turn his attention from the job to the speed-varying device. This is only another way of saying that any reliable mechanical speed-varying device for a tool which would be as definite and easy to manipulate as a motor-controller, would be likely to make group-driving of tools the rule, and individual driving the exception; whereas the tendency of modern times seems to be setting in favor of the individual drive.

An interesting description was contained in one of the papers of an electrically operated coal-hoist. Here the best performance of electrically lifting 100 tons of coal through an elevation of 126 feet was described. The empty shovel weighed more than the average charge of coal or shovel contents. The flexibility and other advantages of the electric motor hoist are pointed out in the paper. It seems a pity, however, that the work done on the descent of the shovel, or about half the work engaged in lifting, should have to be dissipated in a rheostat instead of being restored to the circuit. No doubt in certain cases it would be commercially desirable to save and restore this work, which a simple steam hoist would be compelled to waste.

Pacific Cable Soundings for Commercial Cable.

Secretary of the Navy Moody has directed that the Nero soundings be turned over to the Commercial Pacific Cable Company. This action resulted from a conference between Secretary Moody and Rear Admiral Bradford, Chief of the Bureau of Equipment, in regard to the proposition of the Cable Company to construct a cable from San Francisco to Honolulu. The Secretary has authorized the Admiral to turn over the soundings made by the Navy Department to the Cable Company as soon as the necessary papers have been drawn up.

These soundings, which were made by the Nero, represent more than a year's work, and an expenditure of about $100,000. As a result of the Secretary's determination to relinquish the soundings of the Nero in return for concessions to the government in cable rates and in military use of the cable, it is expected that a cable will be in operation between San Francisco and Honolulu within six months, and work then will be pushed on the line between Honolulu and Manila.

It is due to the work of the Nero that Guam is to be a landing station of the Pacific cable. The Cable company was disposed to believe that there was an abyss in the vicinity of the island which would prevent the laying of a cable by that route. Admiral Bradford showed the company's representatives enough of the soundings to convince them that the survey of the Nero had made a detour of this abyss, and it was agreed to lay the cable by the way of Guam. This action of the Navy Department results from a conference at the Department of Justice between Attorney-General Knox and President Clarence W. Mackay, of the Cable Company; Vice-President Ward and General Counsel Cook. At the close of the conference, Mr. Knox gave out the statement:—that it related "to the conditions prescribed by President Roosevelt for constructing a trans-Pacific cable. These conditions were approved by the President in July last, since which time the Pacific Cable Company has not officially notified the government as to its intention or willingness to accept them. To-day, however, Mr. Mackay explained to the Attorney-General that the delay was caused by protracted negotiations, which have only been brought to a conclusion within the last few days, to secure a landing place in China to comply with the President's condition that an independent American line should be constructed from Manila to Hong Kong, thus giving an all-American through line to the Asiatic continent. It was this condition that was supposed to be the one that the Cable Company would be unwilling or unable to comply with. It now announces its ability and intention to construct a line from Manila to Shanghai, a distance of about twelve hundred miles, and to have the same completed within a year. Owing to the claim by the Pacific Cable people that, as they read one of the other conditions, it will practically prevent the necessary relations with existing lines in China to secure the transmission of American messages to interior points, that provision is being recast to obviate misunderstandings, and will be submitted to the President in a modified form within a few days."

Western Union Wires Along Railways.

At Newark, N. J., on November 22, the proceedings threatened by the Western Union Telegraph Company to restrain the Pennsylvania Railroad Company from having poles, wires and other equipment of the former removed from the railroad system were initiated in the United States Circuit Court, District of New Jersey, when Judge Andrew Kirkpatrick granted a rule to show cause, which carries with it a temporary injunction, operative pending the final disposition of the case. The rule is returnable December 8. The application for the order was made by Rush Taggart, of New York, general attorney of the Western Union, and Richard V. Lindabury, of Newark, who presented to the court a bill in equity, seeking to establish perpetual title to the use of the railroad's right of way for telegraphic purposes, and at the same time filed in the law side of the court a petition praying for the appointment of an arbitration commission or jury to determine an amount of compensation which, according to the claims of the complaining corporation, the railroad is bound under federal laws to accept for the use of its thoroughfare for telegraphic purposes. The contents of the petition are substantially the same as those of the bill of complaint, in which the petition is adverted to as having been filed. The preliminary stay was secured with a view to forestalling the Pennsylvania in the carrying out of its threat forcibly to expel the Western Union system from its own lines on December 1, the termination of the six months' notice to that effect given to the telegraph company last May.

As co-defendant with the Pennsylvania the bill and petition both name the United New Jersey Railroad and Canal Company, which comprises the Pennsylvania's system in New Jersey, and is held by the latter under a so-called perpetual lease. The Postal Telegraph-Cable Company, to which the Western Union is expected to surrender the privileges it now enjoys, is mentioned in the papers only incidentally. The bill of complaint in its opening paragraphs sets forth the details of the incorporation of the United New Jersey Company under various acts and grants of the New Jersey Legislature, and describes the corporate birth of the Pennsylvania by virtue of the statutes of that State. It recounts the leasing of the former company by the Pennsylvania on July 1, 1871, for a term of 999 years, and declares that under the several specified laws of New Jersey, as well as by the general public laws of the State, the joint railroads "were created and made, and now are public highways, and as such are subject to occupation and use by telegraph companies," particularly under the effect of federal laws passed July 24, 1866.

It was reported early this week that the Pennsylvania Railroad had given notice to the Western Union Telegraph Company that the latter's messengers would not be allowed to enter the Pennsylvania's cars to deliver messages. The railroad officials, however, deny that such an order has been given.

Destruction of a Mexican Plant by Fire.

According to Mr. Fred F. Spencer, of the Mexican General Electric Company, the most destructive fire, from an electrical standpoint, that has ever occurred in Mexico, took place November 8, destroying completely the substation of the Bermejillo Light & Power Company at Guadalajora, Jalisco. The fire originated in a cupola on top of the building where the 10,000-volt lines entered, and the 1,000-volt distributing lines and the arc circuits left the station. It was caused by a short circuit between the high-tension lines. Although the walls were constructed of brick and mortar, the intense heat caused these to crumble away on two sides, and falling inward they completely buried the machinery, crushing what had not already been consumed by the flames.

The loss will aggregate $100,000, with no insurance. Among the apparatus destroyed were five 200-kw, 11,400 to 1,040-volt General Electric air blast transformers; two General Electric induction motors and blowers; one 225-hp and 1,000-volt synchronous motor, direct connected to two Brush arc machines of 160 lights each, with exciter and starting motor; several Wagner induction motors ranging from 2 hp to 25 hp; 6 switchboard panels, etc.

Through the energies of the manager of the company light was furnished the customers in a short time, six 300-kw transformers having arrived but a few days before the fire, which were at once set in place and connected. The arc lights were furnished with current from the power house 6 miles distant by means of three Thomson-Houston arc machines, which were at that place. Arrangements are being made to construct a new station as rapidly as possible.

Electric Motive Power on English Railways.

The Northeastern Railway, of England, according to a Canadian correspondent, is about to change a part of its system from steam power to electricity, and Mr. H. A. Watson, its general superintendent, and Mr. V. Reaven, superintendent of motive power, are now in Canada for the purpose of gathering information on the subject. Mr. Reaven says the section on which they propose using electricity is around Newcastle, where forty-seven miles of road are much congested by the dense population, and where they carry 2,500,000 people a year. Tenders are already in for the work, and the amount involved in the change will be about $1,250,000. The company proposes that each car shall have its own motor, rather than use electric engines. Mr. Reaven states that he had learned since reaching this side, that the Lancashire and Yorkshire road had determined to change its motive power to electricity at Manchester, Liverpool and other large centers of population.

FIG. I.—STEAMSHIP "FINLAND."

Electrical Steering-Gear on the "Finland."

TO steer a ship by electricity has long been the ambition of inventors, and some very interesting work has been done in this field. It would appear from recent results that the apparatus designed by Mr. M. Pfatischer, of Philadelphia, accomplishes the purpose very satisfactorily. This gear has been installed upon nine ships, eight of these belonging to the Imperial Russian Navy, and is an acknowledged success. The steamship *Finland*, recently built by William Cramp & Sons' Ship and Engine Building Company, of Philadelphia, for the Red Star Line, is the latest and largest ship equipped with it. The gear is also to be placed on the two liners being built by the Eastern Shipbuilding Company, at New London, Conn., for the Pacific trade. There are many difficult problems to solve in the design and in the manufacture of a thoroughly practical gear which will do the work required of it.

This gear is simply an application of the well-known principle of the Wheatstone bridge to the control of a ship's rudder. If two rheostats of exactly equal resistance are connected in parallel to a source of electric current, the potential of any point on one is the same as that of the corresponding point on the other, and no current will flow through a wire joining them. If, however, two non-corresponding points are joined by a wire, then their potential being different, current will flow in one direction or the other according to the relative position of the points taken.

In applying these facts to the steering of a ship, one rheostat, which we may call the steering rheostat, is placed in the pilot house, or any other steering station; the second rheostat, which we may call the balance rheostat, is placed in the steering-gear room. In each rheostat a sweep is arranged to move over contacts, and the two sweeps are connected by a wire termed the "balance wire." According to whether the sweeps are on corresponding points or not, there is not or is a current in the balance wire. It is this small current which controls an electrical generator in such a way as to cause it to supply current to an electric motor, which turns the rudder. The sweep in the balance rheostat is mechanically connected to move with the rudder. Supposing, then, that the balance has been disturbed, the rudder moves, and by its motion brings the balance rheostat sweep to a point which corresponds to the point the sweep in the steering rheostat is on. Then, as there is no current in the balance wire, the rudder stops moving and remains in that position until the balance is again disturbed. In this way, the rudder can be moved to any position desired.

The heavy currents required to operate the rudder motor are controlled by the small current in the balance wire in the following manner. The field of a small continuously driven exciter dynamo is made part of the balance wire circuit. The exciter armature is connected to the field of the main generator, which is also continuously driven, and its armature is connected to the armature of the rudder motor, the motor field being separately excited. In this way it is evident that the characteristics of the current in the balance wire determine the characteristics of the current supplied to the rudder motor, and so determine the speed and direction of its rotation.

Probably the best idea of the installation of the gear can be obtained from a description of the plant on the *Finland*, which started on her maiden trip across the Atlantic on October 4th. In the pilot house is placed the steering rheostat, which is encased in a brass column with a hand wheel and gears to move the sweep, also a Pfatischer electrical rudder indicator. Thence a five-wire cable is run to the steering-gear switchboard in the main dynamo room. Two wires are required for the indicator, two to supply the rheostat, and one for the balance wire.

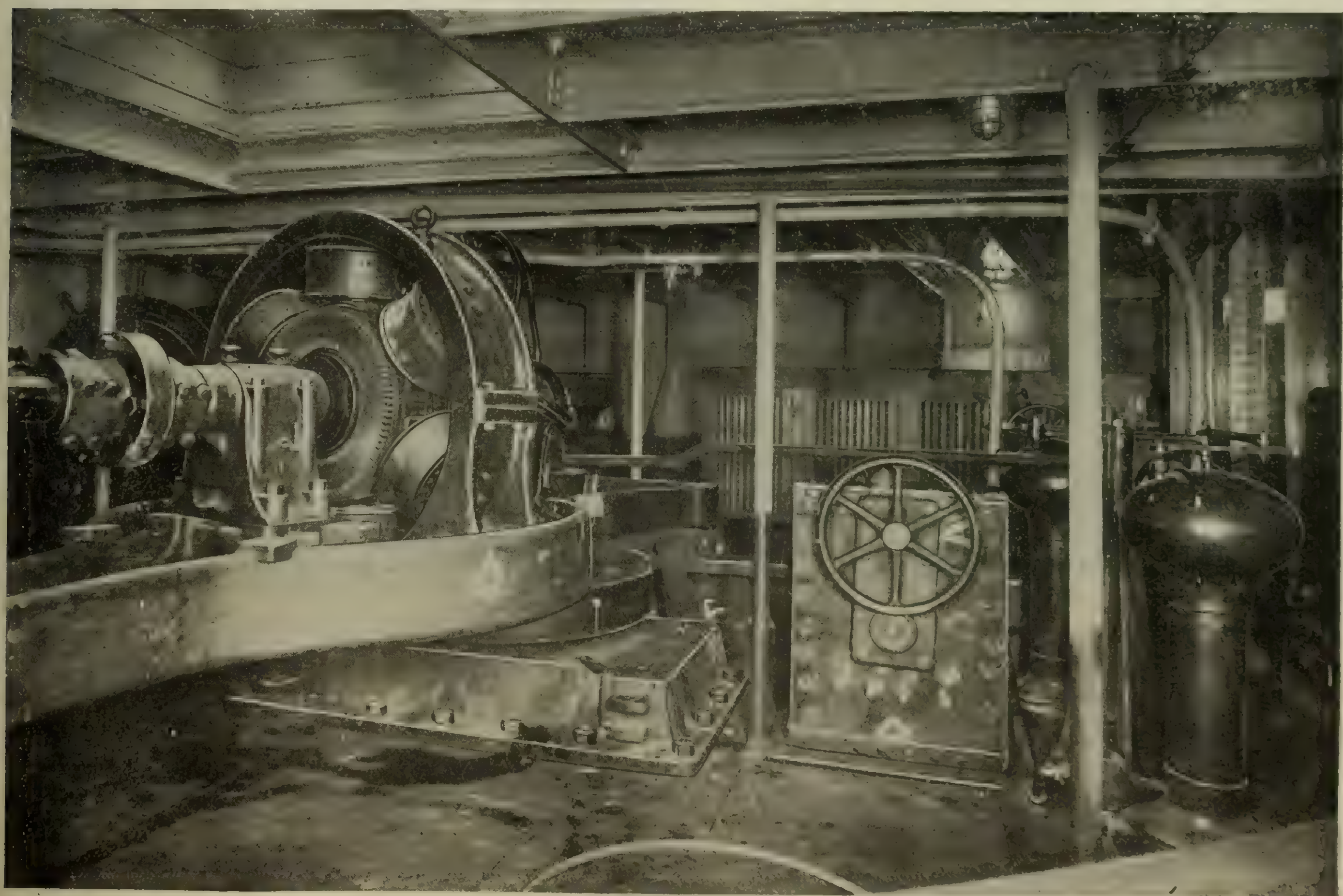


FIG. 2.—STEERING-GEAR ROOM OF THE STEAMSHIP "FINLAND."

In the steering-gear room is the 60-hp, 110-volt rudder motor, mounted on a Brown tiller, built by the Hyde Windlass Company,

of Bath, Me. The balance rheostat is placed in an iron column, having a lever and gears to move the sweep, and a spare balance column is also provided with a hand wheel, so that it can be used as a steering column when desired. There is also a third column, similar in external appearance to the other two, but containing a higher resistance rheostat, which is the transmitter for the rudder indicator in the pilot house. This rheostat is supplied from the ship's lighting circuit. One of the two wires leading to the indicator, which is a voltmeter suitably calibrated, is taken from the middle point of the rheostat and the other from the sweep which moves over the contacts, so that the position of the rudder is indicated at all times. The sweeps in all three columns are connected by links to the rudder post, so that each one is on the middle point of its rheostat when the rudder is amidship, and they are all moved in unison when the rudder moves. The wires from these columns are taken to the steering-gear switchboard in two 5-wire cables; the motor connections are taken separately. In all cases the wiring is in iron pipes.

In the dynamo room are installed the main generator of 60 kw at 110 volts, the exciter, a small shunt generator of 4.5 kw at 110 volts, and the steering gear switchboard. The main generator, shunt generator and exciter are all mounted on one bed plate and are driven by a direct-connected 9-in. by 5½-in. double-cylinder Sturtevant engine at 375 r.p.m. The armatures of the shunt generator and exciter are rigidly coupled together, and are also coupled to the main generator shaft by means of a clutch, which can be easily thrown in or out.

The steering gear switchboard is entirely separate from the main switchboard, and is mounted over the field yokes of the shunt generator and the exciter. On this board are mounted all the necessary switches, instruments and field rheostats connected with the steering gear. A four-pole triple-throw switch controls the connections between the different columns. In one position, connections are made so as to steer from the pilot house using the regular balance column; in a second position, connections are made to steer from the pilot house using the reserve balance column; and in the third position, when steering from aft, the reserve balance column is used as a steering column in connection with the regular balance column. All the other switches, excepting the rudder indicator switch, which is single-throw, are double-pole, double-throw. When in their upward position, the connections are so made that the whole steering gear is entirely independent of the ship's lighting or power circuits, the small shunt generator supplying the current for the rheostats and rudder motor field. In their downward position, the connections are made so that the regular engine and main generator may be stopped, current for the rheostats and motor field, and to run the shunt generator as a motor to drive the exciter, being taken from the ship's lighting circuit, while any one of the four lighting generators is used to supply power to the rudder motor. On each of the lighting generators is mounted a small board with the required switches to connect the machine to the main busbars or to the steering-gear system

Ordinarily, in steering, the switches on the steering-gear board are in their upward positions. The main generator, shunt generator and exciter are continuously driven, the shunt generator supplying current to the columns and motor field, while the main generator and exciter only generate current when it is required, and at a voltage determined by the difference of potential at the ends of the balance wire. Therefore since the speed of a motor depends on the voltage

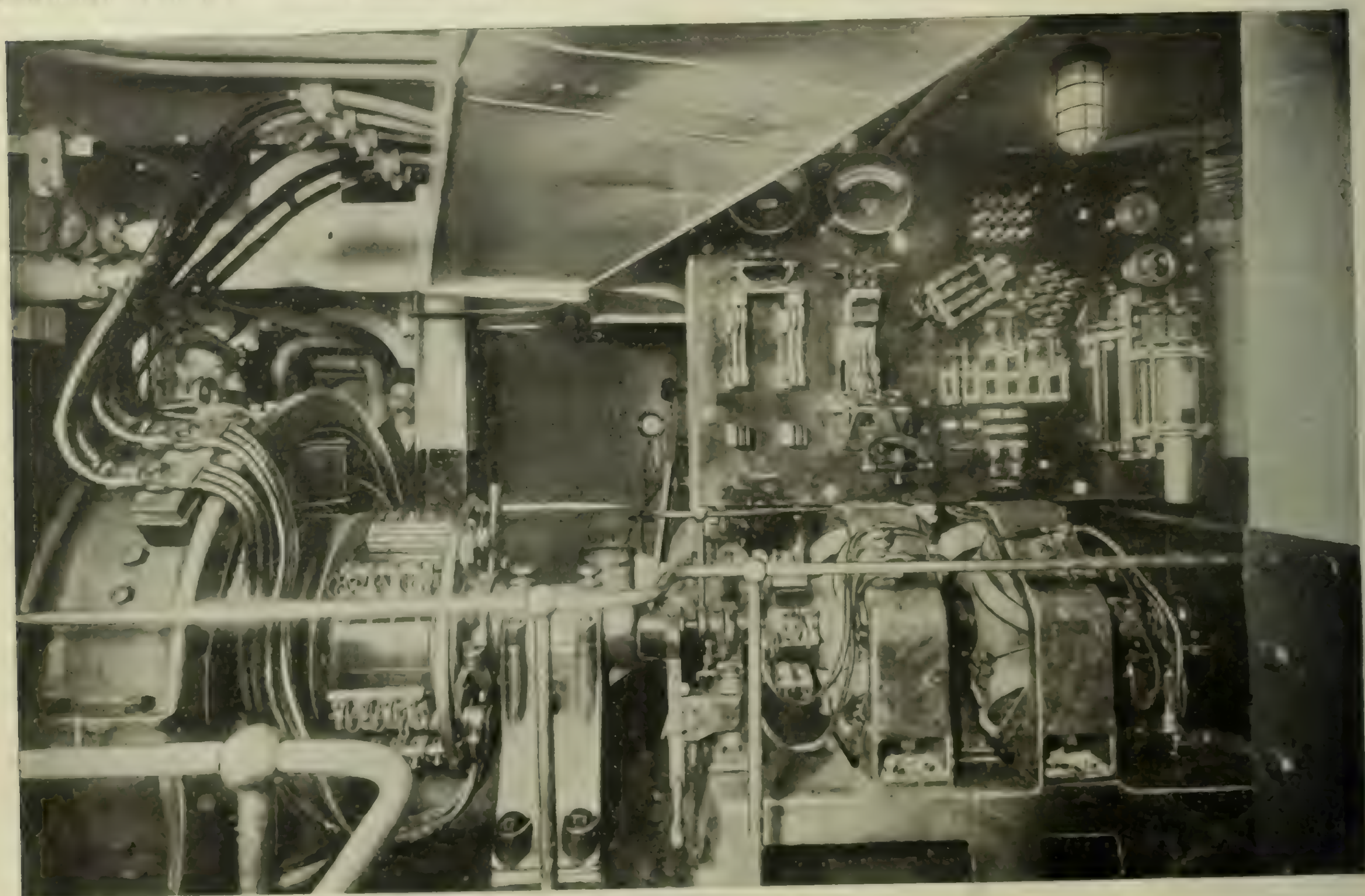


FIG. 3.—VIEW OF THE DYNAMO ROOM ON THE "FINLAND"

at its terminals, the speed of turning the rudder depends on the rate of moving the sweep in the steering column. If in the steering column the wheel is put hard over quickly, there will be a maximum difference of potential between the ends of the balance wire and the maximum voltage will be generated, causing the motor to rotate rapidly, while if the wheel is put hard over slowly the motor has a chance to follow up, keeping down the difference of potential between the ends of the balance wire and therefore keeping a low voltage at the motor terminals, causing it to run slowly. It will be easily seen that the voltage does not reach a maximum immediately on starting nor does it fall to a minimum instantly when stopping. There is a time element introduced in both cases which is beneficial in saving the machinery from mechanical strain, due to the instant application or removal of power as in the case with a steam gear. It is also worthy of mention that in the whole system there is no sparking or flashing at any point, no circuit being opened or closed in the operation of the gear. The result is that the gear does the work required of it in a marvelously smooth, easy and quiet manner, at the same time sacrificing nothing to speed, reliability or pre-

cision of operation. The time from hard over to hard over is less than thirty seconds.

The power required for steering ranges from one to sixty kw, it being generated in the main dynamo room, where the machinery can receive good attention; and on the steamship *Finland*, as above stated, any one of five generating sets can be used to supply the power. The maximum load is only on momentarily; a great part of the time all the power required is that necessary to drive the armature in a dead field. This is very little and offsets what is lost by condensation in the long pipes run from the boilers aft to a steam steering gear.

The whole system is fully protected with emergency devices, so that it would seem impossible for a ship equipped with this gear to be long delayed by any accident to the electrical steering apparatus. Should an accident occur to the main generator or engine, the clutch

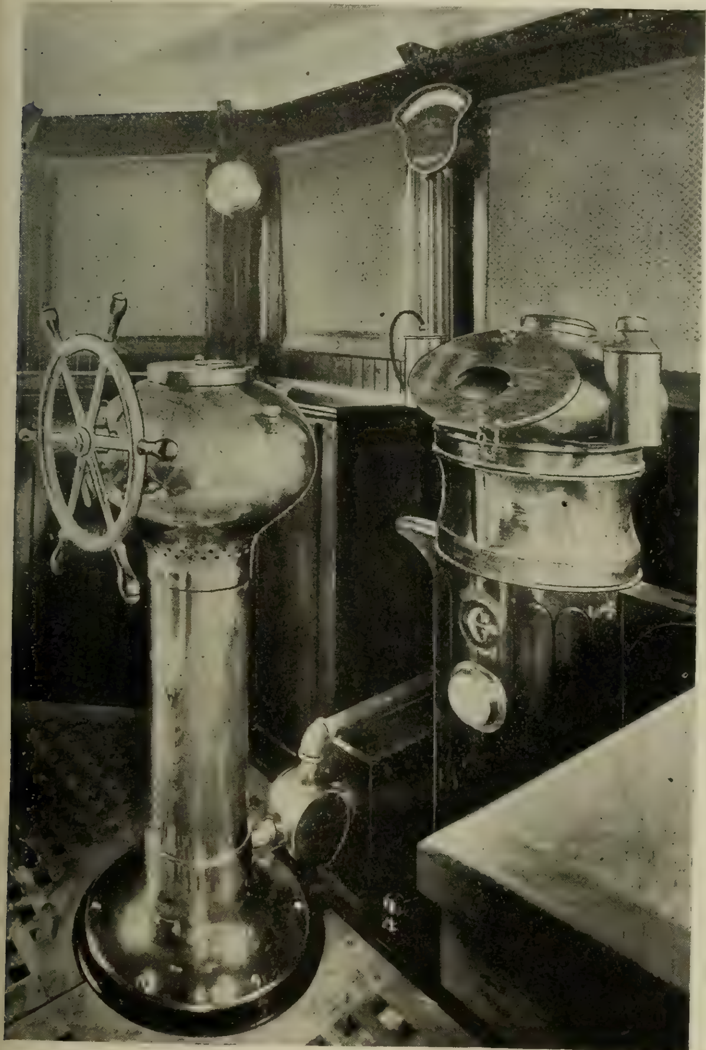


FIG. 4.—STEERING-GEAR IN PILOT HOUSE.

is opened between it and the two small machines, the switches on the board and on one of the lighting generators are changed, all of which can be done in less than one minute, and the ship can be steered as before. If the regular balance column should give out, by putting the four-pole switch on the board in its proper position, the reserve balance column is put in service instead of the regular column. If the steering column in the pilot house should be carried away for any cause, then by putting the four-pole switch into the third position the reserve balancing column is ready to be used as a steering column in connection with the regular balance column.

In perfecting this gear the Electro-Dynamic Company, of Philadelphia, its builder, has made all the parts as reliable as best materials, workmanship and design can do, all parts having large factors of safety. This was absolutely essential. The steering and balance rheostats have been very strongly made, the resistance wire, contacts, etc., are of ample dimensions to carry the current required, and to withstand any mechanical strains which may occur, the whole being well protected in handsome water-tight columns of brass or iron. The generator, motor and switches are also of ample capacity to do their work without undue heating. The insulation of all machines, which is so important, is very carefully attended to, it all being made in the most improved manner, so as to resist the deleterious effects of moisture. It is also tested with 2,000-volt alternating current for five minutes before leaving the factory.

The captain and officers of the Steamship *Finland* are enthusiastic over the performance of this gear, and the Antwerp River pilot expressed himself that he had never taken a large steamer up the crooked River Scheldt with such ease, because of the instant and quick response of the ship to the wheel.

The steamer *Finland*, 17 knots, 13,000 tons, is the first North Atlantic liner steered solely by electricity, but next year two 20,000-ton steamers will be controlled by the same force on their trips from the Pacific coast to the Orient. As several ships of the Russian Navy, which have sailed from Kronstadt to Port Arthur, are similarly equipped, as noted above, it may safely be predicted that within a year or so electrically steered ships of the largest size will be plying on all the oceans of the globe.

The St. Louis Universal Exposition.

By W. E. Goldsborough.

THE achievements, history and possibilities of electricity are to receive special attention and extensive treatment and display at the Universal Exposition of St. Louis in 1904. The authorities of the Exposition have given the science and industries of electricity a place of the first order in the classification of the Exposition. It has been made one of the principal departments, and arrangements and appropriations have been provided on a scale that should insure to the country and to the world the greatest electrical exhibit that has ever been assembled for public and expert inspection.

This seems a significant and extraordinary statement and must imply an extensive general plan for the Exposition. All

FIG. I.—ELECTRICITY BUILDING.

of which is true. And in this connection it should be mentioned that a mistaken idea exists generally of the scope and importance of the St. Louis Exposition. It does not seem to be understood that the Universal Exposition of St. Louis in 1904 is to be the most important and extensive universal and international exposition ever held. This, however, is the case, and too much attention cannot be directed to the words international and universal, as they really describe the nature and scope of the St. Louis Exposition. It is not to be a local or territorial or even a national exposition, as some may imagine. It is to be a world's exposition—a universal exposition in the fullest sense, and, as stated, the most extensive and important that the world has seen.

These facts should be thoroughly digested by the country, especially by prospective exhibitors; and they will be, as the knowledge of what is being done at St. Louis gradually forces itself upon the press of the nation.

The St. Louis Exposition is to be practically a $50,000,000

exposition. Consider what this will mean for the public in the way of a world's exhibition to visit and inspect, study and delight in, especially when the splendid Columbian Exposition at Chicago involved a total outlay of only $30,000,000, and when it is known that the experience in exposition building makes it fully possible to make four dollars yield as much to-day in such work and construction as was gotten out of five dollars in 1893. These facts will make the St. Louis Exposition of almost double the elaboration, importance and interest presented to the world by the great Columbian Exposition of 1893.

There is already about $18,000,000 appropriated for the St. Louis Exposition by the city, State and national governments—the amount about equally divided from each source. To this add $10,000,000, which, at the very least figure, will be spent from the gate receipts and concessions—applied in advance to beautifying and perfecting the Exposition—another $10,000,000 which will be used by participating governments, $5,000,000 by the States and Territories of this country, and $5,000,000 by exhibitors at the Exposition, and you have $48,000,000 already applied in making a colossal exposition, without having touched the millions that will be spent in the amusement, concessionary and other extensive features of the Exposition. The Government appropriation alone for the St. Louis Exposition is about $7,000,000. For the Chicago Fair the Government appropriation was $2,500,000.

The site of the Exposition embraces 1,200 acres, this of splendid park territory adjoining further rich park territory on one side, and splendid rolling country and stretches of palatial residences on the other approaches. The Chicago Fair site embraced something over 600 acres—little over half of what is to be employed in St. Louis.

A comparison of the number and sizes of the various buildings of the two expositions will show in further relief the superiority of the St. Louis Exposition over that of Chicago, which to date is acknowledged to have been the most attractive and extensive held in the world.

The Manufactures and Liberal Arts Building was the great structure of the World's Fair at Chicago in 1893—and it was

FIG. 2.—VARIED INDUSTRIES BUILDING.

truly colossal and impressive. It covered about 30 acres, its dimensions being 787 by 1,687. It housed a considerable part of the exhibits of the Exposition. To enclose this same class of exhibits five buildings will be provided in St. Louis, covering an area of 43 acres, almost one third more than was used at Chicago. The separation into distinct buildings is for purposes of higher classification, for which the St. Louis Exposition will be noted. The Agricultural Building of the St. Louis Exposition will cover 500 by 1,600 feet, or nearly 20 acres; that at Chicago was just half this size. The Mines and Metallurgy Building at the St. Louis Exposition will cover 400,000 square feet; that at Chicago covered 245,000 square feet. The Transportation Building at the St. Louis Exposition will cover 720,000 square feet, nearly three times as much ground as covered by the splendid Transportation Building at Chicago, not including the annex, viz., 245,760 square feet. It covers considerably more space than the building and annex (train sheds) at Chicago combined. At St. Louis there is to be an Education Building, which will cover an area of about 400,000 square feet; Chicago had no building for education, nor has any other exposition had such a building. The Electricity Building at St. Louis will cover about 300,000 square feet; that at Chicago covered 250,000 square feet. Altogether the exhibit space under roof at the St. Louis Universal Exposition will approach 250 acres.

Some seem to have the idea that the St. Louis Exposition is to be similar to the Pan-American Exposition. This misapprehension will easily be dispelled by an acquaintance with the fact that any one of the four larger buildings at the St. Louis Exposition will cover more space than all of the exhibit build-

FIG. 3.—LIBERAL ARTS BUILDING.

ings of the Pan-American Exposition. When it is contemplated that there are to be sixteen of these splendid palaces—exhibit palaces—such as are described above, within the Exposition grounds at St. Louis, some idea may be had of the immensity of the physical aspect and tremendous scope and variety of this Universal Exposition.

Taking this in connection with the amount of money available, it will be easy to understand how this Exposition will constitute the grandest spectacle of architecture and the greatest array of interesting exhibits, instructive, entertaining, amusing, ever assembled for the review of the world. And the universal and phenomenal prosperity of the times will undoubtedly insure to it a phenomenal attendance.

German Electrical Situation.

Consul-General Frank H. Mason, in a very interesting report on the recent commercial depression in Germany, to the State Department, makes the following remarks: Aside from the metal and mining industries, the other leading branches of manufacture seem to have weathered the adverse wind and tide, at least down to the close of 1901, reasonably well. While it is difficult to be exact in a study of this kind, the average dividends paid by joint-stock and limited-liability companies during the two past years may be taken as a nearly correct key to the real situation. The comparison, based upon trustworthy published reports is as follows:

Description.	Dividends 1900. Per cent.	1901 Per cent.
Earthenware, glass, and porcelain.....	13.64	12.41
Chemical manufactures	11.24	10.41
Breweries and distilleries	10.00	9.39
Paper mills	10.06	8.13
Textile manufactures	4.58	3.18
Electrical machinery and supplies.....	0.55	5.79

As might have been expected, the worst showing in this brief list is made by the electrical manufacturers. In a word, the electrical manufacturing capacity of Germany was enormously overfinanced and overexpanded, it has suffered a serious relapse and heavy losses but is now pluckily trying to get back to solid ground. Meanwhile it is turning out large quantities of machinery and materials which except for certain government contracts, are being sold at little or nothing above cost, by way of keeping the factories open and the trained workmen together and employed until brighter days may come.

The Randolph Street Sub-station and the Development of the Chicago Edison System.

ALTHOUGH articles relative to the growth and expansion of the Chicago Edison Company and its allied corporation, the Commonwealth Electric Company, have frequently appeared in these columns, the development has been so rapid that it is proper to record again some of the more recent features and show certain gradual but important changes that are taking place in the character of this company's distribution. In the columns of this journal dated May 19, 1900, and just previous to the National Electric Light Association meeting in that city, a review of the central station situation in Chicago was given, which described the Edison and Commonwealth systems as developed up to that time and gave some insight into the lines which would be followed in the future. Mr. Louis A. Ferguson, now second vice-president of these companies, appeared before the American Institute of Electrical Engineers about a year and a half later (November 22, 1901) with a paper on "Distribution of Electrical Energy in Large Cities," which showed how actively development had been going on in Chicago along lines laid down previously, and also gave a further insight into the probable future work of these companies. An abstract of Mr. Ferguson's paper appeared on page 892 of this journal of November 30, 1901.

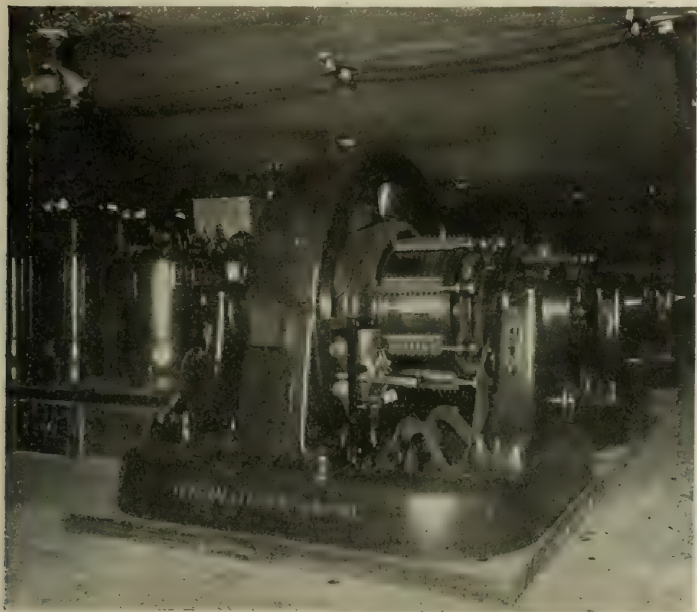


FIG. 1.—SUB-STATION, MASONIC TEMPLE BASEMENT.

For the benefit of those who may not have read the articles referred to it will be in order to say that the greater part of the output of the companies was formerly generated as direct current for use on a three-wire direct-current network. The direct-current three-wire system of supply to the consumer is employed in all places where the density of population warrants it. Although the greater part of the total output, until very recently, was generated as direct-current in a large direct-current station on Harrison Street, at the Chicago River, three-fifths of a mile from the down-town load center, the growth of the load is rapidly forcing the carrying out of a policy of feeding the down-town direct-current three-wire networks from rotary converter sub-stations located at numerous points on the network as near as possible to heavy loads. These sub-stations are at present supplied by 9,000-volt, three-phase currents generated partly by three-phase, 9,000-volt generators, and partly by double-current generators, located at the Harrison Street station. The double-current machines supply either 25-cycle, three-phase current for transmission to sub-stations or direct-current for feeding directly into the three-wire network.

The important point to note is that it is recognized that the limit of economy has been reached in transmitting by direct-current, even in the comparatively congested down-town portion of Chicago, with a power station comparatively near the load center; and that the growth henceforth is to be by the establishment of rotary converter sub-stations. In other words, the area of distribution and the density of consumption on the main three-wire network in Chicago have increased to the point where supply from direct-current generating plants is no longer feasible.

It is but another concrete example demonstrating the correctness of the principle previously laid down in these columns, that alternating-current transmission to sub-stations from one generating plant as compared with the establishment of a number of direct-current generating plants, becomes desirable when the total power to be used is large as compared with the power required at any one point. This is aside from all questions as to the feasibility of securing power station sites for a number of direct-current stations, near the down-town district of a large city.

The Harrison Street generating station of the Chicago Edison Company has stood in the past and stands to-day for all that is best in economical direct-current supply to a down-town district of a great city, but present development must be along another line, not because the limit of capacity has been reached in that plant (as it has) but because the copper investment required forbids further extension along lines considered standard ten years ago when the station was planned. The establishment of a number of direct-

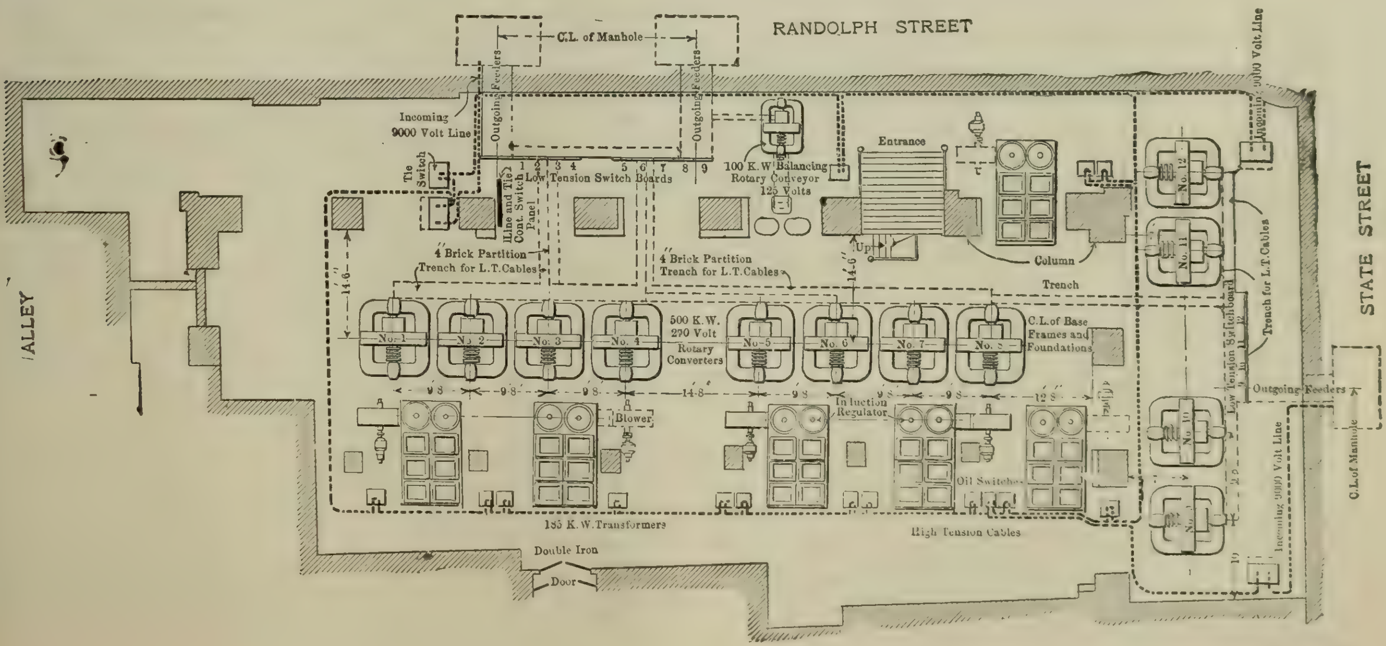


FIG. 2.—GENERAL PLAN OF RANDOLPH STREET SUB-STATION.

current generating stations is also entirely out of the question from an economic standpoint and would be a step backward.

The installation of direct-current generators in the Harrison Street Station was first begun for the purpose of supplying rotary district of Chicago is being supplied both by direct current from the Harrison Street direct-current generators and by direct current from rotary converters fed by 9,000-volt, three-phase current from the same station.

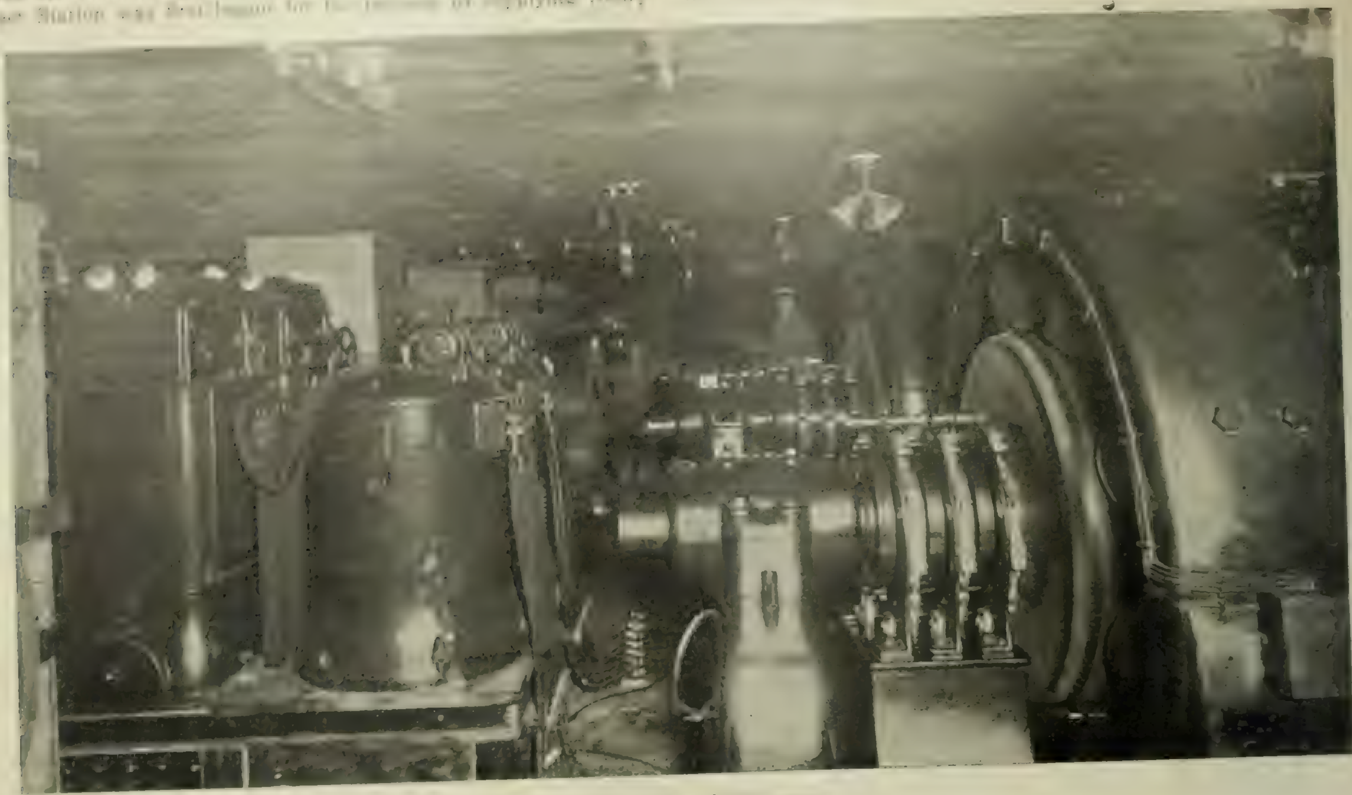


Fig. 3.—Induction Regulators.

converter sub-stations feeding direct-current low-tension networks in certain residence districts where expensively operated steam plants had formerly been run. This company was in fact one of the pioneers in this practice. The establishment of rotary-converter

The most recent of these down-town sub-stations is that known as the Randolph Street Sub-station, which is located in the basement of a famous twenty-one-story sky-scraper, the Masonic Temple. Down-town real estate is so valuable in Chicago that the only

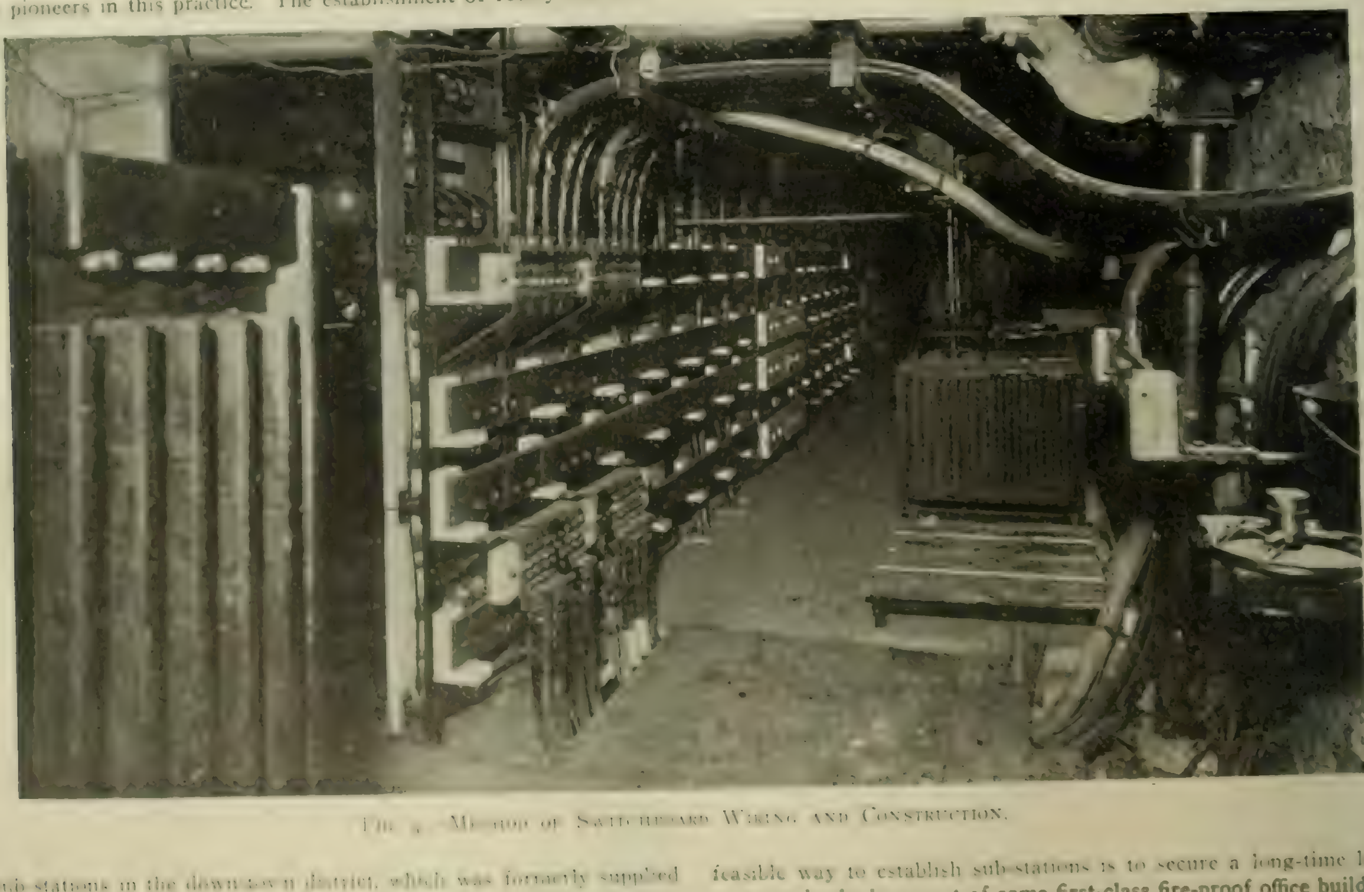


Fig. 4.—Method of Switchboard Wiring and Construction.

sub-stations in the down-town district, which was formerly supplied entirely by direct transmission from the Harrison Street Station, is a more recent development to which it is the purpose of this article to call special attention. At the present time the down-town

feasible way to establish sub-stations is to secure a long-time lease on space in the basement of some first-class fire-proof office building. Less permanent or non-fireproof quarters are manifestly not suitable. The establishment of sub-stations in office building basements is

somewhat of a novelty in engineering practice, but only goes to show the flexibility of the alternating current system of generation and transmission.

One of the reasons for the placing of this sub-station was that the immense new retail store of Marshall Field & Company, just across Randolph Street to the south, contracted to take its entire supply of electric current from the Chicago Edison Company. This establishment is of such size as to call for an amount of electrical energy at this point that would make the cost of copper prohibitive for direct-current transmission from Harrison Street Station. There are also other large and important customers in the vicinity. The sub-station, the interior of which is shown in Fig. 1, is laid out for twelve 270-volt rotary converters of 500-kw capacity each. Five of these have been put in. The arrangement can be seen from the ground plan, Fig. 2. Each converter has its bank of three transformers. This bank is treated as a unit with the rotary converter it supplies. The transformers are mounted in sets of six over air chambers. Pressure is maintained in the air chamber under each set by centrifugal blowers driven by electric motors as indicated. Trenches take care of the low-tension cables. The high-tension busses around the sub-station are carried in lead-covered, three-conductor cable. For each converter there is a 65-kw induction regulator inserted between the converter and the transformers. These regulators are mounted on the same platform as the transformers to get the benefit of the air blast. The range of voltage afforded is from 240 to 270 on the direct-current busses, with the primary voltage on the transformers at 9,000. The transformers have two extra primary taps to allow for line loss between the generating station and sub-station. Each regulator can be turned either by hand or by a small induction motor on top of the regulator. This motor can be rotated either way by a double-throw, double-pole switch on the converter panel at the switchboard. The induction regulators are clearly seen in Fig. 3.

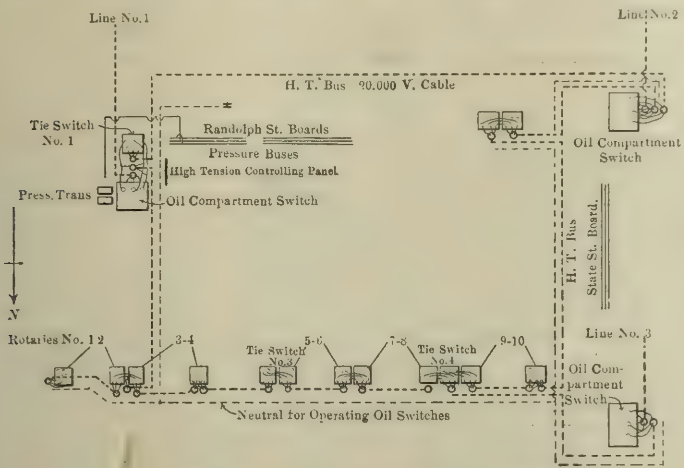


FIG. 5.—HIGH-TENSION BUSSES AND OIL SWITCHES.

The general plan of the incoming transmission lines and outgoing feeders at this sub-station is to be noted especially because it carries out the principle of not "putting all the eggs in one basket." The arrangement of high-tension busses and switches is shown in the diagram, Fig. 5. Beginning with the incoming 9,000-volt, three-phase transmission lines, there are three of these, coming from the same or different generators in the generating station by different routes, entering the sub-station at different places. Each high-tension transmission line, as it enters first, passes through a G. I. solenoid-operated, compartment oil-switch. If this switch is closed the transmission line supplies directly the high-tension bus cables feeding the transformers of four of the rotary converters. The transformers are supplied through G. I. oil-switches, which are placed in the circuit to each bank of transformers. In case it is desired to throw the various bus cables in parallel or if the incoming transmission line switch which would usually supply a bus is opened, and it is desired to run the transformers on that bus from some other transmission line, oil-switches are provided to tie together the different high-tension busbars. This arrangement is made plain by the high-tension wiring diagram, Fig. 5. The sub-station is practically divided electrically into three different divisions, each with its set of high and low-tension busses, but with means for tieing together the various sections when advisable.

The direct-current leads from the rotary converters are run in trenches to the switchboards, and the policy of isolation of the different sources of current supply is also carried out in the plans for the trenches, so that a short circuit in a trench could not spread to cripple more than two converters. Only four rotary converters have leads in any one trench, and there is a brick partition running through the middle of the trench which again subdivides the leads so that only the leads from two machines are in the same compartment.

The high-tension feeder switches and tie-over switches between busbars are controlled by 120-volt, low-tension, direct-current, and these controlling switches are placed on a high-tension controlling panel at one end of the room. On this panel is a diagram showing the relative connections of the high-tension feeders and busses in miniature. The switches of the low-tension controlling circuits which operate the high-tension switches in the incoming feeders, and those for connecting together the different sections of alternating-current, high-tension bus cables in the sub-station, are placed so that their handles form part of this circuit diagram. The diagram also includes the red and green miniature pilot lamps which indicate whether a switch is open or closed. It is therefore easy to tell at a glance just what circuit conditions exist on the high-tension busses at any time. All the high-tension switches have overload tripping relays, which close a switch-tripping circuit at a predetermined overload. On the same board which controls the high-tension feeder switches is a Lincoln synchronizer, which is used in synchronizing the rotary converters. There are also a couple of voltmeters for use in throwing new machines into operation. The solenoids which throw the high-tension switches are operated by 120-volt direct-current. No high-tension lines exist on any of the switchboards, the 120-volt direct-current control circuits only being taken to the board.

Each rotary converter has one switchboard panel devoted to it, and this panel contains both high and low-tension control switches. Fig. 6 shows one of the three switchboards containing two direct-current feeder panels at the right, with two rotary converter panels and the panel for starting the rotary converters at the left. Each converter is considered as a unit with its bank of three 185-kw transformers and 65-kw induction regulator. The switching for the alternating current side of a converter is done on the high-tension side of its transformer. There are no switches between the low-

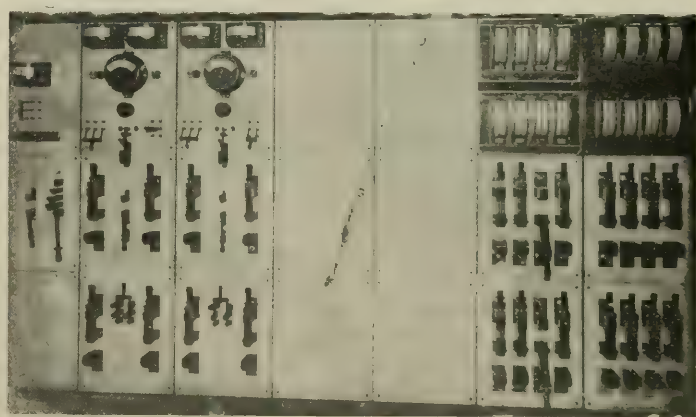


FIG. 6.—CONVERTER AND FEEDER PANELS OF ONE BOARD.

tension terminals of the transformers and the converter, but as a safety precaution fuses have been put on the low-tension transformer terminals.

The low-tension switch which controls the high-tension oil-switch belonging to a rotary converter unit is placed in the middle of the bottom of the top section of each converter panel. Immediately above it is the field rheostat handle. At its right is the double-pole, double-throw switch for running the induction regulator motor forward or back. On the next section below are two 1,250-ampere, double-throw switches in parallel for connecting the positive direct-current terminal of the converter to either one of two sets of direct-current busbars. On the next section below are the two negative switches of the converter. In the middle of the middle section is a positive single-pole switch for connecting the positive terminal of the converter to a starting bus to start it from the 255-volt-mains. In series with this starting bus is a resistance which is gradually cut out by the starting switch. This is the switch with four jaws seen at the left.

The direct-current feeder panels each accommodate four feeders as seen, there being an edgewise ammeter in the positive and negative of each feeder. The rotary converters at this sub-station being 250-volt machines, are adapted for feeding only into the two outside wires of the three-wire network. The neutral bus is not brought to the switchboard, but the neutrals from the street mains and from Marshall Field & Company's are brought in and connected together, where the direct-current feeders enter the building. Any unbalancing of the load on the two sides of the system is now taken care of by the generating station, but a 100-kw, 125-volt rotary converter to be used on either side of the system as required has been provided for as seen by the plan.

The solenoid-operated oil-switch through which each converter's transformers are supplied is provided with a relay to open it upon overload. There is also an automatic circuit-breaker in the direct-current leads of each converter. This circuit, besides opening under an overload, will also open in case current from the direct-current busbars flows through the rotary converter in excess of 500 amperes. The way this is accomplished is very simple, and at the same time reliable. The direct-current ammeter of each converter is provided with a scale which will indicate either the current delivered by or delivered to the converter, such as is common on storage-battery panels. This ammeter therefore shows the current used in starting as well as that delivered after it is started. A contact is put on the pointer of the ammeter which will close a relay circuit, which in turn will close the tripping coil circuit on the direct-current circuit-breaker when the current flowing from the direct-current busbars to the converter exceeds 1,000 amperes. Thus the use of 1,000 amperes in starting the converter is permitted, but reversed current in excess of that amount cannot flow. This provides against the converter running inverted and feeding back current into the high-tension lines should a short circuit occur in the latter. It is also a check on the running away of the rotary converter. A mechanical speed-limiting device is also to be attached to these machines which will open the circuit-breaker when a certain speed is exceeded.

Another noteworthy Chicago Edison Company practice is the arrangement of shunts for direct-current ammeters. Instead of inserting shunt resistances, which are somewhat cumbersome, in series in each feeder or direct-current generator lead, the feeder cable itself is used as an ammeter shunt. A tap is made for the ammeter leads at a couple of points on the cable as it leaves the board. These taps are about 7 ft. apart on a 2,000,000 c.m. cable. The drop of potential over a length of the cable instead of the drop over a prepared shunt resistance is therefore utilized to operate the ammeter. Since, however, the resistance of the cable and consequently the readings of the ammeter would vary according to the temperature of the cable, it is necessary to compensate for this in some way, and this is very cleverly done by winding around the cable for a short distance a coil of fine copper wire of high resistance as compared to the ammeter coils. This wire is in series with the ammeter. The rise of temperature in the cable and in the coil surrounding it is the same. The rise in temperature increases the cable resistance and tends to cause a higher reading of the ammeter. The resistance of the fine wire coiled around the cable increases in the same proportion and as this coil is in series with the ammeter and constitutes the greater part of the resistance in the instrument circuit, the rise in temperature is almost compensated for. The instrument taps to the feeder cables and the coils surrounding the cables as they leave the board are seen in Fig. 4.

Another arrangement tending to neatness and simplicity in switchboard wiring is that of keeping the angle-iron frame of a switchboard [illegible] back of the marble slabs. This permits the potential and pilot circuits to be run much more neatly and safely than if they all must be carried over the iron frame. The method of construction is seen in Fig. [illegible] It will be further noted that the positive feeders all come off from the top of the board and the negative feeders from the bottom. It is not the regular practice of the company to fuse its low-tension feeders. Continuity of service is considered of more value than anything to be gained by fusing feeders. Sources of supply are subdivided and isolated from each other as far as possible, but the network and its feeders are a solidly connected unit.

The division of the sub-station output through three separate switchboards, and the separation of low-tension leads have been mentioned, and these are some of the ways in which the sources of supply are separated from each other. Ordinarily the direct-curren. busbars of these three boards will be independent, but they can be thrown in parallel by tie-over switches. Large consumers supplied mainly from this sub-station have special feeders running direct from the switchboard to the consumer's service board, in addition to supply from the regular low-tension network in the street. In this way the load can be assigned to the sub-station or the network or both at will.

The use of two sets of busbars on all three switchboards makes possible the operation of feeders at 12 different voltages if this should ever be desired. In addition, therefore, to the desirability of keeping the groups of current-supplying units separate from each other in case of trouble affecting one group, the arrangement adopted has the important feature of enabling the sub-station to maintain such a variety of voltages as will allow it the maximum use of the copper installed, and will also allow it to maintain good regulation of voltage on the network.

Head room is of course small in a basement sub-station of this

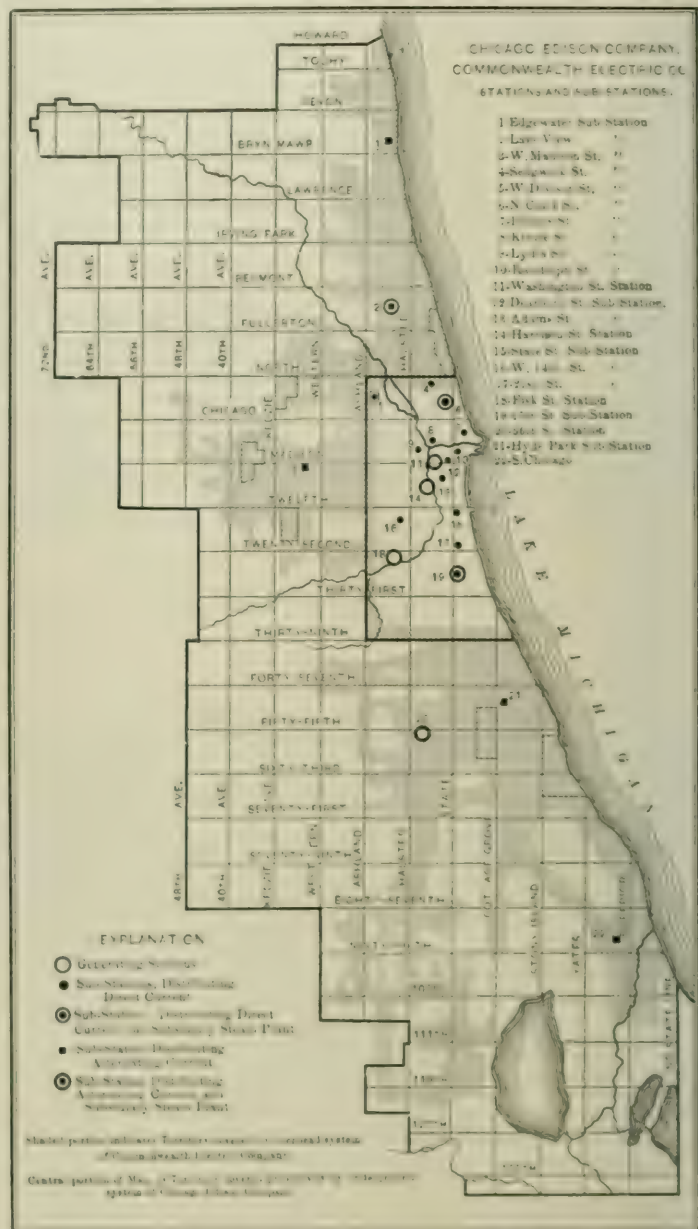


FIG. 7.—MAP SHOWING LOCATION OF SUB-STATIONS.

kind. Since at full load at least 600 kw must be dissipated in heat, the ventilation is a matter of great importance and calls for the rapid changing of air in this limited space. This will be taken care of as needed by fan blowers drawing air from the outside.

It is hardly necessary to say that the company would not be adding sub-station after sub-station to its equipment if adequate provisions were not being made for power plant capacity to supply them with 25-cycle, 9,000-volt, three-phase current in the future, since the Harrison Street Station is now full. As previously announced in these columns, a tract of land has been purchased near Center Avenue and Twenty-second Street for the erection of a 100,000-kw generating plant. Contracts are under way for 16,000 hp of this. The entire output of this station will be 25-cycle, three-phase, 9,000-

volt current, for transmission to sub-stations. Where outlying residence districts are to be supplied the Commonwealth Electric Company has adopted the four-wire, three-phase system, using 60-cycle currents from star-connected generators, giving a maximum of 4,150 volts between the outside wires and 2,400 volts between outside wires and neutral. Mr. Peter Junkersfeld, assistant to the mechanical engineer, fully described the application of this system on the Commonwealth system in a paper before the Chicago Electrical Association April 4, 1902. Where this class of service must be supplied by power from the new generating station, motor-generator substations will be established, taking 25-cycle, 9,000-volt currents and delivering 60-cycle, 4,000-volt currents, three-phase. The rapid growth of rotary converter sub-stations giving direct current can be seen from the accompanying map, Fig. 8, as compared to that in the issue of May 19, 1900.

The comparison shows that in the central portion of the city or Edison district there have been added since May, 1900, some 10 substations feeding direct current to the low-tension, three-wire network, a growth somewhat remarkable. This does not take into account the alternating-current sub-stations. The growth for the current year will be in the neighborhood of 49 per cent. The increase is somewhat astounding and shows how rapidly plans must be made for additional generating and sub-station apparatus to keep up with the growth.

The new generating station, numbered 18 on the map, is about 2 miles south and 1½ miles west of the business center of the city. It has been announced in the newspapers that the Curtis steam turbine of the General Electric Company will be used for the first place in the new plant. The management of the Chicago Edison Company has always been noted for its progressiveness in the trial of new promising apparatus, and it has contributed no little to central station engineering progress. It may furthermore be said to its credit that this progressiveness extends also to the employment of a high grade of educated employees and the offering of these employees every opportunity for keeping abreast of the times and for advancement.

Canadian Niagara Power Development.

The approach of winter finds the work of the Canadian Niagara Power Company well under way at Niagara Falls. This company has had a franchise on the Canadian side for several years. The original agreement gave the company exclusive rights in the matter of power development in Victoria Park, but under a revision of the articles the company relinquished the exclusive feature. The method it has adopted for developing a portion of the power of the Horseshoe Fall is identical with the project of the Niagara Falls Power Company on the American side of the river, that is by means of a wheel-pit and tunnel tail race.

According to the plans the full length of the wheel-pit will be 480 feet, but at present a section 266 feet long is being built. This pit will be 21 feet wide and about 170 feet deep. It has reached a depth of 106 feet, and the rate of excavation is 12 feet a month. The contractors on the pit are Dawson & Riley, of St. Catharines, who have a large force at work, but have been bothered by labor disputes. The manner in which the Canadian pit is being sunk is quite similar to the work that was performed on the American side in the construction of the two larger pits already built there. The rock conditions are almost the same, with the exception that a blue limestone was met near the surface on the Canadian side that was not found on the American side. Water is found a little nearer the surface, but the quantity is not quite so great. The installation to be placed in this pit will develop 50,000 hp, but the entire pit will have room for turbines that will have an output capacity of 100,000 hp.

In connection with this wheel-pit, Dawson & Riley are constructing a forebay of large size. It extends the full length of the pit, and stretches out in front of it to a point where it becomes canal-like. At this point it is 250 feet wide and will be bridged by a magnificent stone arch having a width of 60 feet. On this bridge will be carried the tracks of the Niagara Falls Park & R... Railway and a driveway. The bridge will have five arches, and will be a truly handsome structure. Beyond the canal the forebay again widens out to about 400 feet. It will carry an average depth of 18 feet of water. From a point near the north end of the wheel-pit a canal 16 feet wide and 500 feet long will be built to serve as an ice run. Between the entrance and mouth there will be a difference of four or five feet in the level, giving a good current. Gates will regulate the flow from the forebay.

The tunnel has been driven from the wheel-pit to the lower river, a distance of about 2,200 feet. This tunnel is 25 feet high and 18 feet wide, four feet higher than the tunnel on the American side. In its construction a shaft was sunk midway between the pit and the portal. Men are now working out the lower bench, and about half of it has been removed. It was the intention of the Canadian Niagara Power Company to line this tunnel with brick from end to end, but owing to a scarcity of brick they have decided to use a large amount of concrete in the lining between the spring line and the bottom. This will save using about 3,000,000 brick, and will not delay the work. About 1,250,000 brick will be used in the arch, and the concrete portion of the lining will be faced with vitrified brick. The stone of the lower bench is used in the concrete, in making which 20,000 barrels of Lehigh cement, furnished by the Thorne Cement Company, of Buffalo, will also be used. Anthony C. Douglass has the contract for the tunnel, shaft and portal.

The portal of the tunnel is very close to the foot of the Horseshoe Fall, and owing to the likelihood of vast quantities of ice forming during the coming winter, the masonry work at this point will not be started until next spring. It will be massive in every particular, well calculated to withstand all the remarkable conditions that will surround it at all seasons of the year. When the installation is in operation, the stream from this portal will pour out almost as a part of the Horseshoe flood, and its direction will be about northeast, directly toward Goat Island.

Contractor Douglass' plant consists of two compound duplex Ingersoll air compressors of 125 hp each; two Lidgerwood double-drum hoists, one Otis elevator lift, twelve drills, and a rock crusher. The air compressors are operated by a 400-hp electric motor, the current for which is supplied from the American side. Dawson & Riley's plant is of 750-hp boiler capacity. They have two compound Rand air compressors of 250-hp each; eight Sullivan channelling machines, eight Ingersoll drills, two gadders, and two 10-ton Brown locomotive hoists.

So far as real beauty is concerned, the Canadian side of the river at Niagara is temporarily barren, made so by the fact that all the water which usually flows about the pretty Dufferin Islands has been diverted by a very large dam built by the Ontario Power Company to aid its projected development of power under its franchise and its agreement with the commissioners of Victoria Park. The spectacle thus wrought is attractive and remarkable, and will long be remembered. A large area of the river bed is dry, and the rocky bottom of the river has been explored by thousands of people, all eager to find, in the pot holes, crevices and other depressions, some souvenir of the present-day strange conditions. The dam that has aided in this result is about 800 feet long, extending out into and down the river through six or seven feet of water and a fast current. John J. Albright, of Buffalo, is president of the Ontario Power Company, whose plan of development will be very similar to that of the Niagara Falls Hydraulic Power & Manufacturing Company on the American side. Its power station will be located at the water's edge in the gorge, the site for which is now being excavated at a rapid rate. The penstocks will run through tunnels in the cliff to the supply pipes extending through the park. It is said these latter pipes will be about 18 feet in diameter and throughout their length in the park they will be concealed from view so as not to mar the scenic feature of the locality.

Lion Taming.

Mr. George M. McCarthy, president of the Hudson County, N. J., Society for the Prevention of Cruelty to Animals, believes that lions come within his jurisdiction. Recently one of these animals has been taking part in a play called "The Lion's Bride" at a Jersey City theatre. It was his duty to roar whenever the bride appeared because a Turkish Sultan, whose bride she would not be, had sentenced her to be eaten by the lion. The roars he emitted at sight of the girl frightened the audience, but an animal expert who saw the show informed President McCarthy that the lion's roars were caused by pain and not by anger or a desire to eat the heroine. He also said that he believed the pain was due to electricity. President McCarthy visited the theatre and found that the bottom of the lion's cage, which was of iron, was connected with several electric wires that made the lion roar whenever the current was turned on. He notified the manager that the electricity must be omitted, even if the lion refused to roar without it. The order will be obeyed.

Steam Pipe Covering and Its Relation to Station Economy.*

Before awarding a contract for covering the steam pipes in the Manhattan Railway Company's power house, a careful investigation and test of different types and thicknesses of covering was made under the author's direction. In order to get the necessary data it was decided to carry out a complete test of the various types of covering on the market, and also to investigate the effect of varying the thickness of the insulating wall.

The method adopted is illustrated in Fig. 1, and consisted in coupling up about 200 feet of 2-inch iron pipe and mounting the same on wooden horses about three and one-half feet from the floor, the three lines of pipe being approximately four feet apart and four feet from the nearest wall, in order to avoid any errors due to heat connection and radiation. Sections 15 feet in length were marked off on the straight portions of the pipe, and so arranged as not to include any pipe couplings or bends; two feet from each end of each section heavy potential wires were soldered on to the pipe, and at the extreme ends of the pipe 1,500,000 cm. copper insulated cables were soldered on, the openings in the pipe having been previously closed by means of a standard coupling and plug. One of these cables ran direct to one terminal of a 250-kw, 250-volt, steam-driven, direct-coupled exciter, which was solely devoted to furnishing current for the test, and which could have its voltage varied within wide limits so as to furnish any current up to 1,500 amperes. The cable connected to the other end of the pipe was then connected to three ammeter shunts in series, in order to enable the readings to be easily checked, after which it was carried through a circuit breaker and switch to the other exciter terminal. The pipe covering test was carried on in a vault in which there was no source of heat and no possibility of draughts of air, and arranged so that the section in which the test was being carried on could be locked up in order to prevent interference with the test.

Invitations for bids were sent to all the principal pipe covering manufacturers and jobbers, specifying that each one would be expected to cover one or more sections of the 2-inch pipe for a competitive test, and that samples from the successful bidders' covering would be analyzed in the company's chemical laboratory, and no covering accepted which departed more than three per cent. from this analysis.

A special Weston milli-voltmeter was ordered, with which readings were taken from the potential wires, the latter all being brought to mercury cups on a testing table near which the ammeters were also located.

Preliminary tests were made with a small current in order to establish the individual resistance of the 11-foot sections between the potential wires; this current was then gradually increased and more readings taken together with thermometer readings from thermometers having their bulbs in contact with the pipe at an angle of about 30 degrees, the stems projecting through the covering. From these readings a coefficient of .4640 per cent. increase of resistance per degree Centigrade was determined, and afterwards used in determining temperatures of the various sections. At first it was thought that temperatures could be determined with sufficient accuracy by the thermometers, inserted as above described in the center of each section covered, but, after a preliminary series of readings this was abandoned as inaccurate, owing, no doubt, to the variable contact made by the bulb on the bare pipe. All temperatures were, therefore, calculated by the resistance method.

Current sufficient to heat the pipe to approximately 370° F. (corresponding to a steam-gauge pressure of 160 pounds) was kept on for three days continuously, in order to dry out the various coverings, after which they were allowed to cool off to the air temperatures before starting the test. The temperature of the room was kept between 27° C. and 31° C. during the entire test, each section had about 600 readings taken, and where any doubt existed in reference to readings, the entire series was gone over a second and third time with the gratifying result that it was conclusively shown that the test could be repeated with a variation of results not exceeding two per cent.

The method of test was to put a current of sufficient quantity through the pipe to heat it to say 220° F., and keep this current on for a sufficient time to enable all sections to maintain a constant temperature (this period was found to be about ten hours) when readings of the milli-voltmeter were taken on each section with simultaneous ammeter readings. As all the sections were in series electrically, the current was, of course, the same, so that no error could arise, due to variation of current.

The object of leaving two feet at the end of each section, or four feet between potential wires, was to avoid any error due to conduction of heat through the pipe. Tests were made to prove the efficiency of this precaution, and showed that no perceptible error was introduced.

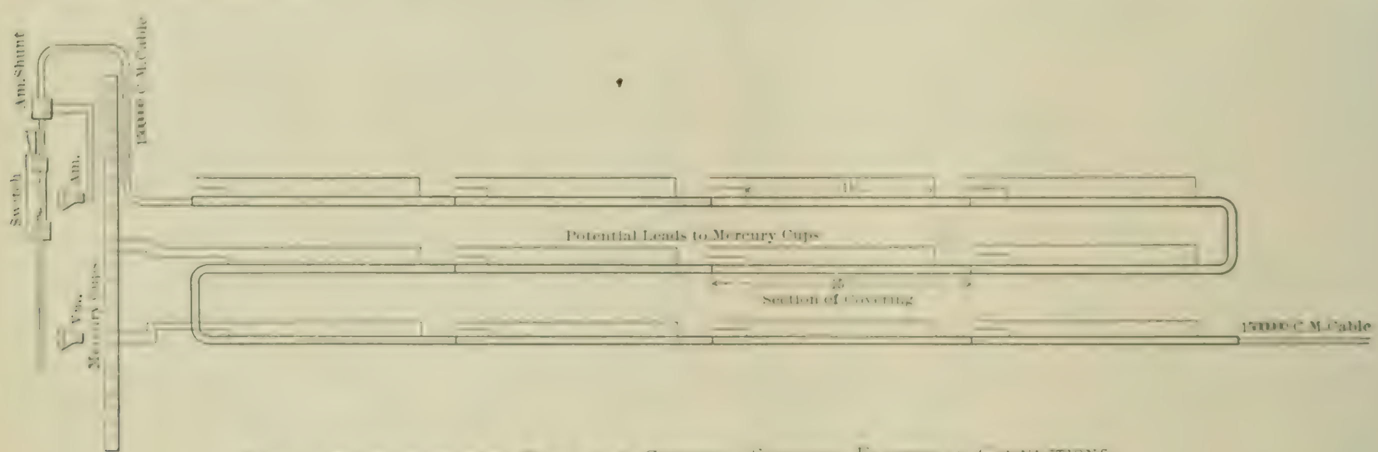


FIG. 1.—DIAGRAM OF 2-IN. PIPE WITH COVERING, SHOWING ELECTRICAL CONNECTIONS.

A constant temperature having been obtained, it is evident that the watts lost in each section give an exact measure of the energy lost in maintaining a constant temperature, and from the watts lost the thermal units are readily calculated. Fig. 2 shows the result of the test values being reduced to loss in B. T. U. per square foot of pipe surface at various temperatures in the curves, and at a temperature corresponding to steam at 160 pounds pressure in the table.

After a series of readings had been completed, the current was raised sufficiently to give approximately 50° F. rise in the least efficient covering, and maintained constant for ten hours, when another series of readings were taken, and so on until the temperature of the pipe had reached a point far above anything used in practice. The extremely high readings were taken as a matter of interest, as they were got when the less efficient coverings were only at working temperatures.

Referring to the table in diagram Fig. 3, the first column refers to the number of curves, the second column gives the name of the covering which, in most cases, is sufficiently descriptive, but a brief description of each covering may be of interest.

No. 2. Solid sectional covering one and one-half inches thick, composed of granulated cork moulded under pressure, and then baked at a temperature of 500° F., 1/8-in. asbestos paper next pipe, finished with resin paper and 8-ounce canvas.

No. 3. Solid 1-inch moulded sectional covering, composed of 85 per cent. carbonate of magnesia, finished with resin paper and 8-ounce canvas.

No. 4. Solid 1-inch sectional covering, composed of granulated

* Abstract of a paper by H. G. Stott read before the 22nd Convention of the Association of Edison Illuminating Companies, held at The Mount Washington, N. H., September 9, 10 and 11, 1902.

cork moulded under pressure and baked at a temperature of 500° F., ⅛-inch asbestos paper next pipe, finished with resin paper and 8-ounce canvas.

No. 5. Solid 1-inch moulded sectional covering, composed of 85 per cent. carbonate of magnesia. Outside of sections covered with canvas pasted on. Finished with resin paper and 8-ounce canvas.

No. 6. Laminated 1-inch sectional covering, composed of nine layers of asbestos paper with granulated cork in between; outside of sections covered with canvas pasted on, ⅛-inch asbestos paper next pipe, finished with resin paper and 8-ounce canvas.

No. 7. Solid 1-inch moulded sectional covering, composed of 85 per cent. carbonate of magnesia, outside of sections covered with light canvas pasted on; finished with resin paper and 8-ounce canvas.

No. 8. Laminated 1-inch sectional covering, composed of seven layers of abestos paper indented with ¼-inch square indentations, which serve to keep the asbestos layers from coming in close contact with one another; ⅛-inch asbestos paper placed next pipe, finished with resin paper and canvas.

No. 9. Laminated 1-inch sectional covering, composed of 64 layers of asbestos paper, in which were embedded small pieces of sponge.

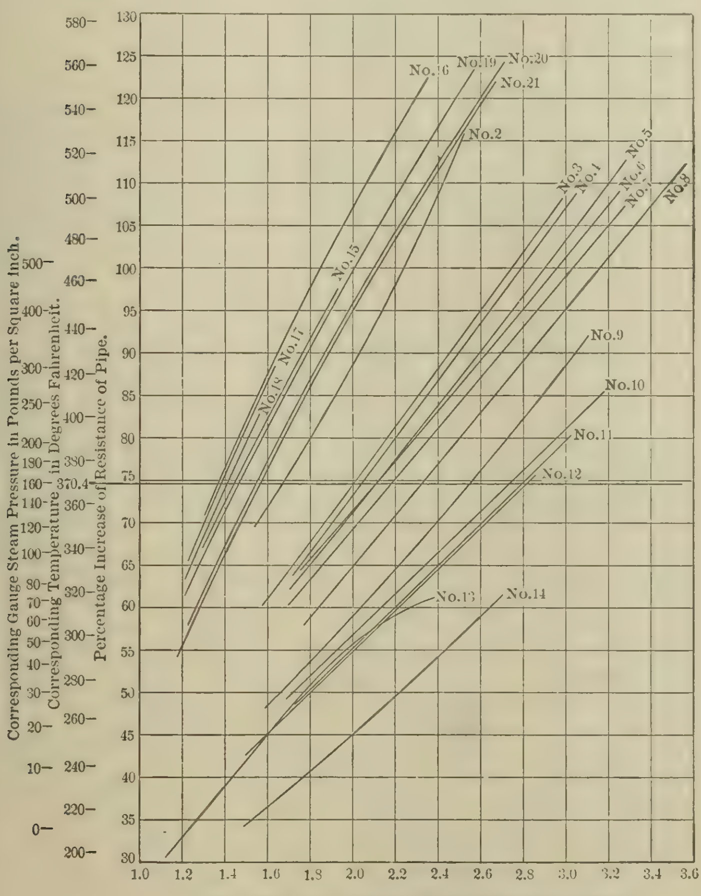


FIG. 2.—RESULTS OF TEST VALUES.

Outside covered with canvas pasted on, finished with resin paper and canvas.

No. 10. Laminated 1½-inch sectional covering composed of 12 plain layers of asbestos paper, with corrugated layers in between, thus forming longitudinal air cells; ⅛-inch asbestos paper next pipe; sections wired on and finished with resin paper and 8-ounce canvas.

No. 11. Laminated 1-inch sectional covering, composed of eight layers of asbestos paper with corrugated layers in between, the corrugations forming small air ducts radially around the covering; finished with resin paper and 8-ounce canvas.

No. 12. Laminated 1¼-inch sectional covering, composed of six layers of asbestos paper with corrugated layers, forming longitudinal air cells; outside of sections covered with two layers of canvas pasted on and finished with resin paper and canvas.

No. 13. Solid 1-inch moulded sectional covering, composed of a magnesia compound mostly talc; ⅛-inch asbestos paper next pipe; finished with resin paper, and 8-ounce canvas. This sample was submitted for low temperature work only, such as boiler feed and drips.

No. 14. Solid 1-inch moulded sectional covering, composed of magnesian compound, principally talc; [illegible] inch layer of asbestos paper next pipe, and finished with resin paper and 8-ounce canvas.

No. 15. "Remanit," composed of two layers wound in reverse direction with ropes of carbonized silk. Inner layer two and one-half inches wide, and one-half inch thick; outer layer two inches wide and three-quarters inch thick, over which was wound a net work of fine wire; ⅛-inch asbestos next pipe, finished with resin paper and 8-ounce canvas. Made in Germany.

No. 16. Two and one-half inch covering, composed of 85 per cent. carbonate of magnesia, ½-inch blocks about three inches wide and 18 inches long next pipe and wired on; over these blocks were placed solid 2-inch moulded sectional covering; outside covered with canvas pasted on. Finished with 8-ounce canvas.

No. 17. Two and one-half inch covering composed of 85 per cent. magnesia. Put on in a 2-inch moulded section wired on; next the pipe and over this a ½-inch layer of magnesia plaster covered with canvas pasted on and finished with 8-ounce canvas.

No. 18. Two and one-half inch covering, composed of 85 per cent. carbonate of magnesia. Put on in two solid 1-inch moulded sections with ½-inch layer of magnesia plaster between; two 1-inch coverings wired on and placed so as to break joints. Finished with 8-ounce canvas.

No. 19. Two-inch covering, composed of 85 per cent. carbonate of magnesia put on in two 1-inch layers so placed as to break joints and finished with 8-ounce canvas.

No. 20. Solid 2-inch moulded sectional covering, composed of 85 per cent. magnesia; outside of sections covered with canvas pasted on. Finished with 8-ounce canvas.

No. 21. Solid 2-inch moulded sectional covering, composed of 85 per cent. magnesia; outside of sections covered with canvas pasted on. Finished with 8-ounce canvas.

Nos. 2, 4, 6 and 15 were excluded by the specifications, which stated that "no inflammable material would be considered," but a test was made at the request of the manufacturers in order to give a comparison with the other materials.

It will be noted that two samples covered with the same thickness of similar material give different results; for example, Nos. 3 and 5 and also Nos. 20 and 21, though of practically equal thickness, show quite a perceptible difference in loss per square foot. Upon investigation, the cause of this difference was found to be in the care with which the joints between sections were made. A comparison between Nos. 19 and 20, showing two coverings having exactly the same total thickness, but one applied in a solid 2-inch section, and the other in two 1-inch sections, proved the desirability of breaking joints.

TABLE I

	Covering	[illegible]	[illegible]	[illegible]
2	Solid cork: Sectional	[illegible]	1.672	87.1
3	85% Magnesia: Sectional	1.18	2.008	84.5
4	Solid Cork: Sectional	[illegible]	2.048	84.2
5	85% Magnesia: Sectional	1.10	2.130	83.6
6	Laminated Asbesto Cork: Sectional	1.43	2.123	83.7
7	85% Magnesia: Sectional	1.12	2.160	83.2
8	Asbestos Air Cell [Indent]: Sectional [Imperial]	1.20	2.333	82.1
9	Asbestos Sponge Felted: Sectional	1.24	2.556	80.3
10	Asbestos Air Cell [Long]: Sectional	1.70	2.750	78.8
11	"Asbestocel" [Radial]: Sectional	1.22	2.801	78.5
12	Asbestos Air Cell [Long]: Sectional	1.29	2.812	78.4
13	"Standard" Magnesia: Sectional	1.12	....	....
14	"Magnesian": Sectional	1.23	....	....
15	"Remanit" [Silk]: Wrapped	[illegible]	1.452	88.8
16	85% Magnesia: 2" Sectional and ½" Block	2.71	1.381	89.4
17	85% Magnesia: 2" Sectional and ½" Plaster	2.45	[illegible]	80.3
18	85% Magnesia: 2-1" Sectional and ½" Plaster	2.50	1.412	89.1
19	85% Magnesia: 2-1" Sectional	2.24	1.405	88.7
20	85% Magnesia: 2" Sectional	2.24	1 555	88.0
21	85% Magnesia: 2" Sectional	2.21	1.568	87.9
	Bare Pipe [From Outside Tests]		13.000	

FIG. 3.—RECORD OF TESTS.

An attempt was made to determine the law governing the effect of increasing the thickness of the insulating material, and for all the

[illegible] square root of the thickness, but the other materials tested did not [illegible]

The column on the right of the accompanying table shows the percentage of heat saved by the different coverings, compared to bare [illegible]

In Table II (Fig. 4) an attempt has been made to reduce all cov- [illegible] the relative efficiency of different types of [illegible] One-inch covering was adopted as the standard, and only those coverings nearly one and one eighth inches thick were used in the comparison in order to avoid errors in calculating the losses in materials which did not follow the square root law closely.

An inspection of the table shows that the carbonized silk covering is the most efficient, having a relative efficiency of 86.9, whilst 85 per cent magnesia comes second with 84.2 per cent. efficiency. The two other samples of 85 per cent. magnesia show efficiencies of 83.1 and 83.2 per cent., thus confirming in a remarkable way the results on the other samples.

RELATION TO STATION ECONOMY.

To determine which covering is the most economical, the following quantities must be considered:

1st. Investment in covering. 2nd. Cost of coal required to supply lost heat. 3rd. Five per cent. interest on capital invested in boilers and stokers rendered idle through having to supply lost heat. 4th. Guaranteed life of covering. 5th. Thickness of covering.

From an inspection of the first three quantities it is apparent that the covering which shows a minimum total cost of the three at the end of a specified time is the best covering to adopt, for the loss in heat at the end of ten years may readily cost over three times as much as the first cost of covering. To enable this to be seen more clearly, Table III was calculated (Fig. 5).

A specific number of square feet of pipe surface has been used in working out the total cost, but it is evident that the curves may be

TABLE III.

	Covering	[illegible]	Heat Saved [illegible]
[illegible]	[illegible]	2.060	84.2
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	83.1
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	"Asbestocel" (Radial): Sectional ...	2.920	[illegible]
[illegible]	[illegible]	[illegible]	76.8
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]

Fig. 5.—[illegible]

[illegible] cost per square foot of material for different thicknesses varies in the [illegible]

[illegible]

[illegible] of all necessary to know how long the covering is expected to last. For example, suppose that a temporary plant is being erected which is not likely to be required for more than two years, a 1-inch covering will be the most economical. For covering guaranteed for ten years, as required by the Manhattan Railway Company, 1-inch covering would show a total cost of $53.663, whilst a 3-inch covering would show a total cost of $38.668, making a net saving of $14.995 at the end of ten years, or $1,499.50 per annum, which, capitalized at 5 per cent. represents $29,990.00.

TABLE II.—[illegible] COST OF COVERING AND HEAT LOSS

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$[illegible] % 1st Cost	% Loss	$[illegible],000 % 1st Cost	% Loss	$5[illegible],000 % 1st Cost	% Loss	$60,000 % 1st Cost	% Loss
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18.5	[illegible]	[illegible]	86.1	[illegible]	88.9	9.3	90.7
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	26.3	[illegible]	[illegible]	80.3	[illegible]	[illegible]	13.1	86.9
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	28.9	[illegible]	[illegible]	78.3	[illegible]	82.7	14.4	85.6
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	80.9	15.9	84.1

Fig. 4.—Relative Efficiencies.

From the above example, it will be seen that whilst pipe covering is a relatively small portion of the many problems confronting the engineer, yet its scientific solution will yield rich results out of all proportion to the time required to solve it.

I would only add that there seems to be no reason for the former practice of putting on different thickness of covering on different sized pipes, excepting the mechanical difficulty of applying a very heavy covering to a small pipe. This difficulty can be overcome by putting the covering on in two separate layers, and this plan should be used on all sizes in order that the joints may be broken, as poor joints may reduce the efficiency of the best covering 6 per cent. or more.

Transmission Committee, American Institute of Electrical Engineers.

At the September meeting of the American Institute of Electrical Engineers, a committee was appointed consisting of Ralph D. Mershon, chairman, and Messrs. F. O. Blackwell, C. C. Chesney, P. M. Lincoln and R. S. Masson, for the purpose of collecting data respecting present practice in electric transmission at high voltage and of presenting a report which will indicate the successful methods which are now in operation in such form as to be of immediate value to electrical engineers. It is within the scope of the committee to secure data upon line construction, insulators, pins and the like, and the conditions of operation at different voltages and under different climatic conditions; to investigate methods of testing insulators and to indicate the method or methods which in its judgment are superior. Also to ascertain the methods employed for voltage regulation, the conditions attendant upon the switching of high-tension circuits and to collect data respecting lightning and static disturbances and the use of grounded protective wires.

Part of the programme of the committee is to secure from time to time from qualified engineers an "introduction to a discussion" on some particular topic relating to high-tension transmission. This introduction will be written up under certain well-defined heads, and will embody the ideas of the member or members preparing it, upon the subject to be discussed. The "introduction" will be printed and sent out to the members of the Institute some considerable time previous to the meeting at which the discussion will take place, so that the members not able to be present at the meeting may take part in the discussion by mail. In contributing to a discussion it is requested that the matter under discussion be taken up under the several heads and in the manner made use of in the "introduction," and that following the treatment of these heads, there be introduced any other matter which the contributor may deem advisable. When a member takes part, by mail, in more than one of the discussions taking place at the same meeting, it is requested that he embody his several contributions in separate letters.

Contributions will be read at the meeting for which they are intended, either in full, in abstract, or as a part of a general statement giving a summary of views of those persons taking a similar position in the matter under discussion, depending upon the merit of the contribution and the clearness of statement of the position taken. In the former two cases they will be read in the name of the member contributing.

The Use and Advantages of the Alternating Current for Land Telegraphy—IV.

BY EDWIN F. NORTHRUP.

It will now be shown that the so-called "tailing out" of the current impulse, so destructive to rapid telegraphy over long lines by ordinary methods, is in the case of alternating-current telegraphy, a positive advantage.

It will help to a better understanding of this matter if we first determine the distribution on the line of the instantaneous e. m. f. and the instantaneous current at the moment when a wave is about to be modified. If the modification of the wave consists in cutting

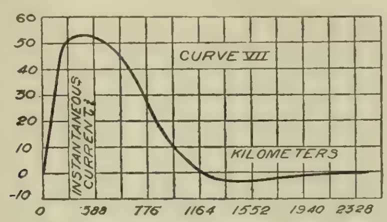


FIG. 21.—INSTANTANEOUS VALUE OF CURRENT.

it out, and matters have been rightly arranged at the transmitting end, the line is opened by the transmitter at the exact moment that the current at the beginning of the line is passing through its zero value. But a long line acts as a reservoir of electric energy and though the instantaneous value of the current is zero at its beginning, it is not so at other points of the line, its value varying from point to point of its length. The value of the instantaneous e. m. f. also varies from point to point of the line.

Having the curves Nos. 1, 2, 3 and 4 giving the square root of the mean square values of the intensities of the current and e. m. f. at all points of the line and also the phase of each, we can plot derived curves which will give the instantaneous values of each at any particular instant which may be chosen.

Curve No. 7 (Fig. 21) gives the instantaneous value of the current at all points of the line at the instant when the current at the beginning of the line is passing through zero value.

Curve No. 8 (Fig. 22) gives the instantaneous value of the e.m.f. at

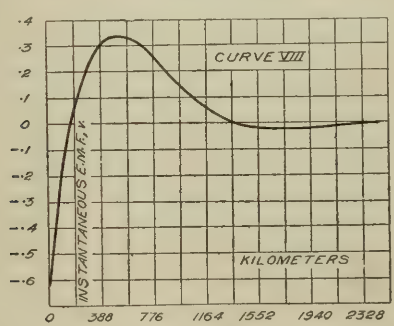


FIG. 22.—INSTANTANEOUS VALUE OF E.M.F.

all points of the line at the same instant. These curves were derived from curves 1, 2, 3, and 4, as follows:

From curves 1 and 2 we obtain the maximum values of the e. m. f. and current at all points of the line by multiplying the square root of the mean square values, as given by the curves, by the $\sqrt{2}$.

The e. m. f. and current vary at all points of the line as a sine function of the time. Hence, if the current at the beginning of the line is at zero phase, and at any other point of the line its phase is ω^1 its instantaneous value at any point of the line is $i = \sqrt{2} I \sin \omega^1$.

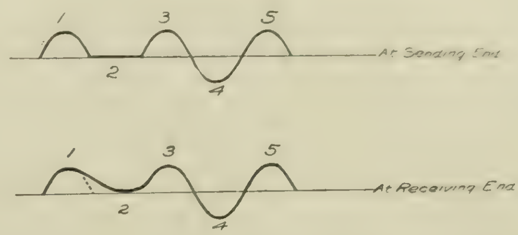
Here I is the value of the current at any point X of the line as given by curve No. 2, and ω^1 is the phase of the current minus 26°, 21′, its angle of lead, at the same point of the line. Similarly the instantaneous e. m. f. is $V = \sqrt{2} E \sin \omega_1$.

Curves 7 and 8 are interesting in several particulars, one being that they show how in a long telegraph line carrying an alternating current, the current at different points of the line is flowing in opposite directions at the same time, and that the e. m. f.'s are opposite at different points of the line.

The condenser capacity of any element of the line will be charged proportionally to the instantaneous e. m. f. at the element. Now, if the line is suddenly opened at one end, or separated from the source of e. m. f. and put to ground, so that its ends are in communication with the earth, the electricity stored up in the line will discharge itself in a manner to produce a different current distribution upon the line, during the semicycle following the opening of the circuit, than would exist if the circuit had not been opened.

Thus, suppose a positive half wave to be cut-out at the generator end, then the current at points in the line distant from the end where the half wave was cut-out, will continue more or less to flow in the same direction that it had just previous to the cutting out of the half wave.

Thus if 2, Fig. 23, represents a cut-out semicycle of the current



FIGS. 23 AND 24.—EFFECT OF CONDENSER CAPACITY.

at the transmitter, this same half wave will appear somewhat as in 2, Fig. 24, at a distant point of the line from the transmitter.

The half wave No. 1 will, so to speak ,have "tailed out" and blended into the next semicycle. This effect at the receiving end is favorable to making a clear signal.

Thus, let A of Fig. 25 represent a group of 11 semicycles, and suppose the half waves 4 and 7 have been sharply cut-out at the transmitter end of the line, as indicated by the heavy lines. At the distant end of the line where the receiving polarized relay is located the 3d and 6th half waves just in advance, in time, of those cut-out will have "tailed out" in a manner somewhat as indicated by the dotted lines.

Let B of Fig. 25 represent the different positions of the tongue of the receiving relay, to which it is carried by each half wave as it comes along.

The position, 4, of the tongue, corresponding to the half wave cut-out, is the same as the position to which it is carried by the half wave which precedes and follows the modified half wave. The same holds true of the 7th position of the tongue, or any other corresponding to a modified semi-cycle. In other words, when a semicycle is cut-out the tongue of the receiving relay stays against the contact to which it was carried by the previous half wave and remains against this contact during the time of three semicycles. Now, the important point to note is, that the more the half wave, preceding the one cut-out "tails out" or blends into the half wave following the one cut-out the more forcibly will the relay tongue be made

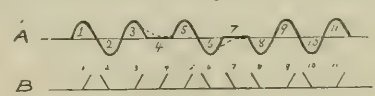


FIG. 25.—SEMICYCLES AS TRANSMITTED AND RECEIVED.

to stick against the contact to which it was last carried. If a half wave is reversed instead of cut-out, the sticking of the tongue against the contact to which it was previously carried will be all the more forcible.

It has been shown in connection with Fig. 20 how it is possible to operate a local relay and hence to receive a signal by causing the tongue of the receiving relay to stick against its contact, or miss a half vibration. As this sticking of the tongue against its contact is only improved by the "tailing out" of the waves, the speed of signaling over a telegraph line by means of the alternating current does not diminish as the length of line increases.

I have found by actual experiment that it was easier to get good clear signals over an artificial line representing a line of great length than over a short wire. The "tailing out" of the wave in the former case, helped to make the relay tongue stick tight, and so to operate with more certainty the local relays employed. Other instruments than a polarized relay could be employed to receive the signals, such for example as a syphon recorder, but the principles above brought out should apply equally to them all.

An important matter to consider in long distance telegraphy is

[illegible] arise which will tend [illegible] ise the transmitting of [illegible] on other neighboring [illegible] dis-charges, earth currents, especially the trolley currents in cities, electrostatic induction from neighboring lines, and to some extent elec-[illegible]

[illegible] nd the capacity of the [illegible] l as a line disturbance [illegible] a disturbing factor of actual lines that is not possessed [illegible]

[illegible] not be given in the present paper more than to show that, with alternating current telegraphy, [illegible] effects can be made of slight consequence as compared with their effects in the ordinary methods of telegraphy. It is a result, of many repeated experiments made by the writer, that the telegraphic signals made by cutting out single, or combinations of, half waves, may be easily transmitted through either condensers or trans-[illegible]h. This being so, line disturbances may be almost [illegible]

[illegible]ng is a condenser method, first applied by the writer, to [illegible] the disturbances due to earth currents:

[illegible] and K_2 are two condensers of about 5 m. f. capacity each, which at all times separate the line from direct communication with the earth. [illegible]

[illegible]

which feeds the line, is separated from direct connection with the earth by the condenser K_1. When the transmitter T_1 operates to cut-out a wave the contact p is broken and the contact n is made, putting the line to earth through the condenser K_2. At the same time the transmitter T_2 which is in series with T_1 operates and short circuits the condenser K_1, discharging it of any electricity that may [illegible] is short circuited by the contact made at C, and the short circuit is taken off K_1 just before the line is again connected to G at p. Thus the line is never in direct communication with the earth, which effectually cuts off earth currents, and after the cutting out of a half [illegible] waves of the same sign are cut out a surplus charge of the opposite sign is given to the condensers which would flow back into the line, if the condensers were not discharged, to disturb the action of the receiving relay at the other end.

The following transformer method of cutting off disturbances will entirely eliminate the effect of earth currents, also leakage and electromagnetic induction from other lines.

[illegible] up into sections, such as A, B and C. The different sections are

[illegible]

[illegible] in the manner shown. The windings of the transformers are so connected that the current in adjacent sections of the line will be flowing in opposite directions at the same time. If the sections are sufficiently numerous the line will thus become non-inductive, electromagnetically, to neighboring lines. The source of alternating current G may also act inductively upon the line through the transformer C_1. The transmitter T may be in circuit with G. The receiving relay R at the other end of the line may also be in a separate circuit H. Half waves cut out by the transmitter T are received by the relay R, the same as if a metallic circuit connected the relay with the source of the alternating current. The above method was devised and tried by the writer for a simplex line. It gave excellent results in this case, and will undoubtedly operate also with duplexed lines.

The disturbing effect of a telegraph line, carrying an alternating current upon other lines, strung on the same poles, need be no greater than lines operated upon the Morse system. The electromagnetic induction may be eliminated in the manner just described, and the effects of electrostatic induction should certainly be no greater than those produced by lines operated upon the Morse system, because the voltages that are needed for the alternating current lines are no greater than those required for the lines of the Morse system.

Small variations in the insulation resistance of the alternating current line, due to weather changes, effect the ratio of the current received to the current sent into the line but slightly, and hence, it is very easy, comparatively, to keep the receiving relays at each end of a duplexed line well balanced. Thus suppose that $R = \frac{I_e}{[illegible]}$ is the ratio of the received to the entering current on the real line. Then [illegible] the current which enters the line, flowing around one coil of the differentially wound relay. When the relay is perfectly balanced, the current in the artificial is $I'_o = [illegible]$. Since R_1 will not change by itself, I'_o will always maintain a fixed relation to I_o unless R changes, in which case I'_o will not keep the same relation to I_o, and the relay will become unbalanced in proportion as R varies. As this matter has an important bearing in favor of alternating-current telegraphy, I have plotted a curve, No. IX (Fig. 28), showing the variations in the ratio of the currents received at a point 1,600 kilometers (about 1,000 miles) from the generator end of a line of

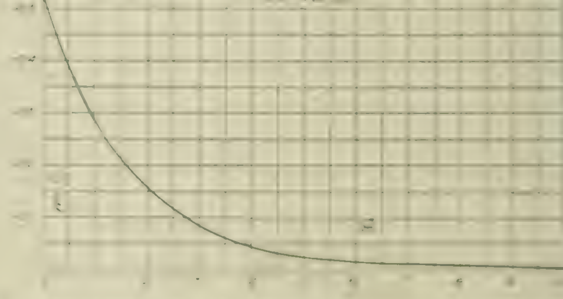


FIG. 28.—VARIATIONS IN RATIO OF ENTERING AND RECEIVED CURRENTS

infinite length, to the current entering the line, as the insulation resistance r_1 $\left(\text{where } g = \frac{1}{r_1} \right)$ is varied in value, all the other line constants remaining unchanged.

Equation No. 25 expresses the values of the required ratio. I have taken $l = 1{,}600$, $r = 2.7$, $x = 1.13$ and $b_c = 3.89 \times 10^{-6}$, and have varied g from o to 10×10^{-6}. The results expressed in this curve for a line of infinite length will serve for all practical purposes for a line of finite length grounded at its ends. If the length of the grounded line is nearly 1,600 kilometers and the current received is the current at its grounded end, then the values of W, as given by the curve, should be multiplied by 2, as explained above.

It will be noted in referring to curve IX that the variation in the ratio grows less and less with increasing line leakage. Hence if the relays of a duplexed line, which is already leaky, have been balanced it ought to be easier to maintain the balance when changes in the line insulation occur, than if the line were perfectly insulated at the start.

The current for alternating current telegraph lines may be ob-

tained from an ordinary 110-volt direct-current circuit, no alternating current dynamo being required. The current used on the line being small, the direct current is easily commuted into an alternating current. A simple method of doing this is to mount upon the shaft of a small direct-current motor another commutator precisely like the commutator used for synchronizing the motor, as described in method 3, page 822. Two stationary brushes take the direct current upon this commutator and two take off from it the alternating current. *A* and *B*, Fig. 29, show the developed commutator in two positions.

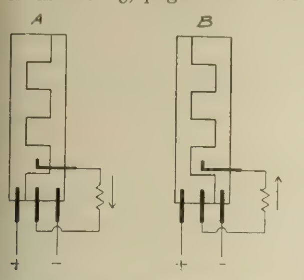


FIG. 29.—METHOD OF OBTAINING ALTERNATING CURRENT.

Such small amount of sparking as would otherwise occur can be disposed of with condensers. The essential elements then which have to do with the alternating current of a duplexed line, without taking account of the local apparatus operated by local direct currents, may consist of what is shown in the following diagram, Fig. 30:

A is a station at one end of the duplexed line, and *B* a station at the other end. The mechanism of station *A* is run in synchronism with that of station *B*. *G* and G_1 are two direct-current motors, the motor *G* being run in synchronism with the motor G_1, by the

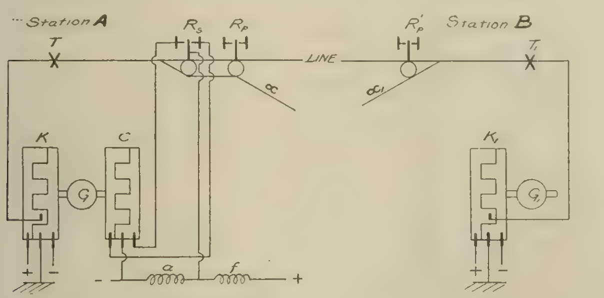


FIG. 30.—APPLICATION OF ALTERNATING CURRENT TO DUPLEXED LINE.

3d method described on page 822. The commutators *K* and K^1 supply the alternating current to the line. The commutator *C*, in conjunction with the synchronizer tongue *Rs*, of the relay at station *A*, maintains the motor G in synchronism with the motor G_1, *a* and *f* are shown representing the armature and field windings of *G* to make plain the electric connections for synchronism. The tongue *Rp* of the relay at station *A* is used for receiving the signals, also, the tongue R^1p of the relay at station *B*. *T* and T_1 are transmitters, of any character whatever, connected in the line at each end. *T* can send to R^1p and T_1 to *Rp*, at the same instant. For printing telegraphy the signaling capacity of the line as above represented would be about 8 messages at a time with 40 words per minute for each message.

With alternating-current telegraphy it is not necessary to have more than one source of current. A line or any number of lines which radiate from a centre, can be operated, with a single source of current located at one end of the line, and messages can be transmitted both ways at practically the same time. The signaling capacity, or words transmitted per minute is, however, theoretically only half that of a regularly duplexed line. Professor Rowland, to whom this method is due, called it his "reflected wave system of telegraphy." The system has important applications and the essential features will be described next.

Italian Railways.

According to recent advices the present arrangement with the government under which Italian railroads are operated will expire in 1905, and it will be necessary for the government to submit its plans for the future to the House of Deputies by June, 1903. It is as yet undetermined whether a proposition will be made to continue the present arrangement, or one by the terms of which the roads would pass from private management. In the meantime the government proposes to build an electric line between Rome and Naples, a distance of about 120 miles, the cost of which is estimated at $4,000,000. The present schedule time of 4½ hours would be reduced by this line to 2¼ hours.

Probable Future Developments in the Use of Electricity on Board Ships.

At the general meeting of the Society of Naval Architects and Marine Engineers, held in New York last week, Mr. F. O. Blackwell read a paper with the above title in which he treated the subjects with respect to the substitution of steam turbines for reciprocating engines for driving the electric generators; the use of alternating-current generators and motors instead of continuous-current apparatus, and the operation of all auxiliary machinery on ships by electric motors.

Mr. Blackwell considers that the steam turbine is ideal for the driving of electric generators. Within reasonable limits, the higher the speed of electrical apparatus the smaller, lighter, and more efficient it becomes, and we may even consider the electric motor and generator simply as a convenient speed-reducing and distributing mechanism which is more efficient than most mechanical connections. Compared with the reciprocating engines and slow-speed generators now used in our Navy, a turbine plant can be designed which will have but one-quarter the weight and take but one-tenth the space. It might also save weight in the structure of the ship on account of its lightness and freedom from vibration.

The steam turbine can be used with a high degree of superheat (when superheated steam comes into general marine use, as it undoubtedly will before long), because there are no lubricated surfaces in contact with the steam, and a high vacuum can be obtained because there are no piston-rod packings to leak air. The entire absence of lubricating oil in the condensed steam is also a great advantage to avoid deterioration and foaming in boilers. The efficiency is very high, especially when we consider that it is the actual efficiency, including all mechanical and electrical losses, there being no such thing as indicated horse-power in a turbine.

The steam consumption of, let us say, a 300-kw turbo-alternator at full load with dry steam at 200 pounds pressure and 28-inch vacuum would be about 20 pounds of steam per kw-hour, or 15 pounds per electrical hp-hour. The steam consumption at one-half load would be about 22 pounds per kw-hour. There is no objection, therefore, to putting in large units and running them much of the time underloaded. In order to appreciate this it should be contrasted with some present reciprocating compound dynamo engines, which take 30 to 50 pounds of steam per kw-hour at full load, and 40 to 65 pounds at one-half load. It is claimed to be at least as efficient as the main engines at full power and much better than they are at cruising speed. It should not be forgotten that the average ship dynamo and engine now in use is of from 30 to 100 kw capacity, and also that the high speed alternator has a higher efficiency than the slow-speed, continuous-current generator, especially at low potentials when the commutator brush friction is high. The steam turbine can be used to drive continuous-current generators, but not to as good advantage as an alternator on account of the high speed.

After a comparison of the continuous and alternating-current systems, Mr. Blackwell says that the polyphase (that is, two and three-phase) system permits the design of a cheaper and lighter generator and motor, and is therefore particularly applicable to operate motors. In addition it gives a motor which will start with full torque, whereas the single-phase, like a single-crank engine, becomes dead-centered at starting, unless somewhat complicated starting devices are employed.

As between the two-phase and three-phase systems, the two-phase requires four wires and the three-phase but three. One-third more copper is required for either one-phase or two-phase than is needed for three-phase under the same conditions. It is evident, therefore, that to supply power to motors the three-phase system is more economical, while for incandescent lamps, one-phase is preferable in order to make the lamp wiring as simple as possible. Fortunately, we can combine these two methods of distribution and get the advantages of both.

The lighting should only be a small portion of the entire load of a ship power plant, and any one three-phase generator can carry it all single-phase without difficulty. The potential supplied for lighting must be perfectly constant in order to give good service and not burn out the lamps. The motors run practically as well with a variable as with a constant voltage. The alternator should therefore be made with a regulating device that automatically gives

constant potential to the one-phase lighting circuit even if the other branches of the three-phase circuit vary.

It is also an advantage of alternating-current machinery that there is no magnetic field set up by the generators, motors, or by the constantly reversing currents in the wiring that can affect the ship's compass. Neither does alternating current cause electrolytic action should it pass through the iron work of the vessel.

After outlining the principles of alternating-current generators, and stating that the synchronous motor is unfitted for shipboard work, the induction motor is described. It is pointed out that the speed of the motor is determined by the periodicity of the system and the number of poles for which it is wound. At no-load it runs at synchronous speed, but under load it ordinarily drops off two or three per cent. If the motor is driven above synchronous speed, it becomes a generator and returns power to the system. Varying the potential within ordinary limits does not affect the speed of the motor.

The torque is limited. Usually the maximum either at starting or full speed is between two and three times the full-load torque, and if loaded beyond this point it stops. The maximum torque varies as the square of the potential, and can be increased for intermittent work by raising the potential. In order to reduce the speed below synchronism, power must be wasted in resistance. To get full torque at starting requires at least full-load current. Induction motors cause a lag in the current wave behind the potential wave, which at full-load increases the current about 10 per cent. without increasing the actual power consumed. The ratio of the actual to the apparent power is called the power factor of the motor.

In the continuous-current, shunt-wound motor, the speed can be changed by varying the strength of the field current within certain limits and with nearly constant efficiency, as is now done with blower motors. In the series continuous-current motor the speed automatically varies with the load (a heavy load giving a slow speed and a light load a high speed) as in most of the hoist motors at present used. A continuous-current motor may also be operated efficiently at any speed by varying the potential supplied to the motor, as for example the present type of electric turret control. The induction motor will not permit of any of these forms of control, and other less efficient methods must be substituted.

There are two forms of revolving secondaries, or armatures, in use in induction motors. In one the winding consists of bars all joined together at the heads, and is known as the squirrel-cage or short-circuited armature. In the other the secondary is polar-wound and the ends of the winding are connected to a variable resistance, either inside the armature or external to it.

In order to vary the speed two methods are used. The polar-winding can be connected to collector-rings so that the current in the secondary is carried to a controller which cuts in more or less resistance. This is known as secondary control. A short-circuited secondary may be used of permanent high resistance. By varying the potential supplied to the motor, the current flowing in the secondary is increased or diminished, and this acting over the fixed resistance changes the speed of the motor. The former method is preferable, as it is more efficient and the power does not go into heating the motor and reducing its capacity, but is dissipated externally. The latter method, however, has the advantage of having only one set of wires carried to the motor, and is, therefore, superior for distant control.

The windings of an induction motor can be connected so as to give two or more speeds by changing from, say, four to eight poles. With a short-circuited secondary this requires no change in the armature. The speed may also be varied by changing the periodicity of the system. A combination of these two methods has been employed to give a considerable number of speeds, at each of which the motor runs with full efficiency. The weight of induction and continuous-current motors is for ordinary speeds about the same. At high speeds, the alternating motor is lighter, while at slow speed it is heavier on account of the large number of poles and greater diameter required.

For shipboard service the choice of periodicity lies between 30 and 40 cycles, with a preference for 40 cycles, which gives a higher maximum speed and a rather better range of speeds. It is also the lowest periodicity that can be used for arc lighting, which will probably be more used than it has in the past.

In transmitting power by alternating currents, in addition to the loss due to the resistance of the conductors, there is an apparent loss of energy and an actual drop of potential caused by the inductance of the wires. The inductive drop is unimportant with small conductors, as used for lighting, but may be considerable with the large conductors and currents required for motors. The inductive loss may also be greatly increased if single wires are enclosed in iron tubes or run near iron work.

If a complete circuit, that is, two wires for one-phase or three wires for three-phase, are placed together, the inductance is practically negligible. By using double-conductor cable for single-phase and triple-conductor for three-phase, alternating current may be run through iron pipes or along iron work without difficulty. The single-phase wiring for lighting will be nearly the same therefore as for continuous current.

The power circuits constitute over nine-tenths of the load, and must therefore be given careful thought. By employing three-phase current a saving of 25 per cent. is effected in conductors as compared with continuous current at the same potential. By increasing the power-circuit pressure to 220 volts, a further saving of copper is made. Two hundred and twenty volts requires but one-third the weight of conductors needed for 125 volts.

The wattless current of induction motors will reduce the economy somewhat, but we can safely say that a 220-volt, three-phase system can be operated with but one-third the copper of a continuous current, 125-volt, other things being equal. Comparing this alternating system with the existing 80-volt, continuous-current, the copper required will be but one-sixth; in other words, the wiring for a 1,200-kw, three-phase system will be no greater than that of a 200-kw continuous-current.

Driving all auxiliaries, including the feed, circulating and air pumps by motors is more efficient and to have many advantages over steam operation. It is argued because the exhaust from the auxiliaries is turned into the feed-water heaters and distilling apparatus, it makes no difference how much steam is consumed by them. This is true to a certain extent, but the energy lost by leakage and radiation in the piping and cylinders cannot be recovered. The hot steam pipes to the auxiliaries are most objectionable in themselves, and a source of constant trouble in service. The auxiliaries are much less efficient when they are operated only occasionally or at less than their full capacity when the ship is running at cruising speed or in port. The mechanical efficiency of the small engines is also very poor.

Auxiliaries which take from 50 to 300 pounds of steam per hp-hour and have to be run by throttling the steam down to a fraction of the boiler pressure, as is often the case now, are so inefficient that the system is little better than heating the feed-water by steam directly from the boiler, which is evidently a poorer method than heating the feed-water in the boiler itself. The proper way is to get as much mechanical power as possible out of the steam before it is turned into the heater and its latent heat given up to the feed-water passing into the boilers. When the auxiliaries average 150 pounds of steam per indicated hp-hour, as they did on the United States Steamship *Minneapolis*, it means that 1½ per cent. of the heat energy of the steam is converted into mechanical power.

By taking steam from the main engines after it has partially expanded, a return of from 8 per cent. to 10 per cent. of the heat energy may be obtained in mechanical power. A pound of coal may only be worth 1/10 of a cent., but the mechanical equivalent of its heat value, 5 hp-hours, may be worth 5 cents, or fifty times as much. Steam for the feed-water heaters, distillers, evaporators, and steam-heating should be taken from between the low and the intermediate cylinders of the main engine, or when that is shut down from some intermediate stage of the turbine wheels of the electric plant.

By using motor-driven auxiliaries, the oil which is introduced into the feed-water by reciprocating engines is also done away with and the resulting troubles with boilers avoided. The combined mechanical and electrical losses in the generator, motor, and electrical transmission can be less than 20 per cent. With a steam economy in the turbo-alternator of 15 pounds per hp-hour, this gives a steam consumption for the motor-driven auxiliary of 18 pounds, or about ⅙ that of the Minneapolis auxiliaries already referred to.

In order to have a basis for figuring, Mr. Blackwell assumed that the United States men-of-war *Connecticut* and *Louisiana* will be equipped with steam turbines and alternating apparatus for driving all the auxiliaries. These battleships, now being built at the Brooklyn Navy Yard and at Newport News, are to have a trial

lisplacement of 16,000 tons, a speed of 18 knots, and main engines of 16,500 hp.

The specifications of the Navy Department do not call for motors to drive the pumps, forced-draught blowers, ash hoists, anchor windlass or steering engine. The following table has been prepared to show what would be the running conditions were all machinery except the propelling engines driven by motors. The number and size of some of the auxiliaries have been changed to meet the needs of electric driving. In some cases the powers have had to be assumed, no data being at hand, and the list is only an approximate estimate to get at the total power needed under maximum and ordinary conditions. The maximum load is taken to be when the ship is going into action at full speed.

The specifications for the *Connecticut* and *Louisiana* now call for two separate power plants, each containing four 100-kw generating sets. In order to take care of the other auxiliaries which the specifications did not contemplate operating by electric power, a larger plant is required, and at the same time larger and fewer units can be used, which is permissible because of the high steam economy of the turbine on partial loads.

The total nominal capacity of all the auxiliary apparatus is seen from the table to be about 2,500 hp. Of this not more than 800 hp could possibly be in full operation at one time even when in action and going at full speed, and not more than 400 hp under ordinary cruising conditions or in port, not including the anchor windlass.

The electric power must be divided into two separate plants, each large enough to supply the maximum load of the entire ship, for example, into two units of 300 kw each. The four steam turbines and generators would therefore each have a rated capacity of 400 hp, with an overload capacity of 600 hp. In port or when cruising at slow speed, one 300-kw unit would be all that would ordinarily be required.

Proposed Motor Equipment of U. S. Battleships "Connecticut" and Louisiana."

Motors for—	Number	Total Rated H.P.	Average Maximum H.P., Full Speed in Action	Ordinary H.P., Cruising Speed	Port H.P.
Blowers, ventilating	41	87	75	75	75
Blowers, forced draught	12	204	204	0	0
Hoists, ammunition	32	274	100	100	100
Hoists, ash	6	48	12	12	12
Boat cranes	4	160	0	0	80
Deck winches	6	180	0	0	25
Windlass, anchor	1	300	0	0	0
Turret turning	12	220	40	0	0
Elevating guns	12	25	5	0	0
Rammers	12	48	5	0	0
Foundry and workshop	2	25	0	25	25
Ammunition conveyors	4	20	13	0	0
Doors and hatches	47	25	0	0	0
Steering	1	100	20	10	0
Ice machine	1	25	15	15	15
Pumps, fresh water	2	10	5	5	5
Pumps, flushing	2	10	5	5	5
Pumps, main feed	4	200	100	25	0
Pumps, main air	2	50	25	7	0
Pumps, circulating	2	200	50	13	0
Pumps, auxiliary feed	4	20	10	5	5
Pumps, auxiliary air	2	5	3	2	2
Pumps, auxiliary circ.	2	10	5	5	5
Pumps, fire, bilge, shaft, etc.	6	100	10	10	10
Pumps, distiller, evaporator, and miscellaneous	8	25	5	5	5
Total motors	227	2,371	707	319	369
Incandescent lamps	1,200	60	30	30	30
Searchlights	6	30	30	0	0
Total power	..	2,461	767	349	399

The use of four units instead of eight will much simplify the electric installation. The proposed four 300-kw units would certainly not weigh more than one-half as much or take more than one-third the space of the eight 100-kw engines and generators which are to be installed.

The three branches of a three-phase alternating circuit either can each be joined only at one end, known as the Y-connection, or at both ends, known as the delta connection. In the Y-connection the potential between the terminals is 73 per cent. more than between the common or neutral point and one of the terminals.

Assuming that the new standard generator potential of the Navy (125 volts) will be used for lighting, and that the lamps will be connected between the neutral and one-line, the potential between the three-phase lines will be 220 volts. This gives a single-phase, low-potential wiring system without introducing any complications and a higher pressure power system. By grounding the neutral, the strain on the insulation might be limited to 125 volts, but this is hardly necessary, as 220 volts is not a high enough potential to cause any trouble. If it were grounded, single-wire lighting circuits might be emplowed with the ship as a ground return. Such a system could not be safely used with continuous-current on shipboard on account of the danger of electrolytic action corroding the ironwork or the currents setting up magnetic fields that might affect the compasses. The inductive drop in a single-wire system would probably make a two-wire preferable, however.

The total number of incandescent lamps on the *Connecticut* and *Louisiana* will be about 1,200, requiring 60 kw with every lamp burning. Probably 30 kw is nearer the usual load, or, say, 5 per cent., of the two generators in use at one time. One leg of a 300-kw generator will carry this without difficulty, and the potential of the generator can be automatically regulated to give constant potential at the lamps. If desired a feeder regulator to boost or lower the lamp potential can be inserted in the lighting circuit, making it possible to control the lamp pressure independently of the speed or voltage of the power system.

The lighting regulation of a large marine power plant of this character, notwithstanding the much greater motor load proposed, can, by means of the automatic devices now perfected, be kept much more constant than in existing continuous-current marine practice and permit the use of three watt per candle-power lamps instead of the low-efficiency four-watt lamps now generally employed. This would mean a saving of 25 per cent. in the cost of power for lighting.

The six searchlights of the *Connecticut* and *Louisiana* will take 80 amperes each, and require 65 volts to give a steady light. When operated from a 125-volt circuit, 60 volts must be used up in resistance. By employing a motor-generator set or rotary converter transforming from alternating current to 60 volts continuous-current, the power consumed by the searchlights is cut in two. Alternating current does not give as good results for searchlights as continuous, as there is no crater to the carbon where the light is concentrated, and which can be placed in the focus of the reflector. The result is that the beam of light is diffused and unsatisfactory.

The present system of turret turning, in which the speed of the motor is regulated by varying the field strength of a continuous-current generator, gives such perfect control over the training of guns that it can hardly be improved upon; but Mr. Blackwood suggests that the same method of control be adopted for elevating and depressing the guns. At present the guns can only be loaded in one position of the turret and elevation of the breech. The ammunition hoist and rammer can readily be arranged so that the guns can be loaded in any position of train or elevation (as in the Vickers' gun mounts in the English navy) and even while the gun is in motion. A controller similar to that used for searchlights with a single handle for both vertical and horizontal movements would permit a 12-in. gun to be manipulated as easily as a small arm. By keeping the gun constantly aimed at the target, regardless of the motion of the ship, it could be fired the moment the breech was closed and the rapidity and accuracy of fire greatly increased.

It has been proposed to turn turrets by switching a continuous-current motor onto a number of different potentials supplied by several generators. A system of operation with alternating currents, similar to this multiple-voltage method, can readily be made by having motors with changeable poles and motor-generator sets to furnish current at different frequencies. It could not, however, have the exact control from an almost imperceptible motion to full speed, the minute changes in direction and the instant response to the will of the gunner required for accurate marksmanship.

In order to operate the six turrets of the *Connecticut* and *Louisiana* even with continuous current, it will undoubtedly be desirable to have a motor-generator set for each turret so that no additional complication is introduced with the alternating system. With balanced turrets, the power required to move them is small, and a high-speed motor generator set would be light and occupy little space.

The long line of piping required to operate the steering gear by steam is most objectionable, as it heats up the ship and cuts through the water-tight compartments. It is also inefficient on account of the constant condensation in the pipes, which must be large enough to carry the maximum load, although the average load is very low.

This is another case where continuous-current has decided advantages. The steering engine is constantly starting and stopping, and will take 100 hp at times, so that any method of control which

[illegible] control used for the turrets. [illegible] into the controller, would be best for electric steering. A motor-generator set would therefore be required with a continuous-current motor applied at the rudder.

The large amount of power needed to operate the anchor windlass has heretofore been an obstacle to driving it by electric power. With the larger electric plant and units proposed, this objection would no longer exist. [illegible] is ample to handle the heaviest windlass. For this purpose a changeable-pole motor might be designed which would give a heavy torque at slow speed or even when entirely "stalled." The slow speed would be used for starting the ship and breaking out the anchor while the higher speed would be employed for hauling in the chain.

[illegible] The continuously running hoists would be driven by constant-speed [illegible] permitting the hoist to be started gradually and run below synchronous speed. The method of control can be either primary or secondary. Instead of solenoid brakes, which are impracticable with alternating-current, automatic mechanical brakes, would have to be used, although small alternating solenoids might be added for retarding the armatures.

The speeds of blowers could be much increased over those now used, especially with alternating motors. Higher efficiencies and much reduced weights of both motors and blowers could be obtained by increasing the revolutions and reducing the diameters. It would be better to keep a constant pressure in the ventilating system and let the amount of air to be supplied be regulated by opening the outlets. In addition, changeable-pole motors might be employed to give, say, three-quarters and full-speed, or two-thirds and full-speed. It is stated that the variation in speed of continuous-current motors by field control cannot yet be obtained efficiently with alternating motors.

In order to make small reductions in the air pressure delivered with alternating-current motors, either the outlet of the blower must be partially closed or the speed of the motor reduced by losing a certain amount of power. Both methods are more efficient than might be thought at first. A blower is practically unloaded by [illegible] the outlet and a small reduction in speed greatly reduces the pressure.

Centrifugal pumps have recently been built in Europe and this country for discharge heads up to 500 feet by using high speeds and having a number of runners in series. There will soon be no difficulty in obtaining these to replace reciprocating pumps for all purposes on shipboard with practically the same efficiencies and with but one-third the weight. These pumps are particularly well adapted to be run by electric motors. Their high speed gives a small, light and efficient motor. They avoid entirely all gearing, valves, and reciprocating parts, and, consequently, much of the noise, vibration, and repairs incident to the operation of reciprocating pumps.

They do not require much variation in speed in order to largely change their capacity. They can be used to maintain nearly constant pressure at constant speed with a variable delivery. If the outlet is closed, there is no great increase in pressure, and the pump [illegible] With such pumps available there need be no reciprocating pumps on shipboard with the exception of those for [illegible]

Where these centrifugal pumps are to be run at widely different pressures or capacities, some of the runners may be cut out entirely or put in multiple with each other. Changeable-pole motors can also be advantageously employed.

In conclusion, Mr. [illegible] expressed the opinion that the steam turbine is the coming method of driving generators. Its rotary motion, light weight, small size and high efficiency at all loads make it particularly suitable for marine use.

Alternators are best adapted to be driven by high-speed turbines, but alternating current has both its merits and demerits. For transmitting power polyphase current is most economical, and the induction motor for constant speed cannot be equalled for simplicity of construction and ability to stand hard usage. It does not, however, permit of as economical or exact speed regulation as a continuous-current motor, although there are possibilities of the development of an alternating commutating motor which will meet these requirements.

As the majority of motors on shipboard run intermittently at variable speed, the selection between continuous and alternating-current should only be made after thorough investigation.

November Meeting of American Institute of Electrical Engineers.

The [illegible] at the monthly meeting of the American Institute of Electrical Engineers numbered more than 200, which was sufficient to crowd uncomfortably the audience hall of the American Society of Mechanical Engineers. The recent great increase in membership, and the growth of interest in the meetings, as well as the rapidly increasing demands of the library, are bringing to a crisis the need of the Institute for the headquarters which it now so conspicuously lacks.

The topic before the meeting was "Variable Speed Control," which was represented on the programme by seven papers.

In introducing the papers of the evening President Scott pointed out that the applications of electricity lead not only to the revolution of old methods, but as well as to the evolution of new ones. Electrical apparatus not only replaces that which it supersedes and gives more efficient service, but it also leads to developments which were impossible by former methods. Illustrations of these were given from various departments of electricity. In the particular case of electrical distribution of power to machines in factories, not only is the service which other systems of power distribution had accomplished, performed more efficiently, but it is much extended.

After outlining the principles of speed variation and the manner in which the problems presented have been met by mechanical means, President Scott stated that it is reasonable to presume that the solution of a problem which has proven so difficult mechanically may involve electrical difficulties as well. Although electrical apparatus may be provided which will accomplish the desired purpose, yet this may be at the expense of added complication, additional apparatus, or increased cost. It is not proper, therefore, to decide a priori that because speed variation can be effected by an electric motor, that the variable speed motor should always be used regardless of conditions, specific requirements and cost.

After some general considerations on types of motors, it is pointed out that the speed of a direct-current motor depends upon the number of turns in series in its armature, the strength of its field and the e.m.f. applied to its armature. In practice speed changes are produced by one of these three methods, or by combinations of them. When the shunt motor is arranged to run at different speeds over a considerable range it will usually be found that the generating plant and the supply circuits are of special type, or the controlling devices are of complicated form or the motor is of greater weight and cost than it would be if it operated at one speed only. Therefore a constant-speed, direct-current shunt motor is to be preferred *per se* to a variable speed motor.

The alternating-current induction motor like the shunt motor is inherently adapted for constant speed service. It may be used also for variable speed work with characteristics analogous to those obtained with the rheostatic control of a shunt motor with unvaried field. It may also be wound so that either of several numbers of poles may be used, thereby securing either of several definite speeds which are sensibly constant with varying load. Just as a shunt motor may be operated at different speeds from generators giving different voltages, so the induction motor may be operated at different speeds from generators giving different frequencies. The single-speed induction motor is, however, the type usually used.

In selecting the apparatus for a new plant it is proper to consider the problem as a whole, to take a general view before concentrating attention upon specific parts. What proportion of the power is to be supplied at constant speed? What proportion of the variable speed work cannot be served satisfactorily from a constant-speed drive with variable pulley ratios or variable gear ratios? What proportion of the work which requires delicate speed adjustment falls within the range of simple and satisfactory mechanical speed-changing devices? What advantages in lessened cost of equipment will be secured by group driving, but furnishing a single large motor for delivering the average power required by a number of machines instead of a large number of small motors each for delivering the

maximum power of the machine to which it is connected? What advantage will there be under the particular surroundings of the installation in reducing the complication and the amount of auxiliary apparatus and putting in motors of the simplest possible type? Taking the plant as a whole, what are the general advantages of one type of apparatus over another, and does the general balance sheet show that the advantages of individual speed control by means of the motors themselves are of sufficient moment to dictate the whole scheme and plan for the whole installation? The varying answers which will be given to these questions in different cases will necessitate different solutions to the problem of selecting the best system. Because speed control can be effected so admirably by the electric motor, it is fitting that we should not go too far and apply the variable speed motor indiscriminately, and it must be recognized that there is the larger problem to be determined in connection with such proposed installation, namely, whether on the whole speed variation by the motor itself should be chosen.

With the title "Electrically Operated Coal Hoist, Having Variable Speed Control," Mr. Pierre O. Keilholtz described a coal-hoisting plant using the Ward Leonard system of control. The apparatus consists of a motor-generator set and a hoist motor, which receives its power from the motor-generator set, the motor of which is supplied with 550-volt direct-current. The field of the generator is separately excited and its strength is controlled by the operator by means of a foot-operated rheostat. The field of the hoist motor is excited by the 550-volt, direct-current. To return the bucket, by means of a double-throw, three-blade switch, the foot rheostat is

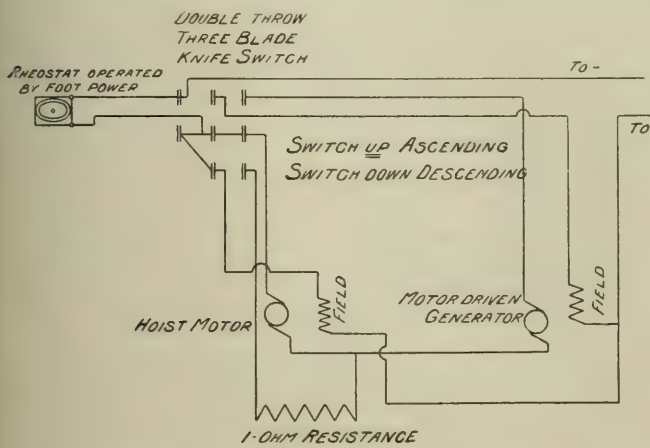


FIG. I.—CIRCUITS OF ELECTRIC COAL HOIST.

cut out of the generator field circuit and cut into the field circuit of the hoist motor; and the armature leads of the hoist motor are cut from the armature circuit of the generator to the rheostat. The motor then acts as a brake.

The total weight of a bucket is 5,237 lbs., and the average lift 126 ft. The average time to raise the bucket is 15 seconds, corresponding to a speed of 8.4 ft. per second. The coil is handled at the rate of 70 tons per hour, and an efficiency of 58½ per cent. is attained. The accompanying cut shows the circuits and connections.

Mr. H. Ward Leonard in a paper entitled "Multiple-Unit, Voltage Speed Control for Trunk Service," described the application of the system known by his name to electric traction, with the addition of multiple control. As is well-known, in the Ward Leonard system the working motor is supplied with variable voltages from a generator driven by a motor or prime-mover, the voltage being varied by varying the field of the generator. When applied to electric railway service, a single-phase motor drives a direct-current generator, the motor taking high-tension current from a trolley line and running continuously. A small direct-current exciter is also driven by the motor, and supplies variable exciting current to the direct-current generator; by means of a reversing rheostat in this exciting circuit, the speed of the motors can be regulated and the necessary tractive effort obtained at any speed and in either direction. Rheostats may be connected to the exciting current at as many points in a train as is desired, and all of the motors controlled from any of these points.

The accompanying diagram shows the circuits and connections. The single-phase motor A^1 drives continually a small exciter E^1 and also a large continuous-current dynamo D^1, whose field is separately excited by the exciter E^1, and has in its field circuit a reversing field rheostat R^1. The armatures of the propelling motors are connected in multiple directly across the terminals of the armature of the dynamo D^1. The field magnets of the propelling motors M^1 are separately and constantly excited by the exciter E^1.

By manipulating the reversing field rheostat R^1, the current through the armatures of the motors M^1 necessary to obtain the required tractive effort, can be obtained at any desired voltage from the lowest voltage to the full-speed voltage, and in either direction.

The simultaneous multiple control of the several locomotive units is obtained by means of the four small wires 1, 2, 3, 4, which are

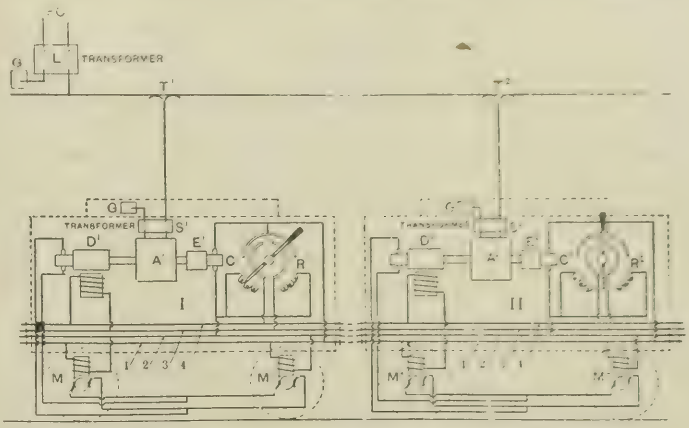


FIG. 2.—WARD LEONARD MULTIPLE-CONTROL RAILWAY SYSTEM.

lead along the train. In the cut, the operator is supposed to be upon the locomotive I. The exciter E^1, which is producing a constant e.m.f., has its terminals connected to the wires 1 and 2. Across these wires 1 and 2 are connected the field windings of all of the propelling motors on the two locomotives, so that they are all constantly and fully excited.

The wires 3 and 4 are also supplied by a current from the exciter E^1, but the reversing field rheostat R^1 is in the path of this current. The fields of the two dynamos D^1 and D^2 are connected in multiple across these wires 3 and 4, which extend along the train. By manipulating the reversing field rheostat R the operator can vary simultaneously and similarly the field exciting currents supplied to D^1 and D^2 and that therefore he can cause the voltage of these two dynamos to vary in exact unison from 0 to the maximum voltage in either sense. Thus, the operator can cause the two locomotives to start, accelerate, run at full speed, retard, and reverse in perfect unison, always dividing the load perfectly under these various conditions. By placing the controller R^1 in its open position and going to the other locomotives, the operator can similarly control the two locomotives simultaneously by means of the controller R^2.

Following are the advantages adduced for this system:

1st. The haulage over existing roadbeds, grades, bridges, etc., of very much heavier trains than can be hauled by any steam locomotive.

2d. A material reduction in the cost of maintenance of ten locomotives as compared with steam locomotives.

3d. A material saving in the maintenance of the roadbed because of the absence of hammer blow, shouldering, rocking and skidding.

4th. A material increase in the weight of the train which could be hauled around a certain curve by a locomotive having a certain weight on drivers.

5th. A material increase in the load which could be started upon a certain grade by a locomotive having a certain weight on drivers.

6th. A material reduction in the dead load necessarily hauled by a steam locomotive, represented by the part of the steam locomotive and tender not on drivers.

7th. A very large increase in the number of trains of given weight and speed which could be operated from a given power house compared with the series parallel or cascade systems. Or, to state this another way: a very much higher rate of acceleration with the same maximum output from the power house, the same conductors, the same weight per train and the same watt-hours per ton-mile, than is possible with the series, parallel or cascade systems.

8th. As each locomotive unit can be equipped with any desired number of driving axles and any desired number of locomotives can be operated under multiple control, the amount of power which can be applied to a single train and controlled by a single operator is practically unlimited.

9th. Fifty per cent. of the energy now wasted on friction brakes can be saved in the form of useful electrical energy restored to the system.

10th. The first cost of equipment will be very much less than that of any system, for equivalent service, which involves the use of sub-stations.

11th. The cost of haulage per ton-mile will be greatly reduced as compared with steam locomotives, especially because of the large increase in the weight of the train which can be hauled.

12th. Difficulties due to electrolysis would be reduced to a minimum.

In a paper entitled "The Storage Battery as a Factor in Speed Control," Mr. H. B. Coho dealt with the use of such battery in printing press operation in particular, with references to other similar power application. In printing press work, in "making up" and threading in paper a positive fixed speed of from 12 to 20 r.p.m. of the press shaft is necessary. In the system described the press motor is supplied with a variable voltage from a storage battery, as indicated in Fig. 3. In the case of the operation of a quadruple Hoe press by this system, the presses operate at 12 r.p.m. in starting

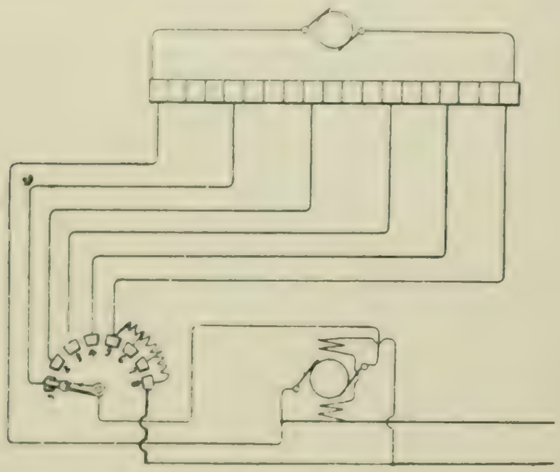


FIG. 3.—STORAGE BATTERY SPEED CONTROL.

to work, and require for this purpose a current of 150 amperes at 40 volts. The threading-in and making-up process lasts at a maximum not more than ten minutes. This process has to be repeated not more than fifteen times in twenty-four hours. From this it follows that a 200-ampere hour battery on an hour rating will more than fulfill the requirements.

The advantages claimed for this system are that one battery will do for a number of presses, for the reason that all of the presses in any establishment are not simultaneously in operation; the battery can be on charge at a very low rate at all times when current is flowing on the mains, thus insuring the best possible results from the battery at a minimum cost for current; the battery having no moving parts, such as bearings and commutators to get out of order, will doubtless appeal to the press operators; the e.m.f. of a battery is constant, while that of any other independent source of supply is variable, depending upon the line voltage; many a press operator has lost his fingers because of sudden variations of voltage supplied to the motor.

The paper refers to the operation of elevators and machine tools by the same system, and it is suggested that counter e.m.f. cells may be applied to obtain the necessary variation in voltage.

A paper by Mr. R. T. Lozier entitled "The Operation of Machine Tools by Individual Electric Motors" opens with a consideration of the advantages of the motor drive for workshops and then offers arguments in favor of individual variable speed motor drives as contrasted with the use of belted-motor group driving. Several systems of motor control are next described. A number of objections are advanced against rheostatic control, which however, is stated to be within its limitations, a system that can be made very useful. The multi-voltage system is highly commended, and the curves of Fig. 4 are given to show its advantages. In the system referred to, if the voltage be divided at three points six different combinations are possible, which will cover all ordinary requirements. For special cases the "teaser" system may be employed, which consists in employing a small motor, which takes current from the main source of supply at the full voltage. This motor drives a small generator wound with large current capacity, which it supplies to the main working motor, when the latter starts, but at low voltage, because the speed is very slow.

The method of varying motor voltage by varying the motor field is criticised, this method giving an increase of not more than 30 per cent. of the normal speed of the motor, and not permitting decrease of speed. The paper concludes with a discussion of high rates of machine service and of the bonus and premium plans for machine operators. By the former plan the premium is fixed by the law of averages, and in the latter by the actual amount of work done, as for example, by the depth of a cut and the area traversed. Following are data given as to cutting rates (revolving), the cut in each case being 3/8 in. and the feed 1/8 in.: Cast iron, old methods, 20 ft.; new methods, 60-80 ft. Unannealed forged steel, old methods, 12 ft.; new methods, 40-60 ft. Steel casting, old methods, 10 ft.; new methods, 40-70 ft. It is stated that in a certain case where two years ago the cutting speed for drills ranged from 9 to 188 r.p.m., and the feed from .005 to .007 in., at present a hole .375 in. is drilled at a feed of .06 in. per revolution.

After reading his paper, Mr. Lozier made some further remarks,

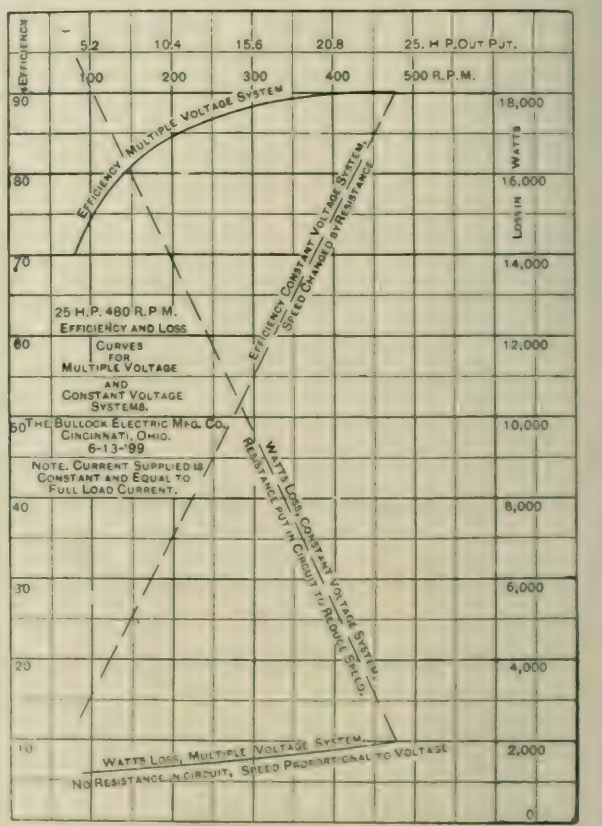


FIG. 4.—CURVES OF BULLOCK MULTI-VOLTAGE SYSTEM.

and called particular attention to the relation which the individual motor with its variable speed bears to what is now known as the "new shop method," under which method the tool equipment is worked to its maximum extent. By this method and using the electric motor, the output can be increased from 100 to 300 per cent., and in some cases to as high as 500 per cent. Referring to balancers on multi-voltage circuit, he said that the larger the number of motors the smaller the balancer may be, and it may be taken as a rule that the armature of the multi-voltage balancer need not be larger than sufficient to operate the largest single motor on the circuit at its lowest speed.

The three-wire system for variable speed work formed the subject of a paper read by Mr. N. W. Storer. In the first part of the paper a classification is made of variable speed motor work under three heads, namely, that requiring a torque increasing with the speed, such as blowers; that requiring constant torque, such as pumps, and that requiring a torque varying with the speed, such as machine tool work. The paper then proceeds to give a description of the Westinghouse three-wire, variable-speed motor system. In this system the generator is of the direct-current type, but in addition to a commutator it has collector's rings connected to points of the winding, as in the case of a rotary converter. A circuit from one to the other ring of a pair contains a balancing coil, the potential at any turn of

which coil corresponds to the potential of a definite point of the armature winding. A wire connected to the middle point of the coil will thus correspond to the neutral of the Edison three-wire system, if the pair of collector rings is connected to diametrically opposite points of the armature. As this principle is applied in the present case, there are two balancing or choke coils and the neutral is connected to the middle point of each. The standard type of direct-current motor is used with the system, but so connected that it may be operated on either of the outside voltage or the half-voltage between the neutral and one of the outside wires, the latter, of course, giving the minimum speed; variation of speed between these limits is obtained by varying the field strength. The variation is affected by means of a controller with steps, resembling the street railway controller.

As an example of operation, a certain machine requires a 5-hp motor to operate it with a speed variation of 1 : 4, say from 1,500 to 375 r.p.m. On the three-wire system this motor will be a standard 10-hp, 220-volt motor operating normally at a speed of 750 r.p.m. Run with full field strength on the 110-volt circuit, it will develop 5 hp at about 375 r.p.m. Operating on this circuit, which has only half its normal voltage, the motor will easily stand an increase of speed 60 per cent. to 75 per cent., bringing the speed up to 600 or 650 r.p.m. When it is changed to the 220-volt circuit, it will have its normal capacity for 10 hp at 750 r.p.m.; but only half-load is required and it will commutate this as easily at a speed of 1,500 as it would 10 hp at 750, because both field strength and armature current will be divided by two. From this it may be seen that when the motor is running at full armature current, the voltage is only one-half the normal voltage. When the motor is operating at full voltage, the armature current is only one-half the normal current. If speed variations of 1 : 6 are required, they can be secured by a very slight increase in the normal field strength of the motor.

In cases where it is impracticable to have two voltages and a wide range of speed is necessary, a double commutator motor may

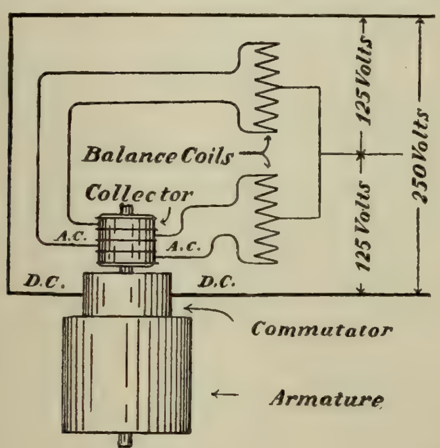


FIG. 5.—WESTINGHOUSE SYSTEM FOR VARIABLE-SPEED WORK.

be used with excellent results. This motor may be built with both ends of the armature wound for the same voltage, in which case they will be connected first in series, then in parallel, giving speed changes corresponding to the speed variations on the three-wire system.

Mr. Geo. W. Fowler in a paper entitled "A Series-Parallel System of Motor Control," described the C. & C. series-parallel system. In this system the motor is of the ordinary slow-speed, compound-wound type, with the exception that it has two separate windings and commutators on the one armature body, operating in one magnetic field. The field windings are so arranged that the series turns can be cut out after starting, thus obtaining the advantages derived by using a compound-wound motor at starting, exerting a powerful starting torque with a minimum amount of current; and the constant speed features of the shunt motor, by cutting out the series, after the motor has reached a certain fixed speed. By the movements of one controlling lever a number of combinations of windings are effected, with resultant variations in speed. Referring to the accompanying illustration, it will be noted that to the left the contacts are sub-divided into many small ones, while those to the right are a fewer larger ones. Those to the left are in use only when the armature windings are in series, while those to the right are in use only when the windings are in parallel. The two divisions have no connection with each other whatever. For use in graduating the speed, there are two banks of resistance used; one bank in circuit with the armature windings when they are in series and which is connected to the smaller contacts to the left, and another bank in circuit when the armatures are in parallel, and which is connected

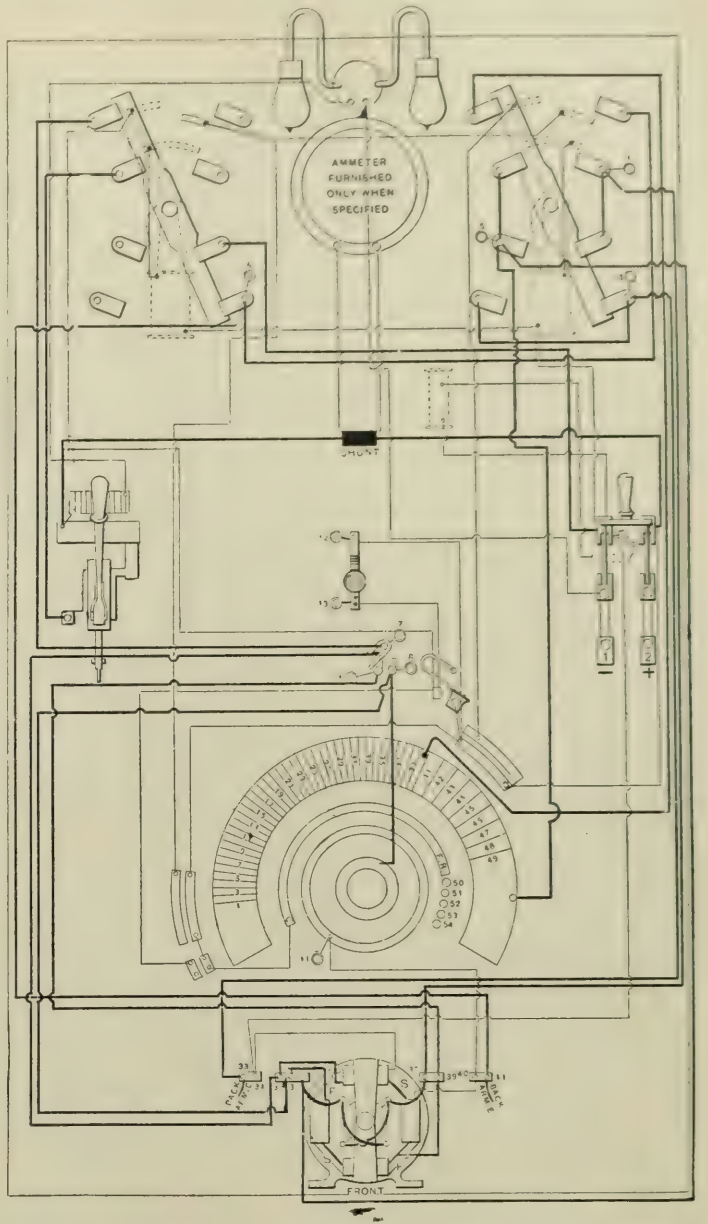


FIG. 6.—DIAGRAM OF C. & C. SERIES-PARALLEL SYSTEM OF MOTOR CONTROL.

to the larger contacts, to the right. The contact rings on the controller are in circuit with the shunt field of the motor, and the small, round contacts are for the purpose of interposing resistance therein for the highest speeds. Change from series to parallel or vice versa are obtained by means of an automatic solenoid switch, which is instantaneous in action. A similar switch is used to start and stop the motor, and may be manipulated from a number of points, which feature is particularly desirable for printing press work. The paper proceeds to show how at different steps of the controller the speed may be varied from 5 per cent. full speed to full speed through eight stages.

In a paper entitled "Continuous-Current Motors for Machine Tools," Mr. F. O. Blackwell brings out the advantages of the electric drive, and discusses several systems of variable-speed motor control. The conclusions are that it will generally be found best to use motors with field control, allowing a total speed variation of 2 to 1 with the two-wire system or 4 to 1 with the three-wire system; that the four-wire system is too expensive for general application if the plants employing it are properly designed and equipped with large enough electrical apparatus; and that for reciprocating tools a two-wire system will meet all requirements and there are very few with rotating tools where it is not better to vary mechanically the speed for greater than 4 to 1 changes in speed.

[illegible] reading the paper. Mr. [illegible] showed a diagram of an experiment with two lathes, one with the lathe driven by cone pulleys and belts, and the other by an electric motor, the work being a 72-in. cast-iron disc with a cut from the periphery toward the center. The electric drive maintained an almost constant speed of cut, and the time was 32 minutes; with the belt drive the speed had to be varied at intervals by cone and pulley changes, and the time required to make the cut was 60 minutes.

Mr. Gano S. Dunn said that as the company with which he is connected is at present in litigation involving a number of the devices presented during the meeting, the attorneys of the company had requested him not to take part in the discussion. He would refer, however, to the behavior of motors under weak fields, and he controverted the implication that if the motor is fully loaded at one speed it will take the same current and deliver the same horse-power when its field is weakened 100 per cent. A motor properly designed to give proper commutation with maximum current and maximum field strength, will not give it with only half the field strength. He admitted that there are motors that will do this, but only because they start off initially with a great excess of field strength, and being thus a special motor, are expensive. A standard motor submitted to a great degree of field weakening will not commutate satisfactorily.

Mr. Heath agreed with Mr. Dunn that a wide range, by means of field variation, necessitates the use of a larger than ordinary motor, if of the ordinary construction of the standard motor; but by a special construction, a form of motor can be obtained that will give practically sparkless commutation over fairly wide range, and still not be largely in excess with regard either to cost or weight of a standard motor. For reasons similar to those of Mr. Dunn, he could not give further information concerning such motor at the present time.

Mr. S. F. Dodd, in referring to Mr. Leonard's paper, said that the only field for the railway system described is in trunk line service. The weight, however, would be excessive; a large locomotive, like that used by the Baltimore & Ohio, and weighing 96 tons, would have a total weight of 150 tons if equipped with the Leonard system.

Mr. Arthur Williams considered that Mr. Lozier, in giving 10 per cent. as an average of motor demand upon the supply service, uses a figure entirely too low. The experience of the New York Edison Company is that the figure is more nearly 25 to 30 per cent. He referred to the fact that on the three-wire system large motor loads are apt to unbalance and interfere with the quality of the service. He considered that while the cost of installing individual motors is much larger in the first place, this is compensated for by its superior advantages. The average loss of power in a machine shop where belting and shafting are used is 50 per cent. of the total power consumed, most of which can be saved by the application of individual motors. The cost of motor current from street circuits is about 6 or 7 cents per kw-hour, and averages from $20 to $30 per year per horse-power.

Mr. Philip Lange said that in the Westinghouse shops no individual motor drives are used, except for large tools, and variations in speed are obtained by mechanical devices, such as counter-shafting. Referring to the statement that it is possible to decrease the time by one-half by the use of proper speed-controlling devices, he said that in the Westinghouse works the same thing had been accomplished by mechanical devices and counter-shafting.

Mr. Charles Day said that the motor question is only one side of a most comprehensive problem which confronts the manufacturer who desires to increase his shop efficiency. The tool steel, the tool itself and the material to be machined enter, in correlation, into the problem and no one factor can be intelligently considered without reference to the others. As long ago as 1895 Mr. B. J. Arnold advocated that tools should be driven at the maximum speed which they would stand, and this view is now gradually being accepted. If this maximum cutting speed (which should in all cases be predetermined by experiment) is to be maintained on work of varying size, a close regulation of speed of the tool—within ten per cent.—is necessary. With cone pulleys the speeds are 30 to 60 per cent. apart, so that to fulfill this requirement the variable speed motor is essential. In addition to the close regulation obtainable, another advantage of the motor drive is the great saving in time effected. Instead of having to stop and lose time in changing his belt, the workman has only to turn the handle of the controller. To obtain variety of speed over wide ranges, a combination of electrical and mechanical devices is advisable. How much of the speed variation shall we obtain mechanically and how much by comparatively expensive variable speed motors? That is a question which can be profitably determined only when all the factors involved have been considered in their relation to one another. Working with a tool steel of uniform quality, such as the Taylor-White, and with a tool driven by separate motor, it becomes comparatively easy to measure the horse-power required to pull cuts of various sizes in various materials. Together with his associate, Mr. Kern Dodge, he had for several years been engaged in compiling data on speeds, feeds and related questions and have obtained some very interesting results. Manufacturers of tools have not, in general, kept pace with the improvements in tool steels and few of the old tools can stand the cutting speeds which we have found to be the most efficient. In many cases, electric motors have been put on tools which should have been consigned to the scrap heap because they were not adapted to run the tool to its limit. He might cite other cases which have come to his notice where the introduction of the motor into the machine shop did not lead to the economies expected. These failures were due, in every case, to the fact that the subject was not comprehensively considered, and the rating of motors and other questions were either left to the supply men or else determined according to ancient shop traditions. If the electric motor is to take the place which has been predicted for it in the machine shop, "rule of thumb" methods of applying the motor must be abandoned and scientific methods take their place.

President Scott, referring to Mr. Day's remarks, said that within the past week a superintendent of a factory told him that in enlarging the factory a large number of machines were ordered specially at an excess cost of 50 per cent., simply in order that they might be mechanically strong enough to stand the high speed at which it is proposed to operate them.

Mr. Lozier said that with the balancer system there is less disturbance of other motors by bunching up on one voltage, than in the case of the three-wire system.

Mr. W. W. Storer took exception to Mr. Dunn's remarks with reference to the commutation of motors with a weakened field. He said that he was entirely unable to agree with the statement that it is impossible for a standard motor properly designed to commutate with the field one-half its normal strength; and that it ought to be well understood that a motor running at a lower voltage than its normal voltage will commutate through a greater range of load with a weak field. He has run motors to the point where the field was only one-half the strength of the armature, and they worked satisfactorily. The three-wire system does not require more than an ordinarily good commutating motor, and there are half a dozen firms in the country which put out such a motor. On the other hand, the multi-voltage system requires a special motor which must be designed for that system. Referring to Mr. Leonard's paper, Mr. Storer said that the system described involves a weight for a locomotive 50 per cent. heavier than it should be.

Mr. H. Ward Leonard said that if there is any system that requires nothing more than the simplest standard form of motor, it is the multi-voltage system. The first time the multi-voltage system was tested was when he presented it to Wm. Sellers & Co., in 1892, and the simple standard shunt-motor at use at that time was tested over the entire range of the various motors touched on in the papers of the evening, and with perfectly satisfactory results in every way. As to the locomotive question, he said that in heavy traction service it is essential to get great weight upon the drivers, and in the case of steam locomotives various complicated devices have been invented in recent years to shift a larger part of the weight on the drivers. As to the increase of weight by a motor-generator on the locomotives, it is entirely insignificant as compared with the entire weight of a 3,000-ton train. Mr. Leonard added that a locomotive built after his system will go into commercial use in Switzerland within the next few months.

Phillippine Cable Code.

It is noted that the high cost of telegraphing to the Philippines of government messages at $1.6[illegible] a word, has caused the War Department to undertake the compilation of a complete code, which contains some 25,000 sentences of frequent use in military communications. In a revision, now under way, a code word for each officer in the army will be inserted.

The Armature Reaction of Alternators—IV.

By C. F. Guilbert.

MAGNETOMOTIVE FORCE EQUIVALENT TO THE TRANSVERSE AMPERE TURNS.

THE influence of m.m.f. due to transverse reaction has been clearly explained by Blondel, but up to the present no expression for the same has been given. We should add, however, that Prof. Arnold has established an expression for the transverse flux by taking account only of the actual width of the pole, and from this the value of the m.m.f. may be deduced.

To establish rigorously the general expression for the m.m.f. due to the current in phase with the no-load voltage, we proceed in the same manner as in the calculation of the current in quadrature; that is to say, we calculate the mean m.m.f. for each relative position of the armature with the field, and then take the mean of this m.m.f. for a semi-period. For the sake of simplicity, we will suppose that the entire current, I, is in phase with the no-load voltage. In the case of the single-phase alternator let the expression for the transverse current be $i = I_0 \sin \frac{\pi x}{a}$ (23)

The width of the pole which we have to consider in this case is as before the apparent width; that is to say, that of the flux proceeding from the pole enlargements and entering the armature. In order to fix our idea, we will suppose that b is greater than b^1, and we will divide the relative position of the armature and field into 4 series (Fig. 4).

1°. x is less than $\frac{b-b^1}{2}$ Under this condition, the armature coil remains in the interior of the space b; the ampere-turns of armature coil then act in a contrary sense on each side of the axis of the field pole, on the tubes of force which are closed around the space b, so that the mean m.m.f. is deduced from the difference $A\ B\ C\ D$ of the two surfaces which the axis of the field pole cuts in the rectangle representing the m.m.f. due to the armature current. The magnetomotive force is thus:

$$N I_0 \sin \frac{\pi x}{a}\left[\frac{b^1}{2} + x - \left(\frac{b^1}{2} - x\right)\right]\frac{1}{b} = N I_0 \sin\frac{\pi x}{a}\cdot\frac{2x}{b}$$

2. If x is comprised between $\frac{b-b^1}{2}$ and $P\,Q$ or $a - \frac{b-b^1}{2}$, the armature coil has partly left the space b, so that the surface cut by the left half-width of that space is constant. We have then for the expression for the mean magnetomotive force:

$$\frac{\text{surface } A\ B\ C\ D - \text{surface } B\ D\ E\ F}{b} = N I_0 \sin\frac{\pi x}{a}\left[\frac{b}{2} - \left(\frac{b^1}{2} - x\right)\right]\frac{1}{b} = N I_0 \sin\frac{\pi x}{a}\,\frac{x - \frac{b-b^1}{2}}{b}$$

3. Beyond the value $a - \frac{b+b^1}{2}$ of x to $\frac{b^1}{2}$, the half to the right of the space b cuts from the rectangle representing the m.m.f. of the coil adjacent to that which we considered alone in starting out, a surface which adds itself to that cut by the half to the left of the pole in the rectangle of the first coil. The m.m.f. is then

$$\frac{\text{surf. } A\,B\,C\,D - \text{surf. } B\,D\,E\,F + \text{surf. } A^1\,B^1\,C^1\,D^1}{b} =$$

$$N I_0 \frac{\pi x}{a}\,\frac{\frac{b}{2} + \left(\frac{b}{2} - x\right) - x - \left(a - \frac{b-b^1}{2}\right)}{b}$$

$$= N I_0 \sin\frac{\pi x}{a}\cdot\frac{2a - a + b}{b}$$

4. Finally, from $\frac{b^1}{2}$ to $\frac{a}{2}$ the two surfaces $A\ B\ C\ D$ and $A^1\ B^1\ C^1\ D^1$ have evidently a constant sum, and we have

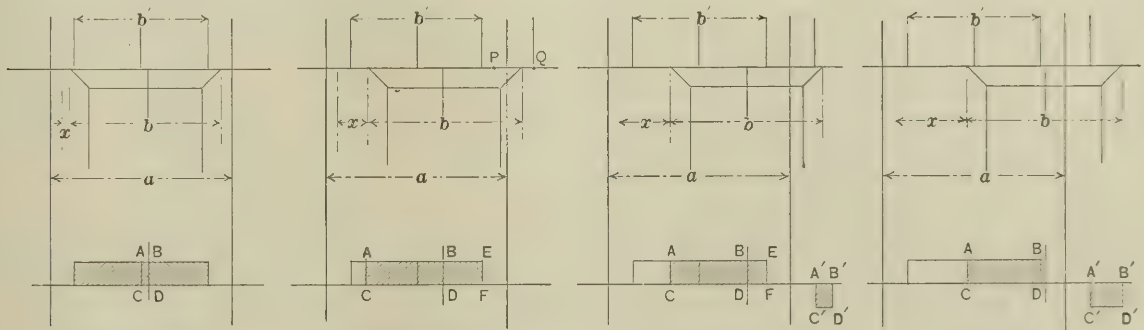
$$\frac{\text{surf. } A\ B\ C\ D + \text{surf. } A^1\ B^1\ C^1\ D^1}{b} = N I_0 \sin\frac{\pi x}{a}\cdot\frac{b - (a - b^1)}{b}$$

$$= N I_0 \sin\frac{\pi x}{a}\cdot\frac{b - b^1 - a}{b}$$

The mean m.m.f. during a half period is then obtained by the summation

$$F_i^1 = \frac{2}{a}\left[\int_0^{\frac{b-b^1}{2}} N I_0 \sin\frac{\pi x}{a}\,\frac{2x}{b}\,dx + \int_{\frac{b-b^1}{2}}^{a-\frac{b-b^1}{2}} N I_0 \frac{\pi x}{a}\left(x - \frac{b+b^1}{2}\right)\frac{dx}{b}\right.$$

$$\left. + \int_{a-\frac{b+b^1}{2}}^{\frac{b^1}{2}} N I_0 \sin\frac{\pi x}{a}\,(2x - a + b)\,\frac{a\,x}{b} + \int_{\frac{b^1}{2}}^{\frac{a}{2}} N I_0 \sin\frac{\pi x}{a}\,(b + b^1 - a)\,\frac{dx}{b}\right]$$



$o < x < \frac{b-b'}{2}$ $\frac{b-b'}{2} < x < a - \frac{b+b'}{2}$ $a - \frac{b+b'}{2} < x < \frac{b'}{2}$ $\frac{b'}{2} < x < \frac{a}{2}$

FIG. 4.—RELATIVE POSITION OF ARMATURE AND FIELD.

To integrate this expression it suffices to assume $\frac{\pi x}{a} = y$.

The mean m.m.f is then

$$F_i^1 = \frac{2\,N I_0}{\pi\,b}\left[\frac{2a}{\pi}\int_0^{\frac{b-b^1}{a}\cdot\frac{\pi}{2}} y \sin y\,dy + \int_{\frac{b-b^1}{a}\cdot\frac{\pi}{2}}^{\pi - \frac{b+b^1}{a}\cdot\frac{\pi}{2}} \left(\frac{a\,y}{\pi} + \frac{b-b^1}{2}\right)\sin y\,dy\right.$$

$$\left. + \int_{\pi - \frac{b+b^1}{a}\cdot\frac{\pi}{2}}^{\frac{b^1}{a}\cdot\frac{\pi}{2}} \left(\frac{2\,a\,y}{\pi} - a + b\right)\sin y\,dy + \int_{\frac{b^1}{a}\cdot\frac{\pi}{2}}^{\frac{\pi}{2}} (b + b^1 - a)\sin y\,dy\right]$$

These integrals are of simple form and lead to the following result:

$$F_i^1 = \frac{4}{\pi^2}\cdot\frac{a}{b}\,N I_0\left(1 - \cos\frac{b}{a}\cdot\frac{\pi}{2}\right)\sin\frac{b^1}{a}\cdot\frac{\pi}{2} \qquad (24)$$

Or by introducing the value $I_0 \cos\psi$ of the maximum watt-current, we have

$$F_i^1 = \frac{4}{\pi^2}\cdot\frac{a}{b}\,N I_0\left(1 - \cos\frac{b}{a}\cdot\frac{\pi}{2}\right)\sin\frac{b^1}{a}\cdot\frac{\pi}{2}\cos\psi \qquad (25)$$

This formula, though established by supposing b^1 less than b, is

nevertheless true for b^1 greater than b.

It is interesting to compare this formula with that which we have obtained from the ampere-turns per pole with direct reaction. It will be seen that aside from the factors $\sin \psi$ and $\cos \psi$, these two expressions differ only by the factors, $\sin \frac{b}{a} \cdot \frac{\pi}{2}$ and $1 - \cos \frac{b}{a} \cdot \frac{\pi}{2}$ which only become equal, for $a = b$. In this case alone the m.m.f.'s corresponding to the two armature reactions, are equal to the sides of a right-angle triangle of which the hypothenuse has the value, $\frac{4}{\pi^2} N I_0 \sin \frac{b^1}{a} \cdot \frac{\pi}{2}$, and of which one of the angles is ψ.

In the other cases this is not true, though it can easily be seen that for increasing values of b, the factor $1 - \cos \frac{b}{a} \cdot \frac{\pi}{2}$ decreases much more rapidly than the factor $\sin \frac{b}{a} \cdot \frac{\pi}{2}$, and consequently the proportionality is not preserved.

As previously shown, it will be easy to deduce from the preceding formula the m.m.fs corresponding to the case where there are several coils per pole, the numerical coefficient always remaining the same.

CASE OF POLYPHASE CURRENTS.

This case can be treated in a manner identical with that which we have adopted for m.m.f. due to direct reaction. The final result will thus be as above,

$$F_1^1 = m \frac{4}{\pi^2} N I_0 \frac{a}{b} \left(1 - \cos \frac{a}{b} \cdot \frac{\pi}{2}\right) \sin \frac{b^1}{a} \cdot \frac{\pi}{2} \cos \psi$$

with the same hypothesis as to N, that is to say, representing by N the number of turns per armature pole.

The examples given above lead naturally to the same numerical coefficients.

Recent Electrochemical Progress.

By Clinton Paul Townsend.

REPRODUCTION OF PHONOGRAPH RECORDS.

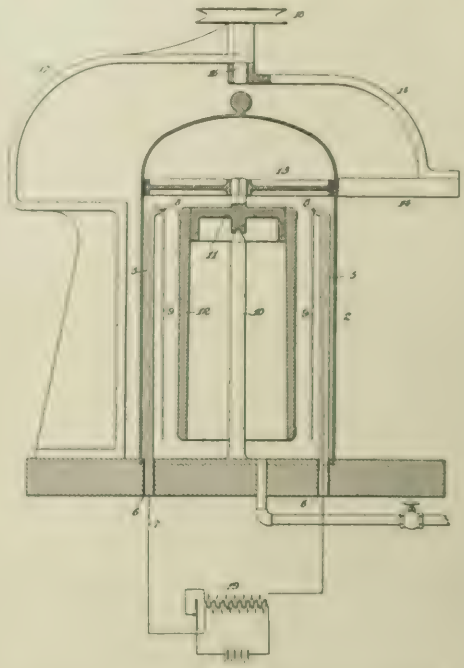
An expert electrotyper experiences no difficulty in obtaining a satisfactory matrix for the production of a molded form; a metallizing coating, an electrodeposit of copper and a strengthening and stiffening backing, suffice. The metallizing may be effected by coating with graphite or bronze powder, by any one of many conducting and adherent mixtures, or by various chemical precipitation methods, and the matrix when detached will represent the original with a minute fidelity which was long considered absolute. But such methods, when applied to the reproduction of sound records and tested by the new standard set by the needle of the reproducer, are found to be crude in the extreme; the complexities of a tone are not to be recorded in so coarse a medium as electrodeposited metal.

Mr. Edison has heretofore suggested that the record be immersed in a bath of metal vapor, or perhaps more accurately, metal dust, produced by an arc in vacuo between metal terminals. This method he now states to be slow, and to be open to the objections that unless extreme care be exercised the deposit is not uniform, and that the heat of the arc is apt to injure the delicate tracery of the record surface. For the arc therefore he substitutes a silent or brush discharge between separated metal electrodes in an exhausted vessel. Between these electrodes the record revolves to equalize the deposit. The annexed figure shows an exhausted bell 2 in which the phonograph record 12 is supported on a standard 10. On either side of the record are sheets 9 preferably of gold, which form the terminals and are connected through wires 8 covered with insulation 5 with the secondary of an induction coil 19. As a convenient means for revolving the record between the electrodes 9 an iron armature 13 is attached rigidly to the record support 11, and is maintained in motion by means of an external magnet 14; this magnet is revolved by a pulley 18 and suitable rigid connections 15, 16, 17.

The use of a discharge of this character for the production of metal coatings is by no means original with Mr. Edison. The conduct of a wide range of metals under these conditions had been previously investigated and the resistance of the deposited films studied: and Boas in particular had proposed to utilize the extremely delicate and perfect coating so produced for the production of mirrors. The novelty of the application consists in supporting, and especially in rotating, the object to be coated between the electrodes.

ELECTRIC ARC FURNACE.

In the *Practical Mechanics' Journal*, for 1853-54, there was described a curious electric furnace, the result of the inventive labors of one Pichon, wherein ores mixed with carbon were said to be reduced to metal while falling through a series of arcs, produced between carbon terminals of such size as would tax the resources of modern engineering. This description represents the first realization that the adaptation of the arc to ordinary metallurgical work requires the distribution of its highly localized heat over considerable areas of the charge. This method with modifications has been a



PROCESS OF COATING PHONOGRAPH RECORDS.

favorite one with later inventors, for it is simpler to cause the charge to move past or through the arc than to perform the reverse operation of shifting the arc; but it is clearly impracticable to control the heat conditions in a freely falling mass. Recently Becker, with the object of melting the raw materials of glass, has developed a series of furnaces wherein the movement of the charge is retarded by impingement upon inclined ledges formed by projecting portions of the furnace wall immediately below and adjacent each pair of electrodes of a vertical series. This method is understood to be in commercial use on a small scale in Europe.

A further development in the same line is offered in a patent recently issued to Albert A. Shade, of Chicago. The form of the furnace is in general that proposed by Becker, with ledges projecting from alternate sides of a vertical chute, and axially aligned electrodes inserted in the walls above the ledges. The novel features are the arrangement of the electrodes in such manner that the falling charge passes always in closest proximity to the positive or hotter carbon; and an adaptation of Zerener's "magnetic blow pipe" consisting of a series of electro-magnets embedded in the furnace walls beneath the ledges and serving to direct the arcs toward or to the portions of the charge there momentarily held. The materials, after passing through the arcs receive their final heating in a crucible, into which a supplemental arc is directed by a subjacent magnet. Iron plates embedded beneath each magnet localize its effect and prevent it from exercising a disturbing influence upon the arc immediately below.

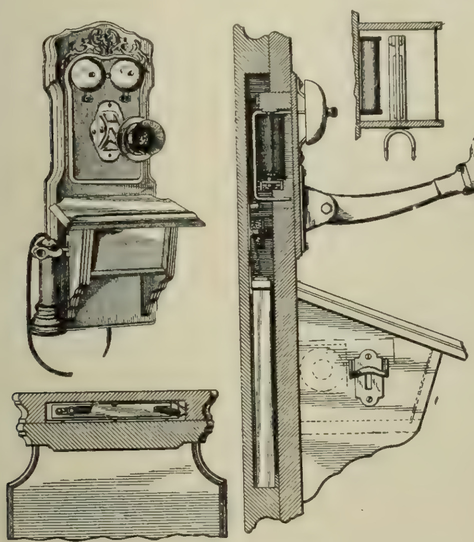
German Atlantic Cable.

The statement of the German Atlantic Cable Company, according to a Berlin dispatch, shows a considerable increase in receipts in consequence of the large traffic with America. A thousand kilometres of the second German Atlantic cable have already been manufactured.

New Telephone Patents.

In the Patent Office issue of November 18 telephony is represented by four patents. One of these describes a new type of insulator, which, though not well developed, is interesting as providing means for dispensing with the usual tie wire. The inventor, Mr. Y. E. Murray, of Washington, Pa., accomplishes this by slotting transversely the upper portion of the insulator, thus forming a recess in which the wire may lie. He also provides a screw cap and wedge so arranged as to clamp the wire securely in position. The usual tie wire groove is also provided for cases in which wires are for any reason to be deadended.

A second patent of interest describes and claims a novel design of telephone wall set, the patent being assigned to the American Electric Telephone Company by Ernest E. Yaxley, the inventor. The accompanying illustration shows several views of Mr. Yaxley's instrument. Instead of the ordinary solid wood backboard, in this wall set a hollow box-like back board is arranged, this being so designed that space is left within it for mounting a condenser—a necessary part of the subscriber's station apparatus of many central energy systems—the ringer magnets, and any protective apparatus which is deemed necessary. The front face of the backboard is hinged and the wiring



YAXLEY TELEPHONE.

is so arranged that the condenser, bell and protectors may be instantly exposed to view for inspection and repair. The hook switch and the induction coil are disposed according to usual custom in a box beneath the shelf of the instrument.

A reissued patent, entitled a "Combined Electric Signal and Telephone System," was originally dated July 31, 1900, Messrs. O. P. and R. H. Yurgae being the joint inventors. The system is designed for use with that type of telephone line wherein one station, known as the main station, receives all calls originated by the other outlying stations. Such lines exist in railway telephone systems where the telephone line parallels the track, instruments being provided here and there from which the progress of the cars may be reported.

In working out the system the inventors have provided that each station by the act of calling leaves at the main station a permanent record of that fact, together with the code number of the station. This result is accomplished by providing at each outlying telephone instrument the equivalent of a district messenger call box wherein the train of gears driving the contact wheel is operated by the telephone hook switch; and by providing at the main or home station a telegraph relay and Morse recorder.

When a station calls, the receiver is removed from the hook, and the latter rises under the influence of a spring, driving the contact wheel. At the same time, the hook switch grounds the contact wheel so that when the teeth of the latter rub upon contact springs connected with the two sides of the telephone line, the line wires are momentarily grounded. At the main station, one terminal of the relay is connected to the line and a grounded battery of suitable proportions is connected to the opposite terminal of this relay. Therefore each time that the line wires are grounded the relay operates and through its contacts operates the recorder. One of the features of the system is the arrangement of the circuits so that the existence of a connection between the main and one outlying station will not interfere with the recording of calls from other stations. It will, however, be impossible to carry on conversation while the call is being recorded.

A third patent relating to telephony is that of Charles G. Burke, bearing the number 713,744. This patent describes a peculiar arrangement of a telephone line wherein the transmitter and receiver at each station are connected to different induction coils whose secondaries are in the line in series. Each of these coils has two primary windings, which the patent states have different numbers of turns, and are of different sizes of wires. Mr. Burke states at great length how the various windings at the various stations are to be connected to the line, and to each other with reference to their inductive effects. He also asserts that if the directions are followed out a material gain in transmission is obtained. A careful study of the patent specification and of the drawings fails, however, to give any clew as to why any such action should occur. In addition, experience and theory point to an exactly opposite result.

105-Mile Transmission Line on Steel Towers.

Robert McF. Doble, consulting engineer of San Francisco, is completing plans for a most interesting long-distance transmission plant at Guanajuato, Mexico, for the Guanajuato Power & Electric Company, in which John Hays Hammond, C. A. Coffin and others are interested. The transmission line is to be 105 miles long, and the line voltage 60,000 volts. Although it has frequently been proposed recently to build transmission lines on steel towers several hundred feet apart, it now looks as if the Guanajuato plant would have the honor of being the first to actually put this idea in practice. The steel towers on this line will be 440 feet apart, making 12 spans to the mile. The conductors will be 19-strand copper cables, equivalent in conductivity to No. 1 solid copper wire. It is a well-known fact that wire cables have a greater tensile strength than solid rods of equivalent cross-section and weight. The use of copper cable instead of the solid wire, of course, makes it possible to use longer spans than could safely be employed with solid wire of the same conductivity. It is said that the tensile strength of the 19-strand copper cable, which is to be used, will be from 60,000 to 70,000 lbs., as against 40,000 for the solid No. 1 wire. The cross-arms and pins will be of iron. There will be but one three-phase line and one insulator for each wire at a tower. Since as a matter of practice at 60,000 volts repair work on one dead line would be impossible if there were another live line on the same poles or towers, it is not considered of any use to put more than one three-phase circuit on a tower or pole line. It is figured that the cost of the tower line will be no higher than for a first-class pole line. Longer spans were not decided upon because they would have necessitated the use of more than one insulator to a wire at the towers. As every insulator is a point of weakness in a line, the fewer insulators the better. In regard to iron pins and cross arms it is considered that if wood pins are used, the breakdown of an insulator always means the destruction of the usefulness of the pin; and the pin must be renewed at considerable trouble and expense for labor. Sometimes the whole cross-arm is ruined. With iron pins and cross-arms, the insulators only need be replaced. The insulators will be Locke, porcelain, made in three parts; an umbrella, a petticoat and a sleeve fitting over the pin. The umbrella and petticoat are glazed together and the petticoat and sleeve cemented together.

The water power plant will be operated under a head of 320 feet. Pelton impulse wheels will be used, and the generators for the four 1,500-kw units will be General Electric, as will all the electrical apparatus.

CURRENT NEWS AND NOTES.

GERMAN NAVY WIRELESS TELEGRAPH SYSTEM.—The report of the German Commander-in-Chief at the recent naval manœuvres says that the experiments proved the practical utility of the Slaby-Arco system of wireless telegraphy.

WIRELESS TELEGRAPHY ON RAILROADS.—It is alleged that a series of experiments will be made on the Grand Trunk Railway system to determine the probability of employing wireless telegraphy to increase the safety of passenger traffic.

FRENCH WIRELESS TELEGRAPHY.—It is announced that the French government is of opinion that the practicability of wireless telegraphy, except for use at sea, has not yet been demonstrated. The French government will permit the installation of a wireless system only under its own control.

BROOKLYN WIRES.—Mr. Robert Grier Monroe, commissioner of water supply, gas and electricity, has ordered the telegraph, telephone and electric light companies in Brooklyn to place their wires under ground at once, and has also directed the Brooklyn Rapid Transit Company to place under ground its feed wires and all others except the trolley wires. He has given the companies until May 1, 1903, to finish this work.

TECHNOLEXICON.—The editors of the technical dictionary, the "*Technolexicon*," now being prepared under international collaboration, requests from manufacturing firms of this country who publish catalogues, copies of these and of other similar printed matter, the same to be addressed to Dr. Hubert Jansen, Berlin S. W., Dorotheenstr. 49. The editors in their work wish to have on file all possible material containing technical terms, and catalogues are very much desired.

A. I. E. E. PROGRAMME.—Following are the partial arrangements up to date for future meetings of the Institute: December 19th, "Braking and Traction Brakes," J. D. Keiley and R. A. Parke; January 23d, 1903, "Telephone Exchanges"; February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippe Torchio and Peter Junkersfeld.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its forty-sixth meeting in the Sturtevant House, New York City, and at the Society headquarters, December 2 to 5, inclusive, when an interesting programme of papers, visits and entertainments will be presented. Mr. F. A. Halsey will read a paper on the metric system; Mr. W. I. Slichter one on "Fly-Wheel Capacity for Engine-Driven Alternators," and Mr. A. F. Nagle on "Analysis of Commercial Value of Water Power per Horse-Power per Annum." Several other interesting papers will be presented.

ELECTRIC RAILWAYS OF MAINE.—Within the past five years the electric railways now in operation in Maine have increased their mileage from 143 to 347. The reports of all the roads show that 25,480,000 passengers were carried during the year ending June 30, 1902. Their gross earnings were $1,449,043, with net earnings of $413,849. It is said plans are under way for the construction of some 200 miles additional of electric railways before the close of 1903. Some of the projected railways are of considerable length. The White Mountain Paper Company is contemplating a 90-mile line in Oxford, York and Cumberland Counties.

MECHANICAL EQUIVALENT OF HEAT.—Dr. Howard T. Barnes, of McGill University, is the author of an extensive paper in the current volume of the *Transactions* of the Royal Society, the title being "On the Capacity for Heat of Water between the Freezing and Boiling Points, together with a Determination of the Mechanical Equivalent of Heat in Terms of the International Electrical Units." In the paper Dr. Barnes develops a continuous electrical method of calorimetry, and gives the results of the application of the same to the determination of the variation of the specific heat with variation of temperature, and to the determination of the mechanical equivalent of heat. The absolute mean value of the latter was determined by this method to be 4.18876 joules, that of the latest determination of Rowland being 4.18320 joules.

POWER DEVELOPMENTS ON THE ST. JOSEPH RIVER.—The St. Joseph River, which flows through Northern Indiana and Southern Michigan, is now the scene of considerable activity in power development. The St. Joseph & Elkhart Power Company, composed of New York and Indiana capitalists, is building dams at several points. One power plant to be located about 6 miles above South Bend, Ind., will have a capacity of nearly 10,000 hp. Another plant is to be located by this company at the Indiana-Michigan line, 6 miles below South Bend. A site for a third dam at Berrien Springs, Mich., is now in litigation with a rival company. The St. Joseph County (Mich.) supervisors have granted franchises to the Michigan Electrical & Hydraulic Company, to build dams at Lelands, Henshaw, Bucker and Colon, on the St. Joseph River.

AMERICAN TRADE PRESS ASSOCIATION held its annual meeting at the Hardware Club, New York City, on November 21, when the following ticket was unanimously elected: President, J. M. Wakeman, ELECTRICAL WORLD AND ENGINEER; first vice-president, J. D. Crary, *New York Lumber Trade Journal*; second vice-president, J. H. McGraw, *Street Railway Journal*; third vice-president, J. A. Hill, *American Machinist*. Directors—E. P. Burt, *Engineering News*; V. S. Mulford, *Jeweler's Circular*; C. T. Root, *Dry Goods Economist*; F. E. Saward, *Coal Trade Journal* Secretary-treasurer, E. C. Brown, *Progressive Age*. The meeting, which was attended by 40 or 50 members and guests, was followed by an excellent dinner and by a symposium at which a number of questions were discussed relative to advertising in the trade and technical press, and in regard to post office matters.

THE CONDENSER IN CONSTANT-CURRENT CIRCUITS.—Four patents issued November 18th to Matthew O. Troy, relate to details of the employment of the condenser as a regulating device for constant-current circuits. Several forms of the application are illustrated. In one case the condenser is in series with differential arc lamps in a circuit supplied from a constant-potential circuit. The condenser is so chosen that when all the lamps are out of circuit, current of the required value will flow. When one of the lamps is cut in the circuit, the inductance of the same balances a portion of the reactance of the condenser; the total impedance of the lamp and condenser therefore remain approximately the same as the impedance of the condenser alone, and a further increase in the number of lamps has a similar effect. One subsidiary advantage of this arrangement is that since a circuit of this kind will take a leading current, there will be a beneficial effect upon the supply system as a whole if other circuits thereon take a lagging current. Should the device in the constant-current circuit not contain sufficient inductance, as, for example, in the case of series incandescent lamps, an inductance coil is placed in series with each device. To obviate any probability of the condenser accentuating the higher harmonics in the current supplied, an inductance coil may be placed in series with the condenser. One of the patents shows an arrangement similar to that of Boucherot for obtaining constant current from constant potential, by the employment of two circuits in parallel with the constant potential circuit, each containing a capacity and inductance, the working circuit being connected on each side between the capacity and inductance. The modification introduced in this arrangement is the use of an additional inductance in series with each condenser.

LETTER TO THE EDITORS.

Electrode Terminology.

To the Editors of Electrical World and Engineer:

Sirs: I should like to make the following correction in, and addition to my article on "Terminology of Primary and Secondary Battery Electrodes," which appeared in your issue of November 15. The statement made regarding the bismuth-antimony couple is incorrect, and should read: If a bar of bismuth and one of antimony are brought into contact and their junction heated, a current of electricity will flow from the antimony, through the external circuit, to the bismuth.

It will be noted, then, that in the chemical changes cited,

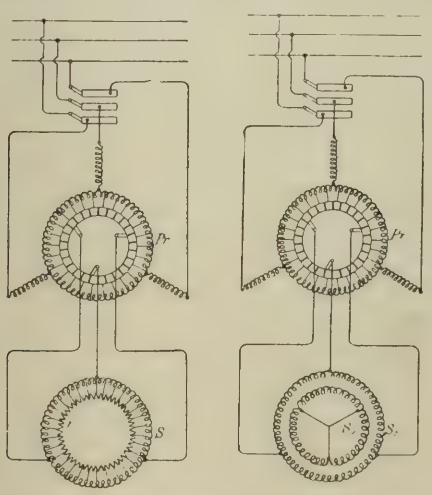
in which so-called static charges are produced, and also in frictional electrification, a system of nomenclature is adopted differing from that of the electric battery or the thermopile, both of which produce a current. The action of the friction machine is somewhat analogous to that of the thermoelectric couple, though differing greatly in degree. The same may be said of the decompositions produced by heat and the chemical's actions of the electric battery. Where static effects are produced the plates (or what correspond to plates) are named positive or negative, according to the charge received, and where dynamic effects are produced each plate is named from its relation towards the other, by which relation it is enabled to receive the charge it does. The former seems the more simple method, and is the one already adopted by many in the case of the storage cell. Primary and storage battery electrodes should certainly agree in regard to the terminology employed. Which should be changed?

SCRANTON, PA. A. L. MARSH.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Compensating the Phase Difference in Induction Motors.—BRAGSTADT AND LA COUR.—An illustrated communication referring to the article of Osnos, which was abstracted at length in the Digest November 8. The arrangement of Osnos is said to have distinct advantages, for instance that it is possible to provide starting resistances for the secondary circuit. On the other hand, especially if high voltages are used, it is a disadvantage that the full primary voltage exists at the commutator. This necessitates careful and difficult insulation, a voluminous and expensive secondary winding, and there is always danger of sparking at the commutators. These disadvantages are avoided in the arrangement shown in the adjoining diagram 1 (which is to be compared with Fig. 1, page 754, of our issue of November 8). In this arrangement Dobrowolski's combination of ring and star connection is made use of, in order to diminish the tension at the commutator; otherwise the arrangement is the same as that of Osnos; for it makes no difference whether the currents induced in the secondary and the exciting currents introduced in it flow in the same winding or in two separate windings. In order to avoid sparks at the commutator,



FIGS. 1 AND 2.—COMPENSATING PHASE DIFFERENCES.

Osnos had suggested placing a special short-circuited winding in the same slots which hold the winding connected to the commutator. If this short-circuited winding has a small resistance, it will diminish the formation of sparks, but it will use up a considerable part of the power supplied to the primary and change it into heat. If the resistance is large, the energy consumed will be small; but then the device will have scarcely an influence upon the commutation. It is, however, possible to place a squirrel-cage winding on the secondary, as shown in diagram 2; it acts upon the commutation like an ordinary Hutin-Leblanc "amortisseur," but has the disadvantage that the motor can be started only with a low starting torque, and that the exciting current goes partly through the resistances *r* instead of the winding *S*.—*Elek. Zeit.*, November 6.

Polyphase Generators.—GOLDSCHMIDT.—An illustrated article on armature reaction and oscillation phenomena in polyphase generators. An iron core always tends to take such a position in a magnetic field that the number of lines of magnetic flux in it is a maximum. If direct current is sent into the stationary armature of a non-excited polyphase generator, the pole system at once takes such a position that it is fully exposed to the magnetizing action of the armature current. If the pole system is slightly displaced, very great forces appear which tend to bring the pole system back to its position. If instead of direct current, polyphase current is sent into the armature, beginning with a very low frequency, then the seat of the armature m.m.f. is displaced slowly along the surface of the armature, and the pole system follows synchronously. By increasing the frequency and therefore also the speed with which the rotary field revolves, the pole system follows synchronously. This is then a machine which is called by Steinmetz a reaction machine, i. e., a synchronous motor without field excitation. This reaction force, of course, also occurs when the field is excited and the machine operates as an ordinary synchronous motor or generator, then the same force comes into action and must be considered in the theory of this machine. He gives this theory with the aid of a series of diagrams; the characteristic feature of these diagrams is the decomposition of the current into two components, corresponding to a decomposition in space of the armature current wave relatively to the pole pieces. He then applies his theory to the operation of alternators in parallel. —*Elek. Zeit.*, November 6.

REFERENCES.

Voltage-drop in Transformers.—BRESLAUER.—The first part of an article illustrated by diagrams in which he discusses the most general case of the inductively loaded transformer and shows that it is possible to predetermine the voltage-drop by means of a single measurement of current for all loads and for any power factor.—*Zeit. f. Elek.*, October 26.

Manufacture of a Dynamo.—MAVOR.—A well-illustrated abstract of a British Association paper on the different steps of "making a dynamo."—Lond. *Elec. Rev.*, October 3.

POWER.

Gas Engines.—BURSTALL.—A note on a paper read before the Birmingham Engineering Society. He does not doubt that in a few years gas engines of some 5,000 hp will be commonly met with. He thinks the ideal method of generating power is in one huge plant situated from 3 to 5 miles from the center of the city and manufacturing three salable commodities, one of which would be the valuable by-product of South Staffordshire coal, sulphate of ammonia; using coal at $1.50 a ton, the ammonium sulphate recovered would sell for $1.12. The second commodity would be the gas manufactured from the same coal as the ammonium sulphate, which, although valueless for lighting purposes, is of very great value for driving gas engines and for heating; this gas, if supplied in bulk, would probably be sold at a profit of 4 cents per 1,000 cub. ft. (the amount per ton is not stated). The third commodity to be disposed of is electricity; it is an open question whether it would pay to transmit the gas in pipes to certain stations about the city's area, and then use it for driving gas engines coupled with electric generators or whether it would be better to combine all the stations and generate electricity in bulk; this depends upon the local conditions. With the gas engine many imperfections must still be overcome, but he feels sure they will be surmounted.—Lond. *Elec.*, November 7.

Power from Peat.—A note on a paper of Sankey on the utilization of the peat bogs of Ireland for the generation and dis-

tribution of electrical energy. Johnson has shown that freshly dug peat may contain as much as 90 per cent. and air-dried turf will still contain from 15 to 30 per cent. of water, and that "ordinary air-dried turf has about half the heating power of good coal." Hansding states that "air-dried machine-made turf, with at most 10 per cent. of ash, has two-thirds the heating power of superior coal, while ordinary turfs are equivalent to only one-third." In a report on the Sahlstroem-Carmichael "carbonized peat fuel" it was stated that, as a rough estimate, the calorific value of 10 tons of ordinary bog stuff, as freshly dug, should at least equal that of one ton of fairly good coal. Some notes are given on the peat bogs of Ireland, and it is concluded that the peat of Ireland would suffice for 1,250 years with an annual output of 100,000 hp.—Lond. *Elec.*, November 7.

Modern Switchboard Practice.—Davis.—A discussion of the general construction of the switchboard, the design and construction of the instruments, and the several methods of operation. Special attention is given to equipments for large systems, particularly the problem of control, and whether the operation is to be by hand or power. The large stations that are now being built have introduced many new problems for the handling of the immense amount of current produced by the large generating units usually at high electromotive force. This has made special switchboard construction necessary as well as the design and grouping of the apparatus to insure the highest degree of safety and best results of operation. The space required, the capacity of the apparatus, the e.m.f. employed, the isolation of the switching devices, and the necessity of fire-proofing and insulating the conductors, all enter as factors of more or less importance in switchboard design. Three kinds of ordinary control are described, together with the apparatus that may be employed for operation, namely, the straight pneumatic, straight electric and electro-pneumatic. The author also describes many special features of design and construction. Modern methods are illustrated and a number of diagrams are presented.—*St. R'y Jour.*, November 1, and *Int. Ed.*, November.

Reference.

Hydro-electric Plants in the Alps.—De la Brosse.—Illustrated descriptions of the power house of the Coulouvreniere, and the power house at Chevres.—*Elec. Age.*, November.

Traction.

The Zossen Test.—Panzarasa.—A communication in which he refers to the paper of Lochner on the results of the Zossen test, and criticizes the conclusion that the resistance per ton is 3.6 kgr. He refers to the two curves in that paper and draws a tangent of the upper part of one curve, showing that if the retardation were constant and equal to that which exists at 100 km. per hour, the train resistance would amount to 8.85 kgr. per ton instead of 3.6, as given. He believes that this figure of 8.85 kgr. checks up closely with the figures for the power consumption.—*St. R'y Jour.*, November 1, and *Int. Ed.*, November.

Alternating Current Traction.—In the introduction to a long abstract of Lamme's recent A. I. E. E. paper, it is stated that Prof. Kuebler recently made extended tests on the Burgdorf-Thun three-phase railroad; a complete publication of the results is promised in the future; but it is stated here that "in the three years since the operation has begun, the use of the three-phase system has been a splendid success. There are no repairs of the motors"; the rheostats and controllers look as though they were still new. At present a somewhat higher voltage is used at the trolley wire, namely 850 volts, but this has caused no difficulties. Even in extended tests in which the motors were intentionally loaded more than in ordinary practice, the windings did not become heated beyond the limit.—*Elek. Zeit.*, November 6.

The Lighting Circuit of Cars.—Gorham.—A communication referring to the disagreeable effect produced by the variation in illumination in the lamps of an electric car produced by the various voltages on the line. He then suggests that instead of connecting these lamps to the main circuit lower voltage lamps should be used and that they should be connected to a storage battery of five cells carried on the car. This storage battery can be charged by connecting its negative terminal to the ground and its positive terminal to the negative terminal of all the power circuits on the car. This would keep the battery charged. Advantages claimed for this method are given.—*St. R'y Jour.*, November 1, and *Int. Ed.*, November.

Electric Urban and Interurban Railway at the St. Louis Exposition.—Goldsborough.—An outline of the general plans of the Exposition authorities for presenting a complete and accurate picture of the development of the electric railway. It has been decided to place at the disposal of the electric railway men a large portion of the space in the Transportation Building for exhibiting apparatus and methods pertaining to the building and operation of roads, and in the Electricity Building for displaying the practical operation of the electric power plant and transmission system, the auxiliary apparatus and all the devices that have been designed for the regulation and the control of the modern electric railway. The management will build a double track 1,300 ft. long, upon which experiments and tests may be made of electric cars of all classes. It is proposed during the Exposition to conduct tests of apparatus and secure data upon the operation of electric railway motors of all classes and under all conditions that are met with in commercial service. A description of the Transportation Building, together with the division of floor space for the several departments that will be represented there and illustrations and plans, are given. There is also a description of the Electricity Building. A feature of all of the Exposition buildings is the fact that there will be no galleries in which exhibts will be placed, ample space being furnished on the ground floor for all exhibitors.—*St. R'y Jour.*, November 1, and *Int. Ed.*, November.

Installations, Systems and Appliances.

Central Stations of Paris.—Eight pages of statistical tables, with some descriptive text. The Continental Edison Company's central station at Saint Denis has at present a capacity of 4,400 kw; the transmission to Paris is made by the three-wire, direct-current system at a tension of $2 \times 2{,}200$ volts (the descriptive text says 22,200 volts, which is evidently a misprint). Another company has largely increased the capacity of the plant at St. Ouen, with the two-phase system and high-tension transmission to several substations in Paris, "redressive transformers" of Hutin and Leblanc converting the two-phase currents into direct current for distribution in Paris. The use of electricity in Paris is increasing. At the end of 1900, there were 13,905 arc lamps and 1,002,039 incandescent lamps in use. Electric power is far from being in general use, but electric elevators are being generally introduced. The statistical tables contain detailed information on the equipment of the various stations of the different companies and on the systems used, but no general summary is given.—*L'Ind. Elec.*, Oct. 25.

Governing Rotary Converters.—An editorial recommending a method of protecting rotary converters from obtaining dangerously high speeds which will sometimes occur from a heavy inductive short circuit. The method proposed is the introduction of a small two-phase induction motor, the two circuits of which are connected one with a series transformer in the leads of the rotary, and the other to a potential transformer across the line. So long as there is no difference in phase between the electromotive force in these two circuits, there will be no torque on the shaft of the induction motor, but when there is a difference in the phases, the motor will tend to turn and it can be so connected with a circuit-breaker that when the difference in phase reaches a predetermined amount the induction motor will open the circuit.—*St. R'y Jour.*, November 1, and *Int. Ed.*, November.

Wires, Wiring and Conduits.

Reference.

Cables.—Bergholtz.—The first part of a long illustrated paper on the manufacture of cables.—*Zeit. d. Oest. Ing. u. Arch. Ver.*, October 21.

Electro-Physics and Magnetism.

Nature of Positive Ions.—Wien.—An account of a series of experiments on positive ions. If the negative electron has an invariable charge and a positive ion is always a single atom from which an electron has been split off, it is reasonable to suppose that the positive electron will also have an invariable charge. It should, therefore, show a specific charge (ratio of the electric charge to the mass), varying only with the atomic weight, and the ratio should change from one substance to another in a manner only dependent upon the known atomic weight of the substance. The author has for some time endeavored to discover such a regular variation in the canal rays; but all the experiments hitherto made result in showing

that there is no abrupt transition from one value to another; the specific charge may be anything from 750 to 10 millions; for both hydrogen and oxygen it figures at about 10,000; this would be the correct figure for hydrogen in the ordinary electron theory, and the author thought that the same value obtained in oxygen might be due to impurities of hydrogen; but the purification of the oxygen led to no more decisive result, and it must, therefore, either be assumed that the positive electron can be bound to a number of material molecules, or that it can be subdivided.—*Ann. d. Phys.*, No. 11; abstracted in Lond. *Elec.*, November 7.

Metallic Films Obtained by Cathode Projection.—HOULLEVIGUE.—An article on the method of producing metallic films of platinum, palladium, iron, nickel, cobalt, copper or bismuth on glass or other substances in a vacuum by cathodic projection, which method has already received practical application for the production of mirrors and resistances. The best method is to place the plate which is to receive the film, upon the anode, and mount the cathode above it in such a way that at a vacuum of a few hundredths of a millimeter the dark cathode space just touches the plate. The current first of all clears the cathode of occluded gases. This first process is particularly long when platinum or palladium are used. Then the substances of the cathode itself is projected and "deposited partly upon the glass plate and partly upon the anode." The deposits may present all degrees of transparency and opacity according as to whether the operation is continued for hours or for days. Bismuth so deposited does not show any change of resistance in a magnetic field, and is therefore probably perfectly amorphous. Iron shows magnetic rotary polarization, but the author has not been able to find the double refraction announced by Righi.—*Comptes Rendus,* October 20; abstracted in Lond. *Elec.*, November 7.

Reflection of Cathode Rays.—AUSTIN AND STARKE.—An account of experiments in which they found that when cathode rays impinge upon a sheet of metal, positive electricity is obtained on the metal under certain conditions. This shows that besides the reflected cathode rays there is a further giving out of negative electricity. This negative electricity is due to a secondary emission of negative electrons by the metal which is struck. These electrons have a velocity of the order of cathode rays; their emission increases with the degree of polish of the reflector, and with the angle of incidence of the cathode rays; it disappears entirely at a vertical incidence.—*Ann. d. Phys.*, No. 10; abstracted in Lond. *Elec.*, October 31.

Potential Drop at Electrodes in Vacuum Tubes.—SKINNER.—An account of a continuation of his researches on this subject. He had formerly found that the drop of potential is apparently caused by a resistance encountered by the gas ion in discharging to the metallic electrode, this resistance increasing with the velocity of impact. To explain this, he conceives that the discharging ion must give up its kinetic energy with its charge, or before it can give up its charge. The ions approaching the electrode will accumulate at its surface until the resulting electric intensity suffices to cause as many to discharge in a given interval as arrive at the electrode during the same interval. Thus the drop of potential will depend on the time required for the discharging ions, arriving with a definite velocity, to come to rest at the electrode. He makes a calculation on this basis, and shows that many of the phenomena are explained by it. The electromagnetic inertia of the ions is, however, ignored. It enters largely into the magnetic influence upon the drop of potential at the electrodes. The magnetic field, in constraining the ions, facilitates their discharge.—*Phil. Mag.*, October; abstracted in Lond. *Elec.*, October 31.

Influence of Becquerel Rays upon Spark Discharges.—CANTOR.—An account of some experiments on the fact discovered by Elster and Geitel that the spark discharge of an induction coil is influenced by Becquerel rays in the same way as it is by ultraviolet rays. The present author shows that the material of the electrodes is of importance; the spark between platinum electrodes is always provoked by a radium preparation, but it is not provoked on substituting aluminum electrodes for the platinum. Electrodes of gold, silver, copper, brass and iron are also sensitive, but to a smaller extent than platinum. The influence of the electrodes is brought out clearly by putting a suitable capacity in parallel with the spark-gap. It is found that only the negative electrons are concerned in this differential action upon metals. Another effect noticed by him is the action of an electrostatic field surrounding the spark-gap in facilitating the discharge between the electrodes; this is, no doubt, another action of the field in modifying the distribution of free electrons in the spark-gap.—*Ann. d. Phys.*, No. 10; abstracted in Lond. *Elec.*, October 31.

Magnetization and Elasticity.—HONDA, SHIMIZU AND KUSAKABE.—An account of an experimental investigation of the change of the modulus of elasticity by magnetization. They found that any substance which undergoes a large change of length by magnetization, also shows a considerable change in its modulus of elasticity. Soft iron increases in elasticity in a magnetic field, rapidly at first, and quite slowly with fields higher than 50 units. In weak fields there is a minute decrease at first, probably due to the lateral contraction previously observed. The greater the load, the greater is the increase of elasticity. Ordinary steel, cobalt and tungsten steel show the same effect, but without any initial depression. The latter is, however, exceedingly marked in nickel.—*Phil. Mag.*, October; abstracted in Lond. *Elec.*, October 31.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Production of Metallic Calcium.—BORCHERS AND STOCKEM.—The authors have devised a process involving the fused salt, which is said to be so simple that it is not only suitable for lecture-room experiments, but also for the production of the metal on a commercial scale. The temperature is a red heat above the melting point of calcium chloride, but below the melting point of metallic calcium; the calcium is then deposited at the cathode in a spongy form. Other calcium salts, especialy calcium fluoride, may also be used, but the authors prefer to use calcium chloride, because it is cheap and it has a suitable melting point. The apparatus used by the authors is illustrated.—*Zeit. f. Elektrochemie,* October 2.

Electrolytic Production of Pure Strontium.—BORCHERS AND STOCKEM.—A short article describing that with a slight modification of their calcium apparatus they were able to produce pure strontium in large quantities, by electrolyzing electrically fused strontium chloride; it is obtained in form of fused globules, of about the same specific gravity as the bath. The apparatus is illustrated. The cathode is an iron rod passing up through a cooling apparatus; a carbon cylinder forms the anode; the strontium is deposited at the cathode in form of globules, which become solid as they are cooled from below. Strontium is, like calcium, a white metal, and just as soft as lead.—*Zeit. f. Elektrochemie,* October 2.

Calcium Carbide Patents.—An article in which it is said that the board of the United Carbide Factories of Nuremberg, Germany, "is about to essay the overthrow of Willson's patents for the manufacture of calcium carbide, in order that Continental carbide may be exported from Germany to the States." The European and American patent question is discussed at some length.—Lond. *Elec. Rev.*, October 10.

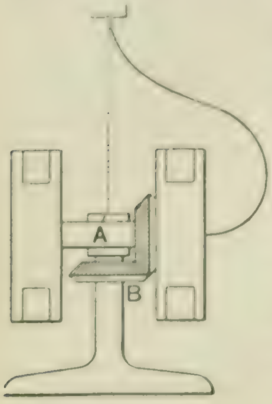
REFERENCE.

Electrochemistry at the Dusseldorf Exhibition.—DANNEEL.—The first part of a long illustrated descriptive article. The introduction refers to the geology, minerals, coal mining, ores and mining installations in general, of a few Western provinces of Germany. He then discusses the exhibits of the Institute of Technology of Aix-la-Chapelle, and describes several metallurgical processes which have been worked out in its metallurgical laboratory, and which will be noticed here under their respective headings.—*Zeit. f. Elektrochemie,* September 25.

UNITS, MEASUREMENTS AND INSTRUMENTS.

The Function of Physical Instruments.—WIENER.—An address in which he states that "every new instrument and every collection of known instruments for a new purpose is seen from the point of view of evolutionary history as a natural development and extension of our senses, as a step forward in our adaptation to surroundings, and an advantage in the struggle for existence." Physical theory may be defined as a guide towards internal adaptation to external phenomena. "Our senses place us in relation with certain happenings in what we call the material universe." These happenings are found to obey certain regularities or "laws." We learn to interpret certain phenomena as functions of preceding phenomena and postulate a "casual connection" between the two sets of phenomena. Further links in this connection are revealed by every new sense we acquire, or by every extension of the scope of an existing sense. Thus our collection of electrical measuring instruments form our "electrical sense" and reveal previously unsuspected links between phenomena.—*Phys. Zeit.*, October 1; abstracted in Lond. *Elec.*, October 31.

Earth Inductor.—TANDIN-CHABOT.—An illustrated description of a contrivance which obviates the use of sliding contacts in earth inductors; when an inductor is turned in a magnetic field, and there is no sliding or liquid contact, any wire making contact with the inductor will become twisted, and will disturb the indications by thermo-electric and other influences. This is entirely avoided by the new inductor, which is shown in the adjoining diagram. It has two parallel vertical coils a few centimeters apart, and mounted on the same horizontal axis; they also rotate about the same vertical axis, but while they are thus rotating, a bevel wheel *B*, mounted on the vertical axis gear into another mounted on the common horizontal axis *A* and makes the inductors themselves revolve about the latter. Any twist of the wire due to rotation about the vertical axis is completely compensated by a countertwist about the horizontal axis, the two bevel wheels having the same number of teeth. The rotation of the inductors in the vertical plane has no influence upon the current induced in them.—*Phil. Mag.*, October; abstracted in Lond. *Elec.*, November 7.



EARTH INDUCTOR.

REFERENCES.

Electrolytic Meter.—A detailed description with illustrations, of Wright's electrolytic meter.—Lond. *Elec. Times*, October 16.

Electrograph.—An illustrated article on the improved electrograph of Palmer and Mills.—*Sc. Am.*, November 15.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Pacific Cable.—An article giving some details concerning the recently completed Pacific cable from Vancouver to Australia and New Zealand. The total length is 7,838 naut. miles. The average speed of laying was 198 nauts. per day. In order that the cable should land only on British territory, one of the sections—from Vancouver to Fanning Island—had to be given a length of 3,458 nauts, which is considerable greater than any other section of cable yet laid. On this account the core had to be given a larger size than possessed by the other sections. From Vancouver to Fanning Island the copper weighs 600 lbs. per naut, and the guttapercha 340 lbs. per naut. Outside the seven strands of the copper conductor of the Vancouver-Fanning Island core are four flat wires, which are given a long lay and flattened down round the central copper strand. In the second section, from Fanning Island to Figi, the corresponding figures are 220 and 180, and in three remaining sections they are all 130 and 130. The armoring of the deep-sea portion of this cable consists of 18 galvanized wires of No. 14 (0.083 in.), each wire taped and compounded. Two tapes and compounds form the outer serving. A table gives the cross sections of the cables used on various sections. —Lond. *Elec.*, November 7.

REFERENCE.

Dusseldorf Exposition.—SEYFFORTH.—The continuation and conclusion of the illustrated article on the electric machines exhibited and in operation at the Dusseldorf exposition.—*Elek. Zeit.*, October 30, November 6.

New Books.

MATERIALS OF MACHINES. By Albert W. Smith. New York: John Wiley & Sons. 142 pages, 17 illustrations. Price, $1.00.

The purpose of this work is to present the information required by the designer in the selection of materials for machine parts. Chapters are given upon the metallurgy of iron and steel, the testing of materials, and the properties and treatment of cast iron, wrought iron, steel, and the alloys. The book closes with a short but valuable chapter upon the selection of materials for any specified service.

The treatment of these subjects is, within restricted limits as to size, unusually full. The style is both compact and clear, and the work, as a whole, is an excellent, though brief, resume, so far as the designer's needs extend, of a most important subject.

The value of the book would be increased materially by an appendix containing summaries of the physical and chemical characteristics of the metals, as recommended or required by various authorities, government bureaus, and companies, as, for example, the American Standard Specifications for Steel and those of the War and Navy Departments, and leading railroads.

THE ELECTRIC TELEPHONE. By Edwin J. Houston, Ph. D., and A. E. Kennelly, Sc. D. Second Edition, Enlarged. New York: Electrical World and Engineer. 453 pages, 152 illustrations. Price, $1.00.

The value of the new edition of this work is greatly enhanced by additional chapters on the common battery system, visual signals and loaded telephone circuits. The chapter on common battery systems will be particularly appreciated as it explains in simple language the various details connected with this latest development in telephony. In the chapter on loaded telephone circuits, the principles are explained of the Pupin system for reducing the alternation and distortion of currents in long-distance telephone lines and in cables.

"THE ELECTRICIAN" ELECTRICAL TRADES' DIRECTORY AND HANDBOOK FOR 1902. London: The Electrician Printing and Publishing Company, Limited. 1,422 pages. Price, 12 shillings, sixpence.

The twentieth issue of this valuable publication is maintained at the high standard of the past. No new features are apparently introduced in this issue, but without the biographical section—now published separately—it comprises 1,422 pages of text, almost half of which number are devoted to statistics, useful tables, parliamentary and legal information, underwriters' and other rules, etc. The biographical section forms a volume of 138 pages, and a pocket in the binding contains large folded charts, giving the data of British electric railways and central stations.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

THE ELECTRICAL TRADES SOCIETY (member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ENGINE BUILDERS' ASSOCIATION, D. N. McBrier, Erie, Pa., Secretary. Next meeting at Sherry's, New York City, December 1 and 2, 1902.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION, Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, December 9, 10 and 11, 1902.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, Thos. R. Mercein, Milwaukee, Wis.

OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION, Secretary, John Brant, 195 Broadway, New York.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION, Secretary, John Ruth.

VERMONT ELECTRICAL ASSOCIATION, Secretary, C. C. Wells, Middlebury, Vt.

U. S. MILITARY TELEGRAPH CORPS, Secretary J. E. Pettit, Postal Telegraph Company, Chicago, Ill.

Voltage Regulator.

The voltage regulator shown herewith, made by the Electric Specialty Company, Kennett Square, Pa., and known as the "Pusey Regulator," is composed of three working parts, namely, a beam controlled by a solenoid for making electrical contact; a reversible motor for working the regulator gear, and a clutch attached to the rheostat and connected to the gear by means of a long link chain. The gear is operated by a solenoid which makes immersion contacts, one contact being at each end of the beam and connected respectively to one and the other side of the reversible motor. In series with the working solenoid is an electromagnet, which so controls the circuit to the beam that no current can pass, except when the latter is energized. This prevents any accident in case the circuit through the working solenoid should become accidentally or otherwise broken. A lamp is placed in series with the working solenoid as a resistance.

The direct-current passing through the beam operates a reversible motor, in the circuit of which is interposed an incandescent lamp as a resistance. The current passes through a spring and contact placed in front of the armature of the electromagnet. No current can pass through these contacts, except when the magnet is energized, and it is impossible to energize it without energizing the working solenoid, and when in series with each other it is impossible to energize one without energizing the other.

The sensitiveness of the machine may be regulated by raising or lowering the immersion contact, and it may be set to work on a percentage of one-fourth of 1 per cent, or closer, if necessary. One prominent feature of the device is its adaptability to take care quickly of increased or decreased pressure caused by increase or decrease of engine speed or a heavy change of load.

The reversible motor operates a train of wheels, which is connected to a friction clutch by a link chain attached to the rheostat arm. This clutch can be attached to any rheostat, and to provide for the possibility of the clutch working the arm of the rheostat around to a full stop, the wheel on the clutch will in that case slip, thus obviating damage to the rheostat arm. The clutch is also arranged so that should it be desired to work the rheostat without the clutch, the latter can be instantly disconnected. The amount of friction required to work the clutch can be regulated by a thumb screw.

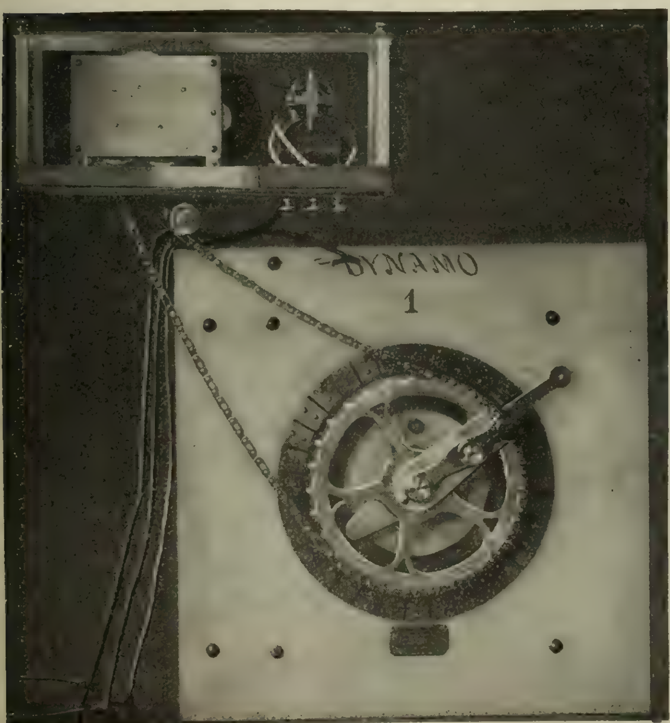


FIG. 1.—MOTOR AND ATTACHMENT TO RHEOSTAT.

One regulator may be so connected as to work several rheostats or machines. The required voltage at any given period of the load can be governed as required by means of an attached choke coil. There is also a compensator attached to compensate for drop in the line at different periods of the load. There are no springs, dash pots and other small apparatus apt to get out of order. The solenoid and beam, and the motor and gear are contained in two separate glass cases with slate bases, and are so arranged as to be readily attached to any switch board. No current is taken except during the time when the device is operating to bring the pressure to a desired point. In installing, nothing need be changed on the switchboard in any way, and the device can be connected to any rheostat in service.

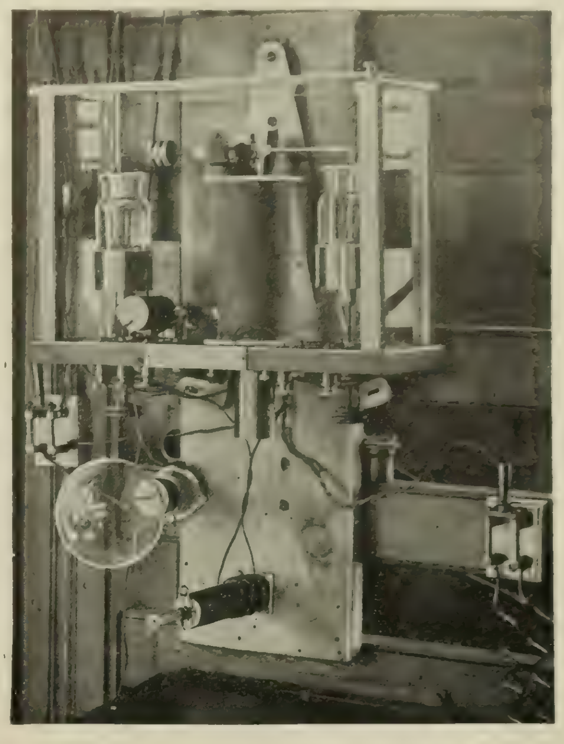


FIG. 2.—CONTACT-CONTROLLING DEVICE.

The Handiness of the Electric Motor.

Through a break-down last week in the engine which runs the big machine shops of the Crosby Steam Gage & Valve Company's works near East Somerville, Mass., the whole plant, covering three floors 45 by 180 in the main building and several separate shops, was suddenly converted to an electric operating basis, on which it will run temporarily, pending the completion of repairs to the steam equipment.

The trouble was noted Monday, when it was discovered that a dangerous crack had made its appearance in the cylinder of the 75-hp engine which furnishes power to the lathes, drills and other machinery with which the shops are fitted. At once it was decided to install an electric motor, and the work was begun as rapidly as possible, in order to have the motor ready for use before it became necessary to shut down the steam engine, which was allowed to keep on running meanwhile. By Friday morning a 150-hp electric motor had been installed, and all connections made for taking current from the wires of the Charlestown Gas & Electric Company; and that morning it was first used. The motor of this size was put in for the reason that it was most readily obtainable, and not because its full power is needed.

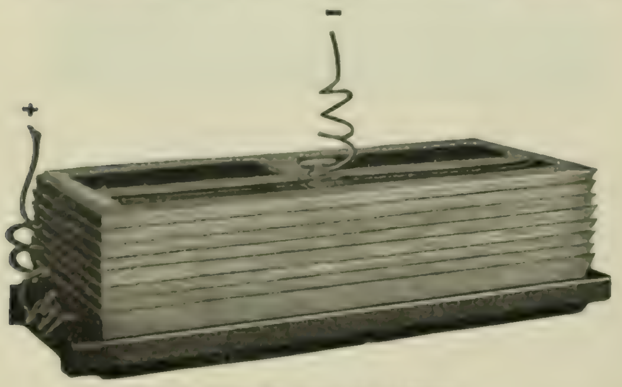
Now that this opportunity to observe the working of an electrical equipment in connection with the plant has come unexpectedly, the Crosby Company will take thorough advantage of it, and will make up figures showing the comparison between the cost and effectiveness of the motor and the steam engine. It is said to be only a question of time when the company will adopt electricity as a permanent feature of its plant.

Smith Storage Battery.

The type of storage battery shown herewith, made by the Smith Storage Battery Company, Binghamton, N. Y., dispenses with jars, the lead plates themselves being utilized for holding the electrolyte. The gridded plates are formed into oblong trays with pointed bottoms, the ends also receding from the top to the bottom so as to permit of nesting. Any desired number of trays can be nested on top of each other, perforated separators of sheets of hard rubber or other suitable material keeping the trays from contact with each other. When nested there is sufficient space between the trays to hold the electrolyte, which is as much in contact with the bottom of the tray above it as with the under one which holds it. This permits of an equal chemical action upon the upper surface of one tray and the under side of the one above it.

In preparing the plates, the under side of each tray is chemically treated to become oxide, and the upper side peroxide of lead. This makes the upper side of each tray the positive side and the under one the negative side of what in other batteries would be a single cell. The addition of another tray to the nest corresponds to adding another cell to an ordinary battery, and increases the potential by two volts. Of course, the bottom of the lower tray and the inside of the upper one are plain and are not in contact with the electrolyte. A battery of eleven trays is thus practically the same as an ordinary one of the same amperage, with ten cells; or it can be figured that the voltage of the battery will be twice the number of trays minus one, though for a good share of the time of discharge on a normal load, the potential is 2.1 volts per cell.

One of the battery terminals, the positive, is attached to the bottom side of the bottom tray and the other, the negative, to the top of the



TRAY TYPE OF STORAGE BATTERY.

upper one. For the use of the entire battery there is no connection between the trays except the electrolyte, the use of "jumpers," between the plates, as in ordinary batteries, being unnecessary. If desired, any combination of series-multiple or multiple-series connections can be obtained that are possible with any battery. One terminal can be applied to the top of any tray of the nest, the other to the bottom of any other tray. The voltage will always be twice as much as the difference between the number of trays. Between the top of the second tray and the bottom of the fourth one gives four volts; the top of the third and the bottom of the ninth, twelve volts, etc.

One of the advantages claimed for this type is its extremely low internal resistance. There are no lugs, soldered joints or loose connections, with connecting wires or strips from plate to plate to offer resistance. At the latter part of a discharge the current does not have to pass from the bottom part of the plate through the already discharged upper end, as in other styles of battery. The discharge is practically continuous from the entire surface of every plate. Another advantage is the rapid or uneven manner in which it can be discharged without fear of buckling. Inasmuch as the discharge is from the entire surface of all of the plates, it is claimed to make little difference whether it is accomplished in two or three hours or two or three days. Since the discharge is from so great a surface, response is made to sudden changes of load with slight variation in potential and the voltage is maintained to a remarkable degree until the battery is exhausted. Other claims are that the form of the battery precludes possibility of the deposit of active material to form a short circuit between the plates, as frequently happens with jar batteries; as the positive face of the tray is up there is no tendency for loosening of material, and should that happen it simply rests in the bottom of the tray, where it can cause no trouble. Owing to dispensing with all jars, either of glass or hard rubber, the weight of the battery is decreased considerably and the cost much more. It is possible to nest an entire battery of any number of cells up to twenty or more.

Improvement in Pendant Sockets.

An improvement in porcelain pendant weather-proof socket, here illustrated, has been recently placed on the market. It is designed on the principle of the petticoat insulator. The hood not only protects the lamp from being dimmed by rain and soot, but acts as a very good reflector. Tests show a marked gain in useful light. Besides the pendant type they are made in bracket styles for ⅛-in. and ⅜-in. pipe, and in all styles with Edison or T-H base. This gives such a range of usefulness for outdoor use that there seems hardly a place where they cannot be used to great advantage. The manufacturer, the H. T. Paiste Company, of Chicago, calls it the "P-K Deep-Grooved."


PENDANT SOCKET.

"New England" Lamp Socket.

The accompanying illustrations show several forms of lamp sockets made by the New England Electric Manufacturing Company, of Somerville, Mass., and embodying improvements in construction and design. The socket is made with a two-piece porcelain, it being claimed that such a construction is not only superior in mechanical strength to the one-piece type, but ensures greater safety from the parts working loose. The working parts are supported by two heavy brass pillars firmly held to two porcelain disks by four screws, thus giving great strength and rigidity. With this construction it is claimed to be impossible for the switch key and circuit-breaking cam to work loose and cause short-circuiting.

The circuit-breaking cam is operated by two bronze springs, having sufficient strength united with proper resistency, and gives an extremely quick break, the length of which between the cam and opposite connecting spring is 3/16 in. The carrying capacity is at least 100 cp on a 250-volt circuit. The fibre linings are treated by a special


FIGS. 1, 2 AND 3.—LAMP SOCKET.

process, which is stated to prevent expansion in moist or contracting in a dry atmosphere.

The lining in the shell is a tight-fitting solid tube 1/32 of an inch thick, projecting 1/16 of an inch beyond the end of the shell; it is made easily removable, but not loose enough to fall out in ordinary handling when the parts are removed for wiring. The cap lining is formed to fit the cap and is held in place by lugs fitting into a groove in the metal. All sockets are made with bayonet joints. It is claimed that the patented cap connection used is the simplest and best means

yet devised of positively locking the cap and shell without binding. The socket has been approved by the several underwriters' associations.

Some Recent Installations of the Oerlikon Machine Works.

The Oerlikon Machine Works have recently installed seven 430-hp direct-current generators in the electrochemical works of the Bussi Company, Italy. Six of these are to be used for the manufacture of soda and calcium chloride by the electrolytic method, and one 450-hp machine for operating direct-current motors. Two 450-hp Oerlikon 3-phase generators have also been installed for transmitting power. All of the machines are driven by turbines.

The Oerlikon company has also sold to the Jonsered Works, in Sweden, five 530-kw, 3-phase generators driven by turbines for the distribution of power for textile and woodworking machines.

Another large installation recently made by the company is in the Lake of Joux and Orbe power station, where 5,000-hp Escher-Wyss turbines have been connected to an equal number of Oerlikon 3-phase-single-phase generators. The single-phase current is used for lighting and the 3-phase currents for power distribution. The necessary exciters have also been supplied from the Oerlikon Works.

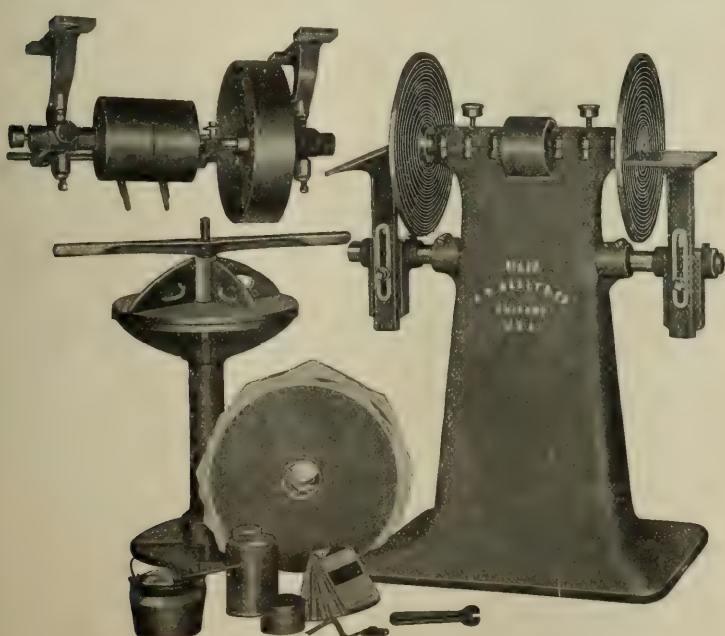
Another installation recently equipped by the Oerlikon Company is at Rauris-Kitzloch, in Austria, for the Neuhausen Aluminum Company. The generators in this case are 3-phase, 1,550-kw machines of 12,000 volts and 45 cycles direct-connected to Escher-Wyss turbines. There are also two 26-kw direct-current generators used as exciters. The power is transmitted 5 miles to a sub-station where six induction 3-phase motors are driven, each connected to a 560-kw shunt generator.

The installations of the company in Sweden also include the installation of five complete sub-station outfits for lighting purposes in Stockholm.

The company is also installing a large transmission system in Selangor, in India, for a water-power plant. There are two Pelton wheels each direct-connected to a 470-kw, 3-phase generator of 6,000 volts and 40 cycles. The transmission line is 11 miles long.

A New Grinder.

We illustrate herewith a new Gardner grinder manufactured by Charles H. Besly & Company, 10 and 12 North Canal Street, Chicago. Having had many inquiries for a machine with 18-in. discs

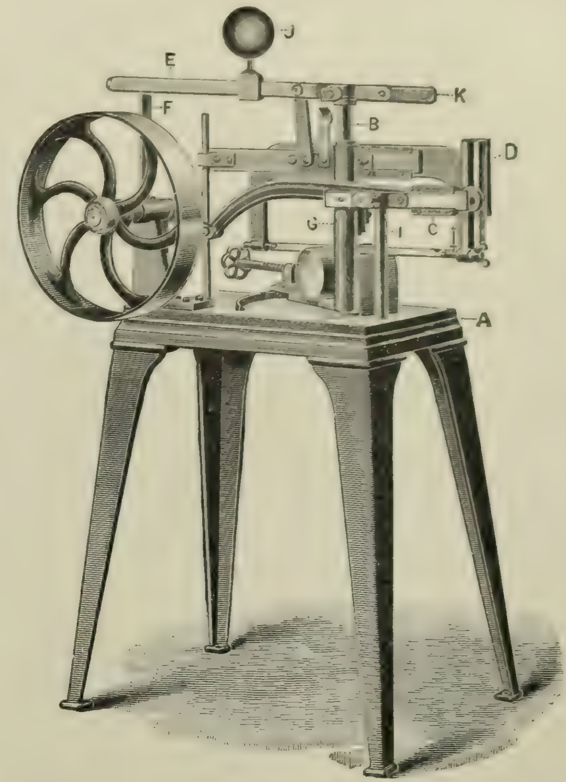


IMPROVED GRINDER.

somewhat cheaper in price than their regular grinder, the appliance shown herewith has been produced to meet this demand. It has floor setting up press, two 18-in. spiral grooved steel discs, two tilting tables, large spindle bearings, and improved countershaft.

Power Hack Saw.

The power hack saw shown in the illustration herewith, made by L. H. Olmsted, Hasbrouck Heights, N. J., is claimed to be a distinct improvement in several respects over the usual tool of this type. The chief improvements consist in a construction which involves a small space to install, which reduces friction, and provides a firm support for the saw frame and the saw guide, thus insuring a true, vertical cut through the work. It also provides simple and efficient means for lowering and raising the saw to and from the work and for conveniently adjusting the pressure upon the saw, and a swivel vice for



POWER HACK SAW.

holding the work, with a pointer or indicator to move along a segment marked to indicate various angles, the work being secured at any angle desired.

The hacksaw is secured in a frame, to which is given a horizontal reciprocating motion by means of a revolving crank and connecting-rod operating in a plane parallel thereto and alongside thereof. Referring to the engraving, *B* is a stout post firmly fixed in bedpiece *A*; a sleeve *G* embraces this post and is adjustable up and down. To this sleeve is firmly secured a horizontal slideway upon which the saw frame slides. The head *C* moves on a slideway supported by the post *I*, and extends into a deep vertical groove *D* in the saw frame. The connecting rod connects the head with the crank so that when the machine is in motion the saw frame is reciprocated the same whether in a high or low position.

The saw guide *H* is attached to the sleeve *G* close to the work and is adjustable in all directions. This is very important, as it prevents the breaking of saws and insures a true vertical cut in the work. The studs upon which the saw is hooked in the reciprocating frame hold the sides of the saw in a vertical position at all times without adjusting. It will be observed that the lowering and raising lever *E*, starting lever *F*, and vice-screw wheel, are all conveniently located at the front of the machine. The weight *J* is adjustable on the lever *E* to give any desired pressure on the saw, and is secured by turning the ball. No countershaft is required, there being a clutch for starting and stopping attached to the machine. It can be placed under a main shaft and belted from a pulley or coupling.

Hartford Electrical Contractors' Association.

Electrical contractors and manufacturers and dealers in electrical supplies in Hartford, Conn., have organized the Hartford Electrical Contractors' Association.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was firm in tone and a fair business was done at 6 a 6½ per cent. for all periods. On the stock market there was a tendency to recover against short contracts and renewed operations on the long side, due to the easing of time money and the pending developments concerning the alleged transfer of the control of the Manhattan Railway to the subway interest and the consequent rise in that stock and the New York traction shares generally. Metropolitan Street Railway, Metropolitan Securities stock and Brooklyn Rapid Transit showed great strength due partly to reports that these properties might all be involved in some deal with the Manhattan. The effect of these demonstrations was felt in the whole list. Amalgamated Copper was strong on covering and support from insiders. The Steel stocks were quiet, but were the objects of some renewed buying for investment. The other industrials were quiet. The sales of Brooklyn Rapid Transit aggregated 159,970 shares, the range of prices being between 57½ and 65, closing at 62½, a net gain of 4½ points. Metropolitan Street Railway closed at 140⅛, representing a net gain of 3⅛ points. This stock ranged between 136½ and 143¼, the sales amounting to 67,500 shares. Manhattan, as above noted, was the most conspicuous stock of the entire list, the sales aggregating 651,485 shares, the price limits being 134¾ and 154¾, closing at 151, a net gain of 16⅝ points. General Electric was an exception, closing with a net loss of 1½ points, at 180, the trading being narrow. Westinghouse common gained 17 points, and preferred 3½, the closing prices being 207 and 204, respectively. Western Union is unchanged, at 90. Commercial Cable closed at 175, being a net gain of 2 points. Following are the closing quotations of November 25:

NEW YORK.

	Nov. 18.	Nov. 25.		Nov. 18.	Nov. 25.
American Tel & Cable	[illegible]	—	General Electric	178	180
American Tel & Tel	166	159	Hudson River Tel.	—	—
American Dist Tel	34	—	Metropolitan St Ry	137⅞	139
Brooklyn Rapid Transit	[illegible]	61¼	N. J. Elec Veh Trns	[illegible]	[illegible]
Commercial Cable	—	—	N. Y. & N. J. Tel	—	164
Electric Boat	20	20	N. Y. E. V. T. Co.	11	11½
Electric Boat pfd	35	37	Tel & Tel Co Am	—	—
Electric Lead Reduction	[illegible]	[illegible]	Western Union Tel	88¾	88⅞
Electric Vehicle	4	4	Westinghouse Com	[illegible]	[illegible]
Electric Vehicle pfd	10	10	Westinghouse pfd	[illegible]	[illegible]

BOSTON.

	Nov. 18.	Nov. 25.		Nov. 18.	Nov. 25.
American Tel & Tel	161½	[illegible]	Western Tel & Tel pfd	99	98
Cumberland Telephone	—	126	Mexican Telephone	2	2
Edison Elec Illum	—	—	New Eng Telephone	135½	138
General Electric	—	—	Westinghouse	97	100
Western Tel & Tel	[illegible]	25	Westinghouse pfd	103	100

PHILADELPHIA.

	Nov. 18.	Nov. 25.		Nov. 18.	Nov. 25.
American Railways	[illegible]	—	Phila Traction	98	98
Elec Storage Battery	80	80	Phila Electric	[illegible]	[illegible]
Elec Storage Bat'y pfd	—	—	Pa Elec Vehicle	—	—
Elec Co of America	[illegible]	[illegible]	Pa Elec Vehicle pfd	—	—

CHICAGO.

	Nov. 18.	Nov. 25.		Nov. 18.	Nov. 25.
Central Union Tel	—	—	National Carbon pfd	—	—
Chicago Edison	—	—	Northwest Elev Com	—	—
Chicago City Ry	[illegible]	[illegible]	Union Traction	[illegible]	15
Chicago Tel Co	—	[illegible]	Union Traction pfd	[illegible]	[illegible]
National Carbon	—	—			

* Asked

RAILWAYS COMPANY GENERAL.—The Railways Company General, which was organized by W. W. Gibbs in 1899, has passed from the control of the Investment Company, of Philadelphia, into the hands of a group of Philadelphia and New York capitalists, headed by Evans R. Dick. Practically no change in the management will ensue. The capital of the company is $1,200,000, the par value of shares is $10, and the last recorded sales were at 4¾. Evans R. Dick continues as president and John J. Collier as secretary and treasurer. Mr. Collier says of the change: "The future of the company will be unaffected by the transfer. The Investment Company of Philadelphia has simply sold out its interest in the Railways Company General, consisting of 42,200 shares out of 120,000, to a syndicate of New York and Philadelphia men, headed by Evans R. Dick. It is the belief of the management that the company will be strengthened rather than weakened by the deal, the members of the purchasing syndicate being chiefly men now connected with the company." The electric interests of the Railways Company General are chiefly in the vicinity of Williamsport, Pa.; Elmira, N. Y., and in Michigan. These properties have been gradually improved, and it is the intention of the purchasers to develop and extend them by means of additional capital.

SOUTHERN CALIFORNIA LIGHTING COMPANIES.—Several electric light and power companies in Southern California are to be consolidated. The principal plants which will be included in a new company are those at Los Angeles, Pasadena, Santa Anna, and Redlands. The new company will probably be known as the Edison Electric Light Company of Southern California. The authorized capital stock of the new company will, it is said, be $10,000,000. Some of the bonds of the company have been subscribed for by Eastern capitalists. The present capacity of the plants which are to be combined is 12,000 horse-power. This is to be increased to four times its present power. It is expected that some of the power will come from the Kern River and the Santa Anna Cañon, from which it will be distributed by transmission lines. One million five thousand 20-year 5 per cent. bonds are to be issued immediately, and have been purchased by an Eastern syndicate of bankers, consisting of N. W. Harris & Company, Rollins & Sons and Perry, Coffin & Burr. Other details have already appeared in these pages.

THE ELECTRIC SPECIALTY COMPANY, of Chicago, on November 7 increased its capital stock to $500,000 and intends to equip a large new plant to manufacture staple electrical goods, together with several patented specialities it has acquired. The directors of the company are H. G. Willard, A. Montgomery Ward, Charles E. Felt, D. Avery Kimbark and John G. Elliott, a combination of business push, conservatism and electrical and mechanical talent. Messrs. Felt and Kimbark were for some time connected with the Pullman Company, and have devised many improvements in electrical apparatus for use on railroad trains as well as specialties of wider application. Among other things, the Electric Specialty Company made the train-connecting switch for electrically lighted trains, which was recently adopted on the overland limited trains from Chicago to the Pacific coast.

DIVIDENDS.—The directors of the National Lead Company have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock. The dividend is payable December 15. The directors of the American District Telegraph Company, of Brooklyn, have declared the regular semi-annual dividend of 3½ per cent., payable December 10.

THE TACOMA DEAL VALID.—In a lengthy decision handed down in the Chancery Court, Vice-Chancellor Emery, of New Jersey, has refused to grant an injunction restraining the Tacoma Railway & Power Company from selling out to the Seattle-Tacoma Interurban Railway Company for $700,000.

BUFFALO BELL TELEPHONE INCREASES CAPITAL.—The capital stock of the Bell Telephone Company, of Buffalo, was increased from $5,000,000 to $10,000,000 at a meeting of the stockholders on November 15.

Commercial Intelligence.

THE WEEK IN TRADE.—Favorable conditions continue in the trade situation. The mild weather is restricting the movement of winter retail goods and delaying collections at a few points, but on the other hand it is favorable to the cotton crop, and enables the railroads to make a better fight against the prevailing freight congestion. In financial circles the tone is better. From Western centers come reports that money has ceased to flow to the country and that the return movement has begun. Export trade returns look better than earlier reports foreshadowed. There will probably be a heavy distribution in Christmas goods, and spring business is in a more forward condition than in previous years. The business of the country offered to the railroads is so large that new measures must be devised to meet the new conditions. At several centers fuel, iron and steel cannot be delivered to consumers on account of the freight blockades. Gross railway earnings for the first half of November show gains of fully 8 per cent. over the same period last year, while returns for the nine months, despite the many disturbances in trade, show increases of 5 per cent. in gross receipts and nearly as large net returns as one year ago. Anthracite is moving to market as rapidly as it is mined and railroad facilities will allow. The iron situation is somewhat stronger than a week ago; Western steel rail mills are reported to have sold practically their entire 1903 production. Plate and structural material are also heavily sold ahead, the latter being quite active. The copper market was weak and prices fell off somewhat; offerings were large but the demand was slight. Lake declined to 11.40c. a 11.60c. for spot to February. Electrolytic and casting stock for the same delivery are quoted at 11.25 a 11.40c., and

standard is nominally 10.62½c. The number of business failures for the week ending November 20, as reported by *Bradstreet's*, was 201 against 205 the week previous and 223 the same week last year.

INDUCTION MOTORS IN WOOD WORKING.—An interesting example of the application of induction motors to the driving of shop machinery is afforded by the plant of Wm. Demuth & Company, Brooklyn, N. Y., manufacturers of tobacco pipes and walking sticks. The plant is situated in East New York and consists of a three-story brick factory, 200 by 600 ft., and a small brick power house building. The original intention of the operators of the establishment was to make use of direct current from the distribution system of one of the Brooklyn power companies, but a polyphase alternating system was finally installed, including two Westinghouse two-phase compensated-field alternators, driven by Corliss and Ball & Wood engines, having a close speed regulation. Excitation is furnished by small multipolar dynamos driven from the main generator shafts. The switchboard contains three panels for generators and feeders. The main power system operates at 220 volts and all motors are wound for this pressure. Lighting is also supplied from the two-phase mains, special balancing transformers being introduced between the 220-volt leads for the purpose of furnishing a 110-volt, three-wire lighting service and equalizing unbalanced loads upon the lighting system. Motive power in the factory is furnished by 14 Westinghouse induction motors, varying in capacity from 5 to 20 hp. The majority of these motors are mounted overhead upon wooden sleepers bolted to the beams of the floor above. They require no care further than an occasional replenishing of the oil wells. Many of the motors operate in an atmosphere heavily laden with wood dust from the wood working machinery and are completely covered with this oil-soaked dust, but show no injury. The motors are belted to short line shafts which in turn drive various types of belted machinery, including turning and mounting lathes, circular and band saws, buffers, blowers, drills and machine shop tools. The motors are started at a reduced voltage by means of Westinghouse starting coils and when near synchronous speed are thrown directly upon the 220-volt system. The power equipment has been in operation for over one year, and has been thoroughly satisfactory in every respect.

SOME C. & C. ORDERS.—The C. & C. Electric Company, of 143 Liberty Street, report receipt of numerous orders for large motors and dynamos. A 225-kw generator has been ordered for power transmission purposes in the new Frazer & Chalmers Chicago shops of the Allis-Chalmers Company. The Lambert Hoisting Engine Company, 85 Liberty Street, is erecting new shops at Newark, N. J., which will be equipped with a 100-kw and a 75-kw C. & C. generator, directed-connected to engines, being built at the Phœnix Iron Works, Meadville, Pa. These machines are intended to be utilized for both light and power. The new apartment house under construction by W. H. Livingston, at 137 West Forty-seventh Street, New York, will have a 75-kw direct-connected generator and a 50-kw one for light and power purposes. One 50-hp and a 30-hp motor have been ordered for operating blowers in St. Patrick's Cathedral, New York. The Park Manufacturing Company, of Chicago, has requisitioned for seven special motors of 10 hp each, which are to be used for charging furnaces in the plant of the Illinois Steel Company. The Lister Agricultural Chemical Works, of Newark, N. J., has ordered a 35-hp motor for power use, being the sixth order received from this source. The St. Louis Water Works, of St. Louis, Mo., has sent an order for a 15-hp series parallel equipment for use in a dredge. The Allentown, Pa., rolling mills are to be installed with four motors of 30 hp each. Another order just received calls for 50 hp and a 35-hp motor for shipment to the Buchanan & Smock Lumber Company, of Asbury Park, N. J. These machines will be used for general power and driving a planing mill. The new Horn & Horn restaurant building in Philadelphia is to be installed with two 60-kw C. & C. generators, to be direct-connected to 90-hp engines, to be supplied by the New York Safety Steam Power Company, of 113 Liberty Street, New York. This outfit will be used for lighting. A large new office building now under construction in Columbia, S. C., is to be installed with two 50-kw C. & C. generators, which will be direct-connected, for lighting purposes, to 75-hp engines, to be manufactured by the Ridgeway Dynamo & Engine Company.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Baltimore & Ohio Railroad Company for the installation of a second battery of Chloride accumulators to be operated at the Mt. Royal entrance of the Baltimore & Ohio tunnel, Baltimore. The first battery was installed in November, 1900, in a building which was designed for the installation of two batteries; and the second battery is put in as the result of the successful service which has been obtained from the original plant. The Baltimore & Ohio Railroad Company has completed its plans for the electric haulage through the tunnel of both its freight and passenger trains, and for this purpose has contracted for two electric locomotives of approximately double the capacity of the ones now in service. The demand which will be occasioned by this increased service necessitated a corresponding increase in the power equipment, and it was decided that the best way of obtaining this was by the installation of another battery. Before the first battery was installed, the load required at times the operation of three 500-kw generators. On the installation of the original battery this number of generators was reduced to one, and it is estimated that even with the increased service of the heavier locomotives and the more frequent trips, the larger capacity in battery output will still admit the entire work being done by the same generator. Three hundred and twenty cells of Chloride accumulators will be operated in parallel with the original battery, giving a total battery output of 2,500 amperes.

BIG SHAW ELECTRIC CRANE CONTRACTS.—Manning, Maxwell & Moore, New York, have just been awarded a big contract for the furnishing of electric traveling cranes to be installed in the new shops at McKees Rocks, Pa., of the Pittsburg & Lake Erie Railroad. The contract calls for one 120-ton crane, with double trolley to operate on a 65-foot span; one crane of 30-ton capacity; one of 10-ton and another of 7½-ton capacity. Five electric motors, having an aggregate capacity of 225 hp, will operate the 120-ton crane and nine motors varying from 5 hp to 35 hp, in all 175 hp, will be utilized for driving the three others. Another important crane contract requisition for cranes having a combined capacity of 145 hp, which will serve as equipment in the new shops of the Pennsylvania Railroad at Wilmington, Del. There will be two cranes of 65 tons each, with auxiliary hoists. The span will be 76 feet. Two 15-ton cranes will also be installed. The span for these cranes will be 47 feet. To work these machines fourteen motors varying from 5 hp to 65 hp, and representing a combined capacity of 350 hp, will be used. The cranes will be built by the Shaw Electric Crane Company, Muskegon, Mich.

POWER FROM THE PUYALLUP.—Some details have already been given in this department as to the plans of the Pierce County Improvement Company and Stone & Webster for developing electrically the power of the Puyallup River, which has its origin in the Glacier of Mount Ranier, State of Washington, and flowing northwest empties into Puget Sound near Tacoma. A dam will be thrown across the river, the water diverted and carried by flume and ditch a distance of 10¼ miles, and will discharge into a fore bay. Two steel pipes leading to the power house will give a head of 850 feet. The power house will be of brick, and will contain four impulse wheels directly connected each to a 3,500-kw generator, whose current will be delivered to transformers at 2,300 volts alternating and stepped up to 40,000 to 50,000 volts, to be transmitted to Tacoma and Seattle, 30 and 40 miles from the power station. By January, 1904, it is hoped to develop 20,000 hp.

THE VILTER MANUFACTURING CO., builder of refrigerating and ice-making machinery, engines, etc., Milwaukee, Wis., has recently closed contracts with the following parties for Corliss engines: Gutmann & Company, Chicago, Ill. (second order), 24x42; Wausau Paper Mills, Brokaw, Wis., tandem compound, 15x30x42; Louisiana Central Lumber Company, Clarks, La., 24x48; Wm. Henning, Vinegar Works, Chicago, Ill., 14x30; Lamar Light & Water Company, Lamar, Mo., 16x30; City Water & Light Department, Fort Atkinson, Wis., 18x36; Ewart Building, Chicago, Ill., 20x42; Warner Starch Company, Waukegan, Ill., twin 28x48; Hilgen Manufacturing Company, Cedarburg, Wis., 20x42; Rock Island Sash & Door Works, Rock Island, Ill., 30x48; American Candy Company, Milwaukee, Wis., 18x36; Boland & Gschwind Company, Limited, New Orleans, La., 20x42, 17x42, 22x42

MACY'S NEW STORE at West Thirty-Fourth Street and Herald Square, New York City, contains thirty-three hydraulic elevators, four electric escalators, with a carrying capacity of 40,000 persons an hour; six iron and marble stairways, eleven water-tube boilers of 3,500 hp, and thirty parcel conveyors. In the building there are 1,400 inclosed arc and 15,000 incandescent lamps. Power is distributed by eighty electric motors, ranging from one-half to 100 hp. The switchboard is ten feet in height and forty-two feet in length, made of Tennessee marble. There is also a large "interior" telephone system, and arrangement whereby fire alarms can be sent in from any point.

BALL ENGINE ORDERS.—The Chartier Brewing Company, Carnegie, Pa., has recently purchased a direct-connected unit, consisting of engine built by the Ball Engine Company, which is direct-connected to a 30-kw Westinghouse generator. The Northern Electric Manufacturing Company, of Madison, Wis., has recently placed in operation a 125-hp engine, built by the Ball Engine Company, Erie, Pa., which is direct-connected to a Northern 75-kw generator. The city of Fayetteville, N. C., has recently installed a 125-hp engine in its electric plant. The Ball Engine Company supplied the engine.

BOILER ORDERS.—The Babcock & Wilcox Company, of 85 Liberty Street, has a contract from the Cincinnati Traction Company for 4,000 hp; also for 1,200 hp of boilers to be installed by the Paxteng Electric Company, of Harrisburg, Pa., and 9,250 hp for the Metropolitan Street Railway Company, Kansas City, Mo.

ALLIS-CHALMERS COMPANY, of Chicago, reports a number of large engine sales for October, including a 32 and 64 by 60 vertical cross compound direct-coupled Reynolds-Corliss engine to the Chicago Edison Company.

General News.

THE TELEPHONE.

WASHINGTON, D. C.—The Chesapeake and Potomac Telephone Company has been authorized to lay a conduit from the [illegible] manhole at Twelfth and H Streets to Fourteenth Street and New York Avenue northwest.

WASHINGTON, D. C.—Comptroller Tracewell has authorized Lieut. Col. Charles J. Allen to pay the Chesapeake and Potomac Telephone Company for the use of a telephone at the statutory rate of $50 a year and accept the company's receipts marked "under protest" until the courts decide whether the act of Congress regulating telephone rates is valid. The engineer's office paid $125 a year for a telephone until June 30, 1898, when the act regulating rates at $50 in the District became effective. Since then no payments have been made because the company has refused to accept them at the statutory rate. The company now desires to collect the $50 a year and give receipts marked "under protest" to protect it in case the courts decide in its favor. The comptroller says in his letter to Lieut. Col. Allen that credit will be given for such payments, but that he must not be understood as sanctioning any agreement as to further payments conditional on the law's being held invalid. This question is to be left open to future decision.

ORLANDO, FLA.—The City Council has granted a franchise to the Sanford Long Distance Telephone Company to erect a line in this city.

BOISE, IDAHO.—The strike of many of the employees of the Rocky Mountain Bell Telephone Company, which has been on in this city for several weeks, was declared off on Nov. 4. It was for $3.25 a day of nine hours in lieu of a monthly sliding rate. An increase in the monthly salaries of the toll road men was also applied for. These concessions were granted and the adjustment was in effect a complete victory for the union men.

SUTTER, ILL.—The Farmers' telephone line will be built from Sutter to Warsaw.

ELLIOTT, ILL.—The Dix Telephone Company has increased its capital from $5,000 to $6,000.

NEWTON, ILL.—The Jasper County Mutual Telephone Company has increased its capital from $5,000 to $10,000.

DANVILLE, ILL.—The city council has granted the Vermillion County Telephone Company a franchise to construct a line here.

ROCKFORD, ILL.—The Home Telephone Company now has 1,000 telephones installed and is thus up to the number required by its franchise as called for by the city ordinance before compensation can be charged.

CHICAGO, ILL.—The Chicago Telephone Company gained 2,940 subscribers in October. This means a total of 57,000 subscribers, or 30 per cent more than in any previous month. The total aggregate gain in the last two years has been about 29,000 subscribers. It is understood that in spite of the reduction in downtown rental receipts, which cut off about $4,000 weekly from the company's earnings, the receipts from the 5-cent slot machines—about $20,000 weekly—show net increases.

RICHVIEW, ILL.—William Rixman, of Irvington, owner of a telephone system extending from New Minden and Hoyleton to Walnut Hill, Ill., and E. Knapp, district manager of the Central Union Telephone Company of Centralia, Ill., have commenced putting up a telephone line from Irvington to Ashley. It will give the patrons free use of the Central Union lines from Richview to Ashley, Irvington and Centralia and over the Rixman line to points mentioned, making a total of about 900 telephones. Few farm houses between these points are without telephones.

WABASH, IND.—The Wabash-Logansport Telephone Company, of Indiana, is ready to contract for the construction of a new line on the north side of the river, between this city and Peru, to be used exclusively for through business.

TERRE HAUTE, IND.—The Kinloch-Long-Distance Company, of St. Louis, is building its line to this city where a connection will be made by the New Long-Distance Company, of Indiana. The Kinloch Company is now within a few miles of Terre Haute and President Sherrin, of the New company, says the Missouri connection will be made in a short time.

NEW ALBANY, IND.—The Independent Long Distance Telephone Company has filed a mortgage for $1,000,000 to the National Trust Company, of Louisville. The mortgage includes the franchises of seventeen long distance companies in Kentucky and Indiana and the switchboard of the new independent company in Louisville, which recently secured control of the independent system in the city.

PORTLAND, IND.—Telephone men from Ft. Wayne, Decatur, Muncie, Winchester and Portland met here recently and discussed plans for the organization of a company with large capital for the construction of telephone plants. All interested were reticent, but it is known that the company will have a capital stock of several hundred thousand dollars and will give its attention to building plants in the West. It is stated that the Indiana and Ohio fields will not be invaded, but operations will be confined to States farther West.

IOWA FALLS, IA.—The Central Telephone Company is extending its system throughout the counties of Hardin, Franklin and Wright. The exchange here is headquarters for twelve telephone lines, running in every direction, and with about 200 telephones on the rural lines.

WESTBROOK, ME.—The Westbrook Telephone Company has been granted a telephone franchise at this place.

MINNEISKA, MINN.—A local telephone company has been organized here. M. A. Callahan, A. Drenkhahn and J. Peshon are interested.

MINNEAPOLIS, MINN.—The Interurban Telephone Exchange Company, of Holmes City, Douglas County, has increased its capital from $10,000 to $100,000.

FERGUS FALLS, MINN.—The Fergus Telephone Company, of Fergus Falls, increased its capital stock from $10,000 to $100,000, of which $75,000 is to be preferred stock, drawing 6 per cent interest. The stock is never to exceed 75 per cent. of the tangible assets.

CENTERVILLE, MO.—The Reynolds County Telephone Company, of this city, has increased its capital stock from $1,000 to $2,000.

ST. JOSEPH, MO.—A meeting of members of the Missouri River Independent Telephone Association and representatives of farmers' mutual companies from surrounding counties was held here recently to consider plans for giving the mutual company the benefit of connection with independent lines on terms advantageous to both. About thirty stockholders interested in various telephone enterprises were in attendance at the meeting. E. H. Ralston, of Maitland, is president of the association, and L. N. Fry, of Grant City, secretary.

BEATRICE, NEB.—An independent telephone system is being installed at this place.

ELGIN, NEB.—The Antelope County Mutual Telephone Company has been organized at this place.

HASTINGS, NEB.—The Adams County Telephone Company, capital $30,000, has been incorporated here. Incorporators: J. H. Lyman, A. L. Clarke, W. H. Ferguson and others.

BENNET, NEB.—The Bennet Telephone Company, of Bennett, Lancaster County, has incorporated, with a capital stock of $10,000. The incorporators are G. W. Eggleston, A. L. Bergthol and E. A. Vanderlip.

NEW YORK, N. Y.—The New York and New Jersey Telephone Company has completed the work of constructing the subway in the Borough of Richmond, and there is now an unbroken line from Mariners' Harbor to Clifton. The work of drawing the cables and making the necessary connections with subscribers is being done by a large force of men. As soon as this is done the company will proceed to remove the wires from the poles and chop down many of the latter. Distributing poles will, however, be maintained at intervals throughout the island. The work has been done under the direction of Deputy Commissioner G. S. Schofield.

ROSEWOOD, OHIO.—The Champaign Telephone Company has been organized, with a capital of $1,500, by M. E. Weimer, T. J. Heck, M. L. Stembel and others.

CLARINGTON, OHIO.—The Clarington Home Telephone Company has been incorporated, with $5,000 capital stock, by H. M. Smith, Albert Dietrick, W. T. Powell, Julius Steigle and J. A. Hyer.

COLUMBUS, OHIO.—The Weston Home Telephone Company has been incorporated, with $10,000 capital stock, by I. N. Niefer, A. S. Murphy, A. T. Mumm, T. J. Pugh, George T. DeWeese, S. B. Ballner and John E. Clark.

GUTHRIE, OKLA.—The Topeka and El Reno Telephone Company, of El Reno, has amended its charter for twenty years, with $100,000 capital. Incorporators: W. F. Evans, of Topeka, Kan.; F. H. Wright and C. O. Blake, of El Reno, Henry B. Johnston, of Chickasha, I. T.; and William M. Grimes, of Guthrie.

WAYNESBURG, PA.—The Mount Morris Telephone Exchange Company, of Mount Morris has bought the entire system of the Mount Morris & Morgantown Telephone Company.

VIBORG, S. D.—The town board has granted to Geo. I. Phillips and associates a franchise for establishing and maintaining a local telephone system.

SALT LAKE CITY, UTAH.—The City Council has appointed a committee to consider the advisability of granting a franchise to the Utah Home Telephone Company to establish a system in this city.

SALT LAKE CITY, UTAH.—The change of switchboards in the local telephone building of the Rocky Mountain Bell Telephone Company has been successfully accomplished. The lines have all been connected with the new board and the telephones are now working successfully throughout the entire system.

KEYSER, W. VA.—A new telephone company has been organized at this place with a capital stock of $30,000, and has purchased the stock of the Piedmont Telephone Company. J. C. Watson is president.

BAYFIELD, WIS.—The Wisconsin Telephone Company will build a line from this place to Cornucopia.

MADISON, WIS.—The Chicago & Northwestern Railway Company is making experiments with the telephone as an adjunct to its telegraph system.

LA CROSSE, WIS.—The Northern Electrical Construction Co. has been incorporated at La Crosse, with a capital of $10,000, to construct telephone lines. C. A. Sterling, M. Berger, W. C. Heinroth and J. Stone are the incorporators.

HAMILTON, ONT.—The telephone committee of the city council of Hamilton, Ont., has reported that it does not consider it desirable to have competition in telephones unless it is to regulate some very grave evil. The almost universal experience has been that competition raises the rates materially to business and professional men, and lowers the rate somewhat to the resident.

OTTAWA, ONT.—The ships of the British Navy, at the present time, are not fitted with the Marconi wireless telegraph system, but on some of the ships instruments of another company have been installed. It is learned that these instruments have not given the best of satisfaction, and steps are being taken to have the Marconi instrument installed. With this object in view, Admiral Douglas, commanding the British North American squadron, recently visited Sydney, N. S., and talked the matter over with Mr. Marconi and his directors, and the result of the admiral's visit, it is said, will be that British warships of the North Atlantic squadron at least will shortly have the Marconi wireless telegraph system, for it is understood that Admiral Douglass and the wireless experts who accompanied him to Sydney will make a most favorable report to the Admiralty.

ELECTRIC LIGHT AND POWER.

CENTRALIA, ILL.—A controlling interest in the Centralia Light and Power Company has been sold to a syndicate. The officers of the new company are: President, M. M. Stephens; vice-president and general manager, H. M. Bylelsby; secretary, L. D. Turner; treasurer, Henry Kohl. The new managers propose to greatly improve and extend their property. It is said they have succeeded in securing control of the local street railway system.

EDWARDSVILLE, ILL.—This city is still in darkness so far as electric street lighting is concerned, but developments looking to the resumption of the service are expected at an early day. A. A. Tebbs, of Washington, Mo., who is said to have secured an option on the local plant, has submitted a proposition to the city authorities. It is also stated that a new company has been formed by residents of this city, which will also ask for a franchise. The matter will be acted on at the December meeting of the city council. The authorities also are considering the advisability of issuing bonds and constructing a municipal plant.

ST. LOUIS, MO.—The board of public improvements has approved plans for two municipal lighting plants and will advertise for bids to be received December 9.

NIAGARA FALLS, N. Y.—The Niagara Falls Power Company has tested the water-carrying capactiy of its tunnel to ascertain if it will meet the requirements of its two-wheel pits in the development of 100,000 horse-power. In every particular, it is said, the tests were successful.

XENIA, OHIO.—Mr. Harry Galligher is at the head of a movement to form a company to establish an electric lighting plant. A petition has been filed with the council asking for a franchise.

MEDINA, OHIO.—The Medina Electric Lighting, Power & Heating Company has been incorporated with $50,000 capital stock by M. J. Van Sweringen, O. P. Van Sweringen, J. G. Boyd, S. C. Stewart and A. J. Watt.

MIDDLEFIELD, OHIO.—This village is to be illuminated by current furnished by a local manufacturing plant. The town has less than 500 inhabitants and is said to be the smallest town in Ohio having electric lights.

BARBERTON, OHIO.—Wires have been strung and 45 arc lamps are being put in place to furnish the village with electric illumination. The contract for current was placed with the Northern Ohio Traction Company, of Akron.

SHELBY, OHIO.—The electric light trustees of the village have adopted a rule providing that lights must be paid for before the 10th of each month or current will be cut off without notice. Heretofore the collection of bills has been an expensive item.

TOLEDO, OHIO.—The East Toledo Heating & Lighting Company has been incorporated, with $10,000 capital stock, by P. McRory, S. H. Mills, S. W. Cook, L. E. Flory and W. H. Tucker. They will establish a plant and furnish power, light, heat and hot water.

CLEVELAND, OHIO.—Mayor Tom L. Johnson is agitating the question of establishing a municipal lighting plant in Cleveland. The present contract with the Cleveland Electric Illuminating Company will expire before very long and the matter of advertising for new proposals is under discussion.

CINCINNATI, OHIO.—The "electric mules" of the Miami & Erie Canal Transportation Company promise to destroy the business of the real live variety in more ways than one. The live mules do not take kindly to the invasion of the electric machines, which are being used experimentally on the canal banks, and there have been several conflicts, resulting invariably in victories for the work of human hands. Within the past few weeks several old-timers have been killed by coming into contact with the rails while the towing-motors were approaching. The company will take all the live mules off the canal in a few weeks, but in the meantime the officials are endeavoring to devise a plan to keep them from all going to the boneyard before the new system is completed.

BAKER CITY, ORE.—The Baker Gas & Electric Company is establishing a new system here.

SALT LAKE CITY, UTAH.—Franchises have been applied for in Lewiston, Vineland and Clarkston, Idaho, the power to be obtained from a plant to be established on the Snake River. A suburban line is also in contemplation connecting the three towns.

SALT LAKE, UTAH.—An electric plant has been purchased by E. T. Loy, manager of the Philadelphia and Arizona Mining Company to furnish power and light for the Minnesota-Connor mine near Chloride. A station has been cut at the 100-foot level and the new plant will be installed at once.

SALT LAKE CITY, UTAH.—The Utah Light & Power Company has deducted 5 per cent. from its October bills on account of deficiencies in the service consequent upon the scarcity of water-power during that month. Automatic stokers will be used under the boilers at the river plant where power is generated.

SALT LAKE CITY, UTAH.—The Utah Light & Power Company has lately erected a new transformer house and will soon have all the apparatus installed. The plant will give the company an additional 2,500 horse-power. The company is preparing specifications for another 1,500-hp reserve steam plant, which will be erected within a year.

SALT LAKE, UTAH.—On the Meadow Valley Wash near De La Mar, Nev., the De La Mar Company will soon build an electric plant to be run by water power. Wires will be run to De La Mar, a distance of 14 miles. The plant will be located about eight miles south of Calientes. One of the directors of the new company is Mr. Simon Bamberger, of Salt Lake City.

LOGAN, UTAH.—Suit has been filed by S. W. Riter vs the Logan City Council to prevent the latter from issuing the $35,000 worth of electric light bonds voted by the people this year. Opponents of the bond have contended that the city has no legal right to issue bonds for more than $28,000. The State land board which purchased the entire issue was satisfied as to the legality of the bond issue, but in order to be perfectly secure, insisted that the question should be passed upon by the courts. The suit was therefore brought and after being passed upon in the district court, the case will be at once appealed to the supreme court.

ALEXANDRIA, VA.—Formal complaint has been entered by the agents representing the various fire insurance companies in this city against the manner in which electricity is being introduced in the business houses here for illuminating purposes, and also for motive power. The agents threaten to cancel policies unless the present process is stopped. The matter has been called to the attention of Mayor Simpson and he will send a communication on the subject to the city council.

THE ELECTRIC RAILWAY.

ROME, GA.—The Electric Railway Company will erect a new power house and purchase 18 cars. The improvements, including a six-mile extension to Lindale, will cost $250,000. Seymour Cunningham, of Washington, D. C., is president of the company.

AUGUSTA, GA.—It is said that the transfer of the Augusta Street Railway and Electric Company to the syndicate controlling the Aiken-Augusta line will be consummated upon the return of the president, Jas. U. Jackson, of the latter line. Notice has been received by the first-named company that the conditions of the sale have been met.

WABASH, IND.—The Wabash and Logansport Traction Company has awarded to the New England Engineering Company the contract for changing the electrical system from direct to alternating current on its line between this city and Peru, and installing the new system from Peru to Logansport on the extension to the latter place. A large addition will be built at the power house at Rich Valley, and a new engine and boiler will be added, while substations will be put in at Peru and a few miles east of Logansport. New equipments are being contracted for and cars will be running from Wabash to Logansport by January 1. The improvements will cost over $350,000.

CAMBRIDGE, CITY, IND.—The interurban railway between Richmond and this city is completed and in operation. The road will be connected in a few days with the Indianapolis-Greenfield line on the west and will be extended to Dayton on the east from Richmond. James Murdock and Richmond people own the road.

PAOLI, IND.—At recent elections held to vote a subsidy tax for the proposed Mitchell, French Lick, West Baden and Jasper Traction Railway, the tax was voted by French Lick and Orange Townships by good majorities. The townships in Dubois County have already voted the tax and the road will be built early next year.

WABASH, IND.—H. M. Law and others, of Detroit, have secured a franchise from this city for an interurban railway from Wabash to Marion. They say they have the funds with which to construct it. G. A. H. Shidler is also asking for a franchise between the two cities. The Union Traction Company is said to be behind Shidler.

KOKOMO, IND.—The Indianapolis Northern Traction Company, through George F. McCulloch, has applied for an electric lighting and heating franchise in this city. Citizens claim to see in this move a continuation of the battle between Marratt and McCulloch. Marratt claims to have a five-year franchise for electric lighting in the city.

NEW CASTLE, IND.—E. J. Binford, of the Indianapolis & Eastern Traction Company (Greenfield Line), was granted a franchise at a special meeting of the city council recently. C. S. Hernley and C. S. Hodges, of the Richmond & Northern Company, who hold separate franchises to forestall the Binford Company, placed a large number of men and teams to work in Main Street at once.

RICHMOND, IND.—The officers of the Richmond Interurban Company announce that in building an extension to New Paris, Ohio, they will build by way of the Cedar Springs health resort, which was established some years ago at a great outlay of money, which proved a failure because of the lack of transportation facilities. The resort will be improved and modernized by Dayton capitalists who own the property.

WARSAW, IND.—L. D. Flemming, representing Lagrange and Ligonier capitalists, has made application to the Warsaw Council for a franchise for an interurban electric railway to connect Lagrange and Warsaw and the intervening towns of Ligonier, Syracuse, Wawasee, Milford and Leesburg. It is claimed that the enterprise has been financed and that much of the right of way outside of the towns mentioned has been secured. Bids to do the construction work will be advertised for soon.

ANDERSON, IND.—The Merchants' Traction Company, of this city, has been dissolved, and the business of the company settled, and the consideration received for the franchise and rights of way which were sold to G. M. Hodges, of Dayton, Ohio, divided among the directors. When Hodges bought the franchise he declared he would build a line from this city to Middletown within sixty days. Nothing has been done, however and it is now generally believed that Hodges represented the Union Traction Company and was simply buying out opposition. The Union Traction Company is getting ready to build the line and Hodges interposes no objection.

LEXINGTON, KY.—The North Middletown, Winchester & Lexington Right of Way & Franchise Company has been incorporated with $5,000 capital stock by C. H. Berryman, Stanley Milward and Rudolph Harting. The company proposes to build lines from Lexington to Winchester and from Lexington to Sharpsburg.

DETROIT, MICH.—The Jackson & Battle Creek Traction Company has been formed, with a capital stock of $1,500,000, by the merger of the Jackson & Albion Calhoun County Railway and the Marshall & Battle Creek Railway. The officers of the new company are General C. M. Spitzer, Toledo, president; A. L. Spitzer, Toledo, vice-president; S. N. Potter, treasurer; W. A. Fotte, secretary. The above with S. C. Rorick, W. A. Bolland, Wm. Robertson, W. H. Thompson and J. R. Nutt form the directorate. J. R. Nutt is secretary-treasurer of the Savings & Trust Company, Cleveland, which has been made trustee for the $1,200,000 bond issue on the road. The line is 45 miles in length.

[illegible], OHIO.—The [illegible] Company has increased its capital stock [illegible]. C. [illegible] is president. The road [illegible].

CLEVELAND, OHIO.—Directors of the Cleveland, Elyria & Western Railway met recently to consider details of a plan to absorb the Cleveland & Southern Railway and the Norwalk Gas & Electric Company.

HUBBARD, OHIO.—The Youngstown & Sharon Railway Company has applied for a 25-year franchise to furnish electric lighting in the village. The authorities are not willing to grant so long a franchise.

CLEVELAND, OHIO.—The Western Reserve Traction Company has been incorporated, with $10,000 capital stock, by T. A. Willard, M. A. Lander, E. Jay Pinney, C. W. Noble and E. H. Gebert. It proposes to build a line from Cleveland to Warren.

COLUMBUS, OHIO.—The Columbiana Electric Railway Company has been incorporated, with $10,000 capital stock, to build a line from Salem to East Liverpool. Incorporators were D. H. Pigg, Elmer H. Miller, Henry R. Young, Daniel J. Ryan and E. C. Herat.

CINCINNATI, OHIO.—Negotiations are pending for the consolidation of the rival Cincinnati-Milford lines headed by the Compton syndicate and the Kroger-Wilson syndicate. There is a third company in the field for a line over this route; it is headed by Senator Roudebush.

CLEVELAND, OHIO.—The Cleveland bankers and capitalists who financed the Northern Texas Traction Company are preparing to issue the securities of the road. The property will be bonded for $2,500,000, with stock of like amount. The Prudential Trust Company, of Cleveland, will be the trustee for the bonds.

CLEVELAND, OHIO.—The Cleveland & Sharon Traction Company has placed contracts for the construction of the first six miles of its road from Middlefield to Mesopotamia. This portion is to be completed by February and next summer the road is to be extended to Sharon. The Osborn Engineering Company, Cleveland, is consulting engineer for the road.

COSHOCTON, OHIO.—The franchise of the Newark, Zanesville & Coshocton Traction Company has been extended one year by the Coshocton County commissioners. The proposed line is a connecting link between Cleveland and Columbus.

YOUNGSTOWN, OHIO.—The Youngstown & Southern Railway Company, which is about to build a line from Youngstown to Columbiana, proposes to extend the road across this county to Salem, Lisbon and East Liverpool. Gen. Asa Jones, J. H. Ruhlman and J. E. Long, of Youngstown, and R. L. Andrews, of Cleveland, who are the chief promoters of the road, are endeavoring to induce the towns along the line to assist in securing right of way.

SPOKANE, WASH.—The old Cook Electric Railway here is figuring on an extension of its lines for about eight miles into the fruit region.

OTTAWA, ONT.—The Ottawa Electric Railway Company is erecting a building for the housing of a large storage battery plant to be furnished by the Electric Storage Battery Company, Philadelphia.

MONTREAL, QUE.—The Montreal Electric Street Railway is now receiving 5,000 horse-power from Chambly. Improvements at the Chambly Falls have been completed and the total capacity of the power company will be 20,000 horse-power. Next spring there will be a further development of 10,000 horse-power at St. Therese Falls.

MONTREAL, QUE.—The Montreal Street Railway carried last year 50,000,000 passengers and showed gross earnings of $2,046,000. Ten years ago the road carried but 11,631,386 passengers and its earnings were only $564,406. The net earnings for the year were $911,032, as compared with $795,413 last year. Several new extensions to the company's system, amounting to fourteen miles of track, have been constructed and put in operation during the year and the rolling stock has been increased. During the year, also, the company has paid the city of Montreal in taxes, $127,257, and for snow cleaning, $50,771, making a sum total of $178,029.

New Industrial Companies.

THE RUSSELL & STOLL COMPANY, of New York City, has been formed to manufacture electric fittings: Capital, $30,000. Directors: F. J. Russell, Theodore Stoll, A. O. Uhitz, of Brooklyn.

THE OLMSTEAD-GOUGH ELECTRIC COMPANY, of Syracuse, N. Y., has been incorporated. Capital, $1[illegible],000. Directors: E. M. Higgins, M. J. Olmstead, of Rochester, and A. N. Ellis, of Syracuse.

THE SMITH STORAGE BATTERY COMPANY has been organized in Binghamton, N. Y., with a capital of [illegible] to manufacture a storage battery invented by [illegible] Smith, of Binghamton.

THE ELECTRIC MACHINERY COMPANY has been incorporated at Minneapolis, Minn. The capital stock is $25,000. The incorporators are T. Boustead, Charles H. Chalmers and William Lau, all of Minneapolis.

THE COOPER HEWITT ELECTRIC COMPANY, of New York, has been incorporated at Albany, N. Y., with a capital of [illegible] to manufacture vapor electric lamps. The directors are Charles B. Hill, John P. Symes, G. H. Stockbridge, Charles H. O'Connor and Leavitt J. Hunt, all of New York City.

THE MARCONI WIRELESS TELEGRAPH COMPANY, of Canada, has been incorporated by the Ontario government to acquire the patent rights, etc., of Marconi's system for operation in the Dominion. The capital is $[illegible],000, and the provisional directors are W. [illegible], New York; J. N. Greenshields, Montreal; W. Barwick, C. Osborne and John Payne, of Toronto, Ont. Mr. Greenshields, who is also acting as solicitor for the new company, announces that the company is about to establish a system of wireless telegraphy across the Dominion, connecting Victoria, B. C., in the west with Cape Breton, N. S., in the east. Stations will be erected at [illegible] points across Canada, and all the principal cities and towns in the Dominion will be included in the system.

Personal.

MISS R. B. RICHARDSON.

MISS ROSE B. RICHARDSON, whose portrait accompanies this, enjoys the distinction of being, perhaps, the only one of her sex in this country engaged in electrical contract and supply business. Miss Richardson has been established for some time in Syracuse, N. Y., and in addition to an extensive supply business, contracts for complete electrical equipments, in such cases personally laying out the work and making the estimates. The success which Miss Richardson has achieved is evidence that the electrical branch of business is no less open to the fair sex than the numerous other branches which in late years have offered them fields for vieing with man in commercial enterprise.

MR. E. G. LONG, manager of the foreign department of the Peckham Mfg. Company, returned this week from an extensive European trip.

COL. R. C. CLOWRY, president of the Western Union Telegraph Company, has been elected a director of the Seventh National Bank. Gould interests are among the dominating factors in this bank.

MR. JACOB WENDELL, JR., of Wendell & MacDuffie, whose offices are in the Havemeyer Building, sailed Tuesday for Europe. According to present arrangement, he will not return until early spring.

MR. FRANK WELZ, connected for some years with the Allgemeine Electricitäts Gesellschaft, of Germany, as electrical engineer, is on a visit to this country with a view to arranging for permanently residing here.

MR. J. DRAPER BISHOP, the electrical engineer and insulated wire expert, has returned to New York from China, where the recent Boxer troubles frustrated his excellent plans for development in the Celestial Empire.

MR. T. C. MARTIN has been appointed by Prest. Ferguson of the National Electric Light Association, editor of progress in the field, to report at the regular annual meeting as to the advances and changes of the year.

MR. GEORGE W. ALDRIDGE, of Rochester, N. Y., a former state superintendent of public works, has been appointed secretary to the New York State Board of Railroad Commissioners with a salary of $6,000 annually.

MR. W. H. BEATTYS, JR., formerly with Sergeant & Lundy, of Chicago, and recently with the Sprague Electric Company, has taken charge of the Chicago office of the Cutler-Hammer Manufacturing Company, 1232 Monadnock Block.

MESSRS. C. A. COFFIN, president of the General Electric Company, and Clarence H. Mackay, president of the Commercial Cable Company, have been elected directors of the United States Mortgage and Trust Company, of New York City.

HON CHANDOS S. STANHOPE, president of the Mexican Tramways Company, Limited, of the City of Mexico, which is now extending its system, arrived last week from Europe en route for Mexico. Mr. Stanhope is staying in New York for a few days at the Hotel Albemarle.

MR. E. B. SCHATTNER, engineer and manager of the Schattner Electricity Meter Company, Ltd., of London, is in New York and will visit other electrical centers while in this country. His meter is of the demand type, and is in general use in London and other parts of England.

MR. CHARLES CARLSON, who has been the night manager of the John Street exchange of the New York Telephone Company for several years, left last week to take a place in the company's office. The girls under his charge gave him a gold watch in recognition of his uniform courtesy and kindness.

MR. R. MEIEHLING.—At the meeting of the council police committee of Reading, Pa., it was decided to engage Rudolph Meiehling, of that city, an expert electrical engineer, to make an estimate of the cost of erecting and maintaining a modern electric light plant sufficiently large to cover the requirements of the city. The employing of the engineer is in accordance with a resolution adopted by councils.

MR. A. E. WINCHESTER, commissioner and manager of the South Norwalk, Conn., municipal lighting plant has prepared plans for extensions. The new equipment will include one 250-hp high-speed engine, simple noncondensing direct connected to a 150-kw 220 to 250-volt multipolar direct-current generator; also one 130-light five-ampere arc generator, direct-connected, an 85-hp 220 to 270-volt motor, also the auxiliary apparatus, switchboard, etc.

WESTINGHOUSE MANAGERS.—The District office managers of the Westinghouse Electric & Mfg. Co., representing all the principal cities of the United States, have spent the past week in their usual annual visit to the works and offices of that company at East Pittsburg. On the evening of November 19 a very enjoyable dinner, in honor of the visitors, was given at the Duquesne Club, at which the engineers and executive officers of the company were also present.

FULLER SUBSCRIPTIONS.—Mrs. and Miss Fuller, wife and daughter of the late Mr. J. B. Fuller, electrical inventor, report the following additional subscriptions in response to the appeal for relief made in these columns some time ago: Prof. W. A. Anthony, $10; L. B. Marks, $5; W. J. Jenks, $5; J. B. Cahoon, $5; Harold Buck, $5; F. Patterson, $10; N. Tesla, $25; A. L. Riker, $10; W. A. Drysdale, $5; Dr. Louis Bell, $5; T. D. Lockwood, $5; C. S. Bradley, $10; R. Lundell, $10; G. S. Dunn, $5; F. V. Henshaw, $5; J. B. Entz, $5; Herbert Wagner, $5; F. Reckenzaun, $5; Prof. C. F. Brackett, $5; Louis A. Ferguson, $5; Samuel Insull, $10; C. J. Goldmark, $5; Prof. D. C. Jackson, $10; Dr. Max Osterberg, $5.

SIR WILLIAM PREECE, the well-known English electrical engineer, ex-President of the Institution of Civil Engineers, in an address before the Society of Arts, said hard things about the British commercial and industrial situation. He declared that the condition of the railways was unsatisfactory. Regarding commercial soundness he said that Parliament had legislated on this matter regardless of commercial prudence. The remedy was in combination of the companies. British commercial and industrial supremacy had practically ceased, largely owing to lack of commercial education and obsolete business habits, and also to lack of commercial patriotism and the free trade fallacy. The nations which had not adopted free trade flourished more than the solitary nation that had adopted it. He instanced the protection of their industries by the Americans, whose policy was dictated by intense patriotism. If the Americans were right in principle and successful in practice the whole policy of the United Kingdom was founded in gigantic error and must lead to commercial ruin.

EDUCATIONAL.

COURSE IN TELEPHONY AT PURDUE.—There are twenty-five students enrolled in the course of telephone engineering in Purdue University at Lafayette, Ind. Sixty others of the present sophomore and freshman classes are taking work preparatory to instruction in telephony in their junior and senior years. The telephone manufacturing and supply houses are taking much interest in this course, as well as the operating companies in the State. Much valuable apparatus has been donated, and the facilities afforded will doubtless go far to qualify students to become telephone engineers.

Trade Notes.

ENGINEERS' STANDARD LIBRARY.—Messrs. Theo. Audel & Co., 63 Fifth Avenue, New York, have just issued a pamphlet giving a synopsis of their "Engineers' Standard Library," consisting of seven volumes.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is distributing samples of I. X. L. Weatherproof Wire, and calls attention to the quality of insulation which it claims is the best on the market. Any prospective buyer not having received a sample, can obtain it upon request.

"THE BROOKLYN EDISON" is the name of a neat little brochure which is now being issued at regular intervals by the Edison Electric Company, of Brooklyn, as a means of pushing its business. Mr. W. Jac Marland, general agent of the company, believes it will be of great use.

B. CABELLA & COMPANY, Milan, Italy, have issued a catalogue consisting principally of a list and data of electrical plants which this company has installed. The list occupies more than 80 pages, and the number of machines foot up to 2,664 of an aggregate horse-power of 43,898.

The CUTTER COMPANY, of Philadelphia, has removed its engineering, sales, advertising and accounting offices to 1728 Spring Garden Street, that city. The company has opened a Cleveland office at 314 Williamson Building, in charge of Mr. G. L. Crosby, who will cover Northern Ohio.

THE BURT MANUFACTURING COMPANY, Akron, Ohio, has equipped a number of mills of the American Sheet Steel Company with the Cross oil filters and Burt exhaust heads. The large new plant of the Allis-Chalmers Company at West Allis, Wis., has also been equipped recently with these oil filters.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, of Chicago, has received word that the Russian government has awarded it the contract for supplying the new central energy switchboards for St. Petersburg and Odessa. This is the largest switchboard contract ever awarded, being for one of 40,000 subscribers for St. Petersburg and 20,000 for Odessa.

"FLASHER SUGGESTIONS," is the title of a folder the Reynolds Electric Company, 221 Fifth Avenue, Chicago, is now sending out for the use of electrical contractors and central station companies interesting their local storekeepers in electrically illuminated, flashed signs. It illustrates a number of forms of street advertising of this kind—too many in fact to enumerate or describe here; but it is a good thing for a supply or central station company to have a liberal supply for distribution among possible customers.

LOSS OF LIGHT.—The Shelby Electric Company, Shelby, Ohio, has just issued an 18-page pamphlet containing a telling argument as to the loss of light in incandescent lamps. It points out the advantages of the new Shelby lamp in the matter of light distribution. These lamps throw the light downward where it is most desired and for this reason it is claimed that it requires less current for the useful light produced. The facts given in the pamphlet are interesting. The company is distributing copies of this pamphlet among the trade.

QUEEN & CO., INC., of 1010 Chestnut Street, Philadelphia, have just issued one of the most beautiful and tasteful trade catalogues we have seen. It is a quarto of 36 pages and is devoted to their self-regulating Röntgen ray tube. It contains several excellent illustrations, including four rich inserts in actual colors, showing the appearance of the tube when operating under different conditions. It is admittedly difficult to describe the phenomena and conditions in so many words, but these faithful and artistic pictures present the tubes exactly as one sees them. Our readers ought to secure copies of this admirable brochure at once.

SILICA GRAPHITE PAINT.—In a folder just issued by the Joseph Dixon Crucible Company, Jersey City, N. J., the subject of stack protection is discussed. Dixon's silica graphite paint is especially prepared for this work, and, it is stated, has been continuously used for nearly forty years by many of the largest steamship, smelting and manufacturing companies in different parts of the world. This paint is also recommended for protection of boiler fronts and flues, steel bridges, viaducts, roof trusses of roundhouses and terminals. It is stated to be proof against the corrosive action of heat, cold, moisture and sulphurous fumes. It is manufactured in various colors.

JESSOP'S STEEL.—A very interesting and beautifully printed brochure has been issued by William Jessop & Sons, Ltd., of Sheffield, England, entitled "Jessop's Steel and How They Make It." The illustrated narrative not only deals with the history of this famous concern, but gives a great deal of valuable and instructive data as to the production of its steel which has so long been a standard specialty in the world of mechanics and engineering. A record stretching back to 1774 is brighter than ever in 1902, and the ideal of excellence aimed at and achieved by this British house may well serve as exemplar and encouragement for every American manufacturer determined to make his product likewise the best for all the world. One section of the pamphlet deals with the use of electric welding at the Jessop Brightside Works.

THE CHICAGO FUSE WIRE & MFG. COMPANY, of 358 Dearborn Street, Chicago, Ill., announces that it has installed at 187 Pratt Street, Buffalo, N. Y., in connection with the Union Manufacturing and Specialty Company a complete equipment for the manufacture of its well-known lines of fuse wire, fuse strip, fuse links and telephone and telegraph specialties. This move has been occasioned by the steady growth of its business and a desire on the part of the Company to do everything in its power to give the best service to its customers in all sections of the country. The headquarters of the Company will remain at Chicago, but the Eastern factory at Buffalo will be in charge of competent men who are thoroughly trained in the details of the business. Mr. W. R. Goodman, secretary of the Chicago Fuse Wire and Manufacturing Company, further states that the new plans contemplate extensions in its field of work.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 18, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

12,056 (Re-issue). COMBINED ELECTRIC SIGNAL AND TELEPHONE SYSTEM; O. P. and H. R. Yurgae, Milwaukee, Wis. App. filed July 26, 1902. (See Current News and Notes.)

713,274. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App. filed Feb. 26, 1898. An overhead insulated conductor having exposed portions and an overhead sectional conductor adapted to be moved into contact with the exposed portion by the pressure of the trolley wheel. (Issued Nov. 11.)

713,340. ELECTRO-MAGNETIC BRAKE; W. T. Pember, Toronto, Can. App. filed March 4, 1902. A bar surrounded by a magnet coil is hung between two wheels and carries two brake shoes adapted to bear against the respective wheels. When the magnet is energized, the magnetic circuit includes the wheels and rail and establishes friction between the wheels and rail as well as between the wheels and shoes. (Issued Nov. 11.)

713,586. FILAMENT FOR INCANDESCENT ELECTRIC LAMPS KNOWN AS NERNST LAMPS; R. Arno, Milan, Italy. App. filed Feb. 8, 1900. An incandescent element adapted for three wire systems, consisting of a ring having three lugs equally spaced apart for connection with the respective wires.

713,589. BRUSH HOLDER SUPPORT; H. A. Balcome, Jamaica Plain, Mass. App. filed March 8, 1902. A ring support mounted to be adjustable towards and away from the commutator.

713,599. TROLLEY POLE; T. C. Buder, St. Louis, Mo. App. filed April 4, 1902. The harp sleeve can turn on the end of the pole when the wheel passes a curve in the wire, and in doing so it rises slightly to ease the wheel.

713,601. RHEOSTAT; F. E. Case, Schenectady, N. Y. App. filed May 10, 1902. A series of resistance grids mounted in an open frame adapted to be secured under a car.

713,603. DYNAMO ELECTRIC MACHINE; A. Churchward, Chicago, Ill. App. filed Jan. 2, 1900. A laminated field core having some of the plates cut away at the polar tips for the purpose of reducing armature reaction.

713,604. DYNAMO ELECTRIC MACHINE; A. Churchward, Chicago, Ill. App. filed Jan. 2, 1900. The poles of the field magnet are formed with slots to control the direction and location of the magnetic flux.

713,605. TRANSFORMER; A. Churchward, Chicago, Ill. App. filed Nov. 13, 1899. The core is built up of U-shaped and T-shaped plates, alternately placed.

713,652. THERMO ELECTRIC GENERATOR; I. Kitsee, Philadelphia, Pa. App. filed Feb. 9, 1900. A material normally in its solid state, but melting in its water of crystallization, is interposed between the two metals to increase the difference of potential.

713,662. RURAL DELIVERY BOX; A. Miesse, Lima, Ohio. App. filed March 29, 1902. When mail is deposited in the box at the roadside, an electric signal is rung in the house.

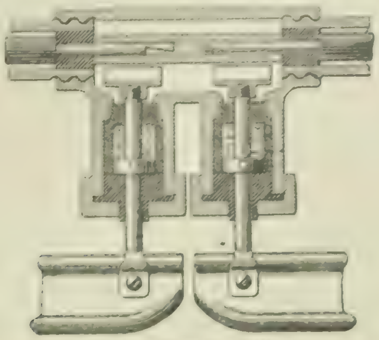
713,668. SWITCHBOARD FOR ILLUMINATING ELECTRIC LIGHT SIGNS; M. Norden, New York, N. Y. App. filed March 11, 1902. A switching mechanism for displaying letters and numerals of a sign.

713,671. MACHINE FOR WASHING MATRICES PREPARATORY TO ELECTROTYPING; Charles M. Oliver, of Baltimore, Md. App. filed Aug. 26, 1902. The matrix is placed on a table which is made to reciprocate under spray pipes by means of a belted right and left-hand worm screw.

713,677. SYSTEM OF ELECTRIC DISTRIBUTION; J. S. Peck, Pittsburg, Pa. App. filed March 27, 1902. (See Current News and Notes.)

713,678. CONTROLLER FOR ELECTRIC MOTORS; T. A. Perkins, Idletown, Pa. App. filed Jan. 6, 1902. The initial movement of the hand determines the direction in which the motor or motors rotate and stores power to be subsequently expended automatically in closing the line circuit and effecting the desired changes in speed.

713,700. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App.



[illegible]—Electric Railway.

filed June 10, 1901. The relay circuit passes through an intense magnetic field, which in reacting upon the field produced by the high frequency oscillations, causes a choking action which compels the oscillations to pass through the coherer.

713,711. BRUSH HOLDER FOR MOTORS; B. A. Stown, Cleveland, Ohio. App. filed July 12, 1902. Details.

713,712. SWITCH FOR ELECTRIC CIRCUITS; H. R. Stuart, Wilkinsburg, Pa. App. filed Jan. 6, 1902. Details.

713,720. SYSTEM OF ELECTRICAL DISTRIBUTION; M. O. Troy, Lynn, Mass. App. filed Dec. 19, 1901. (See Current News and Notes.)

713,721. SYSTEM OF ELECTRICAL DISTRIBUTION; M. O. Troy, Lynn, Mass. App. filed May 31, 1901. (See Current News and Notes.)

713,741. MEANS FOR PREVENTING ACCIDENTS AT RAILWAY CROSSINGS; C. E. Brown, Johnstown, Pa. App. filed April 16, 1902. A gate at a railway crossing cannot be lifted to allow a trolley car to cross until the conductor goes to the other side of the track and operates a circuit closer.

713,742. CONTACT SHOE FOR ELECTRIC RAILWAYS; W. M. Brown, Johnstown, Pa. App. filed Nov. 30, 1901. A shoe having a flexible face, permitting it to yield when passing over button contacts.

713,744. TELEPHONE SYSTEM; C. G. Burke, Brooklyn, N. Y. App. filed May 23, 1901. (See Current News and Notes.)

713,753. COMBINED ELECTRIC LOG AND SPEED RECORDER; F. N. Denison, Victoria, Canada. App. filed Sept. 26, 1901. Details.

713,822. ELECTRIC RAILWAY; E. P. Wetmore, London, England. App. filed Nov. 30, 1901. An unbroken loop of a sub-conductor is raised into a contact box in which a movable terminal engages with an exposed part of the loop.

713,828. AUTOMATIC RELEASING DEVICE FOR SAFETY TROLLEYS; A. C. Wolfe, Denver, Col. App. filed Feb. 6, 1902. A centrifugal governor operates to release the spring from the trolley pole when the upward movement of the pole is abnormally great.

713,829. TELEPHONE; E. E. Yaxley, Chicago, Ill. App. filed Oct. 9, 1902. (See Current News and Notes.)

713,831. FUSE; C. C. Badeau, Schenectady, N. Y. App. filed Jan. 26, 1901. Two separate sections of good conducting metal are separated an arcing distance by a fusible section.

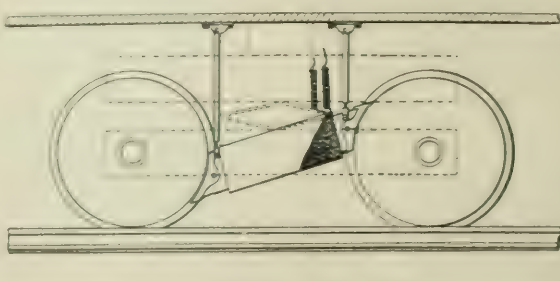
713,858. LATCH FOR CONTROLLER HANDLES; F. B. Corey, Schenectady, N. Y. App. filed April 12, 1902. A mechanical arrangement for enforcing a step by step arrangement of a trolley handle containing a latch.

713,861. VARIABLE SPEED ELECTRIC MOTOR; A. G. Davis, Schenectady, N. Y. App. filed March 29, 1902. (See Current News and Notes.)

713,863. PROCESS OF COATING PHONOGRAPH RECORDS; T. A. Edison, Llewellyn Park, N. J. App. filed June 16, 1900. (See page 868.)

713,864. ELECTRIC HAND SETTING MECHANISM; O. A. Enholm, New York, N. Y. App. filed Aug. 30, 1901. Details.

713,887. CIRCUIT BREAKER; T. J. Johnston, Schencetady, N. Y. App. filed Feb. 1, 1899. Instead of the ordinary iron armature for operating the trip of the circuit breaker, a closed circuited coil through which the magnetic circuit of the series coil is closed, is used and acts to cut down the self-induction and to diminish the loss in the coil.



713,340.—Electromagnetic Brake.

713,901. TRANSFORMER; W. S. Moody, Schenectady, N. Y. App. filed May 28, 1900. An oil case for a transformer having corrugated sides to radiate heat.

713,904. INSULATOR FOR TELEGRAPH LINES; J. E. Murray, Washington, Pa. App. filed April 19, 1902. A plug holding the wire in a groove of the knob is confined by a cap threaded over the knob.

713,923. ELECTRIC FURNACE; A. A. Shade, Chicago, Ill. App. filed Dec. 28, 1901. (See page 868.)

713,934. WATTMETER; V. Arciono, Spoleta, Italy. App. filed June 25, 1902. Two fixed coils in series on the line, two movable coils in shunt and acted upon by the fixed coils, and a reversible motor automatically thrown into operation by movement in one direction or the other of said coils for counter-balancing the action of the current thereon.

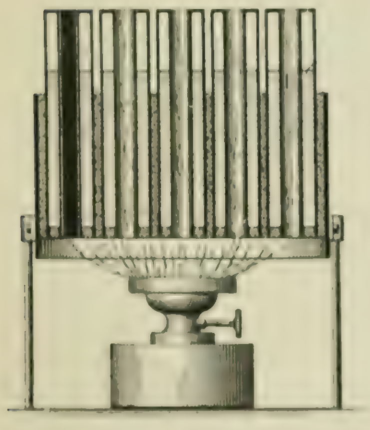
713,992. RATCHET OPERATED ELECTRIC SWITCH; W. Kingsland, London, Eng. App. filed April 22, 1902. Details of a step by step switch movable in either direction and operated by a ratchet and tappet.

714,020. ELECTRIC INTERRUPTER; L. G. Nilson, New York, N. Y. App. filed May 14, 1902. The arc at the contacts of the interrupter is extinguished by a field formed by the magnet which controls the interrupter.

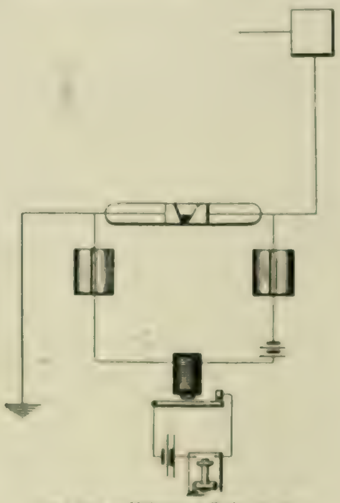
714,021. CONTROLLER FOR ELECTRIC MOTORS; L. G. Nilson, New York, N. Y. App. filed May 15, 1902. Details.

714,022. ELECTRIC LAMP SOCKET; M. Norden, New York, N. Y. App. filed June 5, 1902. The cap which covers the base, has a pair of grooves in which the conductors are deposited and which then guide the conductors on to a pair of brads fixed in contact plates secured to the plates.

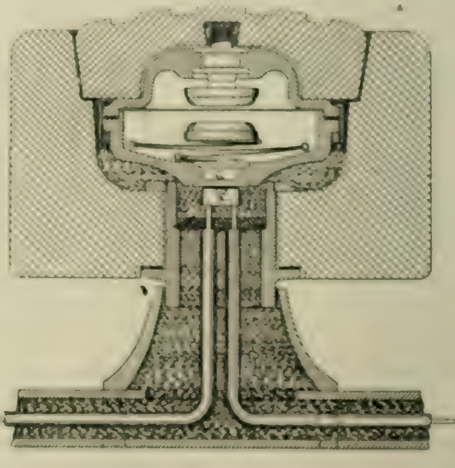
714,046. AMPERE HOUR METER; W. A. Sherlock, San Francisco, Calif. App. filed June 18, 1902. The current is passed through an electrolyte to generate gases, the volume of which is measured.



[illegible]—Thermo Electric Generator.



713,700.—Wireless Telegraphy.



713,822.—Electric Railway.

714,055. SYSTEM OF DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed March 6, 1899. (See Current News and Notes.)

714,093. DYNAMO ELECTRIC MACHINE OR MOTOR; J. W. Blackledge, Chicago, Ill. App. filed Feb. 1, 1902. Details.

714,116. SYSTEM OF DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed March 24, 1902. (See Current News and Notes.)

714,118. SYSTEM OF ELECTRICAL DISTRIBUTION; M. O. Troy, Lynn, Mass. App. filed April 3, 1902. (See Current News and Notes.)

714,119. SYSTEM OF ELECTRICAL DISTRIBUTION; M. O. Troy, Lynn, Mass. App. filed May 31, 1902. (See Current News and Notes.)

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Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

SPECIAL ANNOUNCEMENT TO ADVERTISERS.

The attention of advertisers is directed to an important announcement appearing on page xviii of the advertising section of this issue, on the subject of the new schedule of advertising rates taking effect January 1, 1903.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

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Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, DECEMBER 6, 1902.

CONTENTS.

THE AMERICAN-PACIFIC CABLE.

President Roosevelt's message to Congress this week contains one passage of particular importance to electrical engineers, namely, that in which he describes the course of events with regard to the terms and conditions made with the Commercial Pacific Cable Company, under which "an all-American line between our Pacific Coast and the Chinese Empire, by way of Honolulu, and the Philippine Islands, is thus provided for." This is in reality one of the most important items in the message, and the President will soon have the great satisfaction of using that cable to exchange congratulations with all the rulers of the East as well as with our own dependencies. We could have wished that the cable had been more strictly speaking "all-American," and had been made in this country, but now the main thing is that it will be available to aid and stimulate intercourse with the Pacific. What that may mean commercially to us is intimated by the remarkable article in our pages on the Sydney Tramways, where practically the whole equipment is of American origin. What has been done there can be done elsewhere, especially with the aid of reciprocity treaties, for as the young Prince of Siam suggested when here, it takes two to an agreement and to be friendly, and his people like the rest are ready to meet us half way. There is so much we need from the East and so much we can send there, the Pacific cable has become a necessity to commerce and will, we believe, be an aid to international friendship.

POWER FOR RAILROADS.

We are very much interested in an article by Mr. Cornelius Vanderbilt on electricity as a motive power for trunk railroads, appearing in the *North American Review* for December. It is an extremely creditable production and stamps the young engineer as a thinker of no small ability. It is a careful study of the situation, and reaches the conclusion that while it is possible from the engineering standpoint to adopt electricity, the change is not possible regarded from the financial point of view. Mr. Vanderbilt dismisses at once all considerations as to the convenience and comfort of the passenger, for while admitting that better facilities often pay for themselves, he urges that all that a railroad manager has to look at is freight business. Let us quote him: "We know from experience that, in passenger service, increased convenience and facilities in many cases more than compensate for increased cost of transportation. This convenience, as we may term it for want of a better word, includes general convenience to passengers, speed, number and frequency of trains, and is the all-important point in passenger traffic. Combining this with the fact that, after a certain density of traffic is realized, the fuel cost may be reduced, we have the reason for the success of the trolley system and for the adoption of electricity as motive power on certain metropolitan and suburban roads. In passenger traffic, the position of the road should determine, in the main, whether electricity is to be adopted, due consideration being given to the possibility of increasing the density of traffic by increasing the convenience, and a final judgment being rendered in its favor when it is seen that the density induced by this convenience will warrant the greater first cost and produce a larger net return (after deducting interest and cost of operation of the additional machinery) than will be produced if steam power is used. This net return may be procured either by a decreased fuel cost, if the density of traffic is sufficient, or by increased rates should the convenience be so increased that the passengers are willing to pay for it."

We understand Mr. Vanderbilt to [illegible] that electricity is a good thing for passenger traffic; but he argues that, as to freight it is out of the question; and freight, he contends, is the determining factor. Moreover, the freight traffic is not dense enough, and "it may be said that there are at present no roads in the United States deriving two-thirds of their total revenue from the transportation of freight, which is a fair proportion for a trunk line, on which this condition is found," viz., with traffic density enough for the change.

It is to be noted that Mr. Vanderbilt assumes and talks about "de- [illegible] creased cost of transportation" as associated with the change to electricity; but we are not aware of any facts whatever to justify this idea or inference. It is certainly not derivable from street railway results, nor even from the still limited but profitable changes on the Manhattan; nor from other elevated roads. It will be observed that Mr. Vanderbilt discusses "trunk roads," but we should have liked a closer definition of the phrase, for it is possible that here a confusion may exist in Mr. Vanderbilt's mind. Perhaps it would be fairer to ask, what is the density of traffic at which a trunk road ceases to be a trunk, or whether a trunk is such because of length, or whether it will cease to be a trunk when it is cut up into sections with electricity fed into them. In this change that Mr. Vanderbilt in spite of himself allows to be "in the air," and which he discusses with an almost-thou-persuadest-me attitude, it seems to us that some of the English roads are likely to be leaders, for they are seriously taking up the subject and have the exact conditions of density which we gather from Mr. Vanderbilt's article to be required before steam is abandoned. We shall not be surprised to see England or Germany lead us in this respect, just as the United States has undoubtedly led in street railway work; although we are inclined to claim some of the interurban electric systems as well within Mr. Vanderbilt's apparent "trunk road" category, for length and other conditions.

One other point strikes us in an article we may return to for other discussion, and that is Mr. Vanderbilt's apparent assumption that all is well in the trunk road handling of freight by steam locomotive methods. Now, we can easily conceive methods of freight handling with electric power by which freight would not get so horribly congested as it did recently at Pittsburg, but which would encourage the sending of many a ton of perishable freight that the steam roads do not get. Against steam freight locomotives of but one or two sizes at best, allowing very little variation in size of train hauled, if efficiency is considered, it does seem that the undeniable flexibility of electric systems would enable many new and better things to be done that have not entered into the philosophy of men bred under the more rigid old steam regime.

Round the World by Wireless.

A recent interview with Mr. Marconi brings forth the announcement that an extensive land campaign is in contemplation. The inventor states that as soon as the success of the present Table Head station is assured, land stations throughout Canada will be erected and also in United States territory a belt of stations joining the Atlantic and the Pacific. In the other hemisphere stations of the first magnitude in Italy and at Cape Town are in contemplation, to be followed by others eventually perhaps girdling the earth. It is an interesting programme, and if carried out will be a worthy pioneer in the great scientific advances of the twentieth century. The plan for future work is scarcely less interesting, however, than some of the more general statements here credited to the brilliant Italian. He is definitely quoted as saying that he does not think his system "will be a serious rival to either ocean or land telegraphy, but will eventually become an auxiliary to it." If this published avowal is fully authentic, as it must be assumed to be in the absence of official contradiction, Marconi himself takes a far more conservative view of the situation than some of his followers. It would look as if syntonic working, obviously a prime necessity if an extensive commercial system is to be evolved, had encountered serious limitations. We have several times dwelt on this phase of the matter, which has looked somewhat dubious from the very start, and it would be small wonder if experimentation had taught the difficulties of the situation. Even without it there is surely a great commercial future for wireless working merely along the seaboard, provided it can be made to work with complete reliability over a bare hundred miles or so. Up to the present there seems to be grave doubt whether this limit can be reached in working every day and all day. In the wireless service on the transatlantic steamers there has been beautiful success in picking up passing neighbors at long range, but there have also been lugubrious failures in reaching the land stations at very moderate distances.

It is perhaps too much to expect a comparatively new apparatus to settle down at once to steady work, and the broadest charity should be extended to cover occasional failures, but the cause of such failures is nevertheless a very important matter. If chargeable to the apparatus it is one thing, if inherent in the nature of the transmission it is quite another. We trust that ere long full data on this phase of the subject will have been accumulated. Apropos, Mr. Marconi is quoted as confirming the report that messages from Poldhu were actually received on board the *Carlo Alberto* in Sydney Harbor, but declining to give out the particulars. It is, of course, his privilege to keep such details to himself, but we greatly regret that he could not see his way clear to speak out. The public is very much interested in knowing whether the news from Cornwall consisted of lengthy and coherent messages, or of repetitions of the famous Morse *S*, or perchance *E* or *P*. It is certainly no mean achievement to have received any signals at all over such a distance, but the practical value of the work hinges on getting through actual messages with some approximation to certainty. We might suggest in this connection that it is by no means certain that ordinary Morse would form the best alphabet for long-distance wireless work. One deals in such case with conditions widely different from those encountered in ordinary telegraphy and our time-honored code may break down where another would score a signal success.

The Girdle Around the Earth.

At last, after more than fifty years of gradual extension, the telegraphic girdle around the globe has been completed by the laying of the Pacific cable from Vancouver to Australia. This includes the Vancouver-Fanning Island section, which is the longest in the world, being 3,458 nautical or very nearly 4,000 statute miles in length. This gives England three alternative telegraphic routes to Australia, namely, the new "all-British" trans-Pacific route, westwards, the South African route, also "all-British," and the eastern route, via India. Owing to the great length of the Vancouver-Fanning cable, its conductor has been made extra heavy, 600 pounds per knot, or with about 2 ohms per nautical mile. The total weight of copper in this section must be over one thousand short tons. The average depth of the deep-sea cable appears to be about 2,700 fathoms

or a little over three statute miles. Structurally, the core is interesting, owing to the use of strips in the conducting strand. That is to say, there is one central large copper wire, overlaid by four flat strips applied spirally. This forms a more compact strand for the same mass and conductance than when all the components are cylindrical. Twelve different types of cable enter into the complete route across the Pacific. One of the shore ends is very heavy, and weighs 21 tons to the nautical mile. The division of the cost of this cable is remarkable. Canada and Great Britain each assumes about 28 per cent., British Columbia 11 per cent., and the remaining 33 per cent. is taken by the Australian colonies. British North America consequently pays nearly 40 per cent. of the total cost.

THE BOB-TAILED CURRICULUM.

We have already expressed ourselves pretty fully on the subject of collegiate education, so far at least as engineering students, but a recent pronunciamento from President Butler reminds us that there is still something left to be said. That distinguished educator is quoted as saying in effect, that he favors the two-year college course because it is better for the student to dawdle only two years instead of the canonical four. We earnestly hope that he will take steps in our great metropolitan university to avert dawdling even for so short a term as two years. Perhaps the same cogent line of reasoning may adequately explain the grave doubts which have been expressed by noted business men as to the usefulness of any college course at all. The fact is that the weakest point in our whole modern educational system is a certain apparent incapacity to prevent dawdling. When the cultured graduate of the kindergarten, the juvenile art school, the infantile conservatory of music and three or four prenatal laboratories comes up to the college, he is very apt to interrogate Nature as to the easiest way of sliding through. The whole field of classified knowledge and ignorance is open to his choice in the elective system, and he would reflect discredit on his previous training if it should give him no clue to the smooth and easy path. Now to our mind the first duty of the higher institution of learning should be to take this victim of slipshod soul culture by the nose and lead him firmly up to the strenuous life. It is not so much what he learns, as how he learns, that determines his future capacity for serious work. And according to our observation the average college needs considerably more than two years merely to instill the fundamental principles of mental activity. And from that point education begins.

LONG-DISTANCE WIRELESS TELEGRAPHY.

In a recent number of the London *Electrician,* Lieutenant Solari, of the Italian Navy, has published a very interesting account and journal of wireless telegraphic signalling between the high-pressure sending station at Poldhu, Cornwall, and the Italian cruiser *Carlo Alberto* as a moving receiving station, during the period June to September, 1902. A map printed with the article indicates that on her journey from Kronstadt in the Baltic to Spezia in the Mediterranean the *Carlo Alberto* was more or less in communication with Poldhu. That is to say, messages transmitted out from Poldhu were received by the *Carlo Alberto* at various points all along the route. The maximum distance of transmission was nearly 1,400 miles across England, and also across the Scandinavian mountains. This is certainly a brilliant achievement, and as a *tour de force,* Mr. Marconi may well be proud of it. It is to be hoped that eventually such a programme may be regularly scheduled for the benefit of the ordinary passenger steamer. But at the present early stage of wireless telegraphy development, the event seems only to have been rendered possible by its rarity. The signals emitted from Poldhu must have stirred up the circumambient ether for many a long mile from Cornwall in every direction, to the detriment of efforts that may at such moments have been pending to establish wireless communication on a humbler scale and within a narrower compass.

The *Carlo Alberto* was rigged for the work by the addition of top-gallant masts, and between these masts she supported an imposing array or grid of fifty vertical wires descending nearly to the deck, and resembling a gigantic lyre. Poldhu talked to this floating lyre by electrifying a tall cage of wire with impulsively generated pressures of something like 150 kilovolts, judging from the sparking distance mentioned. Lieutenant Solari several times alludes to the observation first published by Marconi, that during daylight hours the long-distance signals were much weaker than during darkness hours. It seems, in fact, that the best long-distance wireless telegraphy is carried on, if not in the light of the moon, at least in the dark of the sun. This is a curious antithesis to the ordinary method of flag-signalling at sea, which, of course, requires daylight.

Two weeks after the Solari report was printed in the *Electrician* an article appeared by Mr. Maskelyne commenting upon the matter. It seems that Mr. Maskelyne was engaged about the same time in carrying on some independent wireless telegraphic operations at Porthcurnow, in Cornwall, 18 miles away from Poldhu, and his apparatus was inundated with the energy emitted from the latter station. He seems to have kept an automatically registered voluminous record of the outpourings of Poldhu's soul. It would seem, in fact, that at least on one occasion a large audience in the community of Porthcurnow was regaled with a message addressed to the *Carlo Alberto* then near Cagliari. This message was automatically repeated from the wireless receiving antenna on the hill above Porthcurnow to the station in the valley, over an ordinary telegraph circuit. Porthcurnow is an important submarine telegraph station containing a number of trained operators. It is intimated that this message was pumped out into space many times during the succeeding 72 hours; but from Solari's journal it does not seem to have been picked up by his ship until near the end of that period, when, however, it was duly registered, and correctly recorded. Poldhu sometimes talked to the mighty deep in English and sometimes in Italian. So closely did Porthcurnow follow the remarks of her neighbor Poldhu, that on occasion Mr. Maskelyne seems to have been called at 2 A. M. because Poldhu was talking "rubbish." Considering the earliness of the hour this might have been considered excusable in Poldhu. But Mr. Maskelyne forthwith trudged to his wireless cable house on the cliff, to see what the gibberish of Poldhu might mean. It appears that by submitting the received impulses to electro-magnetic analysis he resolved Poldhu's jargon into two coincident emissions. One was an important message addressed to the wandering *Carlo Alberto* on the wide, wide sea across Europe, while the other was a separately emitted set of dots, or impulses, thrown in, like a running bass, to muddle the ether, for the benefit of those in the neighborhood who might have antennae to hear. It also seems that Mr. Maskelyne secured records of both the real message in alt., and of the "running bass" of dots.

Mr. Maskelyne concludes with a pathetic appeal to Mr. Marconi to tune his Poldhu station in some manner that the working thereof shall cease to vex Porthcurnow. The cry here is not for wireless messages, but for their obliteration. Porthcurnow seems to regard Poldhu as a "thunder factory." It has not yet transpired in what light Poldhu regards Porthcurnow. In telephony we have passed through a stormy period as to who should electrically possess the earth. It would now seem that we approach a stormy period in wireless telegraphy as to who shall own the heavens.

Independent Telephone Meeting at Chicago.

As already announced in these columns, the second convention of the Interstate Independent Telephone Association will be held in Chicago on December 9th, 10th and 11th, at the Auditorium Hotel, where space will be provided for exhibits. The general and entertainment committee in charge of affairs is composed of James Wolff, C. W. Farr, H. B. McMeal, W. E. Doolittle, S. A. Dinsmore, F. B. Patten and J. J. Nate.

The provisional programme is as follows:

Tuesday morning, December 9th, Executive Committee will receive visitors at the headquarters of the secretary, after which an inspection of the manufacturers' exhibits will follow. An address of welcome will be delivered at two o'clock in the afternoon by H. S. Taylor, prosecuting attorney, Chicago. The response will be given by President H. C. Raney, of Fairfield, Iowa. This will be followed by the reports of the various committees and the selection of the nominating committee by the States to report on call of the president.

Wednesday morning: "Measured Service," George N. Bandy, Perry, Iowa; "Sliding Scale Rates for Exchanges," Dr. H. S. Herr, Ottumwa, Iowa; "Toll Rates," H. H. Robinson, Cleveland, Ohio. After the reading of these papers on rates and accompanying discussion, time will be taken for a review of the "Restrictions by Municipal Authority." It is expected that synopses of the law in Ohio, Iowa, Wisconsin, Minnesota, Michigan, Indiana, Illinois, Missouri and Kentucky will be given.

Wednesday afternoon: "Settlement of Toll Business between Connecting Companies," A. L. Hutchison, Weyauwega, Wis.; "Enforcement of Message Time Limit," H. E. Ralston, Maitland, Mo.

Thursday morning: "Independent Telephone Securities as an Investment," by Col. J. D. Powers, of Louisville, Ky., and J. H. Layne, of Carthage, Mo., the former treating the subject from a banker's point of view, and the latter from that of the small investor.

Thursday afternoon: "The Berliner Patent, Bell's Claims of Infringement and Litigation now Pending," by J. J. Nate, Chicago, and "Suggested Methods for Improving Long-Distance Telephony," by Senator C. E. Hull, Salem, Ill.

A banquet is proposed for the night of either the 10th or the 11th.

Engine Builders' Association.

The Engine Builders' Association of the United States met at Sherry's on Monday afternoon, December 1, with Mr. W. M. Taylor, of Indianapolis, in the chair. Four papers were read as follows: "Superheated Steam," by Ernest H. Foster, of New York; "High-Pressure Steam Piping," by William Andrews, of New York; "The Early History of the Corliss Engine," by Geo. R. Phillips, of Greene, R. I.; "The History of the High-Speed Engine," by Prof. John E. Sweet, of Syracuse, N. Y.

Mr. Foster in his paper gave in detail the advantages to be derived from the use of superheated steam, and pointed out the precautions to be observed in designing engines and piping systems where superheated steam is used. The use of superheat has been rendered possible by the introduction of mineral oil and graphite lubricants and the evolution of efficient superheating apparatus. At present the superheater may be depended upon as safely as a boiler or engine, or any other part of a steam plant. No difficulty is met now in dealing with the moderate superheat, that is to say, from 100 to 150 degrees. If the engine is compound, the steam having lost its superheat at the exhaust point of the high-pressure cylinder, is resuperheated about 100 degrees in a reheater between the high and low-pressure cylinders, and again loses its superheat while expanding in the low-pressure cylinder, arriving at the point of exhaust with the steam at the temperature of saturation. To employ high degrees of superheating, it is at present considered important to use poppet valves on the high-pressure cylinder at least. Mr. Foster considers that in the present state of the art, it would be best for American engine builders to confine themselves to the use of moderate superheating. A case is cited where the gain in economy with a 1,000-hp engine with the use of high superheat was 30 per cent. Superheating will also enable the steam pipes and ports to be reduced in area. With superheating the use of the steam jacket is obviated. No difficulty is experienced in lubrication if a reasonably good grade of mineral oil is used. Superheated steam is destined to play an important part in the adoption of the steam turbine.

Mr. Andrews gave a sketch of the evolution of steam piping during the past quarter of a century. The present wrought steel piping was introduced about 1892, and has almost superseded all other kinds of piping. With the advent of high-pressure superheated steam the size of pipes has been much reduced. A radical departure consists in running pipes from the header two sizes smaller than that called for by engine builders. These pipes before reaching the engine are carried into a wrought iron or steel receiver placed near the engine, which acts as a separator and has a cubic capacity about three times that of the high-pressure cylinder. The pipe from the receiver to the cylinder is of the full size called for by engine builders.

Prof. Sweet gave his recollections of the early days of the high-speed engine industry, beginning about 1862 with the Allen engine. A considerable portion of the paper is devoted to this engine and its commercial development under Mr. Charles T. Porter. Reference was made to a number of other automatic engines, including the Buckeye, Payne, "Straightline," Armington & Sims, Westinghouse and Ball.

The paper by Mr. Phillips consisted of a biographical sketch of George H. Corliss, which included an account of his various business connections and his litigation with Sickles. The more important early Corliss engine plants were described in detail, and a chronological account given of the improvements made by Corliss from time to time.

On Tuesday afternoon at the business meeting of the association the officers for the ensuing year were elected. Mr. W. M. Taylor was re-elected president, Mr. C. A. Gates vice-president, Mr. C. S Bonsall treasurer, and Mr. F. P. Ide secretary. On Tuesday evening a banquet was served at Sherry's, which was well attended and thoroughly enjoyed by all present.

Drawbacks of the Country Telephone.

The introduction of the telephone into farming and rural districts has been a great boon to all concerned, but some of its drawbacks are hinted at in a recent article in the *Detroit Free Press* as follows:

"City people whose neighbors use their telephones think they know all about trouble," said a ruddy-faced amateur farmer, "but I'll compare notes with them any day. If you are not obliging to your neighbors in the country you had better move back to town; so this is what we go through with in order to be obliging. We have the only telephone in our vicinity, and my wife and I ought to draw salaries as rural messengers.

"The other day a call came to our telephone from someone in town who wished to talk with Mrs. Jinks, our tenant's wife. So my wife had to leave her sewing, don her sunbonnet and plod across the rough fields a third of a mile to tell Mrs. Jinks to come to the telephone. When Mrs. Jinks got ready she lumbered up to our house with a fat baby under each arm, and found out that Rosy, a friend of hers in town, wanted her to come and bring her out to spend the day.

"'Naw,' bawled back Mrs. Jinks; 'ain't got no hoss.'

"In a day or so another friend of the Jinks family telephoned out to say that she and three children would spend Sunday with the Jinkses, and Mr. Jinks must come in with the wagon to bring them out. My wife could not answer that the Jinkses had no horse, as they had just got one; so she promised to deliver the message. She gave the errand over to the Jinkses to me; I intended to attend to it, and forgot it. The folks in town got ready and waited all day Sunday, but no Mr. Jinks appeared. About Tuesday there was a great disturbance on the farm, involving all the Jinkses, my brother and myself, and both of our wives. The message hadn't been carried, and everybody was to blame.

"This is only a sample. We have other neighbors near and far; but our house is the telephone office of the district. People in town get mad at us, and people in the country get mad at us; our lot is hard."

Engineering at Colorado College.

Colorado College, at Colorado Springs, Col., will establish next year a school of engineering to cover five different courses, a general course and four special courses. The general course is intended as a non-professional course. The four special courses are: Civil engineering and irrigation; electrical engineering; mining engineering and sanitary engineering. A new science building is being erected and will probably be completed and equipped by the beginning of the next academic year.

The Sydney, Australia, Tramway System.

By F. G. Sykes.

THE first electric tramway to be operated in Sydney was installed about 1890, and resulted from the conversion of a short steam line between Randwick and Waverly, which could not be made to yield a profit when operated with steam. This experiment was, however, soon discontinued, and the electrical apparatus removed to North Sydney, and erected at the terminus of the cable system as an extension of this system to Middle Harbor. The next development in the electric traction system of Sydney was the extension of the Ocean Street cable tram as far as Rose Bay.

This extension skirts the shores of Sydney Harbor, giving to passengers a view of a beautiful bit of scenery, and from an engineering point of view is remarkable for its steep grades and sharp curves. It is doubtful if any other source of power than electricity could have been successfully employed on this extension. The power was furnished by two 150-kw General Electric six-pole dynamos running at 400 r. p. m., and belted to the engines used for operating the cable cars.

In 1898 the first electric power plant of any size in Australia was built at Sydney, and known as the Ultimo power house. The current generated at this power house was to be used for operating the trams on George and Harris streets, in the center of the business section of Sydney.

Before this time, and with the exception of the short electric trams mentioned above, and the cable trams at North Sydney and Ocean Street, transportation to the various sections of the city was had mainly by means of steam trams, which not only proved very noisy and dirty, but were expensive to operate.

The conversion of these steam trams to electricity was kept in mind when the Ultimo power house was designed, and it was built with the idea in view of increasing it to a size sufficient for supplying the entire system, steam trams as well. While this article deals mainly with the large new power house just built, a brief description of the original one will probably prove of interest.

It is situated close to the tracks of the Government railways and only a short distance from the shores of Darling Harbor, from which a supply of salt water for condensing purposes is obtained. The building is of brick and steel construction, and arranged with the offices in front, and the engine and boiler rooms side by side behind the offices, thus allowing of their future extension. The engine room is 120 feet long and 96 feet wide; the boiler room being 120 feet long and 84 feet wide. The latter is provided with fourteen multitubular 300-hp hand-fired boilers, built by a local firm. Each boiler is 16 feet long and 7 feet in diameter, and has 72 tubes, 4 inches in diameter. The boiler settings are fitted with hot-air economizers. The engine room contains four 850-kw generators, direct connected to cross-compound horizontal engines built by the E. P. Allis Company, of Milwaukee, and arranged in two rows down the

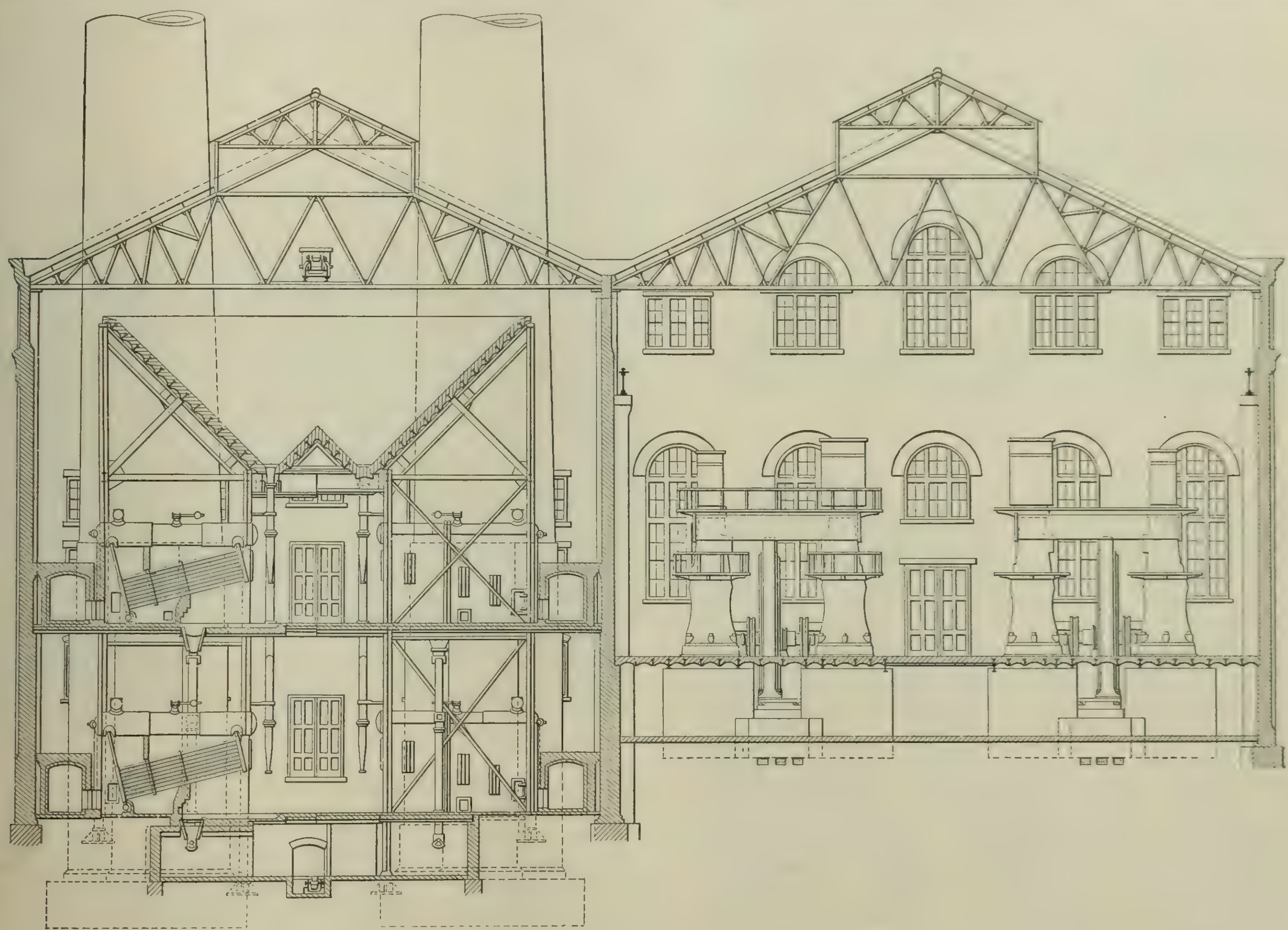


FIG. 1.—SECTIONAL VIEWS OF BOILER AND ENGINE ROOMS, ULTIMO POWER-HOUSE EXTENSION, SYDNEY, AUSTRALIA.

engine room. The engine high and low-pressure cylinders are 26 inches and 48 inches in diameter, respectively, with a 48-inch stroke, and their speed is 100 r. p. m.

They are alternately right handed and left handed, so that one condenser may serve for two engines. The generators are of the General Electric railway type, compound wound, and need no description. The flywheels are of the compound type, reinforced with steel plates, and weigh about 40 tons each.

Blake centrifugal circulating pumps and Blake three-throw plunger feed pumps, all driven by 40-hp slow-speed motors, are located in the boiler room, while Blake steam-driven air pumps are used for the Wheeler surface condensers installed. The switchboard is located on a gallery at the end of the engine room nearest the offices, and was built by the General Electric Company. It is of that company's usual railway type, built of black enameled slate and consists of four generator panels, 17 feeder panels, 5 lighting panels, summation, booster and battery panels. The engine room is provided with two electric cranes

built by the Case Manufacturing Company, Columbus, O., each capable of lifting 30 tons, the span of each crane being about 48 feet.

Without even attempting the conversion of the steam trams to electricity, it was found that this station was almost immediately loaded to its utmost capacity. It, therefore, became urgently necessary to enlarge this power house and to provide the necessary new apparatus as soon as possible.

As some of the steam lines extend for quite a distance into the suburbs, with consequent long feeders, the question arose as to the advisability of increasing the present direct-current installation, or of making an entirely new departure, and providing alternating-current apparatus. With this end in view, the Chief Railway Commissioner, Mr. Charles Oliver, made a tour of inspection around the world. While in the United States, and acting on the advice of Mr. M. G. Starrett, of New York, as well as that of his engineers in Sydney, he decided on a three-phase, 25-cycle, 6600-volt system, using substations with rotary converters and transformers, and in August, 1900, signed a contract with the General Electric Company for the entire station and substation apparatus (except three-phase cable and storage batteries), including the steam machinery, which latter, however, was rebuilt. This machinery has been installed in Sydney, and is now in successful operation.

The general plan of the extension just installed is as follows: The original power house at Ultimo has been enlarged, and three 1500-kw generators with the necessary engines, boilers and other apparatus have been installed. Five substations have been built, one each at Newtown, Randwick, Waverly, Hunter Street and North Sydney. In each of these substations, with the exception of that at Randwick, there has been installed two 450-kw rotary converters, six 175-kw air-blast transformers, and two 500 ampere-hour storage batteries, each provided with a 50-kw booster set for charging purposes. Randwick substation is known as a "single unit" substation, as it contains only one rotary converter and one storage battery.

BUILDINGS AND CRANES.

The plans of the new building known as the "Ultimo Power House Extension" were drawn by J. G. White & Co., of New York, and the building is almost an exact counterpart of the Ninety-sixth Street power house of the Metropolitan Street Railway Company, of New York City.

The boiler room occupies two floors, one above the other, and the ground space occupied is 176 feet long by 84 feet wide. Two coal bunkers of steel construction, and capable of holding 2,500 tons of coal, are built directly under the roof, which is about 75 feet above the lower boiler room floor. Two chimneys have been built, each 224 feet high, and containing about 750,000 brick. Each top is covered with a cast iron cap weighing six tons, and made up of twenty segments.

The engine room is separated from the boiler room by a brick party wall, and is 176 feet long by 96 feet wide. It is lofty and well ventilated, and has foundations built for six units similar to those about to be described. The whole building is substantially built of brick, with brownstone copings, and the roof is built of steel trusses covered with corrugated sheet iron, a monitor being built over the engine room for ventilation.

The engine room is provided with an electric crane built by the Morgan Engineering Company, and having a hoisting capacity of 30 tons, with a span of 96 feet. It is of the box girder type, provided with three G. E. railway motors and controllers for operating from a cage. It is also provided with electrical as well as mechanical brakes.

The substation buildings are brick structures with brownstone trimmings, very effective red tiled roofs, and are divided longitudinally into two parts, one part containing the rotary converters, etc., and the other part the storage batteries, a double interlocking door preventing the fumes from the battery room penetrating into the rotary room.

The battery room, which is 50 feet long by 40 feet wide, is in the double unit substations, two stories high, one battery being placed upstairs, and the other downstairs. The floor upstairs is covered with sheet lead, with the seams burned together, while downstairs the floor is of cement.

The rotary converter room is 50 feet long by 30 feet wide, built in one story, with a monitor at the top. This room is provided with a five-ton traveling crane, built by R. S. Scruttin & Co., of Sydney, and is also provided with a still, heated by a gas burner, for distilling the water for battery use. The floor is of cement, and is tiled around each rotary for a distance of about two feet, thus giving a very finished appearance to the machinery.

BOILER ROOM.

The boiler room contains 32 boilers, made by the Babcock & Wilcox Company, arranged to be set in batteries of two boilers each, eight batteries to be placed on the lower floor, and eight on the upper floor. Each boiler is rated at 450 hp, has 2,852 square feet of heating surface, and was built to operate under a steam pressure of 160 pounds per square inch. The front of each boiler is arranged for the reception of Babcock & Wilcox patent chain grate stokers. The coal is fed from the overhead coal bunkers by means of iron chutes, and feeds over the whole width of the grate, the thickness of the coal layer being regulated by the vertically sliding arrangement of fire doors. The stokers are operated by small engines connected by means of shafting and eccentrics. The John A. Mead system of noiseless coal and ash conveyors is in use, and consists, as is well known, of buckets mounted on wheels and operating on a steel trackway. The apparatus is operated by an electric motor, and includes a crusher operated by a second motor, and of 20 center dumping ash cars.

The feed water is forced from the hot well through two Goubert horizontal secondary feed water heaters, directly into the

FIG. 2.—BOILER ROOM, ULTIMO POWER-HOUSE EXTENSION.

boilers, by means of Worthington compound, duplex, outside-packed, plunger pressure-pattern boiler feed pumps. Three of these pumps are provided, each having two high-pressure steam cylinders 9 inches in diameter, and two low-pressure steam cylinders 14 inches in diameter; four single-acting outside-packed plungers 7½ inches in diameter, all of 10-inch stroke. Each of the above pumps is guaranteed to deliver 240 gallons per minute when running at a piston speed of 52 feet per minute on each side. The two feed water heaters are each provided with 1,500 square feet of heating surface, and are arranged so that the exhaust steam from the boiler feed, circulating and air pumps will be carried through the heaters.

The steam piping was furnished by the Best Manufacturing Company, of Pittsburg, and is laid out in accordance with the most modern ideas for combining simplicity with convenience and safety. Extra heavy piping and fittings were used, and ample provision was made for expansion by using wrought iron bends. The "unit" system has been employed, and the piping for each unit is as far as possible identical.

ENGINE ROOM.

The engine room is provided with three main engines built by the Allis-Chalmers Company, and placed in a row on the side of the room next to the boiler room. Each engine is a vertical, cross-compound condensing machine of the Reynolds-Corliss type, with high-pressure cylinder 32 inches in diameter, and low-pressure cylinder 64 inches in diameter. Both cylinders

FIG. 3.—ENGINE ROOM OLD ULTIMO POWER-HOUSE, SYDNEY TRAM SYSTEM, AUSTRALIA.

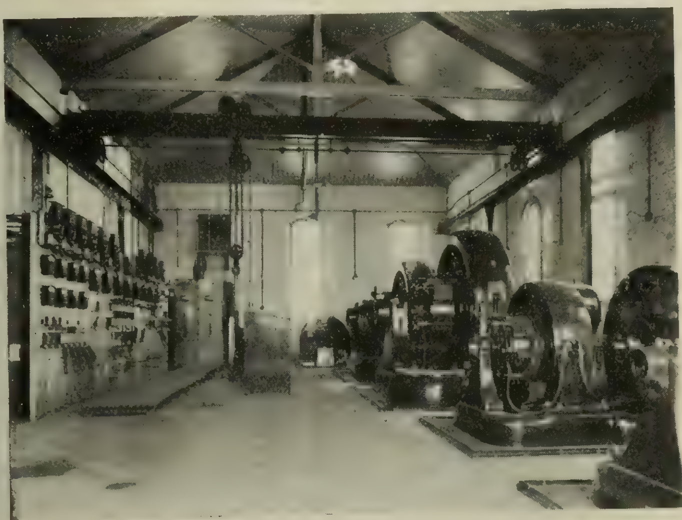


FIG. 4.—ROTARY CONVERTER ROOM, WAVERLY SUB-STATION.

THE SYDNEY, AUSTRALIA, TRAMWAY SYSTEM.

FIG. 5.—HIGH-TENSION CABLES.

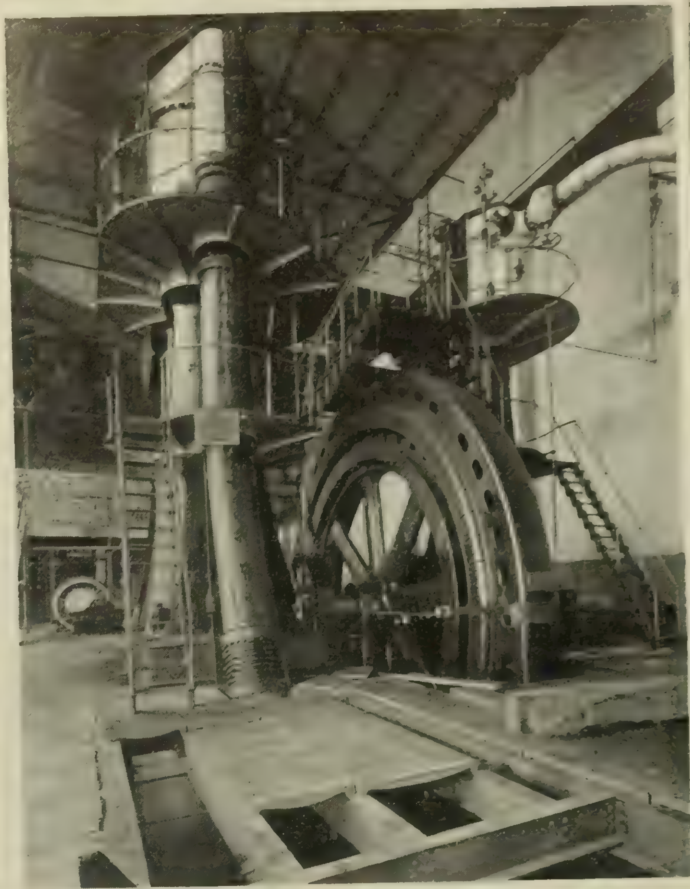


FIG. 6.—ENGINE ROOM, ULTIMO POWER-HOUSE EXTENSION.

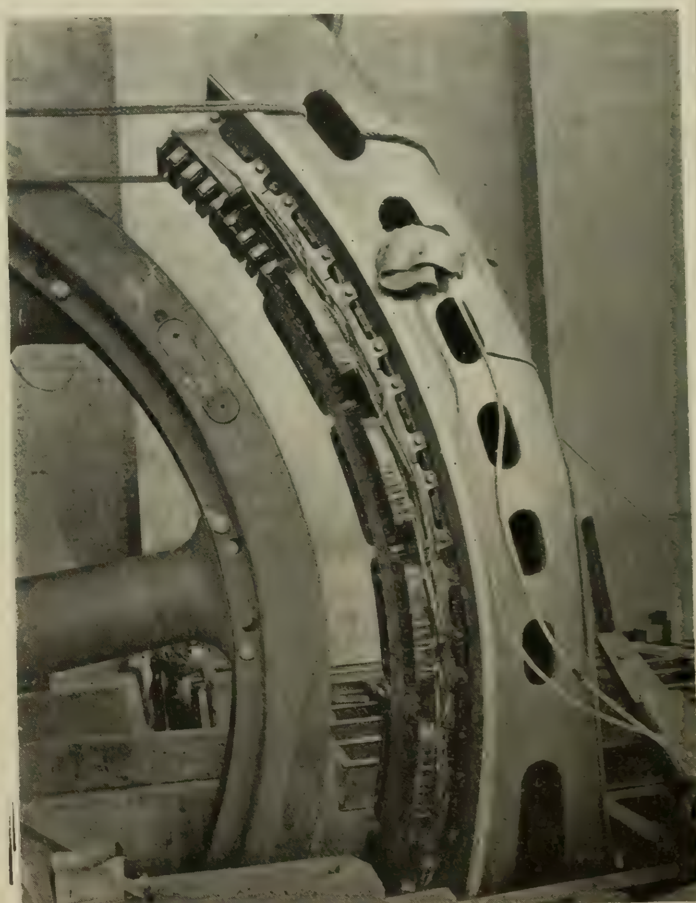


FIG. 7.—SECTION OF GENERATOR ARMATURE AND FLY-WHEEL, ULTIMO POWER-HOUSE.

[illegible] with 150 pounds steam pressure. The steam from the boilers is led directly into a Reynolds separator placed in the basement, flowing from there into the high-pressure cylinder, and thence through a receiver and reheater into the low-pressure cylinder. A small motor is provided for controlling the speed of the engine within two per cent above or below normal, and is controlled by the switchboard attendant. Each engine is also provided with an auxiliary governor attached to a stop valve, located next to the throttle valve, and so arranged that should the engine from any cause speed up five revolutions above the normal, the valve will be instantly and positively closed, shutting off all steam from the cylinders.

Two 150-hp horizontal tandem compound engines made by the Harrisburg Foundry and Machine Works, operating at 270 r. p. m., and each direct connected to a six-pole, 100-kw, 125-volt, compound-wound generator, are located between the main engines and the high-tension switchboard gallery. These engines are equipped with an automatic self-lubricating device, whereby the bearings on the engine frame, crank pin, cross-head pin and guides, will be lubricated from a reservoir of pure oil, which constantly seeks its level, in the engine base beneath the crank pin. The crank delivers the oil from this reservoir in a continuous supply to the crank pin, from which it is thrown off by centrifugal force into a pocket provided in the inside of the oil hood, and from this pocket flows through tubes to the crank shaft bearing and thence back to the reservoir.

Each main engine is provided with a Worthington surface condenser, which, together with its air pump, is located in the engine basement close to its respective engine foundation. Each condenser has a total of 3,600 square feet of cooling surface, and is guaranteed to produce a vacuum of 26 inches of mercury.

Adjacent to the condenser is located a Worthington vertical compound beam air pump, having its steam cylinders of 9 inches and 16 inches diameter, and its air buckets of 20 inches diameter, with a common stroke of 12 inches.

The circulating pumps are placed in the boiler room, and are of the Worthington horizontal compound, outside packed plunger type. The salt water used for condensing purposes is pumped from Darling Harbor, and the piping is so arranged that any circulating pumps can supply any condenser with cooling water.

The two condensers for the exciter engines are similar to those for the main engines, except that they are smaller and are provided with combined air and circulating pumps attached to the same steam cylinder. A gravity oiling system is provided for the main engines.

ELECTRIC GENERATORS.

Direct connected to each of the three Allis engines just described is a General Electric 1,500-kw, 6,600-volt, three-phase generator, running at 75 r. p. m. These generators have their armatures stationary, while the field poles are attached directly to the periphery of the engine flywheel, thus making a very compact generating unit and reducing to a minimum the weight on the engine shaft.

The flywheel hub and spider is a casting in two parts, and the hub is fastened to the shaft by means of six long bolts through the hub, and tightened in place while hot. The rim is made up of eight cast-steel segments, four of which are equal to the circumference of the wheel, the other four being placed beside the first four, but arranged to break joints. Forty field poles, which at 75 revolutions, will give a frequency of 25 cycles, are bolted to the outer face of the engine flywheel rim, the bolts passing right through the rim of the wheel. Exciting current is led by means of two cables fastened to one of the spider arms, from the collector rings on the shaft to the field winding. The stationary armature is divided into four parts for convenience of shipping, which are bolted together as they are assembled. The internal diameter of the armature when assembled is 280 inches. The coils are rectangular in form, wound on forms, and placed in the slots as the armature was assembled in the Ultimo power house.

HIGH TENSION SWITCHBOARD.

The switchboard is located on a raised gallery across the dynamo room, between the old and the new portions of the station. Space is provided on this board for controlling three exciters, two of which are now installed, six three-phase generators, three of which are at present installed, and five substation feeders, all of which are now installed, although as they are at the end of the board, future feeder panels can be installed without disturbing the rest of the switchboard. There is also an exciter summation and a generator summation panel. The instruments and low-voltage controlling apparatus are mounted on blue Vermont marble panels, while the high-tension parts, consisting of switches, busbars and transformers are placed some distance behind the operating board.

Each generator and feeder is controlled by three oil switches, all three connected to a common shaft, which is operated by a lever from the front of the operating board by means of rods and bell cranks. Each of these oil switches is placed in a separate brick comparment, so that any arc which may be accidentally formed in one compartment cannot be communicated to the others. All of the generator switches are provided with reverse current relays, which light up a red lamp on the front of the board should any reversal of current take place, but do not trip the switch, as this is not thought advisable.

All of the feeder switches are provided with overload relays, which in addition to tripping the switch, should the current rise above a predetermined amount, also light up a red lamp on the front of the board, thus drawing the attendant's attention to this switch. Each generator panel is provided with a recording and an indicating wattmeter, a main ammeter and voltmeter, and a field ammeter. Each feeder panel is provided with a recording wattmeter and three ammeters, one for each phase.

The generator summation panel is provided with one recording wattmeter, three ammeters and three voltmeters, thus showing the grounding or unbalancing of any phase. Two indicating wattmeters are also provided, enabling the instantaneous power factor to be determined.

All of the ammeters, voltmeters and indicating wattmeters are of the General Electric horizontal edgewise type, with black enamel finish, while the recording wattmeters are of the round pattern, balanced induction type. Synchronizing arrangements are provided, using both a voltmeter and a lamp, the generators being in exact synchronism when the lamp is dark and the voltmeter reads full voltage.

The exciters are provided with astatic ammeters and voltmeters, while the exciter summation panel is provided with a Thomson recording wattmeter. Both the exciter and generator field rheostats are placed in the basement, and controlled by means of a long shaft with gearing.

All parts of the boiler and engine rooms, engines, switchboard gallery and offices are provided with telephones and signal lamps, all under the immediate control of the switchboard attendant, while he also has communication with each of the substations by duplicate telephone lines.

THREE-PHASE CABLES.

Each of the various substations is electrically connected with the switchboard at the Ultimo power house by means of a duplicate set of three conductor cables furnished by the British Insulated Wire Company. The system in use is the solid laid system so common in Europe, and the cables are placed in wooden troughs and surrounded by an insulating material. Two wooden troughs made of well seasoned iron-bark, an Australian hardwood, which were coated with Stockholm tar, were placed in a trench dug to a depth of about three feet below the surface of the street. One of the troughs, in which the high-tension and 600 volt feeder cables are laid, is about 8 inches deep by 11½ inches wide, while the other trough intended for the return cables is 5 inches deep by 6 inches wide. The cables when laid are supported by bridges of wood, and surrounded by a compound, composed of Stockholm tar, resin and sand, the trough being then covered with an iron bark plank, held in place by three layers of common brick. Each phase of the three conductor cable is composed of 19 No. 16 B. W. G. wires (equivalent to about No. 4—0 B. & S.), stranded together and insulated with 7/32-inch paper, the entire three conductor cable being covered first with 6/32-inch paper, then with lead, and outside of all with impregnated jute. The section of the cable running to the North Sydney substations is laid under the waters of the harbor, and this cable is armored in addition to the cov-

ering stated above, with two layers of No. 11 S. W. G. steel wire, and outside of this with a covering of impregnated jute.

Wirt alternating-current short-gap lightning arresters are provided, both at the Ultimo and substation ends of each duplicate feeder, for taking care of any electric surgings which may be set up in the feeders due to sudden heavy changes of load, or short circuits.

SUB-STATION APPARATUS.

As all of the substations are identical a description of the Waverly substation, shown in Fig. 4, will suffice for all. As stated above, the rotary converter room is provided with two six-pole, 450-kw rotary converters running at 500 r. p. m.

These machines are of the G. E. railway type, and are too well known to need description, except to say that they are provided with four-pole 40-hp induction starting motors. The rotor of these motors is forced directly on an extension of the main armature shaft, and is of the squirrel-cage type. The stator is mounted on a bracket, which is bolted to the pillow block on the collector ring side of the machine.

The 6,000-volt currents upon entering each substation, and after passing the high-tension switchboard, are conducted to two sets of three 175-kw delta-connected air-blast transformers, where the voltage is transformed from 6,000 to 375 for use in the rotary converters. These transformers are cooled by a blower set consisting of a 1-hp induction motor direct-connected to a steel-pressure blower.

FIG. 8.—BATTERY PLANT, WAVERLY SUB-STATION.

The high-tension switchboard consists of two blue Vermont marble panels, in each of which are mounted a horizontal edgewise voltmeter graduated to read to 8,000 volts, and the switch handles. The switches, which are of the oil type, are placed in brick compartments, located some distance behind the marble panels. These switches are arranged to trip on an overload by means of relays, a red lamp placed in the front of the marble panel indicating when the switch is open. The 600-volt switchboard is of the ordinary railway type, built of blue Vermont marble, and provided with astatic instruments, circuit breakers, etc.

In each battery room is located a storage battery built by the Accumulatoren-Fabrik Aktiengesellschaft, Berlin, and consisting of 280 cells. Each cell contains 10 negative and 9 positive plates, and is made of wood lined in the inside with sheet lead. The cells are mounted on a wooden platform, built up of three 11-inch hardwood timbers, placed on edge and floored over. This platform is insulated from the floor by glass blocks, and each cell is insulated from the wooden platform by porcelain insulators, four under each cell. The guaranteed capacity of each battery is 500 ampere-hours. The charge and discharge of the battery is regulated by means of a differentially-wound 50-kw booster direct-connected to a 100-hp multipolar motor running at 900 r. p. m.

GENERAL.

The Sydney and Suburban tram system comprises about 145 miles of track, and operates 527 cars. In the center of the city along George and Harris streets, center pole construction with double bracket arms and cast-iron ornamental bases set in concrete, is used, while all other parts of the city have span wire construction using both wood and Mannesmann steel poles. The track construction consists of grooved girder rails weighing about 83 pounds per yard, laid on concrete foundations with a wood block roadbed. Both Brown plastic and Washburn & Moen solid crown bonds are used for bonding, together with copper cables .45 square inch cross-section, laid between each track and bonded to alternate rails. These cables are laid against the inner rails of their respective tracks, and the two tracks are cross connected every 60 yards. The trolley wire used is of figure-eight section, about 0.13 square inch in cross-section.

Two types of cars are used, one of them being built by the Brill Company, while the other is built by the Clyde Engineering Company, of Granville, Australia. Both Peckham and Brill trucks are used, while the cars are braked by means of the Christensen air brake, the desired amount of compressed air being secured by means of a compressor placed upon the axle and operated by the rotation thereof.

The entire system is under government control, and is operated by three commissioners appointed by the Premier of New South Wales for a term of seven years.

The manner of collecting fares is that in use in most European cities, and consists in dividing the city into sections, a charge of a penny (2 cents) beng collected for each section traveled over. Different colored tickets are issued by the conductor for the various sections, the passenger either paying for one section at a time, or he can pay for the entire distance he wishes to go at once. Each ticket is numbered, and inspectors are likely to inspect each passenger's ticket at any time, thus reducing the chance of dishonesty to a minimum.

Sydney can now boast of having the largest electric tram system in the southern hemisphere, and I may add that it is expected to double the equipment in the near future.

German Electrical Conditions.

Writing from Berlin under date of November 18, a special correspondent of the New York *Evening Post* says: "Germany's electrical industries, which had thus far formed a strong bulwark against the tide of depression, are the last to yield, and acknowledge large losses. Simultaneously with the era of industrial prosperity in Germany, the electrical industries scored one commercial and technical triumph after another. But the buoyancy and prosperity took the form of stock speculation, with the result that several very large companies have already been forced to the wall by creditors and despairing shareholders. Over-capitalization and a too strenuous race for export conquests, at the expense of the reserve funds, have caused a general reaction which was perhaps too long in coming.

The past week has been chiefly eventful because of the symposium of gloomy financial reports submitted by leading electrical companies. The Schuckert Company, which was forced to undergo a thorough process of "sanitation," reports a loss of 21,000,000 marks for the last year, and within a few days the stock was quoted materially lower. The Allgemeine Electricitäts Gesellschaft, which was regarded as the most impregnable, now publishes a statement of expenses and dividends which shows more eloquently between the lines the hard struggle to present an encouraging balance sheet. The dividend of 8 per cent., declared several days ago, is misleading, for the reason that 2½ per cent. is added by transferring a part of the operation fund to the dividend account. The Kummer Company shows a loss of 20,000,000 marks in operations, the Helios Company, of Cologne, of over 9,000,000 marks."

A cable dispatch from Berlin of November 29 says: "A combination of several electric concerns has been effected for the purpose of underbidding American competition. The members of the combination are the Allgemeine Electricitäts-Gesellschaft, Siemens-Halske, of Berlin, and the Schuckert Company, of Nuremberg."

Speed of Pacific Cable.

A recent telegram from Vancouver, B. C., says: "Advices from Banfield Creek state that a speed of a hundred letters a minute has been attained on the British Pacific cable." That sounds rather encouraging.

Telephone Cables—I.

By [illegible]

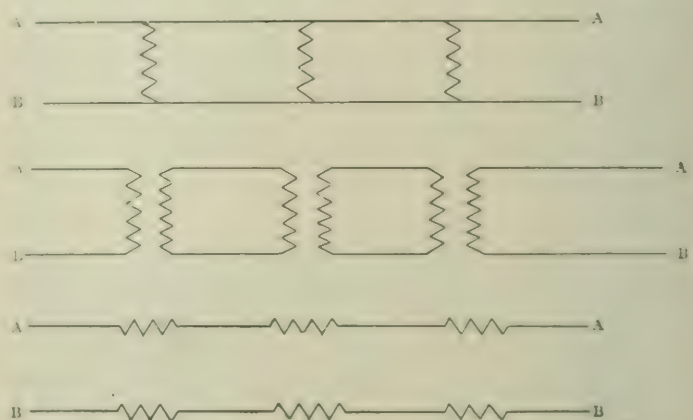
THE PRINCIPLES OF CIRCUIT DESIGN.

Of all of the diverse parts of a telephone system, the conductors connecting the substations with the central office have recently received the least attention. Substation apparatus exhibits itself in a thousand forms, and each issue of the Patent Office Gazette adds to the number. Upon the switchboard and its appliances hosts of inventors have expended their skill, but the metallic road over which messages travel has remained for more than a decade almost unnoticed. As soon as the rapid multiplication of circuits pointed inevitably to underground lines the question of insulation became of paramount importance. The first expedient was to follow the lead of telegraph engineers and lay cables insulated with gutta percha or some of the rubber compounds. Such cables were expensive to install, and even more costly to maintain, as under the trying conditions of urban conduit service, the rubber soon deteriorated. Moreover, the transmission of speech was seriously impaired. Present knowledge of the properties of electrical conductors is much clearer than in the early 80's. But even at that time it was recognized that the resistance of a conductor, and its electro-static capacity, were important factors in speech transmission. The use of the smaller wire naturally employed in cables made an increase in resistance, while the rubber insulation and closer proximity of wires vastly augmented capacity. Observing this marked inferiority in speech transmission, Sir William Preece formulated his famous KR law, a proposition to the effect that unless the product of the capacity and resistance of a telephone line was less than a certain quantity (from 5,000 to 10,000 for open wire circuits, and about 8,000 for cables) the line would not talk. Some lines on the continent of Europe and the first wires from New York to Chicago in the early 90's so built as to make this product greater than the assigned limiting values did talk, and talked fairly well; so the faith of electricians in the KR rule was shaken. Meanwhile, the invention of the Patterson cable placed in the hands of the telephonists a form of underground circuit at once so cheap, so durable and so efficient that it is perhaps not strange that the cable problem was regarded as completely solved, and attention was directed to other fields.

While an extended exposition of the properties of electrical circuits is not only foreign to the scope of these papers, but from its necessarily mathematical character repugnant to the reader, it seems best to roughly sketch the governing factors in order that the principles of circuit design may be comprehended.

Imagine a force pump connected to a line of very elastic hose. If the length of this pipe be very short, each stroke of the pump will be followed by a jet of water from the delivery end exactly corresponding in all respects, save a slight loss in energy due to the friction of the pipe walls, to the motion of the pump plunger. But if the hose be long all the conditions are changed. Before any water can be ejected from the remote end of the pipe, the inertia of the entire water column must be overcome, and if the strokes of the pump plunger be sharp and sudden the first effect is to distend the hose near the pump. The result is an increase in the quantity of water contained in the pipe, and the absorption of some of the energy delivered by the pump in the elastic reaction of the walls of the hose, and the water travels along the pipe as a wave or pulse. If the pump strokes are very short and quick and the pipe large, long and very elastic, it is conceivable that the character of the pump pulsations might be completely changed by the time they arrived at the delivery end, and the form of the water jet transformed from a series of short, quick squirts to a flow more or less steady. In many respects electrical circuits behave in a similar manner, and in the design of telephone conductors, the length of the circuit is an important factor. If lines are of sufficient length, say something more than 15 or 20 miles, so that the energy transmitted as electricity is compelled to proceed as a series of waves, all of the laws pertaining to wave transmission will apply to, and must be recognized in the design of such circuits. If on the contrary, lines are too short to permit the establishment of impulses, the laws of wave action need not be taken into account. In short lines the impulses impressed at one end by the transmitter are received at the other end substantially unchanged in all of their characteristics save a slight energy loss occasioned by the ohmic resistance of the circuit, a quality analogous to the frictional resistance of the water pipe. Contrariwise, if the circuit be long, the energy transmitted proceeds as a series of waves, and under such circumstances the character of the impulses impressed by the transmitter may be completely changed by the action of the longer conductor. In order that articulation may be readily understood, and to enable one to recognize the voices of friends and acquaintances the harmonics, or over tones, in which all speech abounds must be clearly preserved, and it is these ripples upon the vocal sound waves, like the quick, short strokes of the pump that are easily obliterated by the elastic reactions of the electrical conductors over which they travel.

In the analogy, if by any means the elasticity of the pipe could be destroyed, then as the contained water column is inelastic, the strokes of the pump would be delivered at the receiving end unchanged in quantity and in quality. It was an attempt to recognize and to deal with this, at that time but dimly understood relationship, that caused Sir William Preece to formulate the KR law, indicating the impracticability of speech over lines in which the product of the frictional resistance and the elastic reaction exceeded a certain constant. In the hydraulic analogy, such a result would be obtained by substituting a rigid pipe, say, iron, for the rubber hose. Electricians have long known that electrical circuits possessed the property of inductance that was opposed to, and could be made to neutralize, capacity. More than a decade ago Mr. Heaviside showed mathematically that the addition of inductance to a telephone circuit in the shape of a wire coil should improve its talking proper-



Figs. 1, 2 and 3.—Correcting Inductances on Telephone Circuits.

ties, but when he attempted to carry out experimentally his mathematical deductions by inserting inductances concentrated at one or two points the results were disastrous, for lines which had talked passably prior to the introduction of the reactance coils, subsequently refused to transmit a syllable. In 1893, Dr. S. P. Thompson* in a paper entitled "Ocean Telephony," showed that as the capacity of a circuit was uniformly distributed along its entire length it was necessary to similarly distribute the correcting inductances, instead of concentrating them as Mr. Heaviside had done. Dr. Thompson showed two methods for using correcting coils; one plan is illustrated in Fig. 1, in which the coils are placed as shunts across the line at frequently recurring intervals. The other plan, Fig. 2, consisted in introducing transformers, thus splitting the line into a number of sections. As the perturbing action upon voice currents varies as the square of the length of the circuit, such frequent sub-division improves transmission by the simple process of cutting up a long circuit into a number of shorter ones, and by properly designing the transformers they may be made to balance out the capacity of line and act in the same manner as the inductive shunts. This effect Dr. Thompson's paper does not clearly specify, and while he showed a number of methods of building lines whereby their talking qualities may be improved no data is given as a basis for actual design. On December 12, 1893,[2] two patents were issued to Mr. C. J. Reed that embrace exactly the same features as are shown in Dr. Thompson's method. As Mr. Reed's applications were filed nearly

* See proceedings of the International Electrical Congress, page 143.

[2] See patents 510,612, dated December 12, 1893, 510,613 dated December 12, 1893.

a year prior to the International Congress, he must be regarded as a co-inventor or prior to Dr. Thompson. But Mr. Reed's patent gives no specifications as to building or using the transformers, and the language of the patent leaves some doubt as to whether he was fully aware of the possible effect of his invention on the talking properties of telephone circuits.

So it has been reserved for Dr. M. I. Pupin to prove both mathematically and experimentally the truth of the Heaviside theory, and to show that his practice was defective only in the design and location of the balancing inductances. Moreover, Dr. Pupin has gone a step farther than all prior inventors in accurately describing both the way to place the balancing inductance coils, as shown in Fig. 3, with reference to the waves transmitted by the circuit, and the design which should be adopted in their manufacture, in order to secure the best results. Those who are interested in this branch of the subject can do no better than to study carefully Dr. Pupin's papers before the American Society of Electrical Engineers,[3] or to peruse his patents.[4]

Consider whether the hydraulic analogy will not explain the cause of Mr. Heaviside's failure. Suppose in order to counteract the elasticity of the hose one or two iron rings should be clamped about it. Doubtless these rings would have sufficient strength to confine all the energy imparted by the pump, but this restraining action would be restricted to their immediate vicinity, while the remaining and by far the greater portion of the pipe would still possess its original and undesirable elastic qualities. Now when a pump pulse travels along the pipe and reaches one of the confining rings, it cannot here distend the hose, and the wave is suddenly checked in its course, and a portion reflected back upon itself just as on the seashore the retiring breaker interferes with, and confuses the advancing wave. The confining ring thus not only fails to prevent the deformation of the pump pulse by destroying the elasticity of the hose at certain points, but it adds to the existing confusion by reflecting the water wave on itself and setting up interference waves. To the best of our present knowledge the Heaviside coils acted in a similar manner, for while they tended to neutralize the capacity of the circuits in which they were placed, they were so located as to concentrate an excess of balancing action at one or two points, and instead of effecting an improvement set up a series of interference waves which added to the existing distortion. To return to the hydraulic analogy, if for the one or two heavy iron bands a large number of light wire hoops should be placed at frequent intervals along the entire length of the hose, the effect would be much the same as the substitution of a rigid material for the elastic walls of the hose, and the result at the receiving end would be jets of water co-ordinated with the pump strokes in shape and in time.

From this rough analysis it is seen that to properly design an electrical circuit one must regard its length in connection with the mutual relations of resistance inductance and capacity. If the circuit be shorter than the electrical wave length of the impulses it is called upon to transmit there will be no chance for true waves to be formed, and consequently the deforming action just described will not occur, and ordinary transmission in which ohmic resistance is a greater factor takes place. It is probable that voice impulses give rise to few important waves less than 15 miles in length, and consequently in dealing with shorter telephone circuits the effect of wave transmission may be neglected. But when it becomes necessary to consider toll lines running into scores, hundreds or thousands of miles the wave character of the transmission becomes the governing factor.

Subscribers' lines in the larger and telephonically denser cities will not exceed half a mile in length, and in the smaller ones a mile or a mile and a quarter. But few trunk lines even in the largest exchanges are more than five or six miles long, so that in the design of single exchanges the question of wave transmission may be neglected, and circuits proportioned solely from the standpoint of resistance and capacity. Yet it must not be forgotten that as the telephone systems of the country develop, toll line communication will rapidly increase, and so the wire plant for each single office must be based on the probability that in the near future its circuits will be called upon to work in combination with toll lines which will be measured by hundreds of miles.

[3] Trans. Am. Ins. Elec. Engs., Vol. xvi, 1899, p. 93 and Vol. xvii, 1900, p. 445.

[4] Patent No. 652,230, June 19, 1900 and No. 652,231, June 19, 1900.

At present the use of balancing coils in long lines is still in the experimental stage, little or no extended practical experience having been gained therewith, while toward the improvement of transmission over underground cable little has been done beyond laboratory tests. That telephone circuits are soon likely to undergo considerable modification in design, which will result both in less expensive construction, and improved transmission seems certain, though it is difficult to forecast precisely the way in which such a result will arrive. There is no doubt of the wisdom of reducing resistance and capacity in all circuits to the lowest commercial limits, and this goal is to-day the aim of cable designers. The operation of resistance is to transform a portion of the electrical energy carried by the circuit into heat, which is radiated away, and, so far as speech transmission is involved, utterly lost. The amount of energy thus wasted is directly proportional to the square of the current, and the resistance of the conductor. Over conductors of high resistance therefore speech transmission becomes *faint*, but the clearness of articulation is not impaired. Therefore to secure *loudness* in transmission large conductors of material of good conductivity must be employed.

The practical effect of capacity is to prevent successful transmission not so much by decreasing *loudness*, as by interfering with *distinctness*, thus b's and p's, s's and c's sound alike at the end of a high capacity line, and it is difficult to distinguish one word from another, causing frequent repetition. Capacity depends on the area of the conductors, their proximity to each other, and the character

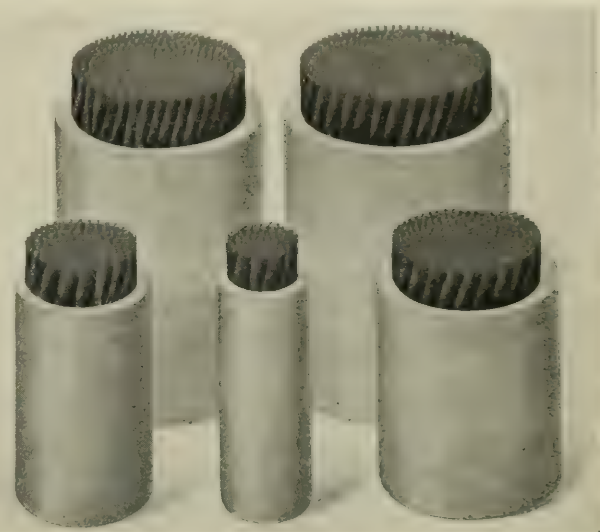


FIG. 4.—PAPER-INSULATED CABLES.

of the insulating material that separates them. The larger the wires of any circuit, and the nearer they are together, the greater the capacity. Air has about the lowest specific capacity of any known substance, so that the use of *any* other kind of insulating material necessarily increases capacity, thus the result of placing circuits in cables has a fourfold effect on transmission.

1st. The use of smaller wire increases resistance and decreases volume.

2d. The use of smaller wire decreases capacity and improves articulation.

3d. Twisting the circuits together brings the wires nearer to each other, increases capacity and injures articulation.

4th. The necessary use of some insulating material besides air, increases capacity and injures articulation.

The net result is a perceptible decrease in volume when long lengths of cable are used, and a very marked impairment in distinctness, even over moderately long lines. The aim of the cable designed should therefore be:

1st. To use the largest wire compatible with reasonable installation cost.

2d. To place the component parts of each circuit as far apart as possible.

3d. To use a minimum insulating material other than air.

The invention of the Patterson, paper, dry core, or air spaced cable, as it is variously called, closely realizes these conditions. Several sizes of this cable are shown in Fig. 4. Copper wire of No. 19, B. & S. gauge, has been the usual size of the conductors. The

requisite number of pairs to form the desired cable is taken, and each wire insulated from its twin by a loose wrapping of carefully dried paper. It is customary to color in some distinguishing manner the paper on the individual wires in order to avoid the frequent testing otherwise necessary to distinguish the components of each one. One method of applying the paper is shown in Figs. 5 and 6, from which it is seen that the wires are simply separated by a sheet of paper, and then lightly twisted together, this twist being sufficient to hold both the conductors and the insulation in their proper relative positions, serving at the same time the very important office of preventing cross-talk due to the mutual operation of electrostatic and electromagnetic induction. A single twisted pair is taken to form the core or nucleus of the completed cable, and around that the requisite number of pairs are

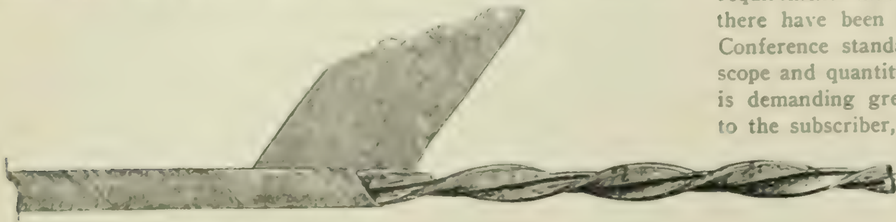


FIG. 5.—ONE METHOD OF APPLYING PAPER TO CONDUCTOR.

assembled in regular layers, each successive layer being "cabled" or wound about the preceding one with a reversed twist, making a complete turn in from 18 inches to 36 inches. This process of "cabling" operates again to eliminate cross talk between successive layers. The use of the paper to separate the individual wires furnishes an insulator of low electrostatic capacity, and yet of sufficient resistance to maintain an insulation of many thousand megohms against the feeble electromotive forces of telephone currents. By twisting the various pairs of wire and the several layers very loosely about each other a considerable volume filled with air remains, and capacity is decreased by preserving as much space between conductors as possible.

To maintain such an arrangement of wires in working condition some protection is absolutely necessary as the insulating material is not only hygroscopic to the last degrees, and would retain its insulating properties for but a short time after being kiln dried, but is also of fragile character, and could not resist an infinitesimal amount of the handling needed to place circuits in their working position. Protection is achieved by enclosing the paper covered conductors in a lead pipe, which, if carefully made is absolutely air tight, sufficiently flexible to be readily introduced into underground conduits or attached to pole lines, and indestructible under the corrosive influences usually encountered.

Not only must the successful cable talk well, but it must be reasonably easy and economical to manufacture, its mechanical attributes must meet the conditions of every-day service, and its design must be such as to make any desired rearrangements of circuits easy. About a dozen years ago the American Bell Telephone Company issued the famous "Conference Specifications," embracing the consensus of existing opinion as to the method of telephone cable building, and under which the bulk of all the telephone cable now in use has been constructed. The essential characteristics of the Conference Specifications are as follows:

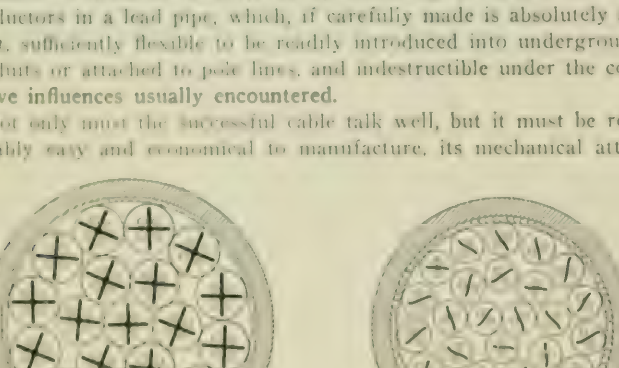


FIG. 6.—CROSS SECTIONS OF PAPER-INSULATED CABLES.

Sizes.—Number of pairs, 25, 30, 50, 60, 100, 120.

Conductors.—Copper 19 B. & S. gauge, conductivity 98 per cent of pure copper.

Insulation.—Dry paper.

Conductor Arrangement.—Twisted pairs, length of twist not over 3 feet.

Core.—Laid up in successive reversed layers, with a lay of at least 1 turn in 2 feet.

Seal.—The end of each length sealed with insulating material for at least 2 feet.

Sheath.—The cores to be enclosed in a lead pipe ⅛ inch thick, having at least 29-10 per cent of tin.

Electrostatic Capacity.—Shall not average more than .080 microfarads per mile.

Insulation.—100 megohms per mile.

Guarantee.—Capacity shall not increase, nor insulation decrease for five years.

The cables produced by these specifications so completely filled all requirements that it is only within the last two or three years that there have been any symptoms of departure from the good old Conference standard. But telephony is extending rapidly in both scope and quantity, wire ways are becoming congested, competition is demanding greater economy in construction and better service to the subscriber, and it appears possible to introduce considerable economy in the cost of wire plant by building cables specifically adapted for the service demanded of them.

At the end of 1901 the approximate statistics for the telephone industry were as in Table I.:

TABLE I.—TELEPHONE STATISTICS, YEAR OF 1901.

No. of Stations	2,300,000
No. of Offices	6,500
Originating calls per day	12,500,000
Toll messages per day	275,000
Per cent toll messages to originating calls	2.2
Per cent trunk messages to originating calls	34.0
Total wire, miles	3,000,000
Aerial wire, miles	1,100,000
Cable wire, miles	1,900,000
Toll line wire, miles	260,000
Per cent. trunk miles to subscriber, miles (when there is more than one office in an exchange)	30.00
Per cent of toll line wire to total wire	8.6

From the table it appears that the toll lines constitute only about 8.6 per cent of total telephone lines, and handle but 2.2 per cent of the total business. While doubtless this proportion will very rapidly increase, and the importance of toll traffic to general telephone business is fully realized, the advisability of designing subscribers' line, trunk lines and toll lines each for its own particular sphere is clearly shown. In 1898 or 1899 the 120 pair cable of No. 19 wire was the almost universal standard, but the rapidly increasing congestion of wire ways is forcing more economical use of space, and 200 and even 400 pair cables have appeared. The standard 120 pair cable had a resistance per circuit mile of 94 ohms, and a capacity of .08 microfarads per mile. Experience has shown that commercial transmission can be carried on through something over 25 miles of such cable, or, in other words, acceptable service can be given through a line having a resistance of, say, 2,,300 ohms, and a capacity of 2 microfarads. Any rearrangement of wire plant that does not interpose a greater resistance and capacity, will, therefore, afford equal service. As subscribers' lines are short, more numerous, and comprise about two-thirds of exchange wire mileage, it would seem feasible to use cable of small wire, and consequently cheaper construction for this part of the wire plant, and for the trunk lines and toll line install circuits of larger wire and better talking properties, thus securing good transmission and reducing installation cost. To illustrate: Compare the expense and electrical properties of two plants, one installed with standard 120 pair cable, and the other having 400 pair cable No. 22 wire for subscribers' lines, and 75 pair cable No. 18 wire for trunk line. The properties of such cables will be about as in Table II

TABLE II.—COMPARISON OF CABLE PLANTS

No. of pair	75	120	400
Size of conductor B. & S.	17	19	22
Resistance per circuit mile in cable	50	94	187
Capacity per mile	.065	.080	.112
Cost per active pair mile	$83.00	$52.00	$21.00

To compare probable transmission assume an exchange where the telephonic density is such as to make the average subscribers' distance from the office half a mile, and the average trunk line length five miles. Such conditions now represent about the aver-

age of the larger cities. Then a comparison between the two plants will be as in Table III.

TABLE III.—COMPARISON OF ELECTRICAL PROPERTIES OF WIRE PLANTS BUILT WITH CABLES AS IN TABLE II.

	120 Pair Cable	75 and 400 Pair cable	Per cent. change
Resistance of two subscribers lines in the same office	94 Ohms	187 Ohms	199.5
Capacity of two subscribers lines in the same office	.080 Mfs	.132 Mfs	1050.0
Resistance of two subscribers lines in different offices	564 Ohms	482 Ohms	85.5
Capacity	.480 Mfs	.437 Mfs	91.0
Cost	1	.695	69.5

By the preceding table it is clearly shown that the 400 pair cable will *not* give a good transmission between subscribers taking in the same office as a No. 19 wire cable will. But as the total resistance and capacity of two such lines is very small a reasonable increase in the objectionable electrical properties is unnoticeable, as the permissible margin is *very large.* Passing to trunk line conversations, it is shown that the combination of the 400 pair No. 22 wire cable and 75 pair No. 18 wire cable decrease resistance to 89.5 per cent of the No. 19, 120 pair plant, capacity to 91 per cent, and *cost* to 69.5 per cent. This is an attractive showing.

Conduits as now built readily take a 2½-inch diameter cable, and possibly one 2¾-inch, so by existing construction cable sizes are now limited to the preceding dimensions, and design must accommodate itself thereto. In a general way it appears desirable to have about seven varieties of cable for subscribers' lines, and about three varieties for toll and trunk-line service. Table No. IV. gives the approximate general properties suggested.

TABLE IV.—CABLE DATA.

Purpose	No. Pairs	Size of wire	Capacity per mile
Subscribers lines distributing cable	10	19	.090
Subscribers lines distributing cable	30	19	.090
Subscribers lines distributing cable	50	19	.080
Subscribers lines distributing cable	100	19	.080
Subscribers lines distributing cable	200	20	.100
Subscribers lines main cable	300	20	.108
Subscribers lines main cable	400	22	.115
Subscribers lines main cable	600	24	.130
Trunk line cable	75	17	.065
Toll line cable	50	14	.050
Toll line cable	10	10	.035

With the selection outlined it would seem possible to so adjust cable design under all usual circumstances as to attain good service at a minimum cost.

The Use and Advantages of the Alternating Current for Land Telegraphy—V.

BY EDWIN F. NORTHRUP.

IN Fig. 31 G is the single source of alternating current located at station A. R is a differentially wound relay at station A and a is an artificial line. A relay R_1 not differentially wound, is directly in series with the line at station B. The mechanism at station B is run in synchronism with the mechanism at station A. T and T_1 are transmitters which break the line to cut out or reverse a wave, but do not at the same time connect the line to earth. The relay R is balanced as follows: The line is disconnected from earth by the transmitter T_1 and the artificial line a altered until it equals in capacity and resistance the open circuited real line. Though both the artificial and real line are disconnected from earth, considerable current will flow into them. Now, putting the real line to earth at station B, the relay R will vibrate again. The vibration is a consequence of the extra amount of current that enters a line grounded at its end over that which enters a line open circuited at its end. The relay R_1 also vibrates.

If the line is broken by transmitter T at station A, all current is cut off the line and relays R and R_1 both stop vibrating. Hence as a signal consists in causing a receiving relay tongue to momentarily stop vibrating, T_1, can signal to R, and T to R_1 by cutting out half waves. But as the operator at each end of the line stops his own relay vibrating while signaling to the other end, it is necessary to arrange matters so that an operator is never receiving while he is sending or sending while he is receiving.

This matter is easily arranged, at the sacrifice of half the number of simultaneous messages, by arranging the segments on receiving and sending sunflower commutators at each end of the line, as shown in Fig. 23. At station A, the operator sends when the trailer t_2, passes over the 3d and 4th quadrants of his sending commutator, and the operator at station B receives at that time on commutator R^1. When the trailers have gone half a revolution the relations of sending and receiving are just reversed. Further details cannot be here given, but the principle should be clear from the above. The method is not experimental, having operated successfully for months over actual lines about 100 miles long.

By using alternating currents and synchronism for telegraphy, problems of the distribution of telegraphic messages can be worked out that are wholly unsolvable by any of the other known methods of telegraphy.

A discussion of this subject is beyond the scope of the present article. The interested reader must be referred to the United States patents on telegraphy distribution recently granted to H. A. Rowland. He will find described in them matter of great value to the telegraphic art, and the clear solution of numerous cases of complicated telegraphic distribution. What has been so far said in regard to the limits of distance over which lines may be operated duplex or simplex, has had regard to lines where the messages are not relayed or repeated. The Rowland patents describe many methods of relaying alternating-current telegraph lines. In general, automatic relaying can be done as simply as it is now done with the Wheatstone automatic system. Further experience will undoubtedly greatly simplify and extend the methods of relaying and of distributing messages.

I will now describe a concrete case of ordinary Morse telegraphy accomplished with alternating currents. The method is not advocated as being in anywise as valuable as the Rowland printing telegraph. It has, however, the advantage of extreme simplicity and

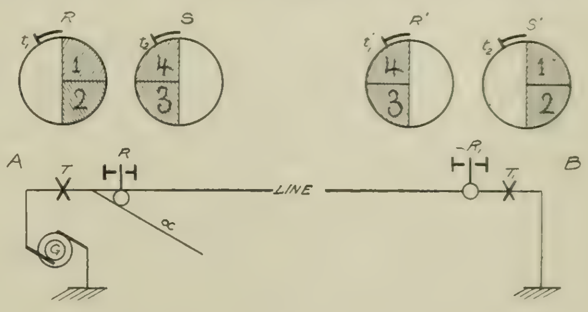


FIG. 31.—"REFLECTED WAVE" SYSTEM OF TELEGRAPHY.

might possibly therefore be tried by a conservative corporation when the far more beautiful, but more elaborate system of printing telegraphy, would not be taken up. The method, with the exception of the synchronism, was worked out recently by the writer. He has not been in a position to give it an actual trial, but his experience with printing telegraphy, which involves a similar class of problems confirms his conviction that it is only a matter of a small amount of experimenting to make perfectly operative this very simple octoplex Morse system of alternating-current telegraphy. In the plan proposed for a system of Morse telegraphy with alternating currents, the chief features are as follows:

The signals transmitted are the ordinary Morse signals and the transmitting keys are operated in precisely the same way as in the ordinary direct-current system. The signals are received on the ordinary sounders in the usual manner. The lines are multiplexed and duplexed so that at least four operators can be transmitting at each end of the line at the same time. In other words, the capacity of the line is at the very least eight messages at a time. The speed at which each operator can send will depend upon his personal skill, the line having a transmission capacity beyond that of the operators. The multiplexing of the lines is made possible by employing synchronism and the alternating current. The signals are made, at each end of the line, by reversing certain of the alternating-current waves.

We will first describe the manner in which a single operator transmits signals, then how these are received, and we will describe finally how, as a whole, the system works octoplex.

The transmitting of the dots and dashes of the Morse alphabet is accomplished by reversing one half wave of the alternating current for a dot, two half waves for a short dash and four half waves for a long dash, or any multiple of these numbers. But matters are so

arranged that a single operator can only reverse every fourth half wave of the current. Hence the minimum time occupied to send a long dash is equal to at least sixteen half periods of the line current.

Fig. 32 gives the method by which a single operator may reverse the half waves. C is a commutator, shown developed, used as a current reverser, the direct current entering it on the leads, D, D_1, and the alternating current leaving it by the leads a, a_1. The alternating current, developed by the commutator, completes its circuit through the primary of a small transformer T. This transformer has two secondary windings, S_1 and S_2, with their turns wound in opposite directions. They are connected to earth at their middle point m. K is a Morse key hinged at h, and moving between the stops i_1 and i_2. V is a thin steel spring extension from the back end of the key. This spring moves between the poles of an electromagnet M, when the key is depressed. The contacts of the key are made at C_1 and C_2 on the spring. If the spring is against the contact C_1 and current is flowing through the coil k_1, then even if the key K is depressed the contact will not be broken at C_1, because the spring will be attracted down by the magnet and will only bend. But if the key is kept depressed and the current through the coil k_1 ceases, then the spring will move up and contact will be made at C_2. If current now flows through the coil k_2, the contact at C_2 will remain closed even if the key is raised. Thus no sparking of any consequence can ever occur at the contacts C_1 and C_2.

P is a sunflower of 4 segments and t a trailer which revolves around the sunflower at such a speed that the trailer passes over one segment of the sunflower for each alternation of the current produced by the commutator C. The trailer t may be mechanically geared to the shaft turning the commutator C. When the key K is not depressed the alternating current generated in the winding S_1, of the transformer will flow down the line L, going one-fourth of the time by way of the key and into segment No. 1 of the sunflower and the rest of the time by way of the circuit x and into the segments 2, 3 and 4 of the sunflower. Every fourth wave can therefore be controlled or modified by the key, and there will be current on the line at all times. If the key is depressed when the trailer is on segments 2, 3 and 4, the secondary windings S_2 of the transformer is connected to the key by the contact C_2, and as soon as the trailer t reaches segment No. 1 the line will receive current from this winding of the transformer. The current, however, from the winding S_2 is opposite in direction to the current which the winding S_1 furnishes, and hence depressing the key reverses every fourth half wave of the current as long as the key is kept depressed. If the key is kept depressed only long enough to reverse one half wave, a dot will be transmitted, if long enough to reverse two half waves a short dash, and if long enough to reverse four half waves a long dash, or the same will hold for any multiple of these numbers. If by chance an operator should depress the key at the instant that the trailer t is passing over segment No. 1 the reversal of the current would be attempted when the wave was at a maximum and this would cause a spark at C_1. The device, or some similar one, of the electromagnet M, and the spring V would overcome this sparking. In any case the sparking would be small and probably do no harm, so that in practice it is probable that the non-sparking device could be omitted. The device, having been described, will be omitted in the description which will follow of octoplex transmission.

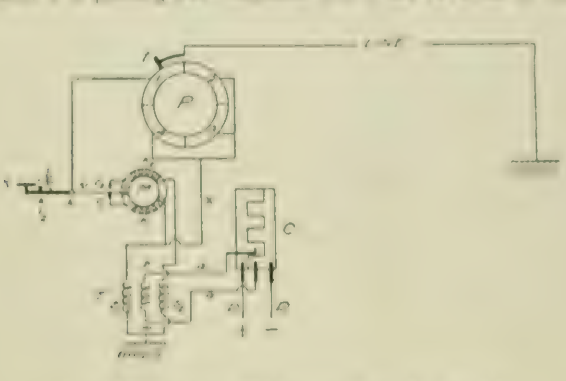


FIG. 32.—METHOD OF REVERSING HALF WAVES.

Fig. 33 gives the method proposed, by which the Morse signals transmitted by a single operator as just shown, may be received. The line current arriving over the line L maintains in vibration the tongues of the polarized differentially wound relay R. The signals which are made by reversing one or more half waves, are received by the relay tongue S_1. The tongue S_2 serves for maintaining the synchronism by any method that may be chosen.

Method No. 3, described on page 822, is a very good one for the purpose. R_1 is a relay which closes its contact k when a wave is reversed. The contact is kept closed for a time, t, to record a dot, 2 t for a short dash, and 4 t for a long dash. The relay performs the same function as one of the relays described on page 822 in connection with Fig. 20. The relay R_1 is, however, connected in the circuits in a different manner than those shown in Fig. 20. The relay R_1 operates as follows: When no half waves are modified the tongues of relay R will always be, for example, against a left-hand

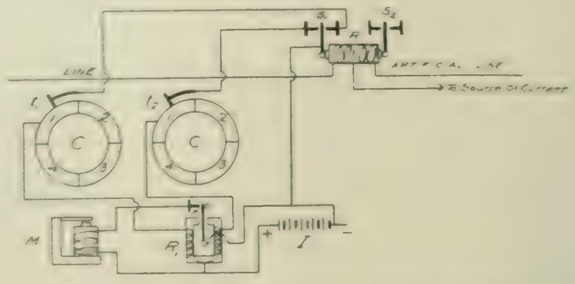


FIG. 33.—METHOD OF RECEIVING MORSE SIGNALS.

contact when the trailers t_1 and t_2 are passing over the odd numbered segments of the commutator C.

In this case whenever the trailer t_2 arrives on segment No. 1 of the commutator, the right-hand coil of relay R_1 will receive current from the current source 1, and the tongue of R_1 will be drawn against its back stop, as forcibly as may be desired. If, however, at the time when the trailers arrive on segment No. 1 a half wave is reversed, the tongues of R will be against their right instead of their left hand contacts. The circuit is completed through the left hand coil of R_1, and the tongue is drawn against the contact k, where it will be left until the trailers again return to segment 1, when the tongue will be returned to its back stop unless another half wave has been modified. As long as half waves continue to be reversed, whenever the trailers arrive on segment No. 1, so long will the tongue of relay R_1 remain against its contaet. Now relay R_1 in closing its contact, k can obviously be made to operate a Morse sounder M, or a tape recorder. The shortest possible time of making a single dot of the Morse alphabet is evidently equal to the time of one revolution of the trailers t_1 and t_2. In general, however, a dot will correspond to two or more revolutions as will be fully shown presently. It is not improbable that the relay R_1 could be so constructed that it would serve in practice for the sounder, in which case the mechanism required for receiving the signals would be somewhat simplified. We will assume for the sake of simplicity in the description to be given of multiplex transmission that this can be done, and that the Morse signals are read by sound directly off the relays connected to the receiving commutator.

Telephones for Freight Trains.

It is stated that freight traffic on Western lines has increased so much of late that it has become very difficult to insure trustworthy means of communication between engine and caboose on long trains. Many of the "double-header" trains hauled daily out of Chicago and Kansas City and other Western points are so long that the rear of the train cannot be seen from the engine when rounding long curves or ascending steep grades. The *Railway Age* tells of some interesting efforts to overcome such obstacles: "The announcement that a western road is to supply conductors with field glasses and a heliograph outfit for use by the head brakeman and the engineer, brings out the suggestion from a Montana paper that while this plan will work on some parts of the line, it will still be necessary to use the long-distance telephone on others, as the trains are so long that the curves shut off the view of the engine from the conductor. The heliograph, it is conceded, may work on the plains, where the vision is not obstructed, except by occasional blizzards, but for mountain sinuosities the trainmen are stated to prefer the far-reaching telephone. Still better, perhaps, might be a narrow-gauge track on top of the train, on which a light trolley car could rapidly convey the train officials in their business trips between rear and front ends."

The Armature Reaction of Alternators—V.

BY C. F. GUILBERT.

EXPERIMENTAL DETERMINATION OF THE VALUES OF F_t AND F_i^1.

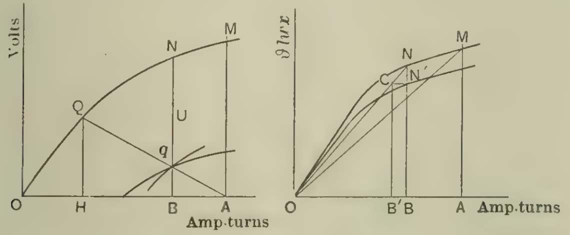
WE can experimentally determine the necessary elements to verify the expressions just given, for the m.m.f's. corresponding to the direct and transverse reaction.

1. Direct Reaction.—Several years ago Blondel published a very simple method for the determination of the e.m.f. corresponding to what it is convenient to call the armature leakage. This method will suffice equally to deduce from experiment the value of the counter ampere-turns. It is merely necessary to introduce a slight correction, which may be dispensed with in some cases, taking account of the influence of the field leakage.

It will be recalled that the method of Blondel simply requires a knowledge of the no-load and short-circuit characteristics established as a function of the field ampere-turns, and of a point corresponding to the machine working on a purely inductive load.

Let $O\ M\ N$ (Fig. 5) be the no-load characteristic, and suppose the excitation is constant and equal $O\ A$ ampere-turns. If we know the exact value of the armature counter ampere-turns corresponding to the short-circuit current I_{cc} for an excitation $O\ A$, by laying off these ampere-turns at $A\ H$, the leakage of e.m.f. of the armature will be represented by $H\ Q$. This e.m.f. is proportional to the current I_{cc}, and it follows that the angle $Q\ A\ H$ is independent of the current. If, then, from the point A we draw a number of ampere-turns, $A\ B$ corresponding to wattless-current I produced by the machine, we will have in Bq the e.m.f. corresponding to this current, and therefore in qN the difference of potential U at the terminals for the excitation $O\ A$ and the wattless output I.

The point q is, in short, determined by two conditions—its vertical distance from the no-load curve, a distance equal to the voltage



FIGS. 5 AND 6.—NO-LOAD CHARACTERISTICS.

U under load; and its radial distance to the point A, which is equal to $a\ \frac{I}{I_{cc}} \times A\ Q$. This point then comes at the intersection of two curves simple to construct, namely, a curve parallel to the no-load characteristic and drawn at a vertical distance U above the first, and a curve from the same characteristic, homothetic with relation to the point A and with a homothetic ratio equal to $\frac{I}{I_{cc}}$.

This method implicitly assumes that the right-angle triangle $A\ Bq$ is always a similar triangle, which is only true if there is no magnetic leakage in the field, or if the magnetic reluctance r is negligible; in other words, is equal to zero. In fact, returning to formula (21), giving the reduction of flux in the armature for a constant excitation F when the machine has an output I, the external circuit being completely inductive, we have

$$\phi i^1 - \phi i = - \frac{F_i\left(1 + \frac{r}{R_a}\right)}{v\left(r + \frac{R_i\ R_a}{R_i + R_a}\right)}$$

If we draw (Fig. 6) the no-load characteristic, and if we join $O\ M$, we know that the tangent of the angle $M\ D\ A$ is

$$\frac{1}{v\left(r + \frac{R_i\ R_a}{R_i + R_a}\right)};$$

to obtain the reduction of armature flux, it suffices then to subtract first the m.m.f. F, then F^1 and finally $\frac{r}{R_a}F_i$. If we lay-off on $A\ B$, the value of the armature m.m.f. F_i, $N\ B$ will represent the load flux if there is no field leakage. In reality the effect of leakage is to diminish still further the armature flux by the quantity

$$-\frac{\frac{r}{R_a}F_i}{v\left(r + \frac{R_i\ R_a}{R_i + R_a}\right)}$$

This second reduction being the increase of the fielo leakage, the flux in the field remains equal to $N\ B \times v$. Stated otherwise, the value r introduced in this formula is that which corresponds to the point N. To account for the flux corresponding to the effect of leakage, we will then only have to draw from B a length $B\ B^1 = \frac{r}{R_a}F_i$. ($r$ being the reluctance corresponding to the point N); draw a perpendicular from B^1 until it cuts $O\ N$ at C; then draw $C\ N$ parallel to $O\ A$. $B\ N$ then represents the available flux in the armature. To account for influence of leakage by the method of Blondel, it suffices then to substitute for the no-load characteristic $O\ N\ M$, the characteristic $O\cdot N^1\ M^1$, which comes somewhat lower.

In practice, in the case of alternators of slight leakage and with well-made field joints, the ratio rarely exceeds .1; the correction is thus of little interest if the armature ampere-turns are small with relation to the field ampere-turns. This, however, is not the case if the joints are defective magnetically, as, for example, in the case of alternators with laminated poles not machined, or where there is large magnetic leakage; in this case the ratio may attain such a value that the correction must be applied.

As an example, the methods above indicated will be applied to a 760-kw-ampere Heyland alternator made by the Société Electricité et Hydraulique, the dimensions of which were given by the writer in these columns in the issue of March 9, 1901.

For an output of 100 amperes to an entirely inductive circuit, Mr. Heyland found for an excitation of 150 amperes or 7,500 ampere-turns, a terminal voltage of 2,140 volts, the no-load voltage being 2,380 volts. Application of formula (12) gives for $a = b$, $F_i = 0.588 \times 6 \times 141 = 500$ ampere-turns.

The graphical method of Blondel, without the correction above indicated, gives practically the same result, 480. The e.m.f. due to armature dispersion is 160 volts. The transverse armature m.m.f. can be determined experimentally only by having a machine working on a circuit containing a capacity so as to render the current practically in phase with the no-load current, as has been proposed by Blondel. The m.m.f. is deduced then from the right-angle triangle of which the hypothenuse represents the field ampere-turns corresponding at no-load to the load voltage, and one of the sides represents the field ampere-turns during the trial.

This method is only applicable if the fluxes are proportional to the m.m.fs; that is to say, if the magnetic circuits are not saturated. If the armature is not saturated, it can nevertheless be applied, but the right-angle triangle, as will be seen further, should be constructed in this case with the voltages at no-load and at load, and the m.m.fs giving rise to the transverse reaction should be taken from the armature characteristic alone; that is, from the line representing the value of the flux in the armature as a function of the ampere-turns necessary to make this flux pass into the armature (air gap and armature iron).

U. S. Patent Office.

The report of the Commissioner of Patents for the fiscal year ended June 30, 1902, shows that there were received during that year 45,562 applications for mechanical patents, 1,807 applications for designs, 139 applications for reissues, 1,849 caveats, 2,460 applications for trade-marks, 1,020 applications for labels, and 270 applications for prints. There were 27,387 patents granted, including reissues and designs, and 1,864 trade-marks, 750 labels, and 163 prints were registered. The number of patents that expired was 20,335. The number of allowed applications which were, by operation of law, forfeited for non-payment of the final fees was 4,123. The total receipts of the office were \$1,491,538.85, the total expenditures were \$1,329,924.63, and the surplus of receipts over expenditures—being the amount turned into the treasury—was \$161,614.22. The volume of work shown by the commissioner's report is greater than ever before in the history of the office, the total number of applications filed having for the first time exceeded 50,000.

The Latest Telephone Exchange on Manhattan Island.

THE evolution of the modern telephone exchange, as exemplified by the development of the New York system, was illustrated and described in our issue of August 30 last, when all the various styles and types of exchange buildings on Manhattan Island were brought under notice. One exchange was not shown, however, that which is known as "Morningside," and which has but just gone into operation. Even if it were not interesting on its own account, it would be interesting as a proof of the rapid growth of the upper west side of New York city in wealth and population, necessitating an equipment that would be creditable not simply to a new urban section, but as the main office of a city of the first class. In fact, these new branch offices of the New York Telephone Company are becoming so large and numerous, no one exchange has much right to be regarded as the "main central" with leadership. These New York exchanges might in fact be considered as constituting a federation, and they mark sharply the difference between electric light and power work and that of telephony. The sub-stations of a big lighting company are in almost all cases merely the recipients of current from a central point for local distribution, and there the function ends. But while these scattered telephone exchanges are in a sense sub-stations, they are also largely autonomous, and generate and dispose of a very notable amount of business within their own respective territories. Hence, while the central station industry, technically considered, might be spoken of as the highest type of "centralization," the telephone service of New York has been pushed even further to a logical point of decentralization, in order to develop to the highest degree its efficiency in each district it serves.

From time to time, the New York telephone districts have been recast, and the new "Morningside" is an illustration of the process, resulting as it does from the annexation of that part of the Seventy-ninth Street exchange district north of One Hundred and Third Street, west of East River, south of One Hundred and Tenth Street and east of Central Park, to the Harlem district. So far as the comfort and convenience of the citizens are concerned such a change and improvement means far more than any political redistribution, the aim of which is too often gerrymandering and nothing else. In this case but one thought has been controlling, namely, to increase the speed and reliability of the telephone service.

The Morningside office was opened October 18, 1902, at which time 2,914 stations were transferred from the Harlem exchange and 301 stations were transferred from Highbridge. Four hundred and nine stations have been added since the office was opened. The office is located in a four-story building erected for the purpose on a 50 by 100 feet lot, at No. 220 West One Hundred and Twenty-fourth Street. The four floors of this building are arranged and used as follows: The top, or fourth, floor consists of one large room, used as the operating room. This floor is especially designed to have the greatest possible amount of light and air. The ceiling is high and there are windows in the front, rear and one side of the room, and a skylight in the central portion of the ceiling. The room is kept supplied with fresh air by means of a ventilating plant. The floor is covered with rubber tiling, with the idea of reducing the noise in the room to a minimum.

The third floor is devoted to the operators' quarters, and is subdivided as follows: In the rear of the building is the operators'

FIG. 2.—MORNINGSIDE TELEPHONE BUILDING.

sitting room. This is a room 14 by 32 feet, with southern exposure and windows on two sides. It is furnished with easy chairs, and newspapers and current magazines are kept on file for the use of the operators. To this room the operators may retire while not on duty

FIG. 1.—MORNINGSIDE CENTRAL OFFICE.

at the switchboard. Next to the sitting room is located the dining room. This room is 20 by 33 feet, and is furnished with a sufficient number of dining tables and chairs to seat one-third of the operating force. Large steam coffee and tea urns are provided in this room, and coffee, tea and milk are served to the operators free of charge during the lunch periods. Next to the dining room, and with a door opening into the hall, is the locker room. In this room lockers are provided in which the operators leave their hats, coats and lunches while on duty at the switchboard and where they deposit their individual transmitter and receiver sets when they go home. Sufficient locker equipment is provided to furnish one locker for every two operators.

In the front of the building on this floor is located the infirmary. This is a small room, 12 by 16 feet in size, to which the operators are taken in case of sickness. It is furnished with couches and easy chairs, and simple medicines are kept on hand for use in case of emergency. A large toilet room for operators is also provided on this floor. The floors of all the rooms in the operators' quarters, except the toilet room, are covered with linoleum. The toilet room floor is furnished with white tiling. The second floor of the building is one large room, and is used exclusively for terminal room equipment. The first floor is occupied by the Harlem branch of the contract department, until recently located in the Hamilton Bank Building, 215 West 125th Street.

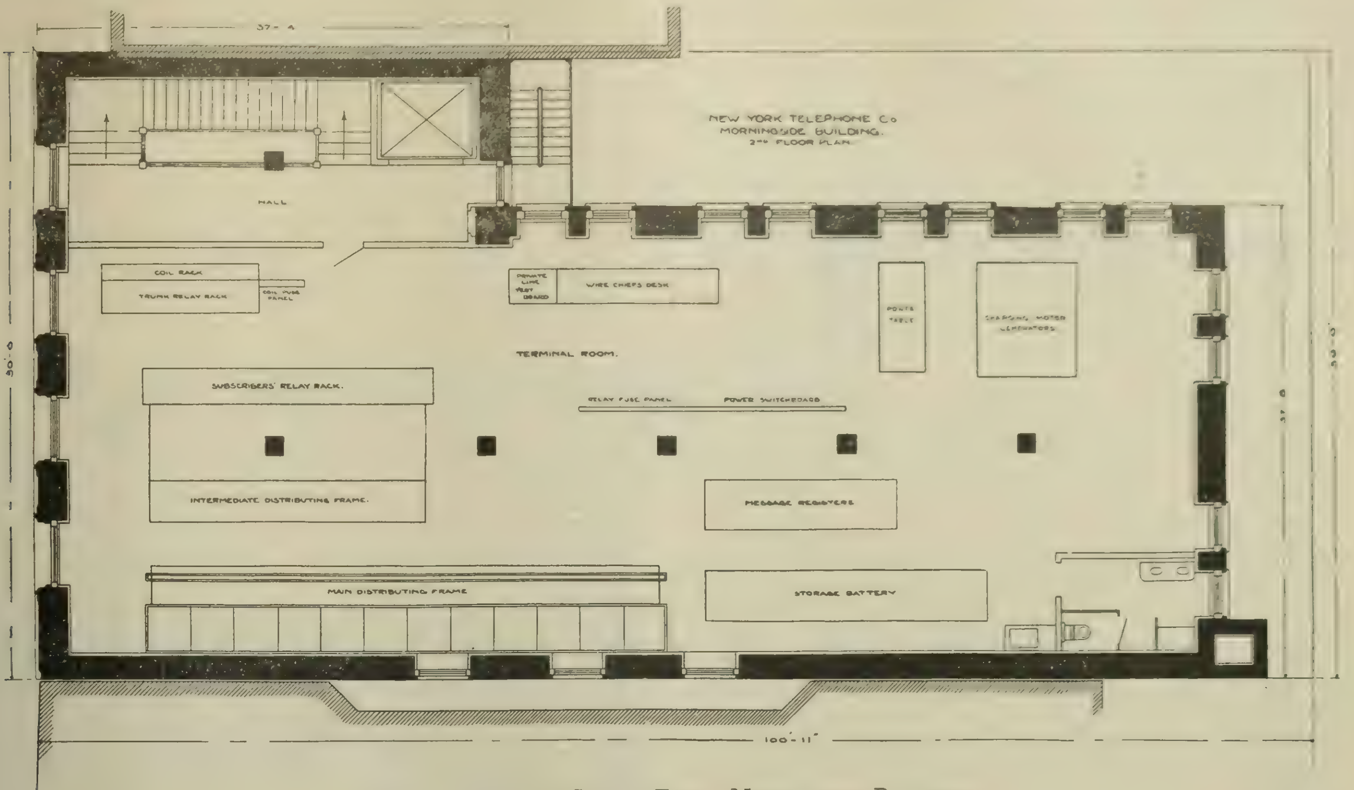


Fig. 3.—Plan of Second Floor, Morningside Building.

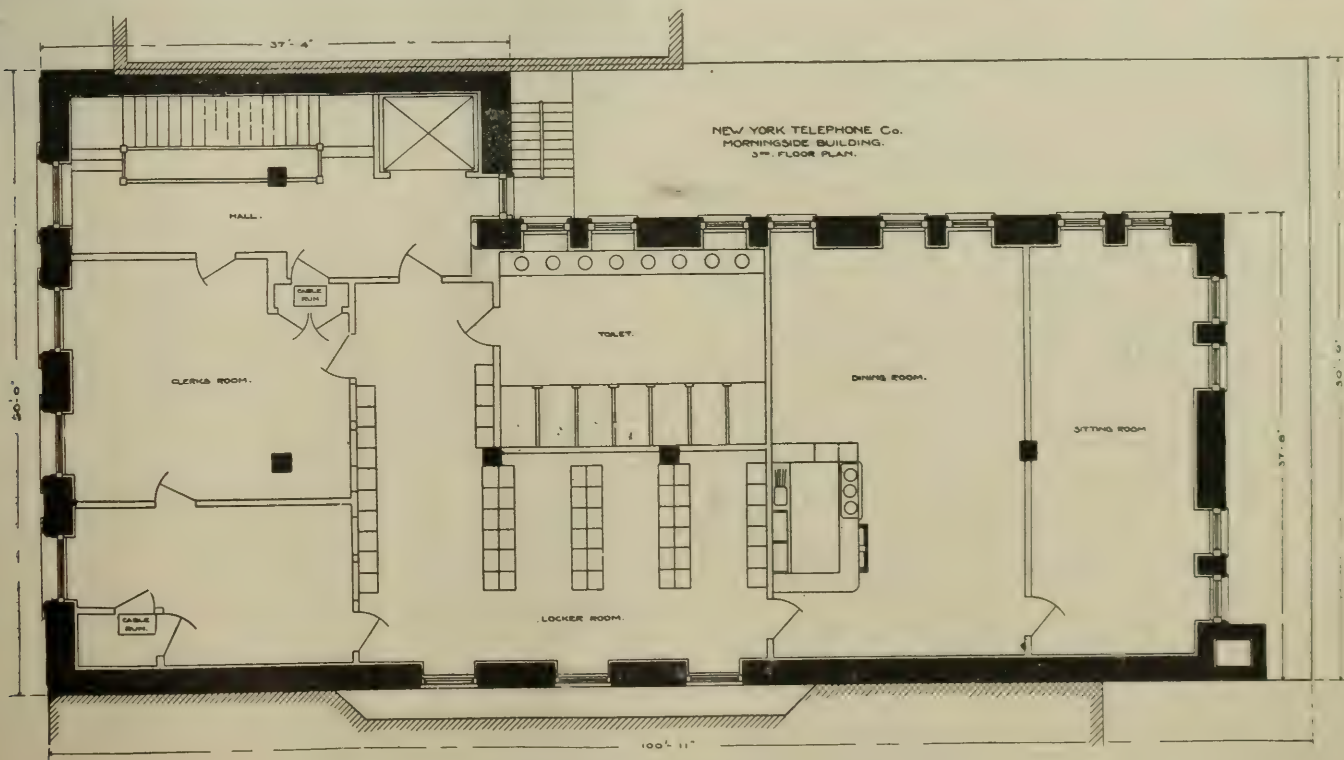


Fig. 4.—Plan of Third Floor, Morningside Building.

[illegible] and subscriber line equipment at this office:

[illegible]	7200 lines.
[illegible]	[illegible]
[illegible]	[illegible] lines
[illegible]	1617
[illegible]	[illegible]
[illegible]	2414
[illegible]	[illegible]

Not the least interesting part of the above data is that which refers to the number of lines and stations transferred, for such figures hint at the necessary complexity of a great modern network like that of New York city.

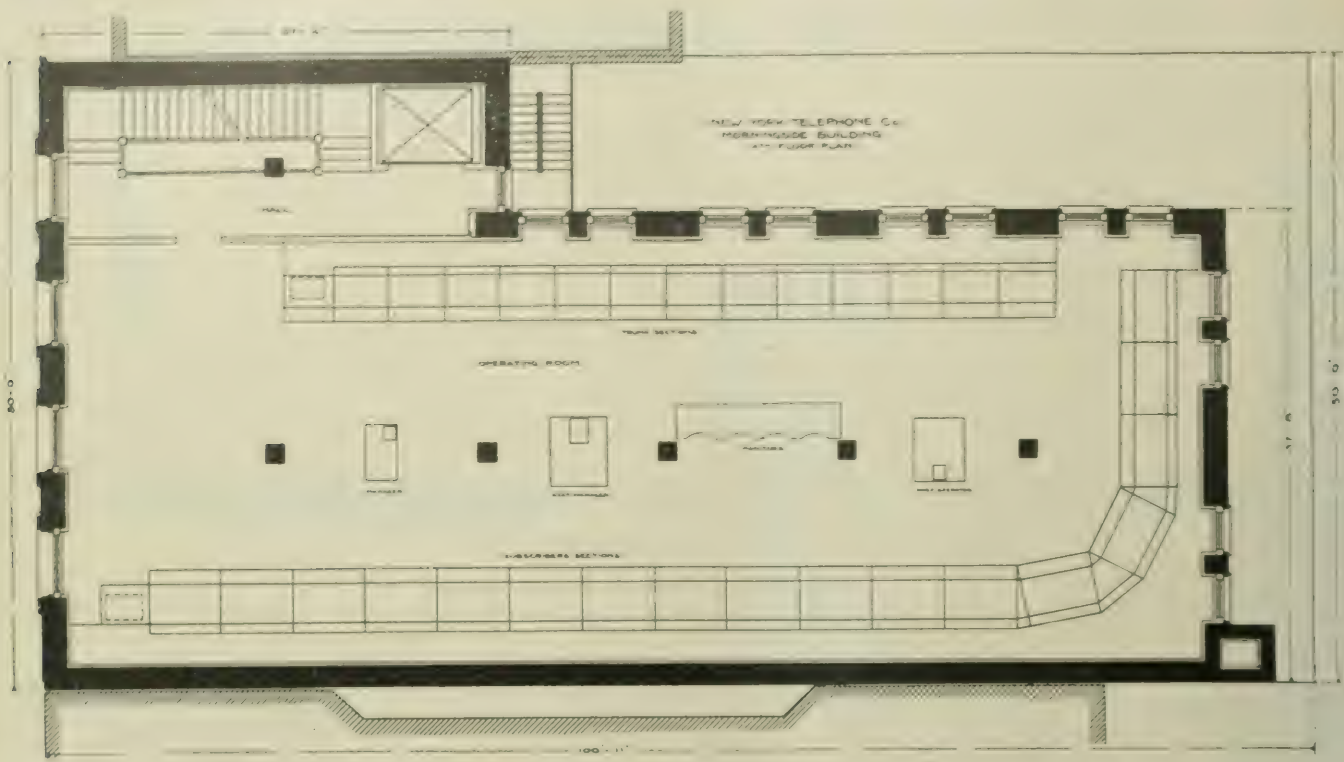


FIG. 5.—PLAN OF FOURTH FLOOR, MORNINGSIDE BUILDING.

The Transmission of Fire Alarms in Chicago.

Mr. E. B. Ellicott, city electrician of Chicago, read a paper on the transmission of fire alarms before the Western Society of Engineers the evening of November 19, 1902. As it is well known that Chicago has one of the most complete and modern fire alarm systems in the country, Mr. Ellicott's paper may be reviewed with profit. Without exception, he said, electricity is the agent which has been adopted commercially in the transmission of alarms. The most commonly used system to-day is only an evolution of the first electrically operated system of 1852. Our present mechanically and electrically perfect street box, so simple in construction that a child can operate it, was represented in the earlier days by a box containing a large wheel, upon the periphery of which were teeth representing numbers arranged to make and break the circuit as rapidly as the wheel was turned. If the individual sending in the alarm was excited and turned the wheel rapidly, the reproduction of the numbers was unintelligible. The present boxes are speeded to send the signals which represent numbers at a uniform rate; and when the box mechanism has been once actuated, it will complete its signal without further attention.

Dr. Channing and Moses P. Farmer were the original inventors and patentees of the electric fire alarm telegraph. It would appear that their system was nothing more than an electric circuit provided with several mechanical means of making a series of breaks in the circuit. The breaks in the circuit actuated a bell-striking apparatus. As first applied, the bells were used in connection with the street boxes, but they were also centrally located, and could be heard at considerable distance.

The modern system is a complicated one. The most important factor in the system, the street or signal box, is the least complicated. Its construction is simple, and if carefully made its operation is practically certain. There is a segment of a gear wheel set in mesh with a small geared ratchet, which is arranged to engage the reduction wheel when the segment has been pulled down far enough to give at least one complete revolution of the character wheel. It is impossible to actuate the mechanism without making a complete record of the box number. Most boxes are designed to write the number of the box four times. By an escapement wheel, the box's speed may be adjusted to suit operating conditions. The pulling down of the handle winds up a spring, which furnishes the necessary power to restore the mechanism to its original position, during which operation the character wheel has been revolved several times, opening and closing the electric circuit a number of times, corresponding to the teeth on the character wheel. The teeth are supposed to represent a certain number, which identifies the location of the box. There must be provided in the box a means of sending other signals than the one on the character wheel, and a telegraph key is provided for this purpose. For acknowledgment of special signals sent, a sounder or bell is provided. The contacts of the box are of a delicate nature, and must be protected from an excess of current due to cross contacts with wires of higher voltage by automatically shunting such currents from the parts liable to injury. On overhead circuits there must be lightning arresters. The mechanism must be enclosed in a dust-proof box, with the actuating shaft extended through the case; and this protecting box must be enclosed in still another box, in which is placed the shunting devices, key, signal bell and lightning arresters. An outer protecting box is provided for the entire inner box and mechanism.

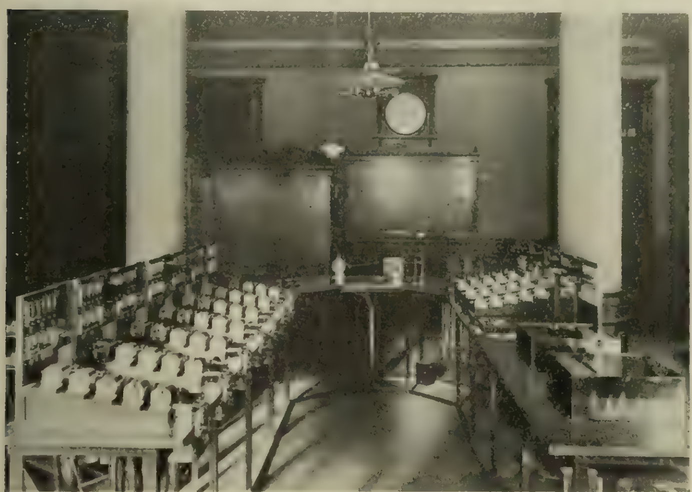
A number of boxes are usually placed in a series on a single line. This is called the signal line; and a current is kept constantly flowing through it, save when interrupted by the sending in of an alarm.

In the modern office each signal line, after passing through a suitable terminal board, is brought to a distributing board, where provision has been made for connecting testing instruments, inserting batteries, circuit-protecting devices and means of switching circuits together, finally terminating in a sensitive relay, adjusted to immediately indicate any actual break in the circuit, or even a small decrease in the normal current on the line. Assuming a box has been pulled, the first break of the character wheel allows the armature of the relay at the central office to make an electrical contact, bringing into circuit a bell, an annunciator indicating the

number of the line, and a small incandescent lamp showing both line and individual instrument. This gives two visual and one audible notifications that a break has occurred in the line. These different signals are not dependent upon each other, and the failure of one will not interfere with the operation of the others.

At each relay is located a three-point switch, normally standing on the point to which the alarm bell is connected. If the break in the circuit is identified as a box number, the switch is turned to another point, which brings a printing register into circuit, and a permanent record of the box is obtained. To the second point of this switch a sounder is connected, which is used for general telegraph purposes.

An alarm having been received, it must be sent to each and every engine house, battalion chief's quarters and police stations. Not only must the alarms be transmitted, but they must be automatically registered in each location, and to avoid possible errors or failure of individual instruments, each alarm must be repeated from an entirely different line, with provisions for a second printed record and an additional gong alarm to insure attention. Means must be provided for the engine companies to advise the main office of their return from a fire, and as this is important information, two separate means must be provided for sending it. When a company has returned from a fire, every other engine company must be notified of it. To devise a means of transmitting this information reliably, quickly and without too great an expense in construction and maintenance of lines, has required skill and inventive ability,



CENTRAL FIRE ALARM OFFICE, CHICAGO.

and the problem was solved by Mr. John P. Barrett, former superintendent of city telegraphs.

A circuit is established through a certain number of engine houses and terminates in the main fire alarm office, at which point it is provided with the same switching and testing facilities described for signal lines. The line is supplied with a slowly alternating current. This reversal of current makes possible the use of the line for two separate classes of signals. At each of the engine houses there is placed in the alarm line circuit a polarized relay that responds to each reversal of current in the line, and has connected to its local points a printing register. When the current is reversed a given number of times at the main office, each polarized relay in the circuit responds, closing a local circuit in each engine house, and automatically printing the number of reversals on a paper tape. In this way the number of the street box is simultaneously transmitted to each engine house. These lines are not used for any other purpose than the printing of the box number.

There is another line similarly constructed and operated, except that it performs two functions. In addition to its polarized relay for each engine house, it has a direct-current relay and a telegraph key, by means of which the Morse Code and a special department code is made available for transmitting instructions, certain reports and alarms not requiring the services of more than one engine, and for receiving the reports of engine companies when they return from fires.

The work of the polarized relay in this circuit differs from that performed in that just described, as in addition to printing the number of the box, it actuates a second circuit, in which is placed a large gong, acting as a "waker" for the men. This gong is always in circuit and will always sound unless the attendant on watch switches it out, which he does if the box struck is not responded to by his company. There is also a small table bell in this line which furnishes a second means of reading the alarm in the event of the register failing.

The receiving and sending of an alarm is briefly described as follows: Simultaneously with the pulling of the street box the annunciator on that line at the main office falls, and an alarm bell rings, calling the attention of the operator, who switches the register into the local circuit of the relay and obtains two perfect records of the box number. At each bank of relays there is located a key controlling the pole changers in the circuits running to all engine houses. The operator reproduces the box number twice on each key, using first the key that controls all alarm lines in which there are only polarized relays. This prints two records of the box in each engine house. Immediately after this it is repeated on the key controlling the pole changers in the secondary alarm wires, and two more records of the box are printed in a like manner; and if the attendant at each engine house is not at his post to hold out of service a large gong, it will sound and awaken the men; so that the attendant must be at his post of duty, and is sure to be caught if asleep when an alarm comes in to which his company should not respond.

It would seem from this description that the operation of such system would be slow, and valuable time might be lost; but actual records of alarms received and transmitted show the average time required to receive an alarm from the box and transmit it over the two lines as described requires but twenty-four and one-half seconds, and with short number boxes has been less than fifteen seconds. This speed cannot be obtained with any automatic transmittig or repeating devices in service at the present time, and it is doubtful if any such apparatus will ever reach the state of perfection that will permit it to equal these records.

Electrical Features of the Aurora, Elgin and Chicago Railway.

The largest crowd ever gathered together at a meeting of the Chicago Electrical Association listened to a paper by Howard Brooks on the "Electrical Features of the Aurora, Elgin & Chicago Railway," on the evening of November 21. This road has justly attracted much interest because it represents the highest type of interurban equipment and construction yet to be found.

The rolling stock as described by Mr. Brooks, consists of motor cars equipped with four 125-hp motors, geared for a maximum speed on a level of 65 miles per hour. Current is conducted to the cars by a 100-lb. third rail. The track rails are 80-lb. and the track construction throughout is equal to that of the best steam roads and suited for the highest known speeds. The power is supplied from one generating station at Batavia, from which it is transmitted to substations at 26,000 volts, 3-phase. Each sub-station has step-down transformers and two 500-kw rotary converters. The switching is nearly all done on the 26,000-volt lines by machine-operated oil switches. The only switches in the main low-tension circuits are the starting switches at the rotary converters. Each generator is connected directly to its bank of transformers, and the switches governing the unit are on the high-tension side. Three 1,500-kw units are in the power station. The transmission lines are aluminum mounted on glass insulators, but these insulators are being replaced by porcelain as rapidly as possible, as the particular lot of glass insulators used on this job seem to have been remarkably defective and much trouble has been experienced from burning off of pins and pole tops.

It appeared from the discussion after the paper that the current necessary to maintain the cars at maximum speed with 600 volts at the sub-stations is 400 amperes. Mr. Gonzenbach, electrical engineer of the company, stated in the discussion that while no elaborate tests on the performance of the cars had been made as yet, some rough tests demonstrated that the standard car of the road could be brought up to a speed of 60 miles per hour in 35 seconds with a maximum current of about 1,200 amperes. The integrating wattmeter readings at the sub-stations show a consumption of 123 kw-hours per car-hour. As the cars make about 28 miles per hour this would equal 4.39 kw-hours per car mile.

The Development of the Fort Wayne Telephone Company's Exchange.

FORT WAYNE, Ind., is a live, progressive city of nearly 60,000 people and growing rapidly. It was one of the first cities to enter the field of independent telephony, sixty of its business men forming a company for this purpose in 1895 under the name of The Home Telephone & Telegraph Co., and capitalized for $100,000. Active steps were taken at once to secure a franchise, which was obtained January 14, 1896, upon submitting a list of eight hundred contracts for telephones, stipulating rates of $36 for business and $24 for residence. At this time the Central Union (Bell) Co., which had been operating for over seventeen years had 527 lines in operation. Construction was begun without delay, and in July of that year service was established. Six months later the number of subscribers had been increased to 1,100, and this ratio of growth made it necessary after two years to increase the capital stock to $250,000. Dividends were paid on the stock within one year after beginning operation, and have been paid quarterly ever since. At the present time, the amount of stock issued is only $200,000, and the investment has commanded a higher premium from year to year. The list of subscribers now counts 800 business houses and 1,700 residences, and there is a waiting list of 200. In order to accommodate the new exchange described in this article, ground was purchased in 1901 in the central part of the city and the contract let for a three-story office building of pressed brick and stone, of which the company now occupies the second and third floors. The second floor is given up to the offices, and the third floor is occupied entirely by the operating room and subsidiary plant and apparatus.

The Fort Wayne Home Telephone Company began operation five or six years ago, as noted, installing at that time a magneto transfer trunking switchboard, with something over a thousand subscribers in service. The outside construction work was practically all overhead at that time, and the system was what is known as common return. Provisions made for the future growth of the exchange at Fort Wayne—as in hundreds of other places—were insufficient, and the exchange soon outgrew the estimated number of subscribers, and the allowance in pole, line and switchboard capacities, made in anticipation of the future growth of the exchange. In consequence of the rapid increase of subscribers, a vast amount of reconstruction work was necessary, and many appliances were added to the exchange equipment from time to time, for the purpose of facilitating the work of operation; but all to no purpose. This has been only too common an experience with independent telephone exchanges.

Something over a year ago the Home Telephone Company decided to abandon the out-of-date apparatus then in service, and install a modern up-to-date central energy multiple system. It was deemed best at that time to perform the work of reconstructing the exchange plant gradually, and that this work should follow the installation of the new equipment as rapidly as possible. This decision was arrived at in view of the fact that the exchange had reached a point where it was practically impossible to furnish satisfactory service, and something had to be done. The Home Company awarded the contract for the complete installation of the switchboard and telephones to the Stromberg-Carlson Telephone Mnufacturing Company, and on July 1, 1902, the new exchange was opened for service. Engineers of the Stromberg-Carlson Company asserted that a combination system such as would be required in order to operate a system of full metallic and common return lines jointly, could be successfully installed and operated. Not only were they warranted in this confidence, as we know now with the completion of the work, but the successful manner in which all obstacles have been overcome, the cutting over from the old board to the new, and the replacing of the old style magneto telephones with central energy instruments is highly creditable to those who had the work in charge.

FIG. 2.—EXCHANGE BUILDING, FORT WAYNE TELEPHONE COMPANY.

The present equipment of the switchboard is complete for 2,280 subscriber lines, with an ultimate capacity for 5,600 lines. Of the 2,280 subscriber lines, perhaps some four hundred are full metallic. The others are on common return circuits. The switchboard is equipped for a full metallic lamp line signal bridged multiple central energy system, with eleven sections installed at the present time, with an equipment for 2,280 subscriber lines, 120 lines to each operator's position. (Fig. 1.) In addition to the subscribers' equipment, there are sixty incoming and sixty outgoing trunk lines, with an ultimate capacity for the installation of 240 trunk lines. The circuits employed

FIG. 1.—SWITCHBOARD, FORT WAYNE TELEPHONE COMPANY.

in the equipment of this switchboard and auxiliary apparatus are many of them entirely new, incorporating features for facilitating operation, and producing electrically more satisfactory results. Changes were also necessary in many of the standard circuits, owing to the peculiar conditions surrounding the installation.

The auxiliary apparatus installed consists of three desks-monitor, chief operator and wire chief and a 3-position toll-line switchboard. The desks are constructed of quarter-sawed oak, matching the main switchboard in design and finish. The monitor's desk is equipped with a sufficient number of cord-connecting appliances, exchange line terminals, and terminals for direct wires to the different positions and offices about the building. Each pilot lamp in the main board is also duplicated in the monitor's desk. Capacity for the growth of the exchange is provided for. The chief operator and wire chief's desks are suitably equipped with line terminals, testing appliances and auxiliary apparatus for the present necessities of the exchange, with capacity and arrangement for additional apparatus when required.

The toll-line switchboard is for three positions of the desk type, of quarter-sawed oak, and finished to match the main switchboard. The present equipment consists of twenty toll and party lines—together secondary output of 100 volts, with primary winding for 40 volts with trunking facilities to the main switchboard and branch exchanges. Fig. 3 illustrates the toll board, showing two positions equipped. The toll lines terminating on this board pass through the main switchboard at the toll or "B" position, where they can be handled at night, or at such times as it may be advisable to dispense with the services of the toll-line operators during the quieter hours. The toll position in the main switchboard is equipped with cord connecting appliances arranged for toll to toll service, and also for toll to central energy service.

The power plant, as shown in Fig. 4, consists of two Roth twin motor generator charging sets, motor end wound for a direct current of 500 volts, with an output of 40 amperes from the dynamo, at 60 volts. These machines are provided with the Cutler-Hammer overload and no current release starting box, and a Roth round type field rheostat. Two Roth ringing dynamotors are installed; one a one-half type with primary winding for 500 volts direct current, and a secondary output of 100 volts alternating; the other a one-quarter type ringing dynamotor, with primary winding for 40 volts direct current, and a secondary output of 100 volts alternating. Each machine is equipped with a "Howler," busy-back and periodic ringing attachment; also with the necessary automatic overload no current release starting boxes, copper hand wheel and index plate.

The storage battery plant consists of two sets of 20 cells each of Electric Storage Battery Company's accumulators in lead lined tanks. The batteries are substantially mounted on heavy stringers and foundations.

The main distributing rack, relay frame and intermediate distributing rack, are equipped for 3,000 lines, and arranged for growth in sections of 800. These racks are made of iron of such cross-section

FIG. 3.—TOLL BOARD.

and so braced as to be strong and rigid. On the arrester side of the main rack are mounted the Cook heat coil carbon and mica lightning arresters. The intermediate rack is constructed in the same manner, with arrangement for the rapid handling of wires in cross-connecting, and equipped with a full number of terminals for the 3,000 lines. The relay frame is constructed much in the same manner, but with a view to easy access to all line and cut-off relays employed in the exchange. These relays are mounted in banks of twenty, and are separately inclosed in tubular cases so as to exclude all dust and foreign particles from coming in contact with their working parts.

On top of the relay rack is provided a box, in which is temporarily placed the apparatus made necessary in view of the combination of the two systems, metallic and common return. This box is wired and arranged with a view to its ultimate abandonment, as it is the intention of the Fort Wayne Company to convert gradually their

FIG. 4.—POWER PLANT.

system to a full metallic exchange, at which time the box and its extra apparatus, together with the cables, will be removed.

In addition to the main central, the company has a sub exchange about one and a quarter miles from the main, to accommodate a growing part of the city. This was started in 1897, but a new corner site has been purchased for the branch, and after the erection of a new building, a new switchboard and plant will be installed there also. Underground cable is now used throughout the entire business section, and is being constantly extended in all directions. The number of feet of 100 and 200 pair of underground cable approximates 55,000 feet, and there is 65,000 feet of aerial cable.

The officers of the company are: Chas. S. Bash, president; L. C. Hunter, vice-president; Wm. L. Moellering, secretary and general manager; Max B. Fisher, treasurer; and John B. Reuss, Isidor Lehman, G. Max Hofmann, P. W. Smith, W. A. Bohn, directors.

Western Union-Pennsylvania Fight.

The Western Union Telegraph Co. has filed its bill of complaint in its suit against the Pennsylvania. It sets up the right of the telegraph company to continue the possession of its lines on the Pennsylvania right-of-way by reason of its compliance with the laws of Pennsylvania, under which its predecessor company, the Atlantic & Ohio Telegraph Company, acquired its charter, and also under the general act of Congress of July 24, 1866. Western Union claims that it has complied with its requirements under the Pennsylvania incorporation and has also complied with the general intent of the United States act. It claims that the United States act made the Pennsylvania Railway a public highway, and that having complied with all the requirements of law since 1851 it is entitled to remain in possession of its lines so long as it tenders the Pennsylvania the agreed or asked rental. The further claim is made by the telegraph company that it has at all times been willing and now offers the Pennsylvania company suitable compensation for service and that notwithstanding this offer the Pennsylvania proposes to arbitrarily and in violation of law depose the Western Union from its lawful rights in favor of the Postal Telegraph Company. It further sets up in the bill of complaint that there is ample right of way for two companies and that it is not necessary, even if lawful, for the Pennsylvania to depose the Western Union in favor of another corporation.

The Present Development of the Steam Turbine.*

By Edwin Yawger.

THE first Parsons Steam Turbine was built in 1884. It was a 10-hp machine, and ran at a speed of 18,000 r. p. m. The date of this first modern type turbine was only a few years subsequent to the first introduction of the modern type dynamo, and at first thought it would seem that the turbine has fallen far in the rear in the general march of mechanical and electrical progress. A reference, however, to the development of electric apparatus since about 1880 will indicate that the turbine has only recently been provided with a field for the application of its peculiar power producing qualities.

When the first Parsons turbine was produced, the largest dynamos were mere toys compared with the machines of today, and a turbine of such small capacity must run at an enormous speed in order to develop its best efficiency. The great preponderance of direct-current apparatus with its difficulties of commutation at high speeds has further checked the application of this high-speed engine in the smaller sizes.

Recent practice in the generation and use of electricity has entirely changed the relation of this prime mover to its application. The rapid growth of alternating-current generation, and the increased size of units has now opened the logical field for the use of this simplest and highest type of prime mover.

The turbine is indeed the simplest of all vapor engines, both mechanically and thermodynamically. The entire rotative effort is produced by the passage of the steam through two simple elements, a nozzle and a moving blade. In the Parsons turbine there may be 20,000 nozzles and 20,000 moving blades, but the function of each pair is precisely alike, and there is no limit except considerations of general design and shop practice to the number of pairs of elements that may be combined in a given turbine. The method by which steam is made to produce the rotary motion of the spindle is by its action and reaction on the thousands of pairs of simple elements. The steam having been admitted through the governing valve enters an annular passage surrounding the revolving spindle. From this passage it enters the first set of nozzles. These nozzles are formed by a large number of curved vanes projecting radially from the cylindrical shell of the turbine. The shape of each nozzle orifice therefore is that of a narrow radial slit. These stationary nozzles or guide vanes deflect the steam to an angle of about 20 degs. from the axis of the spindle. The steam expanding as it passes the orifice then impinges on the first series of moving blades, which are similar to the guide blades, only they are attached radially to the periphery of the rotating spindle.

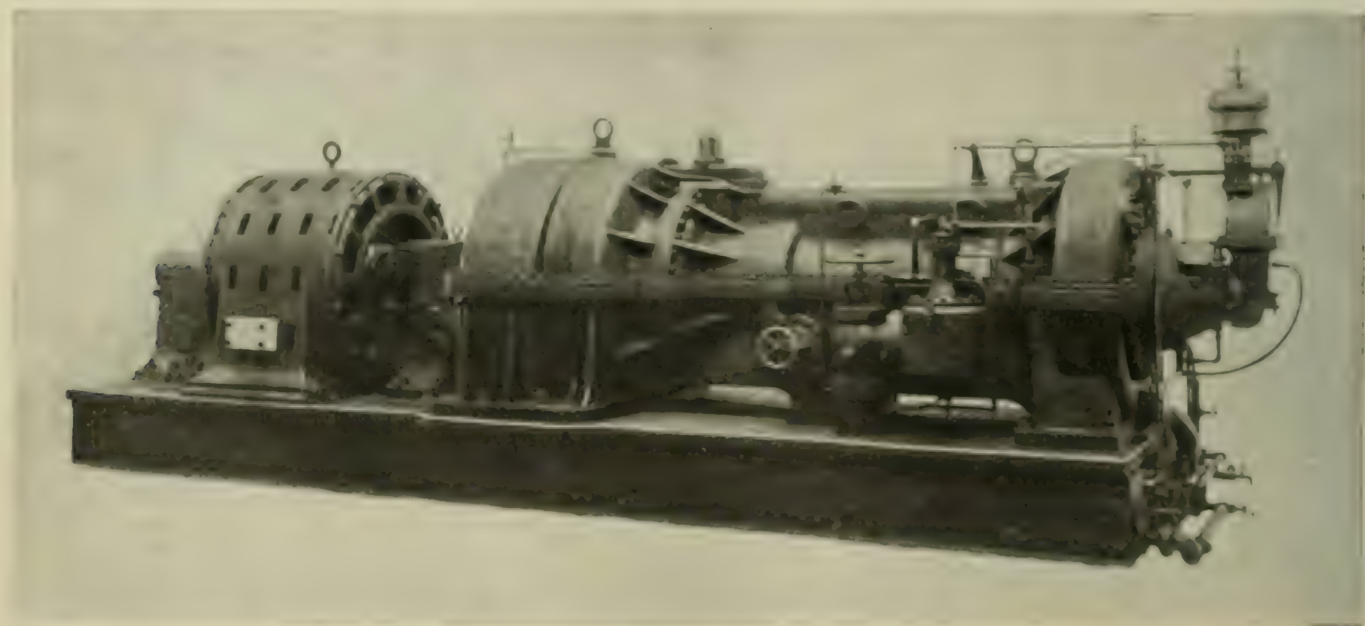


Fig. 1.—1,500-Kw Turbo-Generator Unit.

From the curved moving blades the flow of steam is again deflected back to its original direction, and passes on through the next set of deflecting vanes, which again cause expansion impact and deflection as before. There are anywhere from 20 to 100 of these radial sets of nozzles and blades, according to the conditions of size, steam pressure and vacuum desired. In order to secure the full benefit of the energy of the steam it must, of course, be permitted to expand in doing this work. Each row of nozzles has, therefore, greater discharge area than the one preceding it. This is accomplished by increasing the diameter of the shell and increasing the length of the blades. With a proper arrangement of guides and blades the increase in volume of a unit weight of steam is a measure of the economy of operation.

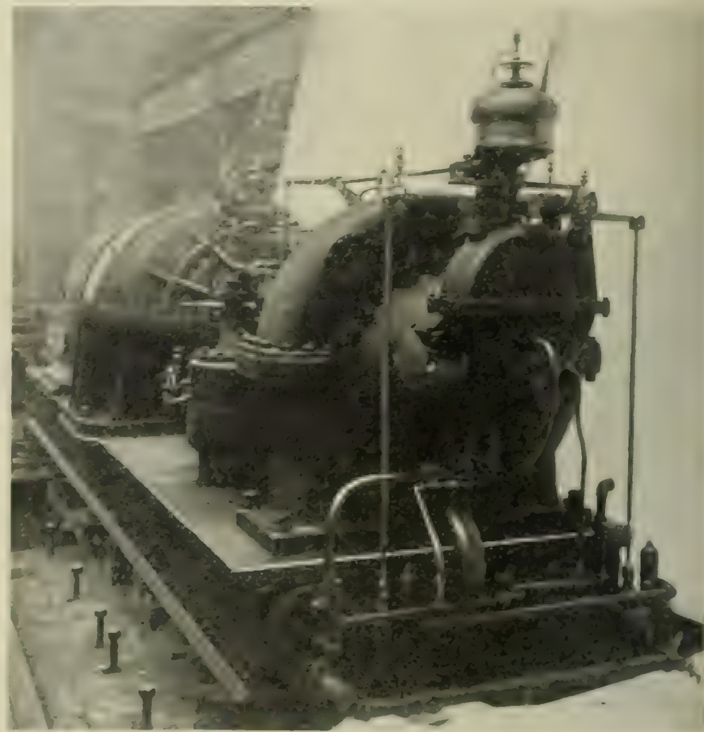


Fig. 2.—1,500 KW Turbo-Generator. Turbine End.

With initial steam pressure at 150 lbs., and a pressure in the last row of blades of 2 lbs. absolute, we would have the steam expanded to 58 times its original volume. In an ordinary compound condensing steam engine the lowest working pressure

* A paper read at the Columbus meeting of the Ohio Electrical Association.

feasible is about 8 lbs., absolute, thus giving with 150 lbs. initial a final volume of 16 times the initial.

A reciprocating engine might be designed to provide for 58 expansions instead of 16, but in that case the low-pressure cylinder would have to be nearly four times the volume that is

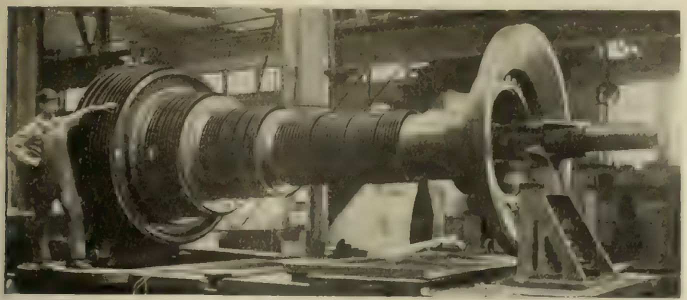


FIG. 3.—REVOLVING PART OF 1,500-KW TURBINE.

given it in ordinary practice, and the friction due to the increased size, together with condensation losses, due to wide difference in temperature between beginning and end of stroke would more than eliminate any gain due to the increased expansion, and the net effect would be to retard the engine with diminishing economy. On the other hand, with the turbines there are no condensation losses, and the addition of a few rows of low-pressure blades to absorb the final energy of steam does not add to the friction of the machine.

It is thus evident that the highest degree of vacuum is of great benefit in turbine practice. It may be added that the turbine is singularly adapted to the use of superheated steam. In addition to the increased efficiency inherently due to superheat, there is a further advantage in the reduction of the fluid friction in the passage of the steam through the blades, and there are none of the attending evils of warping valves and imperfect lubricants.

The exact amount of friction in the turbine cannot be demonstrated owing to the impossibility of securing, by any instruments now available, any equivalent of the indicator diagram. The fact that a turbine without load will continue to revolve for about one-half hour after steam is shut off, indicates how slight must be the friction, especially that of a mechanical nature.

Turning now to the various mechanical details of the machine, next to the essential working parts described above, we would naturally consider, as in other engines, the main bearings to be of the greatest importance. This is emphatically true of the turbine, since a pair of main bearings and a cylinder filled with blades is essentially all that goes to make up such a machine. The duty of these main bearings is much less arduous, however, than that of the bearings of the ordinary engine. There is none of the immense weight of flywheel and reciprocating parts with their attending impact to be upheld and resisted. The turbine bearings support the weight of the revolving spindle only. This spindle, however, at its high speed must revolve about its gravity axis, and this brings in an important function of the main bearing. The gravity axis may differ by, say, .004 of an inch from the geometric axis, and hence it is necessary to introduce that degree of flexibility into the main bearings. This is accomplished by enclosing the bearing shell proper within two or three loose-fitting sleeves, the whole being surrounded with an outer cast iron shell provided with accurate means of adjustment. The bearing and sleeves are lubricated by a forced circulation of oil, and while the shaft is firmly held in place there is no restraint to its revolving with slight eccentricity.

These bearings form the only important rubbing surfaces to be found in the machine, and in case we can prophecy that they will stand up for years against continuous operation, we may consider it a mark of the general durability of the machine. The experience of three or four years in this country and much longer abroad shows that the wear at this point is practically nothing. After a continuous run of 2½ years, 11 hours per day, the bearing of the turbines at the Westinghouse Air Brake Works were examined, and the bearing shells proper were found to be absolutely free from wear, the original tool marks being visible on both the surrounding sleeves and the bearings.

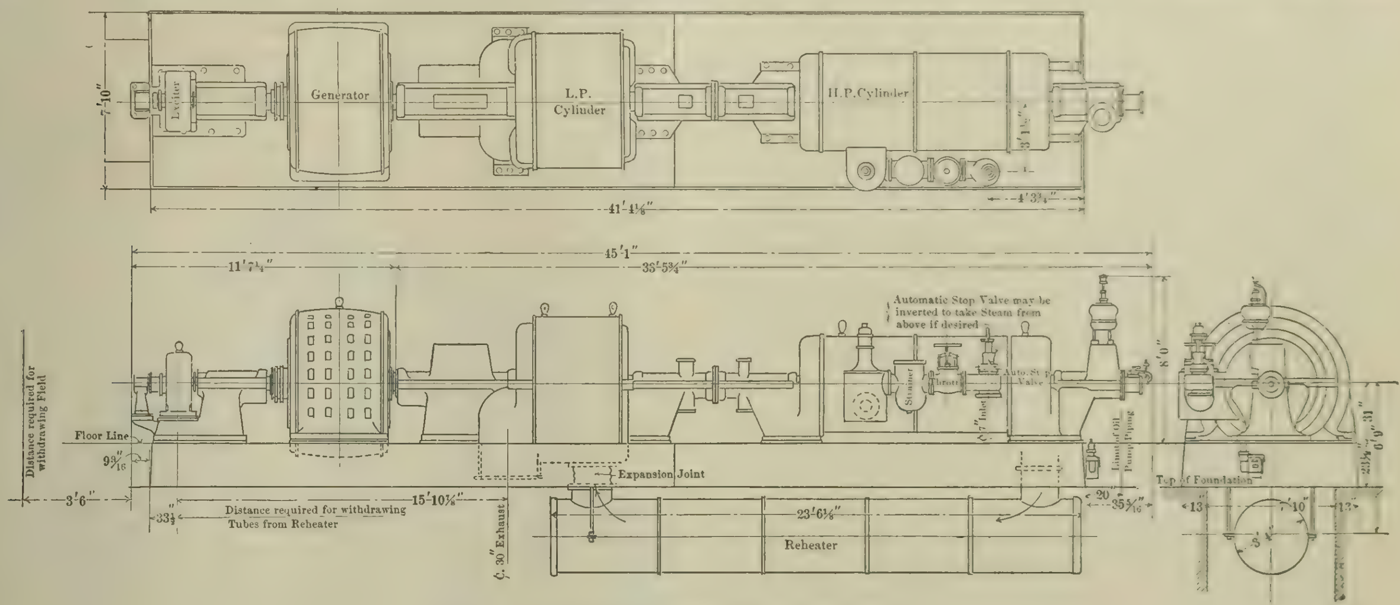


FIG. 5.—1,000-KW TURBO-GENERATOR UNIT.

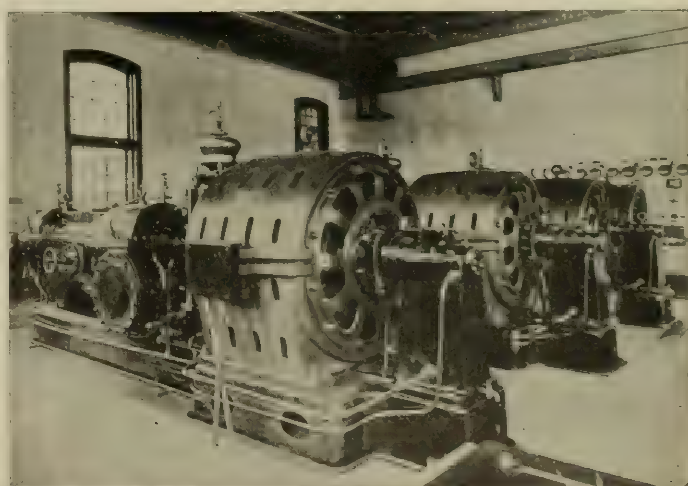


FIG. 4.—POWER INSTALLATION FOUR 400-KW GENERATOR UNITS.

As stated above, the only essential parts of the turbine are a suitable number of nozzles and blades properly mounted and a pair of main bearings. We have only to turn on the steam and

[illegible] thrown around by the force of 20,000 steam jets.

It would soon be found that the combined pressure of the blades and spindle in one direction would create a disastrous end thrust. This is treated in the most natural way possible by providing for a balancing pressure in the opposite direction. A disc with equivalent steam pressure mounted on the spindle is all that is required.

On account of the high speed and peculiar eccentricity of the shaft, it is, of course, not possible to use any of the ordinary

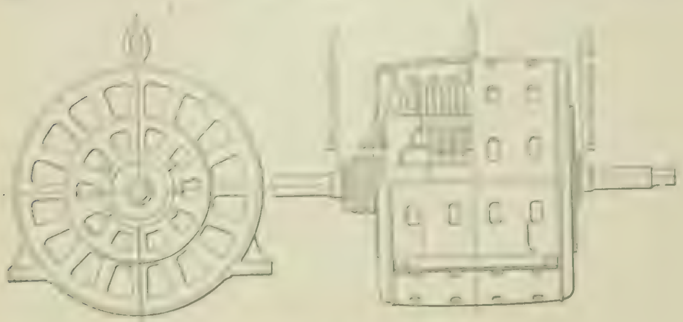


FIG. 6.—1,200-KW TURBO-ALTERNATOR.

gland packing. All glands therefore consist of alternate rings on the shaft and in the shell, which, while not in actual contact, are so close to each other that leakage of steam is prevented.

On a modern reciprocating engine the governor and valve mechanism is considered almost equal in importance to the real working parts of the engine. The eccentrics, rods, bell cranks, links and pins must each and every one be kept up to a perfect state of fit and alignment, else a slight wear in one of the joints will cause the valve to give a faulty steam distribution with its attending pounding, heating, and loss of economy. With the turbine, the governor and admission valve need have only the remotest mechanical connection with the engine itself. In fact, the whole paraphernalia of governing and

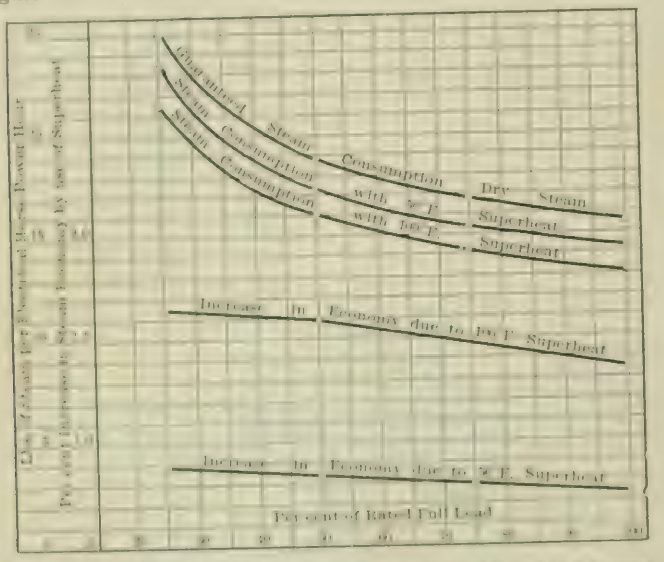


FIG. 7.—APPROXIMATE PERFORMANCE CURVES OF 1,000 KW TANDEM TYPE TURBINE.

admission could be run by an independent motor, or by means of the main generator. The only function of the turbine governor and valve is to let in the right amount of steam. It matters not whether steam is admitted at one precise instant or another, and almost any conceivable amount of wear could take place without interfering seriously with the performance or economy of the turbine. As a matter of fact, the governing mechanism is operated by worm gearing on the main shaft. It is of the fly-ball type, and so designed that the speed will be maintained at any desired uniformity with the further provision that in case of an extraordinary load like a short circuit coming on the machine the governor at once cuts off all steam. Again, should any part of the governor break or for any reason fail to maintain its steady motion, the result would be an immediate shutting off of all steam.

The accessibility of all parts for inspection is almost a novelty in connection with a steam engine. Here it is a case of lifting the cover off and the internal workings are at once exposed.

The accompanying illustrations give two views (Figs. 1 and 2) of a 1,500-kw Westinghouse turbo-generator, and a view of the revolving part of the same (Fig. 3). Fig. 4 shows four 400-kw turbo-generator units, and Fig. 5 represents in line drawing a 1,000-kw unit, the generator being represented to larger scale in Fig. 6. Fig. 7 gives approximate performance curves of a 1,000-kw turbine, showing effect of superheat on turbine economy.

New Southern Bell Exchange at Richmond.

A new exchange building has lately been put in operation at Richmond, Va., by the Southern Bell Telephone & Telegraph Company. It stands on Grace Street, between Seventh and Eighth. It is 40 by 84 feet in plan, and is three stories high, with full basement. The front is of gray pressed brick with terra cotta and Bedford stone trimmings, and is surmounted by a heavy copper cornice. The building is of slow-burning mill construction. All lathing, studding and furring is of metal; the sash and window frames are of metal, and the sashes are glazed with ribbed wired glass. In modern telephone work it is realized that continuity of service is a prime element

RICHMOND, VA., TELEPHONE EXCHANGE.

of efficiency and satisfaction and that in particular the fire hazard has to be dealt with circumspectly, to ensure that no peril of the kind striking in from without shall be able to paralyze the system.

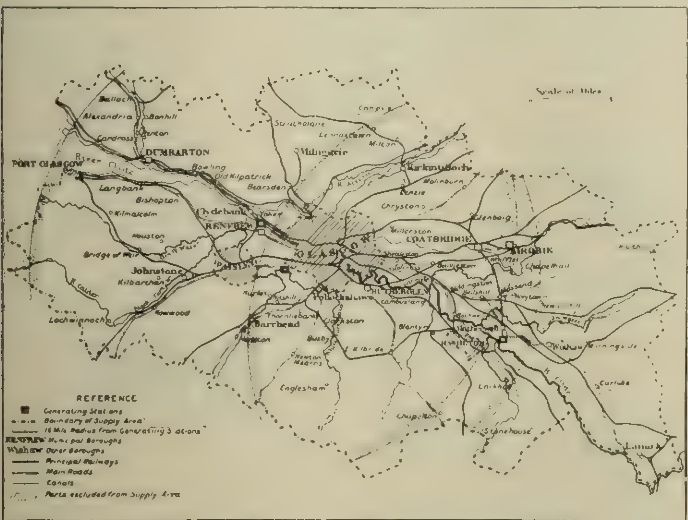
The basement of the building contains the cable vault, the linemen's quarters, and the store room. The first floor is divided longitudinally by a hall, the offices on one side of which are used by the district superintendent. On the other side of the hall are the business offices of the local exchange. On the second floor are located the terminal room, the power plant, storage batteries and inspectors' quarters. The third floor is devoted to the operating room, with the operators' retiring room immediately adjacent. The common battery switchboard has an ultimate capacity of [illegible] lines, the racks, frames and terminals being designed of corresponding size. Mr. E. H. Bangs is the electrical engineer of the company, to whom we are indebted for data.

A Large Power Distribution Enterprise for Scotland.

A bill has recently been sanctioned by Parliament which gives authority for an extensive power distribution scheme contemplating the supplying of power to the industrial region of the lower Clyde River in Scotland. The district covered by the bill includes that part of the Clyde Valley extending about ten miles on each side of the river and about twenty miles up and down stream from Glasgow. The area covered is about 700 square miles, and three generating stations will be erected to meet the demand for power. The scheme has been promoted by a group of manufacturers who desire to obtain cheap electrical power and who realize that this can be better done by joining in a common system than by each putting down his own generating plant.

This is the busiest part of industrial Scotland and contains about 1,200 works, many of which are large iron and steel works, coal mines, shipbuilding yards, and chemical works. Some of these works will alone require more power than many of the local municipalities now provide for lighting purposes, and it was easily shown that it would be inadvisable for the separate boroughs to attempt to supply an amount of power involving so large an expenditure of capital.

The three generating stations are to be built at Motherwell, Yoker and Crookston. The Motherwell station is located in the neighborhood of a large number of manufacturing works and in the center of an extensive coal field and can be connected with the adjoining line of the Caledonia Railway. It is, also, in close proximity to the River



MAP OF GLASGOW AND VICINITY, SHOWING LOCATION OF POWER STATIONS.

Clyde, from which water for steam and condensing purposes can be obtained.

The Yoker station is also situated on the Clyde, near the line of the Lanarkshire and Dumbartonshire Railway, and is in close proximity to a large number of shipbuilding yards, works and docks. Authority has been obtained to lay cables across the Clyde from Yoker to Renfrew, which will enable the works at Renfrew, and other works on the south side of the river, to be supplied from this station.

The third generating station will be situated near Crookston on the Glasgow & Southwestern Railway Canal line; but, owing to the arrangement allowing the company to cross the river, it will not be necessary to construct this station immediately.

The works from which the most urgent demands for power have been received are situated in the areas immediately surrounding the first two sites, and it is intended, therefore, to proceed with these stations first and to install in each a plant of about 4,500 kw capacity. They will be so designed that they can be enlarged from time to time, as the demand requires. A radius of 14 miles from these stations covers practically the whole district in which the company will be allowed to distribute their power, but a large proportion of the works are located within a radius of 6 or 7 miles of the stations. When the stations are in operation, they will probably be coupled together electrically, enabling them to share the loads and average up their power factors or to supplement or aid each other in any emergency. The capacities of the respective stations will ultimately be about 10,000 kw each at Motherwell and Yoker, and 5,000 at Crookston. By utilizing cheap sites for the stations outside of towns and near to the coal mines, it will be possible to generate power at a very low cost. Of the 719 square miles covered by the scheme, only 13 are at present supplied with electricity. It is said that over 300 manufacturers petitioned in favor of the proposition and it is thought that many of the remainder petitioned in favor of the rival Caledonian scheme which was turned down.

The authorized capital of the Clyde Valley Electrical Power Company is $4,500,000, with borrowing powers of $1,500,000. The total cost for plant on the transmission lines is estimated at over $2,000,000. The electrical apparatus, which will comprise polyphase alternating-current generators and transformers for high-voltage power distribution, rotary converters for the supplying of direct current, etc., has been contracted for with the British Westinghouse Electric & Manufacturing Company. Messrs. Strain & Robertson are the engineers of the Clyde Valley Electrical Power Company. Mr. Robert Robertson has recently spent a considerable period in the United States investigating our systems and methods of power transmission and distribution, particularly in our large cities and in such localities as Niagara, Snoqualmie Falls, Wash., Canyon Ferry, Mont., and other places.

Lease of the Manhattan Elevated System.

The general introduction of electricity on the Manhattan Elevated system of New York City and its effect in increasing traffic while reducing operating expenses is seen in the official announcement, issued last week, that the Interborough Rapid Transit Company will lease the Manhattan on a basis of a 7 per cent. dividend guarantee of the latter company's stock by the former. The lease was authorized at meetings of the boards of directors of both companies, the general proposition for such action being approved by both boards of directors. The details of the lease are to be worked out by the officers, under advice of counsel, and the completed document will be submitted for approval to the directors and to the stockholders. The lease will take effect on April 1, 1903, and will be for 999 years. It will cover all the franchises and property of the Manhattan Railway Company. The rental from April 1, 1903, to January 1, 1906, will be the net earnings of the Manhattan Company, not exceeding 7 per cent. After January 1, 1906, the rental will be 7 per cent. per annum on the stock of the Manhattan Railway Company guaranteed by the Interborough Rapid Transit Company. The Manhattan Railway Company stock is to be increased at once to $55,200,000, for the purpose of completing improvements already planned; the present stockholders of the Manhattan Railway Company to have the privilege of taking the new stock pro rata at par.

Provision is to be made in the lease for the ultimate increase of Manhattan stock to the total amount of $60,000,000, including outstanding stock, and due provision is to be made for the application of the proceeds of the sale of the increased stock to the further improvement of the Manhattan property.

The Interborough Company was incorporated May 6, 1902, with an authorized capital of $35,000,000. Under its incorporation it acquired the stock of the Rapid Transit Subway Construction Company. The contract with the city calls for the construction of the rapid transit tunnel for $35,000,000 and its lease to the Interborough for 50 years from date of completion with an option of renewal for 25 years longer. The stock is held in a voting trust. The directors are: William H. Baldwin, Jr., M. F. Plant, August Belmont, Andrew Freedman, James Jourdan, J. B. McDonald, W. G. Oakman, John Pierce, Geo. W. Young, Wm. A. Read, Cornelius Vanderbilt, New York; E. P. Byran, Yonkers, and Gardiner M. Lane, Boston.

The only indebtedness ahead of the common stock is the payment of 3½ per cent. to the city on its contract of $35,000,000 with the city. A sinking fund of 1 per cent. is authorized to commence five years after the road is in operation.

The Interborough Company will pay $10,000 per annum to keep up the organization of the Manhattan Company, in addition to the dividend rental which shall be paid to the stockholders, and the Manhattan stock will be stamped with a contract of the Interborough Company to this effect. The lease will provide security satisfactory to the Manhattan Company for the payment of the dividend rental.

The present capital stock of the Manhattan Railway Company is $48,000,000 and the increase of $7,200,000 to $55,200,000, therefore, represents an increase of about 16 per cent. Investors estimated that the rights to subscribe would be worth about 7. The bonded indebtedness of the company amounts to $39,883,000.

Telephony in the London Fire Alarm Service.

In connection with the improvement of the fire alarm telegraph system in New York City, the question has been raised as to a more

FIG. 1.—METHOD OF BREAKING GLASS.

extended use of the telephone in that department of public utility. The devices herewith illustrated show the system patented and introduced by Commander Wells, chief of the Metropolitan Fire

FIG. 2.—FIRE ALARM TELEPHONE IN USE.

brigade of London. In case of desiring to send in an alarm, the passerby or person running to the street box shown in Fig. 1, breaks the glass, of the alarm post, and the safest way as well as the most convenient of getting at the bell is that of smashing the glass by a lunge of the elbow. The instructions written on the indicator inside are to pull and let go. The alarm bell is sounded simultaneously at the nearest fire station and the brigade is at the same time notified of the location of the fire by the dropping of an armature plate bearing the name of the street in which the fire alarm post is situated.

On arriving at the alarm post, the fireman gives a succession of short pressures to the button until the bell ceases to respond correctly each time. He then brings out his microphone transmitter, inserts the plug or "jacks in," the talking circuit is completed and communication by word of mouth is fully established, the nature of the fire is explained, and orders are given. It is said that the system works quite satisfactorily.

New Telephone Patents.

Of the two telephone patents issued November 25, one relates to the application of the telephone or telegraph to moving trains, while the other covers a new form of selective signal apparatus for party line use. It seems doubtful if either of these inventions has been tried in practical use, for several points in each are somewhat dubious from the practical standpoint.

Of course, the greatest difficulty in applying the telephone and telegraph to moving trains is that of maintaining a sufficiently permanent contact between the stationary wire and the moving contact on the train, and it is this difficulty which the inventor has attempted to overcome by the use of an electrolytic contact cushion. Fig. 1 shows two views of the apparatus. Referring to the sectional view,

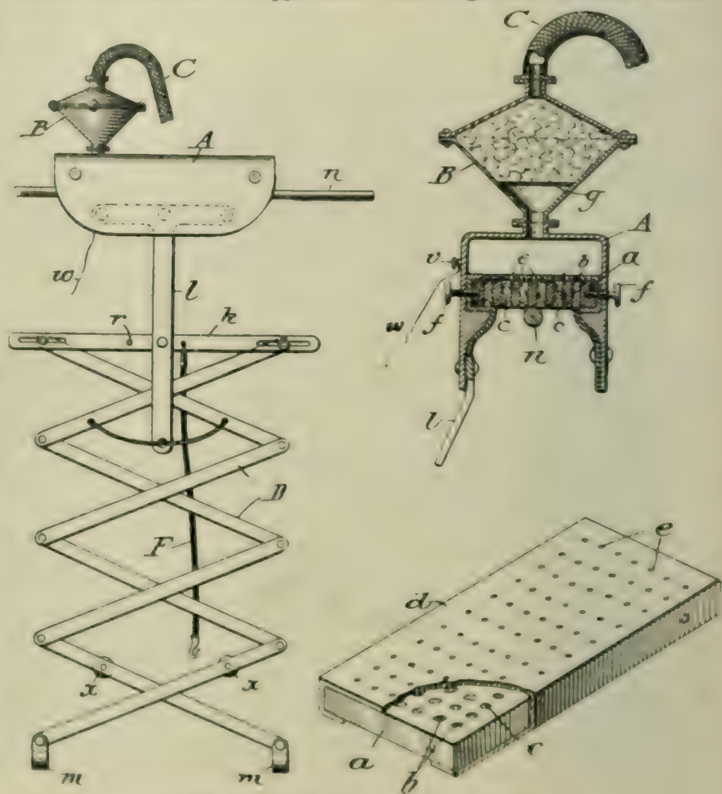


FIG. 1.—JONES TRAVELING CONTACT.

A is a perforated absorbent pad encased in a suitable envelope, another view of which is given underneath. The apertures of the pad are filled with fibrous material such as cotton batting, and the whole pad is carried in a metallic holder, as shown. Upon the top of the metallic holder a receptacle *B* is mounted, filled with salt, saltpeter or the like, and supplied with steam from the locomotive engine through a suitable flexible hose. When steam passes through the salt and becomes condensed, the solution falls upon the pad and keeps it continually moistened with conductive fluid. As shown in the elevation, the holder and pad are to be mounted upon a lazy tongs, which the inventor states is to be attached to the cab of the locomotive under the control of the engineer, who may manipulate the contact to and from the wire by the handles *xx*. A conducting wire is extended from the holder to the cab, and a cord of elastic material is provided to make a springy connection between the pad and locomotive.

While the principle of an electrolytic contact may be all right, it seems certain that with a train traveling at reasonable speed, the arrangement under discussion would fail, for every time a splice in the wire was reached there would at least be some jar which would open the circuit. Furthermore, it is doubtful if anyone could manipulate the contact successfully by the handles *xx*, for a very slight movement of them would mean a considerable movement of the contact, and one can readily imagine the amount of "fishing" engineers would have to do to catch his wire. The patent for this device bears the number 714,189 and is issued to A. I. Jones.

"Telephone switch" is the title of the patent for the selective system, referred to above, granted to Mr. John A. Warrick, of Sheldon,

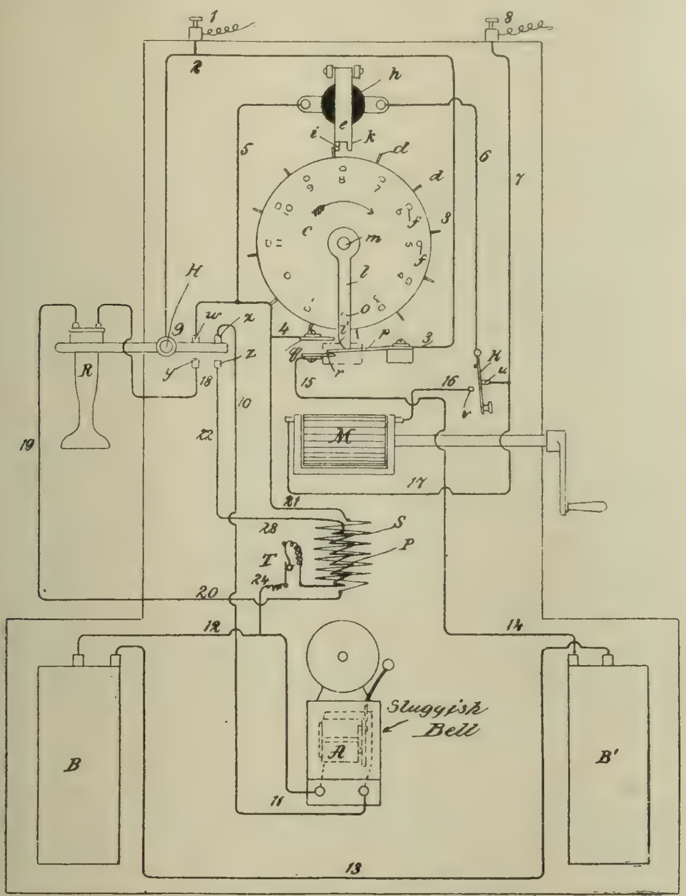


FIG. 2.—WARRICK TELEPHONE SWITCH.

Ill. The system as described depends upon spring motors for its action, one of these motors being located at each subscriber's station. At each station there is also located a desk *C*, shown in Fig. 2. This desk is geared to the spring motor and is controlled by the electromagnet and pallet, shown respectively at *H* and *E*. Mounted above the desk and upon the same shaft is the arm *L*, adapted to revolve with the desk when its boss *O* engages one of the notches *F* of the desk, and also adapted to be turned manually when brought into such a position as to clear the notches *F*. Overhanging the edge of the disc is a stop (not shown in the drawing), beneath which is a key adapted to be so operated by the point of the revolving arm as shown, that it breaks one contact and makes a second. Normally, at each station the arm *L* must be kept engaging that notch of the disc which bears a number corresponding to that of the station.

Now if station No. 2 desires No. 4, the subscriber at 2 moves his revolving arm to his notch 4 and then by means of the direct-current hand generator *M* and the push button *K*, he sends four impulses out on the line and advances all disks and revolving arms four positions; the switches beneath the stops at stations 2 and 4 will then be operated. The switches will not be operated at this time at any other station, for by hypothesis the arm at each of these was a different number of teeth away from its stop than 4. The bell at the selected station rings automatically. When the conversation is completed, No. 2 must, by supplying further impulses to the line, bring all the disks to the zero position, and he must also restore his arm to notch 2, or else he cannot be called except with No. 4, in which case he will not be desired.

The system has a very novel lock-out feature by which if a station tries to break in on a conversation, he cannot do so, for the act cuts off the talking parties. This condition is due to the arrangement of the stop, which clears the face of the disk just sufficient to allow of the passage of the arm when this latter is close to the disk, its boss engaging a notch of the disk. It is therefore only possible to affect the switch of an instrument by electrical impulses thrown upon the line. If the interfering station sends out such impulses, the arms of the talking station 2 and 4 will be moved away from their switches, thus breaking their connections to the line and cutting them off. Furthermore, if any one attempts to make a call when the line is busy, there being no busy test and no way of listening in, a similar cutting off of the existing conversation occurs. This, together with the probability of the subscribers forgetting to wind their machines and also forgetting to reset their arms after conversation, seem to limit the practical use of the system.

Testing the Niagara Power Tunnel.

While the first six units in the new station of the Niagara Falls Power Company will probably be in operation within the next three months, the complete installation of the new wheel-pit will not be in operation until the end of next year. For this reason the company seized an opportunity that presented itself on November 19 to test the full capacity of the tunnel in the development of power. The tunnel was built to carry off the water from turbines having an output capacity of 100,000 hp, and while the company has never doubted that capacity, it felt there would be no harm done in testing the question.

The necessary amount of water was obtained by the operation of the 10 units in wheel-pit No. 1, three new units in station No. 2, and then flowing enough water through the next three penstocks and wheelcases to make the amount equal to what would be used in the development of 100,000 hp. The tests began at 10 o'clock in the morning and were not finished until 5 in the afternoon. While the tests were being made, none of the tenants of the Niagara Falls Power Company had their supply cut off, and there was no interruption in the service except in the case of the mill of the International Paper Company, which was entirely shut down for less than an hour so that the discharge from the turbines, giving 8,000 hp, might not be observed in connection with the discharge from the two wheel-pits. It will be remembered that the wheel-pit of the International Paper Company discharges into the main tunnel through a lateral tunnel. When the installation in the Power Company's two pits and the paper mill pit were all in operation, the tunnel carried off the water in a satisfactory manner, and the tests were announced to be a success. There can be no doubt about the tunnel being able to perform the work for which it was constructed.

An interesting spectacle was developed on the lower river by the tremendous volume of water that was discharged from the portal of the tunnel during the tests. This discharge extended way across the lower river to the Canadian side, a portion of the surface current going up stream and a portion down stream. Close observation of the effect of the rush of water at the portal showed there was considerable space between the top of the arch of the portal and the water; in fact, practically the entire semi-circular arch remained above the water level.

Naturally, the engineers of the company took great interest in the test and the corps was well represented. Among those present was Clemens Herschel, of New York, the consulting hydraulic engineer of the company. Of the directors, Edward A. Wickes and Victor Morawetz were present, as was also William B. Rankine, first vice-president of the company.

Ocean Wireless Telegraphy.

A cable dispatch from London of November 29 says: The *St. James Gazette* says that it has the best authority for saying that the Marconi Wireless Telegraph Company has received no news from the inventor, confirming the statement of Mr. Henniker Heaton, M. P., that a Marconi message would soon reach King Edward from Lord Minto, Governor-General of Canada, as a preliminary to the inauguration of a service across the Atlantic. Lord Minto will probably be asked to open such a service, but the station at

Cape Breton is not yet completed. The Marconi company is not prepared at the present time to indicate the probable date when it will be ready, but it is fully expected that a service will be in operation before 1903. A new magnetic detector is now being tested with a view of increasing the speed of transmission. It is answering the purpose admirably. With the ordinary coherer, the guaranteed speed is only ten words a minute, although twenty words have been sent. According to the inventor, the magnetic detector will enable him to send forty words a minute with comparative ease, and he thinks there will be little difficulty in increasing it to sixty words a minute.

In a special from Glace Bay, Cape Breton, the *New York World* quotes Mr. Marconi as saying: "I do not think our system will be a serious rival to either ocean or land telegraphy. I would say that it would eventually become an auxiliary to it and that the successful transaction of business over the sea will tend to stimulate cable business under the sea. It is possible that our system being cheaper may militate to some extent against the other, though I do not think it will to any great degree."

Social Intercourse by Telephone.

In a recent article on social conditions in the Middle West, Mr. Booth Tarkington in *Harper's Magazine* remarks on the manner in which the long-distance telephone is "kept ringing across these Central States" as a means of maintaining social intercourse. A writer in the *New York Sun* develops the theme in regard to social affairs generally. One reason why the art of letter writing is dying out, he says, is that the telephone is being used more than ever as a means of communication between friends in the matter of invitations, for the announcement of important events and for the sending of messages of congratulation and condolence. Those who cling to the old forms seem to be in the minority to-day. The younger generation refuses to be hampered by the time-consuming methods of several years ago, when a note of invitation, for instance, could not even be sent through the mail, but must be delivered by hand. The modern youth or maiden picks up the telephone and dispatches an invitation to luncheon or the matinee, and even for so serious a function as a dinner it is quite common now for a hostess to call up a friend at the last moment, frankly admitting by the action that she only desires to fill some place that has been left vacant at the last moment. In fact, there is a fad for telephoning messages of this sort nowadays. When it first gained entrance to residences the telephone was intended as a means of communication between a man's office and his home chiefly; then it began to be used for the ordering of cabs, for marketing, for hurrying up slow tradesmen and the various uses connected with housekeeping.

By degrees friends began to make use of the quick method of communicating with each other, and it was so delightfully informal that it became a vogue. Of course, old-fashioned persons regarded with horror the idea of transmitting messages of a social nature in this way; but the age is in such a hurry that the time-saving method has grown to be accepted as quite the proper thing. The informality of the telephone method of communication is what appeals to the younger generation of society. An invitation given or accepted or rejected in this way has not the importance attached to the old method of a note delivered by a messenger. This was a serious affair, and one pondered over the answer to send, the extent of the social obligation involved and other matters. But this message over the wire is different. One does not have time to study questions as to motives, dress, the people one is to meet or any other of the small problems that frequently arise on the reception of a formal invitation. The telephone bidding reeks of the up-to-date. It simply states that the occasion is there waiting, and it calls for a quick decision. There is no reading between the lines and no time to ask why and wherefore. It lacks the chilling dignity and importance that sometimes linger quite unintentionally about a note.

The telephone used as a means of communication between friends must be used carefully, and for this reason in every fashionable woman's sitting-room where her desk telephone may rest, there is a book of record upon which calls sent and received are jotted down.

Calling has also been affected through the use of the telephone. Women are much too busy nowadays with their many affairs to spend time at the old game of paying calls.

CURRENT NEWS AND NOTES.

RAILROAD UP MONT BLANC.—The Geneva correspondent of *The Daily Chronicle* announces that plans have been submitted for the construction of an electric railroad to the summit of Mont Blanc from the village of Les Houches on the Savoy side of the mountain.

DETECTIVE TELEPHONE TAPPING.—It is stated from Stockholm, Sweden, that the creditors of a business man who had serious doubts of his integrity employed a detective to obtain information about him. The detective "tapped" the telephone wire of the house at which the suspect was living and overheard enough conversations to make out a case against the man. It would be interesting to know whether this breach of privacy was effected with the connivance of the telephone authorities.

JIM CROW CARS.—A telegram from New Orleans, of November 8, says: A large number of affidavits were sworn to-day against President Pearson and the other officials of the New Orleans Railways Company, resulting from their failure to place screens or partitions in the trolley cars to separate the white and negro races. The law was passed last July, and the company was allowed 120 days in which to arrange the screens. The law is bearing harshly on the whites, owing to the inadequate number of cars that are being operated during the rush hours.

COMPOSITE ARC LAMP CARBON.—A patent issued November 25 to Prof. A. Blondel, of Paris, France, describes a composite carbon for arc lamps consisting of three concentric parts, namely, of an outer coating of non-scorifiable carbon, an intermediate body of carbon combined with coloring or light-producing salts, and a core of carbon combined with alkaline salts, which may also include coloring or light-producing salts. The body is formed of a paste containing about equal quantities of fluoride or phosphate of calcium, and the coating is formed of pure carbon. The core is made of the alkaline salts used ordinarily in the manufacture of low-voltage and cored carbons, such as tartrates, carbonates, etc., of sodium or potassium, etc.

THE AMERICAN MACHINIST has just celebrated the twenty-fifth anniversary of its existence by issuing a very interesting and very handsome souvenir extra number to celebrate the event. It has become a custom amongst technical and trade journals thus to set up milestones along their pathway and the custom is well justified in the case of publications that are representative of the arts and industries for which they speak. No journal can better claim to have aided and fostered the industries and arts with which it is associated than the *American Machinist*, which always and especially of late years, has been a vigorous and brilliant exponent of progressive tool construction, the development of more perfect machinery, and the advocate of what may best be termed American ideas in the mechanical arts. Of all this the memorial number is a worthy and lasting record, of which its editors and publishers may well feel proud.

NEW ENGLISH SUBMARINE.—A cable dispatch from London of November 29 says: Submarine boat A1, the joint invention of Vickers Sons & Maxim and the Admiralty, was tested in deep sea experiments in the Irish Sea on Tuesday. A heavy sea was running and there was a thick mist. The boat was quickly submerged and traveled several miles, not returning to the surface for some hours. A depth of from ten to fifteen feet was obtained. Manœuvres in and out the flag marks were gone through with, the vessel answering her rudder with great rapidity in whichever direction it was desired to go. She was brought promptly to the surface on several occasions and was submerged with equal rapidity. The surface trials were then run and the speed showed considerable improvement. It is believed that the new boats which are now being built will be more formidable than any with which trials have been made by foreign powers. The A1 returned to Barrow after dark. It is believed she will be fitted with a new petrol engine for the purpose of charging her storage batteries and propelling her on the surface with greater speed than has hitherto been obtained.

THE PENNSYLVANIA-WESTERN UNION FIGHT.—It is announced that the Pennsylvania Railroad Company has agreed to tolerate the presence of the Western Union Telegraph Company's poles and wires on its property until the suit to remove them is determined. The case will now be heard on its merits.

ST. LOUIS EXPOSITION.—Mr. Charles J. Sutter, of St. Louis, secretary of the Electrical Contractors' Association of the State of Missouri, has written the St. Louis Exposition management: "In reference to the meeting of the National Electrical Contractors' Association in St. Louis in the year 1904, I beg to state that, although we had at the previous meeting in Buffalo secured the 1903 meeting for St. Louis and the Detroit delegation were out for the 1904 convention, we succeeded in having the St. Louis meeting postponed to 1904."

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS.—A meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers was held at Canton, Ohio, on November 15. At the afternoon session a paper was read on "High-Tension Electrical Transmission of Power," by T. W. Shelton, mechanical engineer of the Northern Ohio Traction Company. A banquet was given in the evening, after which two papers on mechanical subjects were read. Mr. Elmer E. Miller was re-elected president. The next meeting will be held in February at Warren, Ohio.

SEARCHLIGHTS AS TARGETS.—Gun practice at balloons is not a recent idea, but it is stated that aiming at searchlights is a new refinement of range finding. An interesting experiment in night artillery work was made in Germany recently. A searchlight was placed at a distance unknown to the officers in command of a field battery, and after it was turned on, the guns were brought into action against it. Six 4.7 guns were used, the range was obtained very rapidly, and within five minutes the light was broken to pieces. Another searchlight, at a range of about 2,200 yards, was broken after a few rounds had been fired.

RAILROAD SIGNALING.—After the fatal railroad accident at Offenbach the German government took up the matter of a means of prevention of similar accidents, and a large number of propositions submitted have been examined. One of these is a system invented by Hubert Pfirmann, of Frankfort, which has recently undergone a successful test on a line of railroad between Sachsenhausen and Goldstein. In this system there is an insulated rail between the wheel rails. A sliding contact maintains connection between this rail and the engine, and rheostats are arranged in such a manner along the line that at a certain distance the approach of an engine on the same track is signaled by a red light. By means of the third line the engine driver is able to communicate by telephone to the other train and to give the necessary warnings and instructions.

ELECTRIC RAILWAY SYSTEM.—A patent granted November 25 to M. T. A. Kubierschky, of Berlin, Germany, relates to a system of restoring to the line the energy of retardation of electric railway cars, the method permitting of the location of the necessary means along the line of the railway instead of on the vehicle. Extending from either side of a railway station is an auxiliary trolley line connected with a storage battery, of which there is one for each station. In each battery station there are two switching devices, one for trains from each direction. The main trolley conductor is divided into sections corresponding to the several stations. When a car approaches a station, connection by trolley is made with the auxiliary conductor, whereupon a motor-switching device at the station reduces the tension on the main trolley line by cutting out battery cells; the car controller in the meantime having been turned to the braking notch, the car motors are separately excited, and the current they generate passes into the battery circuit.

COMMERCIAL PACIFIC CABLE.—President Roosevelt signed last week the agreement between the United States and the Pacific Cable Company, and Honolulu will be in direct communication with this country before January 1. The cable ship Silvertown, carrying 2,200 miles of cable for the link between San Francisco and Honolulu, will begin laying the line on December 4. The shore ends have been made ready to the water's edge, and communication can be established as soon as the marine portion is laid. The landing in the United States will be at a point south of the Golden Gate, whence an underground conduit will carry the cable to the Postal Telegraph Company's Building in Market Street, San Francisco. The Hawaiian landing will be on the island of Oahu, and direct connection will be established with Honolulu. A site has already been secured in Honolulu and an office is now being prepared. The contract signed by the President specifies that the entire line from San Francisco to the coast of China shall be completed within one year from the beginning of work, but the cable officials assert that it probably will be completed much earlier.

CABLE MONEY TRANSFERS.—The announcement that the last instalment of money for the completion of the shipping combination, which is to be closed next Monday, was transferred from here to London this week by purchase of cable transfers, has started some inquiries, says the New York *Evening Post*, in regard to the exact nature of this form of remittance The process is simple enough, owing to the use of cable messages sent in cipher code. For instance, a New York house having heavy payments to make on the other side, applies to the local agent or correspondent of a London banking firm for what is known as a "cable transfer" covering the amount desired. If the rate quoted for the transfer is satisfactory, the New York house pays the local correspondent of the London bankers the equivalent (in dollars) of the sum to be paid in pounds sterling at London. To this is added, of course, the cost of exchange and transmission. The bankers effecting the transfer then cable their London branch (in terms known only to the London house and its New York agent) asking that the specified sum be paid immediately to such and such a firm. This is done the same day out of funds that the New York agent or correspondent has actually on deposit in London. The whole thing can be done within a few minutes, including the transmission of the advice by cable, whereas if demand bills were bought it would require a week before the transaction could be completed, since the bills have to be sent by mail. Rates for cable transfers rule generally from ½ to ⅝ cents higher than the price of sight drafts. The system is properly safe-guarded, so that mistakes are virtually impossible.

COOLING RAILWAY MOTORS.—A method of cooling railway motors with compressed air is the subject of two patents granted November 25 to C. O. Mailloux and W. C. Gotshall. The source of compressed air used for the motor-cooling system may be either that which serves for the air-brake system or a different source, but the preferred arrangement is to use the same source of compressed air for both the air-brake and cooling systems The air is conveyed through suitable pipes having flexible couplings leading into the motor case, the air being distributed inside the motor frame between the field coils, by means of perforated pipes or other equivalent distributing device. The control of the cooling air supplied to the motor may be effected in either or all of three distinct ways. The exhaust vents of the present air-brake system may be made to return the air through an exhaust pipe in such manner that the air from the air brake cylinders, instead of being exhausted into the outer air when the brakes are released, is sent through the cooling pipes into the motor cases. The second method consists in the use of automatic devices, whereby air is periodically allowed to flow for a determinate period of time from the air storage cylinders into the cooling pipes. The third method consists in the use of thermostatic devices whereby air will be allowed to flow from the air storage tanks into the cooling pipes whenever a certain limiting temperature is reached. It is claimed that the introduction of such means of artificial cooling will enable the size and the consequent cost of a motor equipment required for a given high-speed service to be materially reduced, and that in cases where a given motor equipment has reached its limitations, owing to excessive heating, the motor output may be materially increased, so as to enable the rate of acceleration and the number of accelerations in a given time, to be both increased, thereby enabling a much higher schedule speed to be attained than would be possible without such means of artificial cooling. The use of artificial means of motor cooling would also permit the introduction of methods of electric braking in many cases where such methods would not now be permissible, owing to the fact that the motors are already overworked, and that the attempt to use the motors as generators in braking would heat them beyond the temperature limits allowable.

NOBEL PRIZE AWARDS.—According to London advices, Nobel prizes have been awarded as follows: Physics, Dr. Arrhenius, of the Stockholm High School; Natural Science and Chemistry, Dr. Emil Fischer, of the Berlin University; Medicine, Dr. Finsen. The Nobel research prize was awarded to Major Donald Ross, of the Liverpool School of Tropical Medicine in recognition of his investigations into the mosquito-malaria theory. Five prizes are, in accordance with the conditions of Alfred Nobel's bequest, awarded to those persons who have contributed most materially to benefit mankind during the year immediately preceding. The amount of each prize is $41,600.

FOUR-WIRE, THREE-PHASE DISTRIBUTION.—With the ordinary star-connected transformer, if a fourth or neutral wire is added to the distributing circuits, no single circuit can be used alone for the reason that there is no corresponding circuit through the primary of the transformers. In a patent issued November 18 to John S. Peck, this deficiency is overcome by providing each transformer with two secondary windings of substantially the same length, which are interconnected so that the current at any given instant through the two secondaries of each transformer will be, with reference to the neutral, in opposite directions.

PARALLELING ALTERNATORS.—In synchronizing direct-connected alternating-current generators having a different number of poles, when one machine comes up to synchronism it is usually the case that another is not in synchronism. A patent granted November 11 to Frank H. Jeannin describes a means of synchronizing under these conditions without the use of synchronizing indicating devices. The machines are connected directly to the circuit in starting up, and to prevent the flow of excessive cross-currents under this condition, the machines are connected in circuit through compensators or tension-reducing devices until synchronism is attained, when the compensators are cut out of circuit. The compensators are merely step-down transformers, with a small winding.

PICTURE TELEGRAPHY.—A patent granted November 11 to Herbert R. Palmer describes improvements relating to that system of picture telegraphy in which the details of the copy to be transmitted are represented by insulating surfaces. The picture is first photographed on a half-tone plate with the use of a mesh so coarse that when etched the picture is represented by depressions in the plate of varying widths of considerable size. These depressions are then filled in with an insulating compound, the plate then being used for transmitting. The picture received is reduced by photography, thereby bringing the dots close enough to give the proper appearance to the eye. This method of transmitting pictures was fully described and illustrated in Electrical World and Engineer, April 13, 1901.

RECORDING ELECTRIC WAVE FORMS.—An electrochemical method of recording electric wave forms is the subject of a patent issued November 11 to Edwin J. Murphy. A paper saturated with a chemical easily decomposed by an electric current—such as an aqueous solution of iodide and bromide of potassium containing starch or dextrine—is caused to pass rapidly between an upper and a lower row of styles. The styles are connected to opposite points of one side of a Wheatstone bridge arrangement in circuit with the varying e.m.f. to be measured. In every half cycle each pair of styles will be at neutral potential and at this point no trace will be made on the paper. The final record will consist of a white curved line on a colored closely lined surface. One of the advantages of this system is that it is unaccompanied by distortion from inertia of moving mechanical parts.

REGULATION OF ALTERNATORS.—A patent issued November 25 to Harold W. Buck describes a means of regulating dynamo-electric machines, and particularly of alternators, whereby variations from a normal voltage acts to modify the field strength. In case of an alternator a rheostat in the alternator field circuit is operated by a motor having a differential winding, one element of which is in circuit with a storage battery and the other with the direct-current side of a small rotary transformer, the alternating current side being connected across the alternator mains. At normal voltage the e.m.fs of the battery and converter balance and the motor remains at rest. In case of variation above or below the normal, the excess or decrease of converter e.m.f. cause the motor to revolve in one direction or the other, thereby causing resistance to be cut in or out of the alternator field.

SUPPRESSION OF "HUNTING."—The suppression of "hunting" of rotary converters is the subject of a patent granted November 11 to Edgar W. Mix, the means consisting in a certain disposition of the brushes on the direct-current side. Instead of providing commutator brushes and arranging them on the commutator in the usual manner, so as to extend over a number of segments just sufficient to secure sparkless commutation, the brushes are staggered, or, in other words, arranged with one or more brushes in advance of the neutral line and others behind the neutral line. The brushes are electrically connected together by circuits of high conductivity, thereby producing local short circuits in the armature conductors connected respectively to the segments within the extreme limits of that portion of the commutator which is spanned by the brushes. The induced currents set up in these local short circuits act to oppose the causes which produce them, and thus act to prevent variations in the speed of the machine.

ELECTRICITY IN THE ARMY.—Notwithstanding the increasing part electricity plays in modern warfare, the only cognizance which it receives as a study at army training posts is at the Signal Corps station, at Fort Myer. Moreover, in the army reorganization scheme of Secretary Root, which is put forward as representing the most progressive thought, this factor is entirely neglected in the section on training. Commenting on the omission of electricity from the curriculum of the general service and staff college at Fort Leavenworth, the *Army and Navy Journal* says: "Secretary Root has gained for himself the highest praise for his generous plan of military training and education, and it is only natural that there should be some defects and omissions in the scheme which will become apparent and will be corrected when the system gets into working order. The subject of field communication is one of the greatest importance in military operations. It has become a vital part in controlling the operation of troops, especially in time of war. It is a factor in military strategy quite as important in its way as are good marksmanship and efficient armament in theirs. For that reason it seems singular that an important matter of this kind should have been overlooked, but the omission will undoubtedly be supplied without the material delay which would impair the efficiency of the system of education at Leavenworth. As a matter of course, it can not be permanently ignored since it bears such a close relation to the success of armies in the field. It should certainly be a part of the education of officers who have to do with the management of troops in the field and who should be fully acquainted with the subject of electricity so far as it pertains to their duties in time of war."

Letter to the Editors.

The Effect of Electrical Waves on the Human Brain.

To the Editors of Electrical World and Engineer:

Sirs: In a letter answering our criticism of Mr. Collins's work on the above subject, which appeared in your issue of May 31, that gentleman objected to the validity of the results we obtained, on the gound of our not using precisely similar apparatus to his own; and advised us to make a further series of experiments with apparatus of a similar nature to that employed by him, without, however, informing us to what extent he found the brain to act as a coherer.

Purely to satisfy our own minds, we followed Mr. Collins's advice and went through, in a systematic manner, all the experiments detailed by him in his first article of February 22, using, however, in addition a milliammeter to test and corroborate the results obtained with the telephone receiver. For a minute and accurate description of our apparatus, we beg to refer the enquirer to Mr. Collins's original article. We may say, however, that Mr. Collins did not specify the metal of which his contact points were made; ours were invariably of platinum.

The results—verified by three observers—were even more definite and conclusive than those obtained with our large apparatus, and

were negative in every case; this, although the resistance in our last coherers dropped from 30,000-40,000 ohms to between 10 and 15 ohms. Consequently, we fell justified in asserting that the maximum amount of cohering phenomena exhibited by the brain, must be less than one-tenth of one per cent.

These experiments were made simply for our own satisfaction, and our results obtained before we were aware of the publication of Mr. Collins's letter in your issue of October 11. If Mr. Collins will be good enough to reread his last letter he will see that the tone he has adopted of mere alternate affirmation and denial—without advancing fresh proof or reasons for either—renders it as useless as it is impossible for us to further answer him.

Should Mr. Collins, however, wish to continue the discussion on scientific rather than on personal lines, we shall be happy to meet any fresh experimental or theoretical evidence of the correctness of his contentions and the consequent inaccuracy of ours.

D. McIntosh.
Montreal, Canada. J. [illegible]-Willmore.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Commutation.—Prenzlin.—A very long theoretical article on sparkless commutation in direct-current dynamos with carbon brushes for running the machine in opposite directions and with the brushes fixed in the neutral line. With the aid of diagrams, the author discusses at length the conditions of sparkless commutation and reaches the following conclusions which are said to have proved to be correct in machines designed for the General Electric Company, of Berlin. The e.m.f. induced by self-induction and by mutual inductions in the commutating coils, for which a formula is given, should not be more than 1.5 volt; his equation shows that this e.m.f. is small if few windings are used per coil; for multipolar machines with several windings per armature coil a series winding is the best. High-speed machines must have great speed of the circumference in order not to make the armature breadth too great. High saturation of the teeth is of advantage. The ratio of the induced current to the supply current at the end of the commutation, for which a formula is given, should never be greater than 0.7. The e.m.f., induced by self-induction and by mutual induction in the commutating coils, multiplies by the ratio of the induced current to the supply current at the end of the commutation, should not be greater than 2 volts. The e.m.f. which is induced in the short-circuited coils due to the movement in the magnetic flux produced by the magnet poles and the armature ampere windings, should not be more than 2 volts. The current density representing the ratio of the total supply current to the total brush section of the poles of equal signs, should not be greater than 5 to 6 amperes per sq. cm. The current density at the end of a brush leaving a commutator bar, due to both the supply current and the induced current, should not be greater than 20 amperes per sq. cm. No resistances, like nickeline bands, should be inserted between the winding and commutator. The General Electric Company, of Berlin, now makes motors up to 50 hp and more for fixed position of the brushes with rotation in either directions.—*Elek. Zeit.*, October 23, 30.

References.

General Transformer.—Eichberg.—An illustrated article on the diagrams representing the action in the "general transformer."—*Zeit. f. Elek.*, October 5.

Brush Holder.—An illustrated description of a brush holder devised by Gand. It is for a radial brush and contains a clamp for easily replacing the carbon brush.—*L'Ind. Elec.*, October 25.

Lights and Lighting.

Reference.

Nernst Lamp.—An article on the gradual development of the Nernst Lamp, with a portrait of Nernst.—*Elec. Rev.*, November 15.

Power.

Power Transmission in India.—An illustrated article on the power transmission from the Cauvery Falls to the Kolar gold fields. The distance from the power house to the nearest motors attached to the line is 92 miles; after reaching the gold fields the length of the distributing systems places the farthest motor considerably over 100 miles from the source of power. The increase in output in the gold fields, due to the introduction of electric power, is in certain cases as high as 15 per cent. The power when delivered at the gold fields is used for two main purposes, for crushing gold quartz and for the driving of the air compressors which work the compressed-air mining tools below the surface; there is a continuous load for practically the whole of the 24 hours. The motors now installed vary in horse power from 5 to 400, and the average output is over 130 hp per motor. As a rule, induction motors are used, but some of the larger ones are of the synchronous type, which enables the lag of the current in the line to be adjusted. Four thousand hp have been contracted for to cover a period of the next 10 years. The turbines were furnished by a Swiss Company, and the whole electric plant by the General Electric Company of this country. Three-phase currents are generated at 2,200 volts and transmitted at 30,000 volts. At the transformer station at the gold fields the voltage is reduced to 2,300, which is the distributing pressure employed. A further reduction to 220 volts is made wherever small motors are to be supplied, but every motor taking 100 hp or more is wound for 2,300 volts. The loss between the power plant and the motors is approximately 20 per cent.—Lond. *Elec. Eng.*, October 31.

Traction.

Repulsion Motors for Single-Phase Traction.—Cramp.—A communication in which he expresses himself quite strongly in favor of the single-phase repulsion motor, his opinion being based upon a series of experiments made by Faussett and Ablett. "A continuous-current motor with laminated magnetic circuit" is said to be really only one type of the repulsion motor, and in fact one of the worst types, very inefficient and troubled with vicious sparking. The latter fault is of course met with in most forms to a larger or smaller extent, but they have entirely overcome it "with the help of special yet simple construction," which however is not described. They have also found that the efficiency of the machine may also be considerably improved by means of special windings. Ablett has also recently found that the starting torque is entirely a question of design, that is to say, that the motor may be arranged to start under full load almost equally well with small currents and low power factor or with large currents and high power factor; but in no case need there be large currents and low power factor as in the single-phase induction motor. With regard to Lamme's objection to the repulsion motor, on the ground that it is difficult to reverse the direction of rotation, their experience is that the reversal of the repulsion motor can be easily effected; and if the movement necessary to cause this is performed while running, the motor immediately begins to act as a powerful electric brake. The repulsion motor has the advantage over the alternating-current series motor in that the motor and commutator are in no way connected with the transmission line or stator windings, so that there may be a low pressure on the commutator, while the pressure of the line or stator is very high.—Lond. *Elec.*, November 14.

Single-Phase Railway Systems.—Geipel and Lange.—A communication referring to a recent criticism of the Ward Leonard system, in which it was said that while with the converter system a train can be moved from rest at a slow speed with a smaller current than in the ordinary method, yet if the train is accelerated at the same rate up to the same speed in both cases, the maximum current in the motor must be the same if the weights are the same, and since the converter-equipped train weighs more than the other, it will not take a small but a larger maximum current to start. The present writers point out that although the maximum current might be greater, yet that current is required at a low voltage: it is one of the

[illegible] large current which is required for starting and accelerating, direct from the [illegible] had been made by Mordey and Jenkin, but that its fallacy had been pointed out by Wilson and Kapp, who showed that there is a time during starting when both large current and full voltage are required simultaneously in the motors, so that the maximum power is not reduced by this system. The power required at starting is not affected by the fact that the line voltage may be transformed down in the converter; the question is entirely one of fluctuations of power.—Lond. [illegible] 11.

[illegible]—[illegible].—An article in which he calls attention to the importance of comparing the records of each week and month with those of the same period during the preceding years and believes that these comparisons can most easily be made graphically. He gives as a sample some curves showing the cost of power stations, repairs, train men, and receipts per car-mile of the railroad with which he was connected in St. Louis. He also suggests that many valuable lessons can be taught by plotting out street railway statistics: as, for instance, on one line the kw-hours per week and month and on the line below it the kgms of coal burned during the same periods. If the station efficiency is constant, these lines as plotted will remain the same distance apart, although each will have fluctuations depending upon the output. If, however, through the use of an inferior quality of coal or for some other reason the station production becomes less efficient, the coal line will approach closer to the kw-hour line. If on the same chart another line is drawn showing the car-miles, and the kw-hour line approaches the car-mile line, it shows that more power is being taken per car than formerly. The same system can be used for comparing the earnings and other data of various street railways, and he gives as an example of this a reproduction of a chart to show the relative time required by the different railways between Portchester and New York City.—*St. R'y Jour.*, November 1, and *Int. Ed.*, November.

Electric Heating of Tramway Cars.—An illustrated article. It is said that generally a consumption of 80 to 100 watts per seat is counted upon, to get under normal conditions a temperature of 54 to 59° F. There are installations in which 65 watts per seat are sufficient; 100 watts suffice in the coldest days. The electric-heating apparatus of the Schindler-Jenny system are described. The heating wires are closely embedded in an insulating material which itself is contained in a metallic cover. One thousand watts are said to suffice for heating a car of 16 to 20 seats.—*L'Ind. Elec.*, October 25.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central Station Statistics of Switzerland.—An abstract of the report of the Swiss Electrical Society on the electric stations in Switzerland. There are 235 plants, of which 194 are municipal and 41 private. In 215 plants water power is used, in 14 gas or petroleum engines, in 6 steam engines; 20 of the 215 hydroelectric plants contain steam engines as reserve. The 215 water-power plants have a total capacity of 104,900 kw; the 14 plants with gas or petroleum engines 2,700 kw; the 6 steam plants 3,300 kw; the total capacity is therefore 110,900 kw. Only 11 plants have a capacity of more than 3,000 kw. 104 plants use single-phase or two-phase or three-phase alternating-current, 101 plants use direct current, and 11 plants a combined alternating and direct-current system. The energy is used in the following industries: 64,700 kw or 63 per cent. are used for electric light and power, 14,400 kw or 14 per cent. for electric traction, and 24,000 kw or 23 per cent. for electrochemical purposes; but 15,000 kw of the latter are not used at present on account of the critical condition of the calcium carbide industry. The Swiss Electrical Society has appointed a committee for inspecting electric plants; the government gives for this purpose a subvention of 10,000 francs ($2,000); the number of plants which have subscribed for inspection, increased from 30 in June, 1898, to 251 in June, 1902. The total number of inspections was 318 during 1902, i. e., an average of 1.26 per subscriber. This committee also makes tests of insulation material.—*[illegible]*, November 6.

REFERENCE.

Contact Surfaces in Apparatus.—[illegible].—An article on the choice of the proper dimensions of contact surfaces and screws of electric apparatus.—*Zeit. f. Elek.*, October [illegible]2, 19.

ELECTRO-PHYSICS AND MAGNETISM.

[illegible] Electron.—ABRAHAM KAUFMANN.—Two papers on the fundamental conceptions concerning electrons. Abraham develops a dynamical theory of the electron as a basis of an electro-magnetic system of dynamics. He starts from the supposition that the electron, as it appears in free motion in the cathode and Becquerel rays, is a sphere, in the volume of which the electric "charge"—whatever that may be—is equally distributed. The "electricity" is to be contained in the volume elements of the electron just as ordinary matter is contained in volume elements of a rigid body. The whole dynamics of the electron are based upon a fundamental kinematical equation, the Maxwell-Lorentz field equations, and a fundamental dynamical equation which implies that the resultants of the inner and outer forces and couples vanish. The main differences between this kind of dynamics and ordinary dynamics are that the electro-magnetic dynamics applies to velocities nearly as high as that of light, whereas ordinary dynamics applies only to small velocities. Kaufmann proves by the exact agreement of a series of tests with a formula of Abraham, that the "mass" of the electron is purely apparent and due to electro-magnetic inertia.—*Phys. Zeit.*, October 10; abstracted in Lond. *Elec.*, November 7.

Velocity of Röntgen Rays.—BLONDLOT.—An account of experiments in which, by a method resembling that of Roemer for determining the velocity of light, he found that the velocity of Röntgen rays is of the same order as the velocity of Hertzian waves.—*Comptes Rendus*, October 27; abstracted in Lond. *Elec.*, November 14.

Loss of Weight of Radioactive Substances.—HEYDWEILLER.—An article in which he reaches the conclusion that the energy of radium rays is due to the conversion of gravitational potential energy into radio-activity. He finds that the loss of weight of a radio-active substance is much greater than was supposed by Becquerel. One of de Haen's "concentrated" radium preparations lost 1 mgm in 50 days while enclosed in a sealed glass tube, the loss of weight observed per day being 0.02 mgm. He points out that the amount of energy of radioactivity is strikingly similar to the amount of potential energy lost in the earth's gravitational field. The substance loses potential energy at the rate of 120,000,000 ergs per day. This amount is recovered to the extent of 100,000,000 ergs per day in the form of radio-active energy.—*Phys. Zeit.*, October 15; abstracted in Lond. *Elec.*, November 7.

Sparking Distances.—EARHART.—An illustrated article on a series of measurements of sparking distances. The main difficulty was to measure a small distance accurately, which was done by the interferometer method. In a diagram he gives the results obtained with air under ordinary atmospheric pressure, as a dielectric. From ½ to 2 microns the potential required for discharge varies directly with the distance. At about the latter point the curve takes a sudden bend and proceeds in nearly a straight line, varying with the distance but according to a different law. If the theory of an air film surrounding the surfaces of bodies is accepted, the sudden variation in the form of the curve would indicate the thickness of such a film as being about 1 micron.—*The Rose Tech.*, November.

Magnetic Reluctance of a Stretched Iron Bar.—FRAICHET.—A description of an experiment in which an iron bar was made the core of an induction coil, the primary winding being supplied with direct-current. The terminals of the secondary coil were connected with a galvanometer. When the bar is stretched, the fibres of the iron, being not all identical, break one after the other. The galvanometer shows a series of jerks as soon as the elastic limit is surpassed, each jerk meaning the rupture of a fibre and indicating the size of the fibre by the extent of the swing. A bar of hard-tempered steel possesses no fibre, and, therefore, the flux traversing it varies continuously until the metal is ruptured.—*Comptes Rendus*, October 27; abstracted in Lond. *Elec.*, November 14.

REFERENCE.

Electron Theory.—LORENTZ.—A highly theoretical paper on "the fundamental equations for electro-magnetic phenomena in ponderable bodies, deduced from the theory of electrons."—*Proc. Roy. Akad.*, Amsterdam, September 27; abstracted in Lond. *Elec.*, November 7.

ELECTRO-CHEMISTRY AND BATTERIES.

Price of Bleaching Powder.—An editorial note on the failure of the convention between the English and foreign producers of heavy chemicals, which may be serious for the new electro-chemical works

which depend upon bleaching powder for their profits. During the past four years bleaching powder has been artificially maintained at an average price of $30 per ton. Contracts have now been signed for the delivery of large quantities at the low price of $20 per ton; should the price fall to $17.50 a ton, many of the electrolytic alkali works would find themselves in an unenviable financial position.—Lond. *Elec.*, November 14.

Recovery of Tin from Tin-Plate Scrap.—A note on a Swedish patent of Bergman. The scrap is placed in an iron vessel filled with a solution of caustic alkalis, together with a depolarizer; there will be electrical action, in which the scrap is stripped and the tin goes into solution, from which the tin is precipitated as oxyhydrate by means of a current of carbon dioxide; the precipitate dissolved in acid is electrolyzed for the tin.—*Chem. Zeitung*, 1902, p. 625; abstracted in *Eng. & Min. Jour.*, November 15.

Copper-Depositing Plant.—A brief illustrated article on a copper-depositing plant which has recently been erected by an English company "for the purpose of forming the reflectors, or rather refractors manufactured by them. These reflectors are made by mounting a series of prisms in light frames made of metal strip, and on the edges of these strips copper is deposited to form a beading which naturally adapts itself to the shape of the edges of the glass prisms, and holds them rigidly in place." No further description is given. The depositing plant consists of two multipolar dynamos, each giving 1,000 amperes at from 2½ to 5 volts.—Lond. *Elec. Rev.*, October 10.

REFERENCES.

Electrometallurgy.—BEADLE.—A series of articles on electrometallurgical problems, especially discussing the methods which have been proposed for producing metals from the ores. The first three articles deal with copper, lead and zinc, but do not seem to give anything new.—Lond. *Elec. Rev.*, September 26, October 10, 24.

Electrolysis and Physiology.—BERTHELOT.—An account of an investigation of certain voltaic cells whose behavior has an important bearing upon the physiological action of the animal cells composing the human body; he studied more especially the very small chemical transformation accomplished in a single animal cell during the impact of a single blood-wave.—*Comptes Rendus*, September 29; abstracted in Lond. *Elec.*, October 31.

Manchester.—WALKER.—An illustrated description of the electrochemical laboratory at Owens' College, Manchester. This is the first laboratory opened in England for the study of and research in electrochemistry and electrometallurgy. It is under the direction of R. S. Hutton.—*Eng. & Min. Jour.*, November 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Tesla Transformers.—DRUDE.—An article on the construction of Tesla transformers. The main problem is to establish magnetic resonance between a coil of a few turns attached to a capacity, with a coil of many turns without terminal capacity. This involves a lengthy process of trial and error, especially in the construction of powerful transformers. The author has therefore worked out a method of calculating the period of the secondary coil and the inductance of the primary. Incidentally some points of importance for radio-telegraphy are touched upon. The period of oscillation of various coils of wire was determined by exciting them by means of an exciter of known dimensions and noting their maximum resonance. Results obtained on one coil can be transferred to another and geometrically similar coil by simply multiplying them by the ratio of any homologous linear piece. To obtain maximum efficiency wood should not be used for cores of coils; ebonite or glass are preferable. Cotton insulation of the wires increases the period by about 1.5 per cent., if its thickness is equal to that of the wire. The period of a coil is always increased by a terminal capacity, but is never doubled.—*Ann. d. Phys.*, No. 10; abstracted in Lond. *Elec.*, November 7.

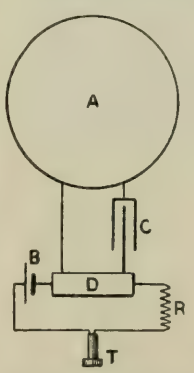
Determining the Period of Rapid Oscillations.—DRUDE.—A description of a method of determining the period of rapid oscillations of condenser discharges of wave-lengths varying from 10 to 100 metres, such as used in Braun's application of oscillatory condenser discharges to wireless telegraphy. For short waves, of lengths less than 12 metres, the primary condenser circuit whose period is to be determined, excites a secondary circuit consisting of two accurately parallel copper wires, 1 mm thick, joined permanently at one end, while at the other a metallic yoke can be displaced along the wires until accurate resonance is obtained, as indicated by a maximum luminosity of a vacuum tube laid in the center between both ends. Then the wave-length equals the total length of the secondary circuit plus the length of the yoke, plus 3 cm, the latter being due to the capacity of the luminous tube. For longer waves, the author uses a parallel circuit 2 m long, which at one end contains a condenser consisting of two circular plates, whose distance can be nicely regulated and accurately determined; the wires are bridged by a movable yoke, and maximum resonance is tested by a vacuum tube applied to one condenser plate.—*Ann. d. Phys.*, November 11; abstracted in Lond. *Elec.*, November 14.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Marconi's Experiments.—MASKELYNE.—An article presented as "a supplement to Lieut. Solari's report on the radio-active expedition of H. I. M. S. *Carlo Alberto*," which was recently abstracted in the Digest. While these experiments have proved that wireless telegraphic messages could be transmitted successfully from England over continental Europe to the ships in the Mediterranean Sea, the present author proves, by means of a reproduction of records recorded, that these messages were successfully intercepted by a station outside of the Marconi company. It appears that the syntonic system, which had been claimed to have been perfected, was either not used or is ineffective. The international conference proposed by the government of Germany is said to be something for which the time is absolutely ripe. "It is time that the matter should be publicly thrashed out. Above all, it is time the public realized that so-called wireless telegraphy is, properly speaking, not telegraphy at all. It is merely a means of signalling invaluable in its own special field, but which can only be employed when time, place and circumstances permit."—Lond. *Elec.*, November 7.

An editorial on the same subject, in which it is said that "wireless telegraphy stands before us to-day as an object both for pity and for anger. * * * It has generated into a mockery of the fair repute of science."—Lond. *Elec. Rev.*, November 14.

Telephonic Detector for Wireless Telegraphy.—JERVIS-SMITH.—A communication in which he describes an instrument which he believes to be serviceable for practical working in inductive telegraphy. Bleekrod has described a coherer consisting of steel needles resting on carbon blocks. The combination was found to decohere so that a telephone could be used in connection with it to detect the transient influence of the Hertzian wave. The present author repeated the experiment and enhanced the effect by imparting a very slight vibration continuously to the coherer. A system of steel rods and carbon blocks was supported on a piece of thin wood; this was so attached to a Morse instrument that the roughened roller which feeds the paper slip touched the wooden support; the contacts were by this means very slightly shaken and a slight buzzing sound was produced in the telephone. But when the system was influenced by the Hertzian wave the telephone gave out very loud and clear ticks. The apparatus was used also in connection with a large coil which played the part of a secondary coil, the primary coil being at a distance. The large coil (12 ft. in diameter) was connected to the coherer through a condenser of about ⅕ microfarad, which permits the electricity due to induction to act on the decoherer or coherer without short-circuiting the circuit of the coherer. The connections are shown in the adjoining diagram, which *A* is the large coil, *C* the condenser, *D* the coherer, *B* the battery, *R* a resistance, and *T* the telephone. The primary coil was similar in size to the secondary, but made of thick wire ⅛ in. in diameter, the ends of which were attached to the outer coatings of two Leyden jars standing on a sheet of ebonite, their inner coatings being connected to the terminals of an ordinary induction coil, a high-pressure spark-gap taking the place of the usual knobs between which the spark passes. This method of forming the circuit he finds to be far the best; also in the case of the Tesla inductor. The primary and secondary coils were placed so that their planes were at right angles to a common axis passing through their centers. If the coil *A* be rotated through 90° the effects are greatly diminished, but not entirely extinguished; the correct position of the coils can be found by taking the magnetic bearing at each station. When, instead of a telephone, a dead-beat galvanometer is used, the deflections are definite and easily read. His experiments were made over the rather short distance of 1¼ miles.—Lond. *Elec.*, November 7.



TELEPHONE DETECTOR.

[illegible]

[illegible] Great Britain in the financial year ending March 31, 1902. Also the conclusion of the report on telegraphy and telephony in Switzerland in 1901 and an article on telegraphy and telephony in Norway in [illegible]

MISCELLANEOUS.

Preparation of Turf by Electricity.—DELAHAYE.—An article on a process used in Stanzfjorden, Norway, where an electric-lighting, power and heating plant was installed in 1898. The price of turf in that locality is extremely low and there is an entire absence of coal and wood, while electric power is available in large quantities and low cost. It was therefore decided to remove the water from the turf by electrical means in order to use it for heating purposes. The [illegible] motor, 2,500 blocks being pressed per hour; these are placed on cars, each carrying 140 blocks, and a train of such cars runs into the "drying tunnel" where a hot stream of air meets it, the temperature being 40° to 50° C. at the entrance and 90 to 100° C. at the exit. The drying installation contains a hot-air generator which is fed with the gases escaping from the dry distillation of the turf; there are also three electric ventilators. After this preparation the blocks are placed in iron cylinders of 1 m diameter and 2 m height, with movable covers, which contain manometers and cocks for the escaping gases and steam. The temperature required for the evaporation of the steam and the dry distillation is produced by electric resistances arranged in a zig-zag, around which the turf is placed; the design of the furnace prevents losses by radiation. From 100 kg of raw turf there are obtained 33 kg of fuel, 4 kg of potash, 40 kg of ammoniacal waters and 23 kg of burnable gases. The fuel contains 76.9 per cent. of carbon, 4.6 hydrogen, 8.2 oxygen, 1.8 nitrogen, 4.8 water, 0.7 sulphur and 3 ashes. The fuel sells well.—*Revue Ind.*, July 26; abstracted in *Zeit. f. Elek.*, October 12.

Removing Hair by Electricity.—[illegible].—An article on the electric method of removing hairs which is said to be both the slowest and the surest. The cathode is the fine needle of platinum, gold or, still better steel, which is introduced along the hair down to the bottom of the bulb. A current of 1 or 2 milliamperes is passed for [illegible] effective galvanocautery. The intensity of the current may be increased if the patient can bear it, and the time of operation diminished proportionally. The hydrogen disengaged round the needle in the shape of a slight whitish foam forms a guide as to the process of the action, and when it is finished the hair comes out without any effort, taking with it a number of inflated clear cells surrounding it like a sheath. According to Giovannini the cells of the epithelium and the endothelium are especially sensitive to the action of the current, whereas the epidermis and cornea resist better, so that the destructive action of the current always acts upon the bulbs of the hair, although the needle may not touch them exactly.—*Arch. d'Elec. Med.*, October [illegible]; abstracted in *Lond. Elec.*, November [illegible]

Ocean Wireless Telegraphy.

The *New York Sun* quotes Mr. Marconi as follows: "I will confirm the report that messages were received by me on board the Carlo Alberto in Sydney Harbor from the station at Poldhu, Cornwall. [illegible] work here. Several improvements have been made both in the transmitting and receiving apparatus, [illegible] minute."

Brussels-Antwerp Railway.

[illegible] cession to construct an electric railway from Brussels to Antwerp The syndicate will complete the line in eighteen months and will run trains that will cover the twenty-six miles between the two cities in [illegible]

New Books.

MAGNETISMO E ELETTRICITA. Hoepli Manual, 1902. By F. Grassi. [illegible] pages, 280 illustrations.

This is one of the series of well-known pocket-books published by Ulrico Hoepli, of Milan, Italy. The author covers in an elementary way all the subjects relating to electricity and its application. The presentation, while simple, is, however, attractive for the clear exposition of the fundamental principles of theory and apparatus described, as well as for the large amount of historical information given pertaining to different inventions and modern applications.

BOOKS RECEIVED.

ELECTRICITY AND ITS SIMILITUDES. The Analogy of Phenomena Natural and Spiritual. By Charles H. Tyndall, Ph. D., S. T. D. New York: Fleming H. Revell Co. 207 pages, 9 illustrations. Price, $1.00.

ELEKTROMOTOREN FUR GLEICHSTROM. Von G. Roessler. Berlin: Verlag von Julius Springer. 136 pages, 49 illustrations. Price, 4 marks.

[illegible] KONSTRUKTION VON DYNAMOMASCHINEN UND ZUR BERECHNUNG VON ELEKTRISCHEN LEITUNGEN. Von Dr. Max Corsepius. Berlin: Verlag von Julius Springer. 269 pages, 108 illustrations. Price, 5 marks.

MANUAL OF RURAL TELEPHONY. By J. A. Williams. Cleveland: Manual Publishing Company. 177 pages, 104 illustrations. Price, $1.00.

NOTES ON THE LAYING, REPAIRING, OPERATING AND TESTING SUBMARINE CABLES. By Captain Edgar Russel, U. S. Signal Corps. With a Supplementary Chapter on Factory Testing, by Lieut.-Col. Samuel Reber, U. S. A. Washington: Government Printing Office. 70 pages, illustrated.

THEORETICAL ELEMENTS OF ELECTRICAL ENGINEERING. By Charles Proteus Steinmetz. New York: Electrical World and Engineer. 323 pages, 144 illustrations. Price, $2.50.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: December 19th, "Braking and Traction Brakes," J. D. Keiley and R. A. Parke; January 23d, 1903, "Telephone Exchanges"; February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES, Secretary, W. H. Johnson, Philadelphia, Pa.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ENGINE BUILDERS' ASSOCIATION, D. N. McBrier, Erie, Pa., Secretary.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION, Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, December 9, 10 and 11, 1902.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION, Secretary, H. K. [illegible], Lancaster, Ky.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York.

SOUTHERN INDIANA TELEPHONE ASSOCIATION, Secretary, E. W. Pichardt, Huntingburg, Ind.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, Thos. R. Mercein, Milwaukee, Wis.

OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION, Secretary, John Brant, 195 Broadway, New York.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION, Secretary, John Ruth.

VERMONT ELECTRICAL ASSOCIATION, Secretary, C. C. Wells, Middlebury, Vt.

U. S. MILITARY TELEGRAPH CORPS, Secretary J. E. Pettit, Postal Telegraph Company, Chicago, Ill.

The Application of Telpherage to Freight.

BY H. MCL. HARDING.

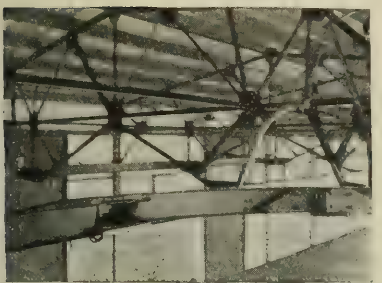


FIG. 1.—FREIGHT HOUSE TELPHER LINE.

At the present moment when one hears so much about freight congestion on the main lines of steam railroads, it is unusually pertinent to inquire whether the application of such a system as electric telpherage might not be availed of, if not to prevent such increasing trouble at least to alleviate it very considerably. The present system of handling miscellaneous freight at terminal stations is absurdly slow and expensive as compared with progressive methods used in all other branches of railroad management. Time, attention and money have been lavishly given to such problems as decreasing the amount of coal consumption and reducing the cost of maintenance of the roadbed and the rolling stock, but up to the present time, apparently, it has seemed impossible to lower the cost of loading, unloading and storing freight Here is to be found, if it were carefully followed up, the secret of the slow delivery of which so many merchants complain. It is like the delay of a telegraph message, which will go over the wire in a flash, but may stay for hours on the operator's hook awaiting the attention needed to put it over the line.

Concerning the unloading of freight, the following data may be of interest:

In the United States, Canada and Mexico there are approximately 1,500,000 freight cars costing $750,000,000. Of this number 90 per cent., or cars valued at $675,000,000, are idle. In other words, a freight care moves on an average about two hours a day, and is idle for twenty-two hours. This is largely due to the fact that the cars must remain so long on the tracks in freight yards waiting their turn to be unloaded. By means of overhead electric carriers or telphers these cars can be unloaded and loaded when at any position in the yards, and need not be moved to the freight station.

The work to be done may be divided into three parts: (1) Taking freight from the cars on the tracks to the warehouses or freight sheds; (2) transferring it to wagons or trucks for local distribution; (3) taking it to other tracks, where it is loaded in cars for smaller cities.

A large proportion of the handling of freight, especially the distributing, assorting and tiering, is done by men. The carriers and hoists, taking advantage of the flexibility of electricity and the ease with which it may be controlled, as well as of its cheapness, make it possible to reduce terminal expenses to their proper proportion in the cost of the "haul." Electricity, under the name of telpherage, is doing for the transportation of freight what it has accomplished in street railways for the transportation of passengers, with results even more gratifying, because the need is more urgent. In the case of street railways the question was electricity vs. horse power. In the case of freight yards it is electricity vs. man power. There is, of course, no power so costly as man power and none so cheap as electric power in handling material. Obviously, then, no method of saving is more desirable than the substitution of electricity for manual labor.

As to the second point, the transferring of freight from the cars, freight sheds or warehouse to wagons for local distribution, or from wagons to the freight houses or directly to the cars, telpherage is calculated to do the work much more satisfactorily than it can be done by any other method. When a load is brought in from the yards, it may be placed exactly where it is desired, that is, it may be carried in through any one of a number of openings and deposited at any one of a number of unloading stations. That portion of the freight for local distribution will be carried by a telpher through the freight houses to the doors or openings where wagons are stationed.

The tracks are so arranged in loops and at such an elevation as to pass above the wagons. The load can be either taken from or delivered to the pier sheds or freight stations from the wagons without any manual labor. There is also a great saving of time, avoiding the necessity of the long waits by the teamsters, obviating the confusion and crowding of the long lines of trucks waiting for their "turn" to load or unload, saving much of the space reserved for horses and wagons. Time, therefore, being saved and heavy lifting rendered unnecessary, a railroad or steamship line thus using electricity is naturally popular with shippers and teamsters. The saving in labor for the transportation company is so great as to be almost incredible.

The handling of freight to be reshipped is vastly facilitated by electric conveying, whether the material is sorted in the cars in which it is originally shipped and taken directly to other cars bound for other and smaller cities, or whether it is to be removed to the freight house, sorted and then taken back to the yards. Since double tracks may be used in the yards or a single track may be laid out so as to form a circuit with numerous cross-covers, as many telpher carriers as are needed may be employed and the two operations of loading and unloading go on simultaneously.

It is impossible to explain here such details as track scales, suspended scales for weighing and the devices used by freight agents for examining and sorting packages. These points have, of course, received careful attention, as they are of great importance in increasing the speed with which the work may be done. Inspectors' houses can be constructed at convenient locations upon the line, through which the telphers and load must pass, for weighing, marking, checking and inspecting the various kinds of freight.

FIG. 2.—TELPHER TRACK IN FREIGHT YARD.

The speed on straight, level stretches can be 800 to 1,500 feet per minute. This may be increased if experience proves it desirable. The amount of power consumed during an average day of ten hours should be, measured by meter, not more than one horse-power per ton. This includes both hoisting and conveying. If the line be one which employs a telpherman, he should receive a little less than is uusually paid to the motorman of a trolley cai in that vicinity. If he controls the telpher and hoist from the truck platform, he can readily assist in the loading and unloading, besides attending to the weighing, attaching, hoisting and conveying. A usual method, however, is to have a number of trucks, and while the loaded trucks are being transported the empty trucks are being loaded, so that the telpher only stops long enough to attach and detach the trucks, replacing empty with full ones. In many cases, as soon as the hoist has lifted the load just clear from the floor, the telpher commences to transport.

The cost of maintenance should be very small. The telpher driving wheels are of very hard steel, and, even when in continuous use, should last for a long period. As they are of small diameter they may be replaced easily at an expense of only a few dollars. The track is protected from dirt and grit, since it is overhead. It is strong, and, as it supports light weights in comparison with those

[illegible] to have exceptionally long life. The maintenance of the supports is the same as for ordinary steel or wooden supports for any overhead structure.

Among the most obvious advantages of overhead electric carriers, as used in handling freight, are that: No ground or floor space is required, the tracks being equivalent to a second story. No drays are used on or between the tracks. Lifting and rehandling are reduced to a minimum. The loading and unloading are done so rapidly that not only can much of the congestion now noticeable in all important freight yards be avoided, but it is also possible by telpherage either to double the capacity of any freight yard or to decrease its size by one-half. Smaller storage stations or sheds will be adequate, since there will be little delay in sorting the freight and removing it for distribution. The load, whether in the form of boxes, barrels or buckets, can be deposited just where it is needed. Hand tiering will be avoided, as will also the slow, laborious lifting of box upon box or barrel upon barrel.

The application of electricity to industrial purposes is not new, but up to the present time the large electrical manufacturing establishments have concentrated their energy and their capital upon the development of electric lighting and heating plants, stationary motors

FIG. 3.—TELPHER LINE HANDLING SUGAR HOGSHEADS.

and various minor devices. Those connected with the application of electricity to the transportation of material, or telpherage, have been in the past closely identified with the introduction of electricity in the street railway system. To them it seemed, as it must to every one who investigates the subject, that the next step was logically the commercial development of the application of electricity to the handling of material along the lines indicated.

Optical Principles and Electric Light Reflectors.

It is a well-known law of optics that the inside face of a polished glass surface will reflect all rays striking it at an angle of 45° or more. Now if two polished glass surfaces are placed at 90° to each other, any ray of light striking the first surface at 45° will be reflected on to the second surface striking it also at 45° and being reflected back parallel to its original direction, as shown in Fig. 1. A ray of light *L* striking the glass surface *B C* perpendicularly passes through, strikes the inside of surface *A B* at 45°, practically *all* the light is reflected on to surface *A C*, where it is again reflected, emerging through the surface *B C* into direction *L*[1].

Making use of this optical law, a prismatic reflector has been placed on the market, which although made of absolutely transparent glass, and devoid of any silvering amalgam or white surface, yet makes a most efficient reflector, is rich and sparkling in appearance, and sold at a moderate price. For these "Pagoda" prismatic reflectors, several advantages are claimed. Compared with white opal reflectors, they are said to be more efficient and are certainly more decorative and rich looking. It is said that they are quite as efficient concentrators of light as the silvered or the mirror reflectors, while they do not cut off all the upward and side light. Then again there is nothing to get out of order or tarnish about them. The cut (Fig. 2) will give a general idea of this new prismatic reflector, which has a good deal of the appearance and sparkle of cut glass. These reflectors are being manufactured and sold by the Holophane Glass Company, who bring to bear on their manufacture all the scientific experience embodied in their well-known Holophane prism globes. A very useful innovation, and one that will be appreciated by those who use electric lamps in very large quantities, is a small prismatic

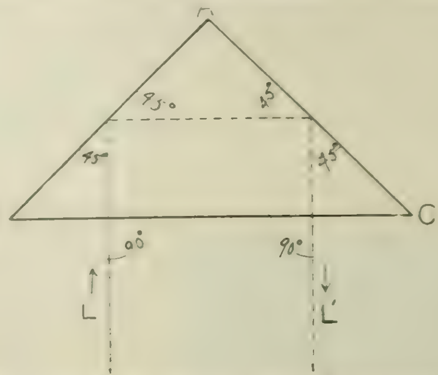


FIG. 1.—ILLUSTRATION OF LAWS OF REFLECTION.

reflector which is made to rest on the electric bulb itself without the need of a holder. Where hundreds or thousands of electric lamps are used, the first cost of getting a suitable holder for each often is the cause of their remaining bare. By dropping over the electric lamp a small "Pagoda" prismatic reflector, such as we describe, all the efficient light concentration downward of a larger reflector is obtained at a very small first cost.

In a recent interview with the president of the Holophane Co., the

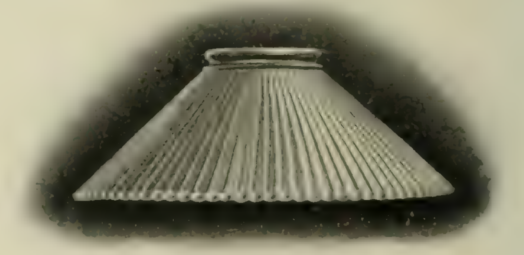


FIG. 2.—PRISMATIC REFLECTOR.

difficult points involved were explained. Two prism glass globes were shown apparently identical (Figs. 3 and 4). They were the same size, shaped alike, both ribbed vertically inside and horizontally outside; in fact the following two cuts are made like these two globes. It is evident that the ordinary unscientific mortal can see no difference between two such globes.

Over a light and tested by a photometer, the Holophane with its calculated prisms was found to give nearly double the efficient

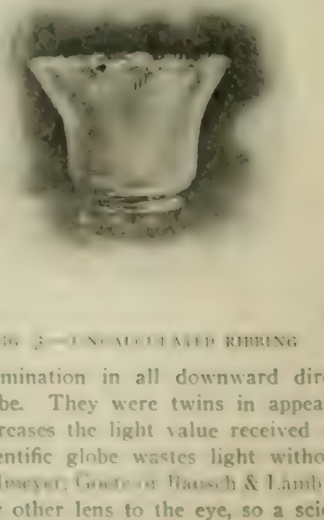


FIG. 3.—UNCALCULATED RIBBING

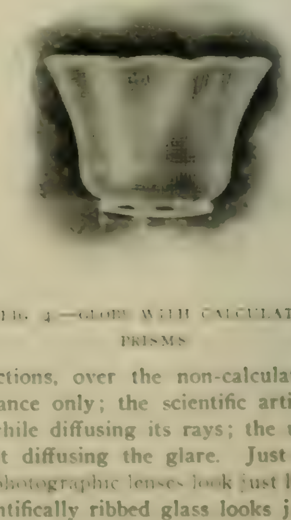


FIG. 4.—GLOBE WITH CALCULATED PRISMS

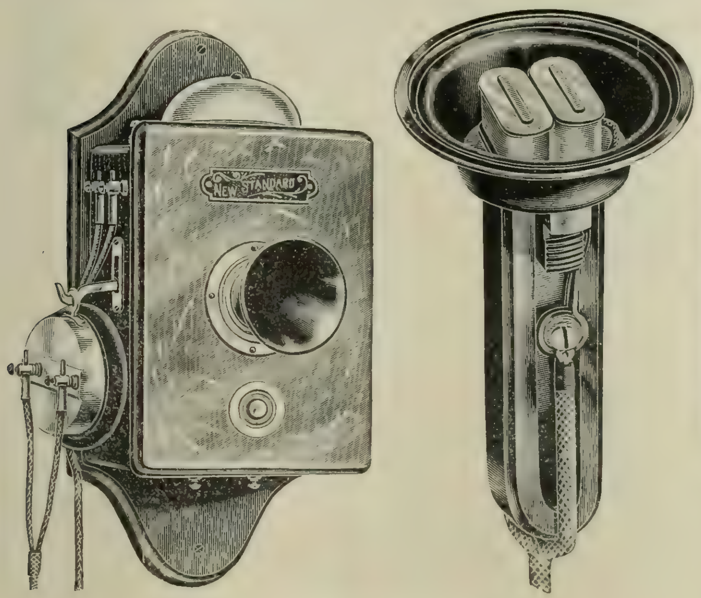
illumination in all downward directions, over the non-calculated globe. They were twins in appearance only; the scientific article increases the light value received while diffusing its rays; the unscientific globe wastes light without diffusing the glare. Just as Dallmeyer, Goerz or Bausch & Lamb photographic lenses look just like any other lens to the eye, so a scientifically ribbed glass looks just like an ordinary ribbed glass to the eye. A reflector covered with

vertical prisms carefully made with finely polished surfaces at 90° will reflect over 90 per cent. of light, and can be made to concentrate downward as powerful a light as a silvered reflector. Exactly the same shape and size reflector covered with exactly the same number of prisms but at each having an angle of 120° instead of 90° will not reflect or concentrate any light. Yet off the light, the two reflectors are identical in appearance.

The Holophane Glass Company now have a well-earned reputation for turning out scientific glass globes, and as the same glass and care is applied to the making of these prismatic reflectors they should find a ready sale. In order to distinguish these prismatic reflectors from the Holophane glass, the trade mark "Pagoda" has been adopted, a name suggested by their appearance resembling that of the pagoda temple roof of India.

New Russell-Tomlinson Telephones.

The Russell-Tomlinson Electric Company, of Danbury, Conn., has been introducing an improved type of its "New Standard" tele-



FIGS. 1 AND 2.—TELEPHONE AND RECEIVER.

phone, Fig. 1. This instrument is fitted with a new solid back transmitter which has the working parts of the company's long distance instrument. This instrument is fitted with a double pole

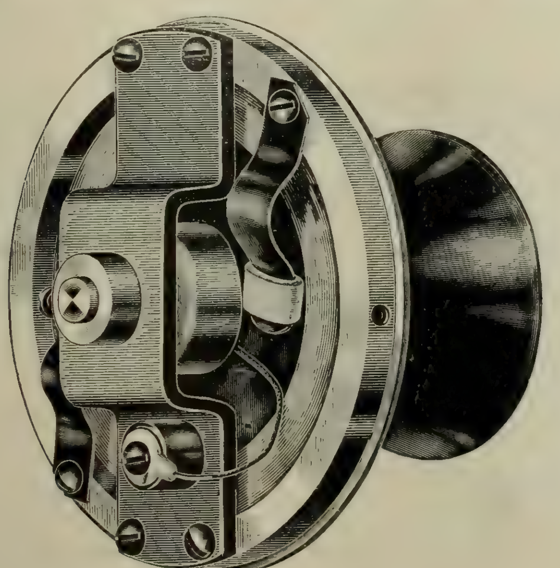


FIG. 3.—LONG-DISTANCE TRANSMITTER.

watch case receiver, and is high in efficiency. Each telephone is equipped with an induction coil, and is built on the lines of the long distance apparatus. It is designed for circuits up to 2,000 feet, and is suitable for hotel installation, etc. The cut (Fig. 3) shows the company's long distance transmitter. This is built on lines of the solid back, and can be accurately adjusted.

An improved desk set is one of the new productions. The essential features are that all contacts are platinum, and working parts are encased in the base of the instrument, which is absolutely dust-proof and easy of access. The new self-contained receiver is shown in Fig. 2. This receiver has all the working parts in metal, which does away with the expansions and contractions that happen when metal parts are cast in the receiver shell.

Central Energy Telephones for Mines and Interurban Railways.

A new central energy mine and railway telephone set, especially designed to meet the conditions of bad weather, hard usage and places where high potential currents abound, is shown herewith in Figs. 1 and 2. This outfit is made by the Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill., and Rochester, N. Y. The iron box which protects the telephone proper, is said to be weather-

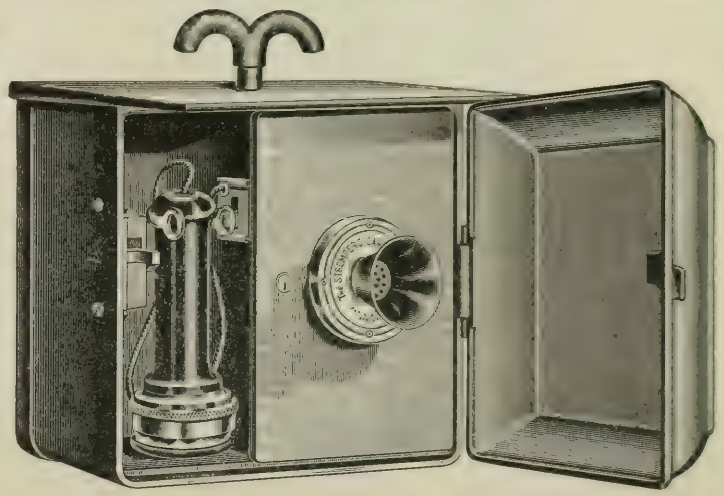


FIG. 1.—MINE AND RAILWAY TELEPHONE.

proof and absolutely water-tight. The line connections are brought into the box through a double elbow, at the top, as shown, thus eliminating any chance of water coming in contact with any connections in the box. The mechanism is completely protected by the inner case, which is locked and only accessible to the person having charge of the maintenance of the system. The various parts of the apparatus are mounted on the inside of the inner case door, which, when it is open, reveals all parts in a manner convenient for inspection, test or repairs. The equipment of a single telephone consists of one long distance transmitter, one bi-polar receiver, platinum contact hook

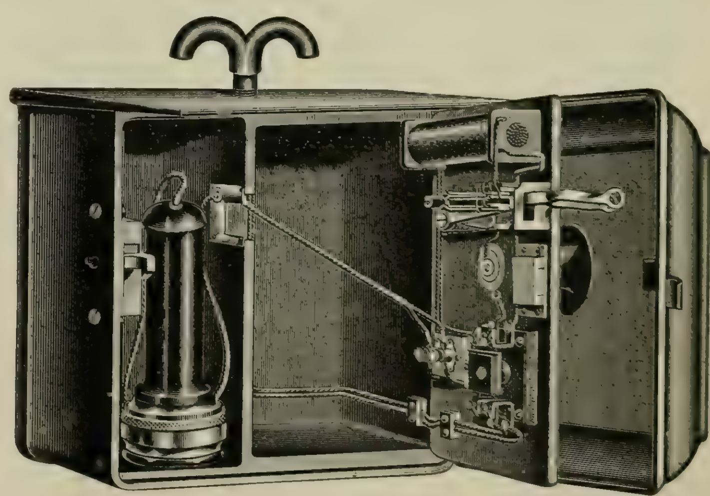


FIG. 2.—INTERIOR VIEW OF MINE AND RAILWAY TELEPHONE.

switch, metallic carbon and fuse lightning arrester connectors, and all parts necessary for the complete operation of a central energy system. All metal parts are non-corrosive, all circuits are wired with the best grade of rubber insulated wire and all parts are interchangeable.

The line cut-out device is provided when specified and is intended as an absolute line disconnector, when the receiver is hung on the switch-hook and the outer case door closed. This makes it impossible for any high potential current arcing to take place in the case when the apparatus is not in use, the carbon and fuse arrester being permanently connected to outgoing lines.

That part of the equipment shown in Fig. 3 is known as the cut-in station, and is intended for use in connection with the instruments already described and shown in Figs. 1 and 2. This box is weatherproof, provided with hinges and lock and made of heavy cast iron. It is so constructed that it may be used without unlocking. In the lower end of the box an opening is provided with a self-closing trap door, which may be opened by pressing upwards. This equipment consists of a bridging jack with heavy german silver reinforced springs, and mounted on a heavy hard rubber base, with heavy

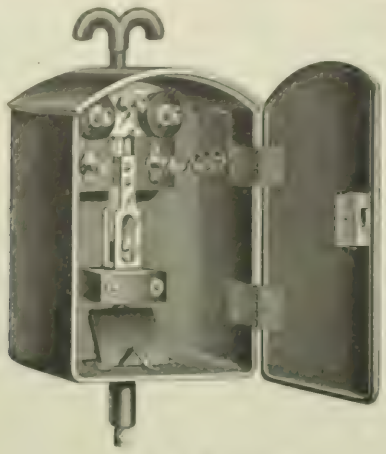


Fig. 3.—Cut-in Station.

sleeve the plug guide, the tension of the springs being sufficiently strong to retain the plug firmly in position and assuring perfect electrical contact. On the bottom of the box, there is a "Y" shaped groove which forms a path for the plug to the opening in the spring jack sleeve, thus making it convenient for the user to insert plug into the jack. The mere insertion of the plug calls headquarters.

This instrument bids fair to become a very popular instrument with street railway people and it is understood that the Stromberg-Carlson Company has a number of contracts already executed for this line of apparatus.

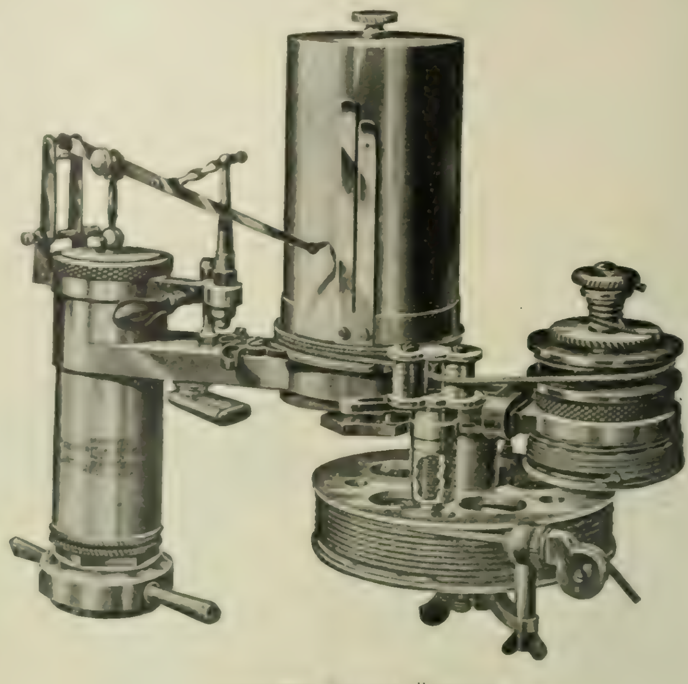
Indicator "Take-Up" Device.

A trouble experienced in using the detent on the steam engine indicator lies in the slack given up by the cord between the paper drum and reducing bushing on wheel. This slack, if not properly guided, when throwing on the detent, is liable to get foul, thereby in many instances wrecking the instrument or at least breaking the cord, thus causing delay and inconvenience to the operator. The take-up device here shown is for the purpose of doing away with this annoyance. It is simple in its construction and can be applied to any standard indicator.

It consists of a short horizontal arm, at one end of which is a vertical bearing, in which sets a steel pillar on the upper end of which there is a frame holding a double set of loose steel pillars, and between these the cord from the paper drum passes. On the lower end of the vertical pillar there is a light spiral spring enclosed. This spring causes the upper frame to revolve when the cord becomes slack, and it is arranged that the cord winds on the frame, to be given up again when the tension is applied.

The object of the device is to permit the operator to take as many cards as desired without unhooking from the crosshead or stopping the engine, no matter what speed. This, of course, pertains to indicators that are fitted with a detent and using a direct-connected reducing motion, the latter being by long odds the most popular in modern engineering practice.

Where an indicator is used in connection with a pendulum, lazy-tongs or reducing motion attached to the engine frame there is less trouble, and generally a rubber band is employed to take care of the slack cord, which works fairly well. In this case the take-up device is in the shape of a regular guide pulley to connect direct to the indicator; the guide pulley is removed and this put in its place and wound up, when it is ready for use. It can also be used with satisfaction as a guide pulley if not needed to take up slack cord, as the little pulleys are arranged to let the cord run through with perfect freedom. Immediately the detent is engaged it picks up instantly what slack



Indicator "Take-Up" Device.

cord there is. The tension of the spring in this device being so much weaker than the drum spring, as soon as the detent is disengaged the cord is instantly released, drawn out taut and assumes its regular position. The take-up device may also be attached to an engine frame and used in various other ways. It works at any number of revolutions and is designed to fit all standard indicators and reducing wheels, or it can be made as a special fixture. The manufacturers are James L. Robertson & Sons, 204 Fulton Street, New York.

Electricity in a Temporary Ball Room.

The handiness and flexibility of the Elblight system of electric lighting cables and signs have already been brought to notice in these columns. A recent pretty illustration of these features was afforded

Fig. 1.—Illumination of Ball Room.

by the ball given at Morristown, N. J., by President McCurdy, of the Mutual Life Insurance Company, of New York City, when the appliances of the Elblight Company of America were freely availed of for

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was firmly held, with a fair demand. The closing rates were 6 per cent. for 60 to 90 days, 5½ a 6 per cent. for 4, 5 and 6 months. The stock market was narrow, public participation being slight. The expectation of continued firmness in money restricted active operation, and some attention was paid to the prospects of Congressional action for the regulation of "trusts," industrials being dull and heavy. The announcement of the Manhattan lease was a leading incident in the market, and this stock was the leader in point of activity. The other tractions sold off when it became definitely known that neither Metropolitan nor Brooklyn Rapid Transit would participate in the deal, but the latter was very strong on Friday, closing on Saturday at 63⅞, a net gain of 1¾ points. It reached as high as 65¼, the transactions for the week aggregating 92,475 shares. Metropolitan closed at 139⅞, being a net loss of ¼ point. The highest figure of the week was 142¼ and the lowest 138½. Manhattan Elevated ranged between 149¾ and 158, closing at 156½, representing a net gain of 5½ points over our last previous quotation. General Electric was quiet, only 2,000 shares having changed hands. The closing quotation was 179, being a net loss of 1 point. This was also the lowest price, the other extreme being 180—a range of only one point. One hundred shares of Westinghouse common sold at 206, a net loss of 1 point; the preferred closed at 208, being a net gain of 4 points. Western Union lost 2 points, closing at 88, after having reached 89¾. American Telegraph & Telephone closed at 161, a loss of 1 point. In Boston, General Electric made a gain of 1½ points, as compared with the last previous prices. Following are the closing quotations of December 3:

NEW YORK.

	Nov. 25.	Dec. 2.		Nov. 25.	Dec. 2.
American Tel. & Cable..	—	89	General Electric	180	177
American Tel. & Tel...	159	159	Hudson River Tel.....	—	—
American Dist. Tel.....	—	35	Metropolitan St. Ry....	139	141½
Brooklyn Rapid Transit.	61¼	64⅝	N. E. Elec. Veh. Trns..	5/16	⅛
Commercial Cable	—	170	N. Y. & N. J. Tel.....	164	162
Electric Boat	20	20	N. Y. E. V. T. Co....	11½	—
Electric Boat pfd......	37	37	Tel. & Tel. Co. Am....	—	—
Electric Lead Reduc'n..	3½	3½	Western Union Tel.....	88⅛	87¾
Electric Vehicle	4	4	Westinghouse Com......	200	200
Electric Vehicle pfd....	10	11	Westinghouse pfd......	206	205

BOSTON.

	Nov. 25.	Dec. 2.		Nov. 25.	Dec. 2.
American Tel. & Tel..	160⅞	160¾	Western Tel. & Tel. pfd	98	—
Cumberland Telephone .	126	—	Mexican Telephone	2	2
Edison Elec. Illum......	—	—	New Eng. Telephone...	138	137
General Electric	—	178½	Westinghouse	100	101
Western Tel. & Tel....	25	—	Westinghouse pfd	100	102

PHILADELPHIA.

	Nov. 25.	Dec. 2.		Nov. 25.	Dec. 2.
American Railways.....	—	52¾	Phila. Traction	98	97¾
Elec. Storage Battery...	80	79	Phila. Electric	9	8¾
Elec. Storage Bat'y pfd	—	—	Pa. Elec. Vehicle	—	—
Elec. Co. of America...	9¼	9½	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	Nov. 25.	Dec. 2.		Nov. 25.	Dec. 2.
Central Union Tel......	—	—	National Carbon pfd....	—	100*
Chicago Edison	—	175	Northwest Elev. Com..	—	—
Chicago City Ry.......	211	211	Union Traction	15	14¼
Chicago Tel. Co........	160	—	Union Traction pfd...	45	45
National Carbon	—	30*			

* Asked.

MANHATTAN ELEVATED.—The directors of the Manhattan Elevated Railway Company have voted a quarterly dividend of 1½ per cent. on the stock, payable January 2d next. This is an increase of one-half per cent. from the late quarterly dividends of the Manhattan Company. The elevated railway has paid at the rate of 4 per cent. annually since the first quarter in 1897. From 1891 to 1896, inclusive, it paid 6 per cent. annually; the subsequent reduction being due to the great loss in earnings, after 1896, through diversion of traffic to the street-car lines. In the few years prior to 1891, the dividend was uncertain, owing to the damage suits of abutting property. The Manhattan Elevated directors have called a shareholders' meeting for January 16, to vote on the plan to increase the company's capital stock from $48,000,000 to $60,000,000. Of this new stock, 72,000 shares are to be issuable as soon as authorized, and the remaining 48,000 shares to be issued at some future time, not; however, prior to January 1, 1906. The circular adds: "The purpose of so increasing the capital stock of the company is to provide the additional funds needed to complete the contemplated improvements in the structure, equipment, and property of the Manhattan Railway Company, including the cost of substitution of motive power, new plant and equipment, additional yard facilities, purchase of real estate and interests therein connected with the right of way of the company, and other necessary requirements in the construction, maintenance, and operation of the railways of this company properly chargeable to capital account." The increase in stock was provided for by the terms of the lease of the Manhattan to the Interborough Company. The last increase in the company's capital was in March, 1899, when $18,000,000 was sold to meet the cost of the proposed electrical equipment.

BOSTON ELEVATED.—The annual report of the Boston Elevated Railway Company for the year ended September 30 has been filed with the Railroad Commissioners. Compared with previous years the figures are as follows:

	1901-2.	1900-1.
Gross	$11,321,030	$10,792,993
Operating expenses	7,862,571	7,336,597
Net	3,458,459	3,456,396
Other income	......	76,503
Total net	3,458,458	3,532,899
All charges.....................	2,836,560	2,896,359
Balance	621,898	636,530
Dividends	600,000	575,000
Surplus	21,898	61,539

In 1899-1900 the gross earnings were $10,141,209, and in 1898-9 they were $9,671,440. The number of revenue passengers carried was 222,484,811, against 213,107,600 last year. There are 7,166 employes and 2,187 stockholders.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company instrument statement for the month ended November 20 and since Dec. 20 shows:

	1902.	1901.	Changes.
Gross output............	93,487	88,497	Inc. 4,990
Returned	36,838	27,510	Inc. 9,328
Net output..........	56,649	60,987	Dec. 4,338
Since December 20:			
Gross output............	994,422	867,323	Inc. 127,099
Returned	420,682	352,173	Inc. 68,509
Net output............	573,740	315,150	Inc. 58,590
Total output.........	3,099,316	2,467,966	Inc. 631,305

DIVIDENDS.—The directors of the South Side Elevated Railroad, Chicago, have declared a quarterly dividend of 1 per cent., payable December 31. The directors of the Massachusetts Electric Co. have declared a semi-annual dividend of 2 per cent. on the preferred stock. The Philadelphia Electric Co. has declared a dividend of 18¾ cents per share. This is 3¾ cents more than the company's first payment, but directors of the company say that there is practically no change. It is argued by some of them that the first dividend was when $6.25 had been paid in upon each share, and was virtually at a 5 per cent. rate, being 2½ per cent. on $6. In the official statement the present dividend was said to be at the rate of 5 per cent. on $7.50 paid.

STANDARD TELEPHONE COMPANY.—A special dispatch from Atlanta, Ga., of November 29 says: "Application was made to Judge Newman in the United States Court this morning for a decree for the sale of the property of the Standard Telephone Company under a mortgage given to the City Trust Safe Deposit and Security Company of Philadelphia to secure an issue of $550,000 worth of bonds. Judge Newman, after hearing argument in the case, said he thought the property ought to be sold, but that he would not sign an order until next Saturday in order that the attorneys for intervening bondholders who resisted the decree might have time to reach an understanding as to terms.

COLORADO SPRINGS MORTGAGE.—The Colorado Springs & Cripple Creek District Railway Company (electric) has filed a mortgage with the Morton Trust Company to cover an issue of $3,600,000 5 per cent. 40-year gold bonds to take up its first and second mortgage bonds and provide $1,600,000 for new work.

KEYSTONE TELEPHONE.—It is announced that the $2,500,000 unissued preferred stock of the Keystone Telephone Company will not be issued, but that a loan probably not to exceed $2,000,000 will be negotiated to complete the company's equipment in Philadelphia.

ALLIS CHALMERS.—The Allis Chalmers Company stock has been listed on the New York Stock Exchange consisting of $16,250,000 7 per cent. cumulative preferred stock, and $20,000,000 common stock.

Commercial Intelligence.

THE WEEK IN TRADE.—[illegible] distributive trade somewhat, but general industry is active all over the country, manufacturers and producers being still urgently pushed to deliver on orders booked some time ago. Improvement is noted in the transportation congestion, but the car shortage is still a cause of worry to railroad managers and merchants alike. Lower prices for cereals, provisions and finished iron and steel give hope for better export trade and the possibility of cutting down some of the unfavorable foreign trade balance shown early this year. Collections are still good in a majority of cases; money tends towards greater ease, but the return of currency from the country is slow. On the Pacific coast, trade is very active, and from the South come good reports, except Texas, where two weeks' rain has hurt the cotton crop and business and delayed collections. At the East a satisfactory condition of trade prevails generally. In the iron trade there is a more cheerful sentiment; finished products are firmer in tone. Among the other metals, copper is weaker in tone, and tends downward on increased offerings and weak foreign markets. One million pounds of December electrolytic was offered at 11.25c., but no bid higher than 11c could be obtained. The closing quotations were: 11.25 a 11.50c. for Lake; 11.12½ a 11.25c. for electrolytic and casting stock, and 10.50c. for Standard. According to *Bradstreet's*, the number of business failures during the week ended November 27 aggregated 182, as against 201 the previous week and 189 the same week last year.

EQUIPMENT FOR BIG INDIAN POWER PLANT.—The Cauvery Falls power transmission plant, which is equipped with American electrical machinery, and whose present capacity is about 4,000 hp, is to be extended to 10,000 hp, and Major A. C. Joly de Lotbiniere, the deputy chief engineer of the Mysore government, is now here with a view to making the necessary purchases. The plant, which began active operations June 30 last, generates power for the purpose of operating the gold mines in the Kolar district, India. Prior to utilizing electricity, steam power was employed to work the Kolar fields, the cost being $155 per horse-power. The present power is sold at $145 for the first year. For the second, third and fourth years the charge will be but $90 per horse-power. For the fifth year the price will not exceed $120, while the five years following power will be delivered to the mining interests at $50 per horse-power. It is estimated by the engineers that the higher charges made during the first five years besides making full provision for the working expenses and repairs will enable the Mysore government, which operates the plant, to compensate itself for the capital outlay which before the system is completed will entail an expenditure of some $6,000,000. The transmission line is the longest in the British Empire. The distance over which the power is transmitted before any motors are attached to the lines is 92 miles, and after reaching the goldfields the length of the distributing systems places the farthest motor considerably over 100 miles from the source of power. The General Electric Company filled the contract for the electrical portion of the system, Mr. Axel Ekstrom of the company being the chief engineer in charge of the construction work. There are six generators of 720-kw capacity each, 2,200 volts; two exciters of 75 kw each, direct-connected to dynamos; 12 transformers of 400 kw each, and several motors, mostly induction, varying from 4 hp to 400 hp and averaging 130 hp each. The labor arrangements are such that there is a continuous load for practically the whole 24 hours. One of the main generators is kept in reserve. The turbines are of Pelton type, built by the Swiss firm of Escher, Wyss & Company, of Zurich. There are six machines of 1,250-hp capacity each working with an effective head of 382½ feet. Two smaller wheels drive the exciters. The power operates mines where [illegible] men are employed, 14,000 of whom work underground.

H. B. COHO & COMPANY, INC., general sales agents of the Keystone Electric Company, report recent sales of Keystone generators and motors to the following customers: American Hard Rubber Company, Butler, N. J., one 30-hp motor, one 10-hp motor; Ball Engine Company, Erie, Pa., ten motors; Carnegie Coal Company, Carnegie, Pa., one 175-kw generator, with switchboard; Clemson Bros., Middletown, N. Y., one 10-hp motor; Erie City Iron Works, Erie, Pa., one 67-hp motor; Erie Forge Company, Erie, Pa., one 25-kw generator; Fischer Motor Vehicle Company, Hoboken, N. J., one 5-kw generator; Franklin Supply Company, Franklin, Pa., one generator; Herbert Manufacturing Company, Erie, Pa., one 15-kw generator; Jones Bros., proprietors Grand Union Tea Company, Brooklyn, N. Y., one 30-hp motor, one 20-hp motor, one 15-hp motor, one 10-hp special motor, two 5-hp motors, one 7.5-hp motor; Leggett Bros., New York, N. Y., one 3-hp motor; W. C. McIntire & Company, Philadelphia, Pa., one 200-kw generator; Malleable Castings Company, Sharon, Pa., one 5-hp motor; Mansfield Coal Co., Carnegie, Pa., one 150-kw generator; Masurite Explosive Company, Sharon, Pa., two 8.5-hp motors; Penn Boiler Works, Erie, Pa., one switchboard; J. C. Stearns, Buffalo, N. Y., one 5-hp motor; Union Ice Company, Erie, Pa., one 30-kw generator; United States Mint, Philadelphia, Pa., five special vertical motors; H. F. Watson & Company, Erie, Pa., one 25-kw generator; Watson & Stillman, one 18.5-kw generator; A. C. Welchans, Lancaster, Pa., two 85-kw generators with switchboard and motors.

THE NORTHEASTERN TELEPHONE COMPANY, of Portland, Me., has placed an order with the Automatic Electric Company, Chicago, for a switchboard and telephones for the new exchange, which will be built in the city of Portland. The switchboard will have a capacity of 10,000 stations with 2,500 connected up in the beginning. A building site has been purchased in the heart of the city, and the architects are now in correspondence with the engineers of the Automatic Elctric Company to the end that the exchange building shall be best suited for the automatic system. The Northeastern Company proposes to install a model plant. All outside work will be of the most modern type; in the business part of the city all cable will be placed underground, and the aerial work will be of the most durable character. Within a radius of one and one-half miles of the exchange there is a population of 40,000 people. The promoters of this enterprise believe that as soon as their exchange is in working order and the people are familiar with the service, the number of subscribers will be rapidly increased to 3,500 or 4,000.

HEINE BOILER ORDERS.—The Heine Safety Boiler Company, of St. Louis, whose New York offices are in the Bowling Green Building, has just secured a contract from Cerveceria Cuauhtemac, Monterey, for the shipment of two boilers of 250-hp capacity each, for installation in an electric plant in that Mexican city. Among recent domestic orders is one for 1,050 hp in three units for the big new India Building, Boston, Mass., where the equipment will be utilized in connection with a large lighting and general power plant. The Reading Cement Company, of Reading, Pa., which concern is building an extensive plant, to be electrically operated, has ordered two 350-hp Heine boilers. The Jennings Electric Light & Power Company, of Jennings, La., has contracted for the supply of a 250-hp boiler. The Utah Electric Light & Power Company, of Salt Lake City, Utah, has also ordered a Heine boiler of similar capacity, and the Philadelphia & Lehigh Valley Traction Company has requisitioned for 300 hp outfit for installation in its Ambler, Pa., plant.

STOREY MOTOR GROWTH.—The Storey Motor & Electric Company, of Harrison, N. J., of which Mr. Henry E. Fanshawe was recently elected a director, is pushing matters actively. Its manufacturing department has been placed under the care of Mr. Thos. J. Fay as general manager, he having resigned from the C. W. Hunt Company. Mr. C. H. Shum, formerly of the La Roche Company, of this city, and the Bergmann Works in Germany, has been appointed as electrical engineer. He is a Cornell graduate of 1895 and well posted. The company has increased its machine tool equipment and is experiencing an excellent demand for its product, orders being many times greater than last year. The company are paying special attention to variable speed motors for direct-driven tools, and in this field their contracts are already abreast of their capacity for several months to come.

THE WAGNER-BULLOCK ELECTRIC COMPANY has closed a contract with the Stuparich Manufacturing Company to install a complete plant for the electrical operation of its large photographic-mount factory in San Francisco. A number of direct-current motors will be direct-connected to the various machines. The whole plant will be operated under the system upon which the Bullock Electric Manufacturing Company holds patents. A 50-kw generator, belted to a 100-hp Nordberg-Corliss engine, will supply current for the operation of the motors.

GOVERNMENT CONTRACTS OPEN.—Proposals will be received until Saturday, December 20, for furnishing engines, generators, boilers, etc., for a complete electrical power plant for the Frankford Arsenal, Philadelphia, Pa. Major Frank Heath is in charge of the work. Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until December 16 for the navy yard, Mare Island, Cal., for a quantity of transformers, electric cable, etc., for the training station, San Francisco, Cal.

GATES AFTER BARBADOES LIGHTING CONCESSIONS.—Franchises are being sought with a view to the construction of plants to light the principal towns in Barbadoes, British West Indies. It is reported that parties are now on the spot in the interests of John W. Gates and his friends. Two of the towns from which concessions are sought are Bridgetown, having a population of about 22,000, and Sperghstown, which has about 2,000 inhabitants.

CONTRACTS PENDING FOR NICARAGUAN ROAD.—Contracts are about to be let by T. H. Davis, the manager for an electric road in Rivas, Nicaragua, which is styled the Compania de Tranvia de Rivas. Rivas has a population of about 9,000.

ELECTRIC TRACTION FOR GRANADA.—The Compania de Tranvias de Granada, of Granada, Nicaragua, is to be converted from a horse to an electric road, and will be considerably extended.

MESSRS. QUEEN & COMPANY, Philadelphia, sold recently to a representative of the Japanese Government one of their X-ray machines for a rather novel purpose. The government representative who placed the order explained that in the governmental mints in Japan they coin a great many gold dollars, and the government has suffered considerable loss in the past through dishonest employees swallowing gold dollars and carrying them out of the mint "in their little insides." The X-ray apparatus will be used to examine employees as they depart from the mint daily, and will, of course, reveal the presence of any dollars which may be in the man's stomach at the time. It is not proposed to put every employee through this examination each time he leaves the mint, but it will be done from time to time, unexpectedly, and any employee will be liable at any time to be called up for the X-ray examination. In this way the government hopes to inculcate in its employees the fear of detection which will prevent the form of theft referred to. Possibly the same ingenious idea could be applied in South Africa to diamond stealing by the black laborers at the mines.

DEVELOPMENT AT CORSICANA, TEX.—The Corsicana (Tex.) Gas & Electric Company is installing a new plant. The system is to be three-phase alternating-current, the arc lights to be run from the main three-phase generators through series transformers and of the enclosed arc type. There will be three 150-kw three-phase 2,300-volt generators direct-connected to tandem compound automatic engines of 225 hp each, three 175-hp water-tube boilers, feed-water heaters, etc., entirely new. The electrical apparatus will be furnished by the General Electric Company, the engines by the Russell Company, of Massillon, Ohio, and the boilers by the Stirling Company, of Barberton, O. The entire lines over the city are being reconstructed with new poles and new copper. Mr. F. N. Drane, the present manager of the Corsicana Gas & Electric Company, is actively engaged developing the new plant.

MORE NIAGARA POWER.—A new factor in the power development at Canadian Niagara has presented itself by the application of a new syndicate for a franchise to develop power in Victoria Park. To all indications this latter company aims to be thoroughly Canadian, for it is to be organized by Canadians, Canadian capital is to be used, and the power is to be sold in Canada for use by Canadians. This is the substance of a statement made by Frederic Nicholls, director of the Canadian General Electric Company, who is interested in the syndicate, as is also William Mackenzie, president of the Toronto Railway. The application is being considered by the government and the park commissions. If granted, it is understood the company would erect a power station at the water's edge in the gorge below the prospective plant of the Ontario Power Company.

TO BUY EQUIPMENT FOR MEXICO.—Mr. Harold J. Ross, of the City of Mexico, is now in New York for the purpose of letting contracts for the equipment of an electric transmission plant near the town of San Martin, Texmelucan, in the State of Puebla, Mexico. It is proposed to utilize the power of a large waterfall on the haciênda owned by Monseñor Guillow, the archbishop of Oaxaca. The initial capacity of the plant will be 500 hp. The power will be transmitted to Texmelucan, which is situated about 10 miles distant. The energy will also be used to operate cotton mills and other industrial plants in the vicinity. Later on a larger amount of power will be generated for transmission to Tlaxcala and to the haciendas located between San Martin, Texmelucan and the city of Puebla.

APPARATUS FOR BRITISH COLLIERIES.—American electrical machinery is to be installed on an extensive scale in several of the more important English and Welsh collieries, contracts having lately been closed with the Westinghouse interests, which will represent an expenditure of considerably over $1,000,000. The principal contract calls for a 4,000-hp plant to be erected in the collieries of the Staveley Coal & Iron Company, of Chesterfield, English Midlands. Another important contract has been secured from the Sneyd Colliery Company at Burslem, Staffordshire, where a 1,500-hp equipment will be utilized. The Byers Green Colliery, at Auckland, north of England, will also have an extensive American electric coal-cutting equipment.

MORE NIAGARA POWER.—A new factor in the power develop-of the City of Mexico, has acquired a concession for the purpose of constructing a hydraulic plant on the River Atoyac, located near Cordoba, in the State of Vera Cruz. The franchise permits of the utilization of 11,000 liters per second. All the material, etc., rendered necessary for the construction and equipment of the plant is to be admitted into Mexico free of duty. Thomas Braniff, Jr., also of the Mexican capital, has secured a concession for the erection of a water power plant on the River Blanco, located in the Canton of Orizaba, in the State of Vera Cruz. The concession provides for the use of 29,000 liters of water every second.

MACHINE TOOLS FOR SOUTH AFRICA.—Young & Park, Inc., of 45 Broadway, New York, are at present filling some fair-sized contracts for machine tools, etc., for shipment to South Africa. Through this firm, Wm. Sellers & Company, of Philadelphia, have secured an order for planers, the Hendley Machine Company, of Torrington, Conn., is furnishing large lathes, the J. A. Fay & Egan Company, of Cincinnati, O., have got orders for wood working machinery, etc., and Cox & Sons, of Philadelphia, are about to make shipment of some screwing machines. Young & Park are now figuring on some large lots of centrifugal pumps for shipment to Johannesburg.

ELECTRICAL GOODS FOR EGYPT.—Mr. Selim Chaker, of Cairo, Egypt, who handles American machinery for the Egyptian, Soudanese and Palestine markets, is now in the United States. He has placed a large contract with the Elliott & Hatch Book Typewriter Company, of 256 Broadway, New York, for machines which will write in Arabic characters. Mr. Chaker is on the lookout for electrical goods, etc. He is a guest at the Stevens House, 27 Broadway. According to present arrangements, he will be here for a month at least.

THE BOSTON TELEPHONE SELECTOR COMPANY has incorporated under the laws of the State of Maine, to manufacture the Mayberry-Holmes party line system. The offices of the company are at 183 Essex Street, Boston, and its officers are as follows: Watson M. Holmes, president; F. E. Mayberry, vice-president and electrician; N. L. Johnson, secretary and treasurer. This company has recently equipped an exchange at Hoosick Falls, N. Y., with a 250 line capacity, 120 lines of which are installed.

CONTRACTS FOR JAPANESE PLANTS.—Some very important contracts for electrical equipment, etc., will be placed within the next few days, in connection with Japanese electric traction and lighting projects, by Mr. A. L. Bagnall, of the American electrical engineering and contracting firm of Bagnall & Hilles, of Yokohama, who has just arrived in New York. Mr. Bagnall is making his headquarters at the offices of the New York Insulated Wire Company, 114 Liberty Street.

THE MECHANICAL BOILER CLEANER COMPANY, manufacturers of the Garrigus mechanical boiler cleaner, reports an order just received for eleven cleaners from the Milwaukee Electric Railway & Light Company. This is the fourth order received from that company, and is a favorable indication of the merit of this invention. Mr. W. R. Mason is the sales manager for this company, with offices at 413 Western Union Building, Chicago.

NEW MANHATTAN CARS.—The Manhattan Railway Company has closed a contract with the Wason Manufacturing Company, of Springfield, Mass., for sixty cars of a new type. They are to be much heavier than those now in use in the company's lines and will be equipped with Westinghouse air brakes. This contract is entirely independent of the order for 250 cars upon which the Wason Company has been at work for several months.

TUXEDO LIGHTING PLANT.—The New York electrical engineering and contracting firm of Sanderson & Porter have been commissioned by the Tuxedo Electric Light Company, of Tuxedo, N. Y., to draw up plans for an extension of the company's plant. The present equipment consists of Babcock & Wilcox boilers, General Electric Company's belted generators and Fishkill tandem compound condensing Corliss engines.

DURBAN ROAD TO BE EXTENDED.—The Durban municipal electric traction system, which is mostly operated with American equipment, is to be extended from that South African city to Sydenham, one of the old suburbs. The British electrical engineering and contracting firm of Macartney, McElroy & Company, Limited, whose New York offices are in the Havemeyer Building, is reported to be after the contract.

WATER-POWER PLANT TO LIGHT AMECA, MEXICO.—Contracts are shortly to be let for the equipment of a hydraulic plant, which is to be constructed on the hacienda de la Estaizuela in the State of Guadalajara, Mexico, for the purpose of generating and transmitting energy to light the city of Ameca, which place has a population of about 12,000. The transmission line will be about 10 miles in length.

SEPARATORS FOR JOHANNESBURG ELECTRIC PLANT.—The Goubert Manufacturing Company, whose offices are in the Singer Building, Liberty Street and Broadway, has secured a contract from Young & Park, Inc., whose offices are in Aldrich Court, 45 Broadway, for two large separators, to be installed in an electrical plant now under construction in Johannesburg, South Africa.

ANOTHER MEXICAN ELECTRIC TRACTION PROJECT.—It is proposed to convert the horse tramways in the city of San Luis Potosi, Mexico, into an electric traction system. The existing lines are about 13 miles in length. The equipment, etc., will be purchased in the United States.

LARGE LONDON PUMP CONTRACT.—William E. Quimby, Incorporated, is figuring on a big contract for pumping equipments, intended to be installed in a large electrical plant in the British metropolis.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material and machinery from the port of New York for the week ended November 15: Argentine Republic—[illegible] pkgs. material, [illegible]. [illegible]—[illegible] pkgs. material, [illegible]; 1 pkg. machinery, $62. Berlin—8 pkgs. machinery, $577. Bristol—3 pkgs. machinery, $160. British East Indies—2 pkgs. machinery, [illegible]. British [illegible]—[illegible] pkgs. machinery, [illegible]; [illegible] pkgs. material, $2,231. British Possessions in Africa—23 pkgs. material, $1,970. British West Indies—14 pkgs. material, $294. Central America—18 pkgs. material, $699. Cuba—41 pkgs. material, $449. Canary Islands—3 pkgs. material, $60. Chili—60 pkgs. material, $1,472. Dutch East Indies—1 pkg. material, $15. Ecuador—2 pkgs. material, $23. Genoa—12 pkgs. machinery, $600. Hamburg—12 pkgs. machinery, $900; 29 pkgs. material, $3,561. Havre—14 pkgs. material, $337. Liverpool—272 pkgs. machinery, $25,089; 32 pkgs. material, $2,150. Leeds—3 pkgs. material, $104. London—119 pkgs. machinery, $2,619; 81 pkgs. material, $6,489. Lisbon—1 pkg. material, $8. Mexico—232 pkgs. material, $2,526; 1 pkg. machinery, $2,160. Nova Scotia—14 pkgs. machinery, $523. Newfoundland—2 pkgs. material, $83. Rotterdam—16 pkgs. machinery, $686. Southampton—22 pkgs. material, $2,023. San Domingo—72 pkgs. material, $508. Wiborg—2 pkgs. machinery, $1,130. Exports for the week ended Nov. 29: Antwerp—62 pkgs. material, $2,308; 5 pkgs. machinery, $130. British Possessions in Africa—31 pkgs. machinery, $1,100. British West Indies—1 pkg. machinery, $100. Bremen—1 pkg. material, $200. Brussels—35 pkgs. machinery, $2,000. British Guiana—14 pkgs. material, $400. Birkenhead—1 pkg. machinery, $75. British East Indies—31 pkgs. material, $4,069. Berlin—5 pkgs. material, $1,080; 1 pkg. machinery, $68. Chili—6 pkgs. material, $408. Central America—170 pkgs. material, $1,662; 31 pkgs. machinery, $722. China—1 pkg. machinery, $58; 1 pkg. material, $20. Copenhagen—46 pkgs. machinery, $3,650. Cuba—81 pkgs. material, $2,202. Ecuador—8 pkgs. material, $172; 1 pkg. machinery, $65. Glasgow—3 pkgs. material, $115; 63 pkgs. machinery, $7,890. Genoa—21 pkgs. material, $750. Havre—1 pkg. machinery, $75; 7 pkgs. material, $269. Hong Kong—6 pkgs. machinery, $225. Hamburg—10 pkgs. material, $270. Japan—46 pkgs. material, $13,292; 23 pkgs. machinery, $5,979. Kirkcaldy—6 pkgs. machinery, $1,175. Liverpool—318 pkgs. material, $25,367. London—78 pkgs. material, $5,826. Madrid—1 pkg. machinery, $42. Manchester—235 pkgs. machinery, $28,123; 16 pkgs. material, $1,423. Mexico—97 pkgs. material, $2,321; 41 pkgs. machinery, $2,767. Naples—6 pkgs. material, [illegible]. Newfoundland—7 pkgs. material, $202. Odessa—3 pkgs. machinery, $1,000. Philippine Islands—17 pkgs. material, $1,418. Peru—21 pkgs. material, $808. Stockholm—1 pkg. material, $10; 1 pkg. machinery, $34. Southampton—28 pkgs. material, $948 Siam—75 pkgs. material, $5,010. St. Petersburg—1 pkg. machinery, $400. U. S. Colombia—8 pkgs. material, $185. Venezuela—26 pkgs. material, $156.

THE SPRAGUE ELECTRIC COMPANY is receiving many orders for its direct-current apparatus, and reports among recent sales the following: Twenty 200-kw turbine generators, three 75-kw generators and four 20-kw generators to the De Laval Steam Turbine Company, Trenton, N. J.; one 200-kw belted type and one 200-kw engine type generator to H. O. Wilbur, Philadelphia; one 200-kw engine-type generator to the Otis Elevator Company, Yonkers; one 200-kw belted-type generator to W. D. Ewart, Chicago; one 40-kw and two 35-kw belted-type generators to the Criterion Hotel, New York; one 75-kw belted type generator to C. Poyet, New York; one 50-kw belted-type generator to the American Express Company, Chicago; two 3-hp round-type motors to the West End Theatre, New York; eight 8-kw generators, six 5-hp and four 1-hp motors to the Fischer Motor Vehicle Co., Hoboken, N. J.; one 40-hp medium-speed motor to J. F. Perkins Company, Brooklyn; one [illegible]-hp motor to L. W. Pond Machinery & Foundry Company, Worcester, Mass.; one 40-hp belted-type motor to Michle Printing Press Manufacturing Company, Chicago; two 20-hp motors to the Sigourney Tool Company, Hartford, Conn.; one 17-hp motor to the Martinique Apartment House, New York; two electric hoists to the Phœnix Iron Works, Phœnixville, Pa.; one electric hoist to Landis Tool Company, Geiser Station, Pa.; one electric hoist to the American Car & Foundry Company, Berwick, Pa.; one electric hoist to Scranton Supply & Machinery Company, Scranton, Pa., and one electric hoist to Pond Machinery & Tool Company, Plainfield, N. J.; two electric hoists to Michigan Alkali Company, Wyandotte, Mich.

THE MONTEREY, MEX., STREET RAILWAY COMPANY, which concern, as already noted in these columns, has been formed with American capital for the purpose of constructing and operating an electric traction system in the city of Monterey, Mexico, has purchased the Ferrocarriles Urbano de Monterey "Empresa Mexicana," which operated the principal horse tramways in Monterey. With the lines recently acquired, the American interests, who are represented by the banking house of Sperry, Jones & Company, of Baltimore, Md., have now control over 70 miles of road. The conversion to electric motive power will be proceeded with immediately and will mean an expenditure of at least $5,000,000. The Empresa road was purchased for $252,000. All the material and equipment will be purchased in the United States. A. W. McLimont, the chief engineer and general manager of the Monterey Street Railway Company, will arrive in New York Monday to place contracts. While here he will make his headquarters in the Washington Life Building, 141 Broadway. In the meantime a contract valued at about $10,000 for line construction work, tools, etc., has been awarded to the New York Hardware Company, of 54 Stone Street, New York. The Monterey system will be a double-track one.

IMPORTS OF MANUFACTURING MATERIAL.—The activity of the manufacturers of the United States, measured by the figures of imports of manufacturers' materials and exports of manufactured articles, is greater than ever before. Imports of manufacturers' materials in the ten months ending with October, 1902, are, as shown by the figures of the Treasury Bureau of Statistics, 365 million dollars, against 201 million dollars in the corresponding months of 1896, 274 millions in the corresponding months of 1899, and 319 millions in the corresponding months of 1901. The imports of manufacturers' materials in ten months of 1902, therefore, are 15 per cent. higher than those of 1901, the highest record heretofore, and more than 30 per cent. in excess of the figures for the corresponding months of 1896. On the other hand, exports of manufactures are also larger than those of any preceding ten months' period, with the single exception of 1900, showing an increase of 15 million dollars over the total for the ten months of 1901, and being actually more than double the figures for the corresponding months in 1895.

INSTRUMENTS FOR JAPANESE NAVY, ETC.—Foote, Pierson & Company, of 82-84 Fulton Street, New York, have secured a contract from the Japanese Government for special electrical instruments for the navy department. An order has also been received from the same government for recording instruments, to be used in connection with wireless telegraphy. The United States Government has allotted a contract to the Fulton Street concern for electrical tidewatre indicating devices for automatically recording the range of the tide at various coast fortifications. Substantial orders are also to hand for Argus lightning arresters for use in connection with aerial underground and submarine cables.

MEXICAN LIGHTING PLANT TO BE ENLARGED.—The Postosina Electric Company, of San Luis, Mexico, which was formerly known as the San Luis Potosi Electric Company, is about to award contracts for the enlargement of its plant, which is at present equipped with a 500-kw alternating-current generator, belted to a 750-hp engine, both built by the Westinghouse interests. The additions will involve the installation of a 1,000-kw equipment. Sanderson & Porter, 31 Nassau Street, New York, have been retained as consulting engineers by the Mexican company.

OCTOBER EXPORTS show a decided tendency toward recovery from the depression, due largely to the short corn crop of last year and reduced foreign demand for other breadstuffs. The total exports for October were larger than those of any preceding month in the history of our commerce, except October and December, 1900, and October, 1901. The following shows the October exports in each year, from 1895 to 1902: 1895, $87,090,972; 1896, $113,516,586; 1897, $111,744,517; 1898, $118,619,563; 1899, $125,966,527; 1900, $163,389,680; 1901, $145,659,415; 1902, $143,179,752.

THE DE LAVAL STEAM TURBINE.—Curtiss-Crippen Engineering Company has opened an office in 1232 Monadnock Block, Chicago, in charge of L. F. Mahler, who was formerly a constructing engineer for the De Laval steam turbine in Europe. Mr. Mahler also represents the allied company, the New York Electric Headlight & Train Lighting Company, which uses the De Laval turbines for train lighting and electric locomotive headlights. The Pennsylvania company now has one train of the limited service equipped with a turbine driven lighting unit.

ESCHER, WYSS & CO., of Zurich, Switzerland, have been awarded a contract to build three new turbines for the Canadian Niagara Power Company. Each wheel will be of 10,000-hp capacity, and it is understood will be of similar pattern to the wheels installed by the Niagara Falls Power Company in wheel-pit No. 2, which are of the Francis or inward discharge type. The new turbines are to be delivered the latter part of next year.

MOTORS, ETC., FOR MEXICAN TRANSMISSION PLANT.—Rossiter, MacGovern & Company, 141 Broadway, is about to let contracts for motors, etc., to be used in connection with the Toluca, Mexico, power transmission scheme.

THE MEXICAN TRAMWAYS COMPANY, LTD., of the City of Mexico, contemplate still another extension. It is now proposed to extend the lines to Texcoco, which will mean the construction of nearly 20 miles of track.

General News.

THE TELEPHONE.

BIRMINGHAM, ALA.—The People's Home Telephone Company has petitioned for the right to increase its rates.

MENA, ARK.—The Kizer Telephone Company has been incorporated with a capital stock of $50,000. It proposes to build and operate telephone lines in the counties of Miller, Little River, Sevier, Howard and Polk. A. J. Kizer is president.

ATLANTA, GA.—The Southern Bell Telephone Company has begun work on a $35,000-annex. Accommodations will be provided for 10,000 telephones.

WAYNESBORO, GA.—The Augusta Telephone and Electric Company will install a new Strowger telephone exchange in Waynesboro, starting with about 100 telephones.

BOISE, IDAHO.—The Independent Telephone Company announced that the New Placerville line is in service. This gives two independent company lines to Placerville.

LEWISTON, IDAHO.—The work of surveying for the new telephone line down Snake River, from the Imnaha to Lewiston, has been given to McCullough & Doughty.

EVANSVILLE, IND.—The franchise of the Cumberland Telephone Company in this city having expired and the company given official notice three months ago to vacate the streets and alleys, it now comes forward and proposes that the question of a new franchise be submitted to a board of three members and on its decision a new lease be written.

BONEPARTE, IA.—The Union Telephone Company is extending its line from this city to Harrisburg township.

SLOAN, IA.—The Sloan Telephone Company has been organized here with a capital stock of $3,000. W. D. Buckley is president.

WATERLOO, IA.—Representatives of sixteen independent telephone companies met here recently and formed the Northeastern Iowa Independent Telephone Association. The object of the association is to secure better connections and to regulate the toll rates for the different lines.

DES MOINES, IA.—The Hawkeye Telephone Company is stringing 800 miles of copper wire from this city to surrounding towns on four different routes. Of this line, 400 miles is to be used by the Hawkeye Company. The other 400 miles will be leased by the Weare Commission Company. The latter will be independent service, serving offices which the Weare Company will open in twenty-four towns surrounding Des Moines.

FRANKFORT, KY.—The Owenton Telephone Company has been incorporated; capital, $7,500. J. W. Counvach, J. Gayle and J. A. Johnson are the incorporators.

HOPKINSVILLE, KY.—The Cumberland Telephone Company has let the contract for a new exchange and office building at this place which will cost about $15,000.

COLDWATER, MICH.—The Himebaugh Telephone line will be extended to Coldwater.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company has increased its capital stock to $2,000,000.

SAGINAW, MICH.—The Valley Telephone Company, of Saginaw, Flint and Bay City, has completed a contract with the Alma Telephone Company to construct a line from Flint to Holly and to connect there with the Alma Company. At the same time it will connect with the Oakland Telephone Company, and by that means Oakland County will have independent connection with the northern part of the State.

JACKSON, MICH.—The Jackson plant of the Citizens' Telephone Company has been placed in operation with 1,000 subscribers connected up. The board has a capacity for 1,600 lines. The plant originally belonged to the Federal Telephone Company, of Cleveland, and that company still maintains a heavy interest in it, although the control was sold some time ago the Citizens' Telephone Company, of Grand Rapids.

MINNEAPOLIS, MINN.—The Twin City Telephone Comapny has opened its new building at Cedar and Eighth streets, St. Paul. Thousands of people were shown through the building, every department of which was open to the public in the afternoon and evening.

WATER VALLEY, MISS.—The Cumberland Telephone Company is establishing a local exchange. Long-distance connections have been made.

HELENA, MONT.—Dr. Emil Dorn, of Chicago, has applied for a franchise for the construction and operation of a telephone system in Helena.

OMAHA, NEB.—The Nebraska Telephone Company has been granted a franchise in this place.

FAIRMONT, NEB.—A franchise has been granted to John Barsby, of this city, and C. H. Brown, of Grinnell, Ia., to construct and operate an independent telephone system here.

OGALLALA, NEB.—The stockholders of the Ogallala & Keystone Telephone company have elected the following officers: President, Hugh Carnahan; treasurer, Malcolm MacLean; secretary, W. A. Barnard; board of directors, J. J. McCarthy, W. Davison, M. MacLean and H. Carnahan.

MIDDLETOWN, N. Y.—The Farmers' Union Telephone Company, of Sussex, N. J., has completed its line to Johnsons. From there the line will be built to this city by the way of Slate Hill.

TROY, N. Y.—The Commercial Union Telephone Company has been incorporated here for the purpose of effecting a consolidation of the independent telephone lines throughout the State, and subsequently to instal telephone systems in cities and towns in which no independent lines now exist. The ramifications of the new company's lines will extend as far west as Buffalo, as far north as Montreal, and as far east as Rutland, Vt. The new company will operate in the cities and villages of Renssalaer, Saratoga, Washington, Warren and Essex counties, and in cities and villages of adjoining States. The capital stock is $10,000, and the directors for the first year are: John T. Christie, William C. Geer, Cornelius V. Collins, William Connors, Stephen C. Medbery, Peter McCarthy, William D. Mahony, James H. Cladwell and W. L. Burk. All of these are Troy men, except Mr. Medbery, whose residence is given as Ballston, and Mr. Burk, who is a resident of Glens Falls.

WILMINGTON, N. C.—Work of placing the local telephone wires of the Bell Company underground has been commenced.

ASHEVILLE, N. C.—The Asheville Independent Telephone Company proposes to build a new telephone exchange in Hendersonville, N. C., and the material has been ordered. It is said that the Bell Company had intended to ··t in exchange if sufficient encouragement was offered.

CRAYTON, OHIO.—A new telephone exchange is being installed at this place.

PORTSMOUTH, OHIO.—The Portsmouth Home Telephone Company will build a line from Fullerton up Tygart Valley to Tygart.

TIPPECANOE CITY, OHIO.—The Tipp Interurban Telephone Company is installing a new board and a number of new telephones. John I. Young is manager.

REPUBLIC, OHIO.—Citizens of this town have organized a company and contemplate installing a Globe automatic exchange. J. T. Carbin is in charge of the work.

SANDUSKY, OHIO.—It is stated that the deal whereby the Sandusky Home Telephone Company was to have been absorbed by the Local Telephone Company, of Norwalk, has fallen through. It is understood that the Sandusky people held out for $50 per share of par value for the stock, whereas the best the Norwalk people would give was $40. The Sandusky Company is in a very prosperous condition and the local people are well satisfied to keep their property.

MASSILLON, OHIO.—Stockholders of the Massillon Telephone Company have elected the following directors: O. C. Volkmer, H. A. Croxton, J. C. Putnam, J. B. Hoge, J. H. Hunt, F. S. Dickson, Maxime Reber, R. W. Judd and W. S. Cory. The company is controlled by the Federal Telephone Company, of Cleveland, and the majority of the directors are identified with the latter company. It was decided at the meeting to spend $10,000 for new cables and enlarging the switchboard.

PORTLAND, ORE.—The Boston Telephone Selector Company, capital stock $500,000, has been incorporated. J. F. Fanning is president.

HANOVER, PA.—Extensive improvements are being made on the telephone system of the United Telephone & Telegraph Company.

CHARLESTON, S. C.—The city has granted the Southern Bell Company the privilege of placing its wires underground.

COLUMBIA, S. C.—In view of the comment caused by the rapid absorption of independent telephone exchanges by the Bell Company the statement is made that the State legislature holds the power to revoke, amend, or modify the charter of the Bell Company in South Carolina at pleasure.

MARION, S. D.—J. A. Steninger, of Parker, has for the second time been granted a franchise to establish a local telephone system at this place. The original franchise granted him was defeated as the result of a referendum election called by local capitalists who believed the franchise should have been granted to home men. This objection was waived.

CLARKSVILLE, TENN.—The Home Telephone Company will erect an exchange building in this place.

TERRELL, TEX.—A telephone franchise has been granted to C. T. McCreary, of St. Louis; R. W. Wortham, of Paris, and T. R. Bond, of this city.

NEWPORT NEWS, VA.—The Bell Telephone Company, which recently purchased the independent telephone system in Hampton, will expend $20,000 remodeling the system.

RICHMOND, VA.—A bill has been introduced in the State Senate to give telegraph companies the right to build along the routes of railroads without having to acquire the consent of the railroad company.

PARADISE, W. VA.—The Paradise & Bigman Telephone Company has just been organized, and will build a line between the two places named.

HIGHLAND, WIS.—A new telephone line is being built from Montfort to this place.

MILWAUKEE, WIS.—The Wisconsin Telephone Company will erect a telephone exchange on Fourth Street to cost $12,000.

JEFFERSON, WIS.—Application has been made by Frank P. Mansfield, of Lake Mills, for permission to construct and operate a telephone exchange in this city.

KENOSHA, WIS.—Articles of incorporation for the Citizen's Telephone Company, Kenosha, have been filed with the Secretary of State. The incorporators are G. A. Yule, C. C. Brown, John B. Sloter, N. J. Corcoran, H. B. Robinson and J. Cavenaugh. The capital of the company is placed at $50,000.

KENOSHA, WIS.—Kenosha is in the throes of a telephone war, and two companies are now in the city seeking a franchise to build an independent system. At the last meeting of the common council C. A. Sterling, of La Crosse, asked for a franchise, and J. A. Keelyn, of Chicago, is seeking a right to establish in the city "a model system."

BUFFALO, WYO.—The Powder River Telephone Company, with Buffalo as its headquarters, was incorporated in 1891, with a capital stock of $10,000. The system has rapidly and steadily grown until now it counts 275 miles of lines with 13 stations telegraphically recognized by the Western Union. The system is now extended across the Big Horn range to Ten Sleep in the Big Horn Basin, where it connects with the Bell system, thus giving Buffalo telephone connection with every county in Wyoming except Wilson and Crook.

Electric Light and Power.

[illegible] Grass [illegible] in diameter [illegible] nt is generated at 500 volts, and [illegible] re to 16,000 volts. This will be [illegible] tained from the South Yuba Water Company's main Placer County ditch. The new system will compete with the Bay Counties Power Company in Nevada County. [illegible]

LEWISTON, IDAHO.—The Big Buffalo Mining Company whose properties are located at Buffalo Hump, this state, is about to install an electric power plant on its claims on Sheep Creek and will also put a large mill on its ground.

[illegible]

[illegible] capital stock of $5,100, by W. M. Buchanan, Anna K. Buchanan and William N. Buchanan, to supply electric light, heat and power.

VINCENNES, IND.—The Vincennes Electric Light and Power Company has been granted a twenty-five-year extension of its franchise.

[illegible]

OSKALOOSA, IA.—The property of the Oskaloosa Light & Power Company has been conveyed to the Oskaloosa Traction & Light Company. The [illegible] Oskaloosa Traction & Light Company, which is an organization composed largely of Ottumwa capitalists. The property of the old company is in the hands of Samuel Mahon, of Ottumwa, as trustee.

JORDAN, MINN.—The Jordan Electric Light Company has been incorporated here. The city was unable to dispose of its bonds for electric light [illegible] pany was given a ten-year franchise.

FARIBAULT, MINN.—The Minnesota Institute for Defectives has decided to install an electric ironing addition to its laundry, the present output of which is 30,000 pieces per week. Mr. A. R. Tracy, of this place, is engaged in putting in this up-to-date improvement, which consists of three dozen electric laundry irons including automatic regulators and several electric body and bosom ironing machines.

[illegible] Renner. Capital, $2,000,000.

ALBANY, N. Y.—The North Hempstead Light & Power Company has increased its capital stock from $50,000 to $100,000.

TOLEDO, OHIO.—Alderman Usher has started a crusade to give Toledo a municipal lighting plant by introducing a measure providing that the matter of such a plant shall be submitted to popular vote at the next spring election.

[illegible] has been incorporated to build a power and lighting plant at Medina. Incorporators: O. P. Van Sweringen, M. J. Van Sweringen, J. G. Boyd, S. C. Stewart and A. J. Watt. Capital stock, $50,000.

[illegible] awarded in the very near future. The matter has been held up for some time. The plant will provide current for 1,500 arc lights and it will cost about [illegible]

LAWRENCEBURG, TENN.—The city council authorizes an election on December 16 to vote on a bond issue of $20,000 for water and lights.

NASHVILLE, TENN.—During the coming year the lighting facilities will be increased by the addition of 100 arc and 1,000 incandescent lights. The capacity of the lighting plant may be doubled later on.

NASHVILLE, TENN.—Chas. H. Fish, of Detroit, has purchased Caney Fork Falls, paying $100,000 therefor, and will erect an electric plant to furnish power to various Tennessee towns, including Nashville.

SWEETWATER, TEX.—A Mr. Williams has secured an electric light franchise in this place and has placed contracts for equipment.

SALT LAKE CITY, UTAH.—The Utah Sugar Company proposes to establish [illegible]

[illegible] Improvement Company's plant in Fairhaven and its water-power electric plant now being constructed at Nooksack Falls. They have obtained control of the electric railway line between Fairhaven and Whatcom. They will soon acquire [illegible]

The Electric Railway.

QUINCY, ILL.—Contracts have been signed between a syndicate of Quincy capitalists and the firm of Bracey, Howard & Co., of Chicago, for the building of an interurban electric line from Quincy to Beardstown and from Quincy to Niota. The enterprise will require $3,000,000 for construction and equipment. The Rushville and Beardstown line is seventy miles long and the Niota is sixty miles. A line south through Pike and Calhoun counties to St. Louis will be built, it is said, immediately upon the completion of these lines.

VINCENNES, IND.—The Southern Indiana Traction Company—Vincennes-Jasper Line—has been granted a franchise in this city.

LOUISVILLE, KY.—Articles of incorporation have been filed by the Brownsboro Railway Company with a capital stock of $25,000. The incorporators are Emory D. Frazer and Mark Sands, of New York; L. G. Fisher and James H. Simpson, of New York; A. G. Turnipseed, of Cincinnati; J. Morton Morris and Clayton B. Blakey, of Louisville.

BOSTON, MASS.—The Secretary of State has issued a charter to the Greenfield, Deerfield & Northampton Street Railway Company Association. The directors of the company are J. B. Bridges, W. W. Sanderson, W. H. Belden, Oscar Belden, D. E. Cook, J. A. Taggart, E. C. Crosby, M. A. Coolidge, H. L. Williams, C. W. Wyman, F. E. Pierce, A. W. Clapp, D. P. Abercrombie, Jr., C. R. Graves and Philip Witherell. The capital of the company is $20,000.

BATTLE CREEK, MICH.—The Michigan Central Traction Company has applied for a franchise in Battle Creek.

KALAMAZOO, MICH.—The Michigan Traction Company is planning to spend $80,000 in improvements during the coming year. The company has placed an order for several new long cars.

MANKATO, MINN.—The City Council, of Mankato, where an electric city railway has long been talked of, has finally given a franchise to a Chicago company, which expects to build the line at once. This road, which will in all probability connect with St. Peter, Minn., will be the first rural electric railway in Minnesota, and no doubt will be the nucleus of many other rural urban lines.

JERSEY CITY, N. J.—The North Jersey Street Railway Company will build a new car barn at Montclair, N. J., at a cost of $100,000.

SYRACUSE, N. Y.—It is announced that the Auburn & Syracuse Electric Railway Company, now operating the street railway system in Auburn, has completed its financial plans for an interurban line between Auburn and Syracuse. The bonds have been purchased by N. W. Harris & Co., New York.

SCHENECTADY, N. Y.—The boycott on the Schenectady Street Railway Company's lines was lifted on November 26 by the Trades Assembly. It was explained that the boycott was taken off because the press of the entire country has raised such a howl over the expulsion of William Potter from the painters' union that public sentiment was turned against the boycott.

NEW YORK, N. Y.—Soundings are being taken in the Hunters' Point section of Long Island for what is expected to be the largest electrical power house in the world. The building is to be erected by the Pennsylvania Railway Company, and it is the reported intention to develop motive power to operate the entire underground system, which the company contemplates running under Manhattan, in addition to several of the shorter branches on the Long Island Railroad.

UTICA, N. Y.—The local trolley system was put out of business for five hours on the night of Nov. 18 as the result of a peculiar incident. A large blue heron alighted on a wire carrying power from the Trenton Falls station to one of the local sub-stations of the Utica and Mohawk Valley Railroad Company, and shortly thereafter the bird's bill came in contact with another wire. Immediately the current was short-circuited, the fuses at the sub-power-station burned out, the wires broke, the power stopped and the 22,000 volts that the wires carried wrought havoc with the bird. Scores of trolley cars on the city and suburban lines were stalled, and for five hours, or until the cause of the mischief was discovered and the damage repaired, all electric traffic in the Mohawk Valley was suspended. The trolley company sustained considerable loss as a result of the bird's prank.

NEW YORK, N. Y.—The Board of Estimate of New York met last week to consider the application of the New York City Interborough Railway Company for a franchise to operate street railways in the Borough of the Bronx. This company was formed as a rival to the Union Railway Company, which has become a part of the Metropolitan system. Everett P. Wheeler appeared as counsel for the New York City Interborough Company. He said that if the franchises were granted to his committee they would pay the city 15 per cent. on the gross receipts. He said the Union Railway Company was now paying 1 per cent. The company wanted the right to lay tracks on streets and also across Macomb's Dam Bridge. The new roads would erect thirty-six miles of trolley lines, of which twenty-four miles would be completed during the first year and the gross receipts from the first year would amount to $450,000. William H. Page, Jr., counsel for the Union Railway Company, spoke in opposition to the application. He said that the company should first apply to the State Railroad Commission.

YOUNGSTOWN, OHIO.—A syndicate represented by Max P. Goodwin, a Cleveland attorney, has secured nearly all the required right of way for an electric railway from Youngstown to Canfield.

COLUMBUS, OHIO.—The Central Market Street Railway Company has purchased land on Mound Street where it is proposed to erect two large car barns, a storage battery station and a rotary sub-station.

LIMA, OHIO.—The Lima Electric Railway & Light Company has about completed its new power plant which will supply current for both the lighting and street railway systems of the town. The plant has a capacity of about [illegible]

IRONTON, OHIO.—Traction men from Columbus and Portsmouth are securing right of way to extend the Portsmouth Street Railway to Hanging Rock, where it will connect with the Camden Interstate Railway, forming a through line to Huntington, W. Va.

DELAWARE, OHIO.—The Delaware, Berkshire & Sunbury Electric Railway Company has issued bonds to the amount of $150,000 and filed a mortgage for the same amount to secure the bondholders. The company will build a line from Delaware to Sunbury.

COLUMBUS, OHIO.—The Urbana, Mechanicsburg and Columbus Electric Railway has closed a deal for the purchase of five acres of land in this city for terminal purposes. The Columbus power house of the company will be erected there, also the car barns and a freight depot.

FOSTORIA, OHIO.—The Toledo, Fostoria & Findlay Railway Company has disposed of a large block of bonds in New York and will start work as early as possible on its proposed extension from Fostoria into Toledo. The company owns private right of way the entire distance.

CINCINNATI, OHIO.—The Cincinnati Car Building Company will soon be organized by the Widener-Elkins syndicate. The Chester Park car shops of the Cincinnati Traction Company will be sub-leased and cars will be built for all the Widener-Elkins properties throughout the country.

YOUNGSTOWN, OHIO.—President Asa W. Jones, of the Youngstown & Southern Railroad Company, announces that the bonds of the company have been under written by a New York syndicate and that the road will be extended to East Liverpool instead of terminating at Columbiana as originally proposed.

CLEVELAND, OHIO.—Plans for the absorption by the Cleveland, Elyria & Western Railway, of the Cleveland & Southern Railway and the Norwalk Gas & Electric Company, have been worked out. The new company will have a capitalization of $5,000,000, of which $2,000,000 will be preferred and $3,000,000 common stock.

LANCASTER, OHIO.—The officials of the Scioto Valley Traction Company have practically completed negotiations for absorbing the Lancaster Traction Company, which operates a steam dummy line from Lancaster to the Boy's Industrial Home. It will be equipped with electricity and operated as a part of the Scioto Valley line.

TOLEDO, OHIO.—Work is to start at once for extending the Toledo & Monroe Railway from Monroe to Detroit. The company will use the overhead equipment now strung on the Detroit & Toledo Shore Line. Charles R. Hannan, of Council Bluffs, Ia., and Mathew Slush, of Mt. Clemens, Mich., have become interested in the Toledo & Monroe Company.

CLEVELAND, OHIO.—What is claimed to be the fastest long-distance run ever made by electric traction was recorded by a special car on the Lake Shore Electric Line on a trip from Cleveland to Toledo on Nov. 13. The car left this city at 3 A. M., arriving in Toledo, a distance of 120 miles, at 6.10 A. M., making the actual running time 3 hours and 10 minutes.

STEUBENVILLE, OHIO.—The Wellsburg, Steubenville & New Cumberland Street Railway Company has been incorporated under West Virginia charter with $10,000 capital stock. Incorporators: J. C. Mitchell, Henry M. Camp, of Rochester, Pa.; James E. Newell, East Liverpool, Wm. Freudenberger, of Steubenville, and Cyrus Ferguson, of McDonald, Pa.

CLEVELAND, OHIO.—The Cleveland, Akron & Southern Fast Line Railway Company has organized as follows: Judge C. R. Grant, president; C. A. Gates, vice-president; C. H. Wheeler, secretary-treasurer; T. L. Childs, general manager; George W. Sieber, general counsel. The company is negotiating for the purchase of the Cascade Mill and water power near Akron, for use in generating power for the road.

CINCINNATI, OHIO.—The Widener-Elkins syndicate, which has recently obtained control of the Cincinnati & Interurban Railway (Millcreek Valley), is planning to extend the line to meet an extension of the Indianapolis & Shelbyville Railway, also owned by the syndicate. The syndicate is planning lines in the direction of Chicago and the ultimate intention is to have a through line from Cincinnati to Chicago, by way of Indianapolis.

CINCINNATI, OHIO.—President G. R. Scrugham, of the Cincinnati & Eastern Railway, has announced that his company will introduce a novelty in the shape of moonlight excursions over the road between Cincinnati and New Richmond. The road runs along the Ohio River for a number of miles, affording a fine view of some of the most picturesque portions of the stream. On moonlight nights there will be no lights in the cars.

CINCINNATI, OHIO.—A merger of the Compton and Kroger traction interests in and around Cincinnati has been effected. The Cincinnati Milford & Goshen Traction Company promoted by W. C. Compton and the Cincinnati, Milford & Loveland Traction Company, headed by B. H. Korger, have been consolidated into a new corporation chartered as the Cincinnati, Milford, Loveland & Goshen Traction Company. The company is capitalized at $850,000 and both of the old interests will be represented in the directorate.

WAPAKONETA, OHIO.—The Sandusky Southwestern Electric Railway Company has elected officers as follows: George A. Hurd, Boston, president; S. W. McFarland, Wapakoneta, secretary; Samuel P. Douglass, Toledo, treasurer; F. O. Oleson, Wapakoneta, general manager; W. H. Hyke, Toledo, general superintendent, and I. E. Yarnell, Toledo, solicitor. The above with L. N. Means, Wapakoneta, and John Van Fleet and William P. Heston, Toledo, are directors.

CLEVELAND, OHIO.—The "community of interests" between the Widener-Elkins syndicate and the Pomeroy-Mandelbaum syndicate for control of lines in the vicinity of Cincinnati has been consummated and W. Kelsey Schoepf, president of the Cincinnati Traction Company has been elected to the directorate of the Cincinnati, Dayton & Toledo Traction Company (Southern Ohio). He will also bear the new title of chairman of the board. It is also understood that the Pomeroy-Mandelbaum people have secured large holdings in the Cincinnati Traction Company, but the amount is not given.

CLEVELAND, OHIO.—Frank L. Krause, chief promotor of the Pennsylvania & Ohio Traction Company, which proposes to build a road from Cleveland to Sharon, states that work on the line will start early in the spring. The road will be almost entirely on private right of way. The running time from Cleveland to Sharon will be two hours. It is stated that a private right of way has been secured into the center of Sharon which will save much time. It is announced that the road will be capitalized at $2,500,000, and that arrangements have been made to sell the bonds in Cleveland and Detroit.

GUTHRIE, OKLA.—The Guthrie Light and Traction Company, of Guthrie, has been incorporated for twenty years with [illegible] capital, to construct an electric railway system in Guthrie. The incorporators are John Shartel, of Oklahoma City, F. H. Greer, C. M. Barnes, H. H. Hagan and W. H. Mertens, of Guthrie.

OKLAHOMA CITY, OKLA.—The Oklahoma Traction Company, of Oklahoma City, has been chartered for 20 years, with $2,000,000 capital, to construct and operate a railway from Guthrie via Oklahoma City to Fort Reno, seventy-five miles. The incorporators are John Shartel, Selwyn Douglas, M. L. Spitlock, of Oklahoma City, U. C. Guss and George Green, of Guthrie.

PITTSBURG, PA.—A building permit has been issued in Allegheny to the Pittsburg Railways Company for its new power house on Brunots Island, Allegheny. The structure is to cost $100,000.

PHILADELPHIA, PA.—The 6,000 and odd motormen and conductors of the Philadelphia Rapid Transit Company have had their wages increased one cent an hour. The increase will cost the company about $275,000 additional expenditure annually. This advance is designed in effect to put the employees on the same wage-earning basis that the 10 per cent increase has accomplished for the Pennsylvania Railroad employees.

SUMMERVILLE, S. C.—It is said that all preliminaries have been completed for constructing an electric railway to Charleston. Negotiations for issuing bonds are now pending. Ohio capital is backing the undertaking.

AUSTIN, TEX.—The charter of the Metropolitan Street Railway Company, of Dallas, with a capital stock of $4,500,000, has been filed. The company has all the electric railway lines at Dallas, and will build interurban lines between that city and adjacent towns. All the directors are Dallas men with the exception of Guy E. Tripp, of Boston.

EL PASO, TEX.—The street railway system is tied up by a strike of all its operatives who went out on Nov. 19. The men asked for an advance of 10 cents an hour and for the reinstatement of a discharged man. They were earning 15 cents an hour. The management declined to treat with the union and the cars were run into the barns and abandoned.

SALT LAKE CITY, UTAH.—A franchise has been granted to the Consolidated Railway & Power Company to extend its lines to several of the smelters in this locality, also on several streets of the city.

WASHTUCNA, WASH.—Colonel Lunceford and P. R. Clark, of Ritzville, have petitioned the Adams County board of commissioners for a franchise for the construction of electric railway and for the transmission of electric power along the public roads of this county.

NEW INDUSTRIAL COMPANIES.

THE AMERICAN DRY BATTERY COMPANY, of New York, has been incorporated with a capital of $2,000. Directors: J. R. Colburn, L. A. Merrill and F. J. Byrne, New York.

THE WILKINSON-RICHARDSON COMPANY has been organized at Middletown, N. Y., to manufacture electrical supplies. The capital is $15,000 and the directors are J. W. Richardson, C. B. Hulse and T. C. Rogers, of Middletown.

THE CINCINNATI EQUIPMENT COMPANY has been incorporated with $15,000 capital by A. W. Goldsmith, Emil Jacobson, H. Henke, Eugene Brunsman and Frank Fromhold. The company will rehabilitate locomotives, cars, and street cars.

THE TEXAS TELEPHONE MANUFACTURING COMPANY has been organized at Austin, Tex., for the purpose of manufacturing switchboards and electrical specialties. The capital stock is $10,000. O. L. Brailey is president and treasurer, A. E. Jeavons vice-president and general manager, and H. Snelling secretary.

LEGAL.

TRANSFER OF UNISSUED PATENTS BY ORAL AGREEMENT.—Judge Baker, of the United States Circuit Court for the District of Indiana, has rendered an important opinion in a case involving a contention as to the validity of an agreement granting an exclusive right to manufacture under a patent when such agreement is an oral one and granted prior to the issue of the patent. The plaintiff, Frank B. Cook, contended, in the words of the opinion, "that an oral agreement for the sale of an invention made after application for a patent and before it is granted, is invalid both at law and in equity when pleaded as a bar or defense to a bill by the patentee for infringment." The court held that an oral agreement for the sale of an invention, founded on a sufficient consideration, made pending an application for a patent, is valid in equity. That while the inventor's exclusive right to an improvement commences only with the issue of a patent, he is vested by law with an inchoate right to its exclusive use which he may perfect and make absolute by proceeding in the manner which the law requires. That Cook possessed this unchoate right at the time the oral agreement was made with the defendants, the Sterling Electric Company, the invention then having been made and an application for the patent pending. Cases are quoted which the court states establish the doctrine that an oral agreement for the sale and assignment of the inchoate right to exclusive use of an invention before a patent has been granted therefor,

[illegible] of the Revised [illegible] to be in writing [illegible] in equity [illegible] may be of [illegible] the complainant and [illegible] that the defendants should file a bill setting up their equitable rights and compel a transfer of the legal title, the court said this contention overlooks the fact that this is a suit in a court of equity where, in matters within its jurisdiction, an equitable title is as good as a legal title as to all parties affected by such equity. It cannot be maintained in a court of equity that a party holding the equitable title will be denied his equitable rights by the holder of the naked legal title. In such a case the holder of the legal title stands, in a court of equity, as a mere trustee for the use and benefit of the owner of the equitable title or estate. It certainly would be against conscience to permit a complainant, while holding the consideration for the oral agreement of sale, to pursue the defendants as wrong doers.

OBITUARY.

G. H. [illegible] from Waterville, Me., dated November 25, says: Mr. George H. Crosby, of Albion, the inventor of the Crosby steam gauge, [illegible] last Saturday night. He was 70 years old. He went to Boston when a young man and engaged as a machinist, and while in that city brought out the steam gauge that bears his name. He became wealthy through the invention. A widow and three children survive him.

PERSONAL.

MR. W. STEWART has been appointed electrical superintendent of the Adams Gas Co., of Adams, Mass.

MR. F. A. LA ROCHE sailed on the Celtic on Wednesday last for a two-months' trip to England and France.

MR. F. J. LAMB, of Grand Rapids, Mich., has sold out the electrical business of Lamb & Co. to Mr. John Ruthven.

MR. HENRY G. FOREMAN has been elected chairman of the Chicago [illegible], succeeding Mr. Jesse Spalding.

MR. FRANK J. SPRAGUE, who has been in Europe for some time past for recreation and to look over the electric railway field, is expected home early this month.

MR. F. S. DICKSON, the new president of the Federal and the Cuyahoga Telephone companies, of Cleveland, has decided to make Cleveland his permanent headquarters.

MR. CORNELIUS VANDERBILT has written an able and interesting article in the December *North American Review* on electricity as a motive power for trunk railroads.

MR. C. T. YERKES.—The passenger list of the Hamburg-American steamer Deutschland, from Southampton, December 1, contains the names of Mr. [illegible] Yerkes.

MR. AUGUST BELMONT, president of the Interborough Rapid Transit Company, is to become president, it is stated, of the newly acquired Manhattan Elevated Railway Company.

MR. J. BEYERS HOLBROOK, M. E., has been admitted to partnership in the engineering firm of Charles Henry Davis & Partners, as the heating and ventilating engineer of the concern.

MR. CHARLES A. TREMERE, formerly president of the Florida Electric Company, of Jacksonville, Fla., is no longer connected with that corporation, having sold out his interest to Mr. T. W. Dunk, of that city.

MR. ANDREW CARNEGIE, who has been ill in London for the past few weeks, on account of eating bad food in a Swiss hotel, is reported able to sit up and much better. He was, according to a London dispatch, to sail for New York on Wednesday of this week.

MR. F. A. PICKERNELL, electrical engineer for the American Telephone & Telegraph Company, in New York, is removing to Boston, where, it is understood, the "long-distance" engineering work will be concentrated. He and his associates will be greatly missed.

MR. E. R. KNOWLES, C. E., E. E., of New York City, has been retained as consulting electrical engineer for the St. Lawrence Power Company, and has just returned from a trip of inspection of their large power plant at Massena, N. Y., recently illustrated in these pages.

MR. W. F. C. HASSON has been elected chairman of the Honolulu Engineering Association, this office corresponding to the usual one of president. Mr. Hasson is Government electrical inspector for the Territory of Hawaii, the duties of the office including both outdoor and indoor inspection.

MR. R. C. WILSON, of the British Westinghouse Electric & Manufacturing Company, Limited, is now on this side. Mr. Wilson has charge of the turbine engine department of the new Manchester plant of the British Company and is at present in Pittsburg [illegible] in the Westinghouse works there.

MR. A. B. CHANDLER, the veteran telegraphist and [illegible] president of the Postal Telegraph Cable Co., was slightly [illegible] while helping to extinguish a fire which broke out in his [illegible] in Brooklyn and which did considerable damage. The [illegible] is that Mr. Chandler escaped without personal injury.

MR. WILLIAM J. CLARK, general manager of the foreign department of the General Electric Company and also one of the leading officials of the British Thomson-Houston Company, Limited, which is now controlled by the General Electric Company, is on a visit to the United States and making his headquarters at the offices of the General Electric Company in New York City.

MR. JOHN D. ROCKEFELLER, of the Standard Oil Company, is now the largest stockholder of the Manhattan Elevated Railway Company. He has, in round numbers, 100,000 shares of the stock which is 25,000 shares more than stands in the name of Mr. George Gould. Mr. Russell Sage, who has always been rated the largest stockholder next to Mr. Gould has reduced his holdings to 12,000 shares.

MR. Y. NOGAMI, chief engineer of the Tokio Electric Light Company, of Japan, whose plant is to be largely increased for the purpose of furnishing power to operate over 20 miles of new track of the Tokio Street Railway Company, is now in New York. While here he will secure data regarding equipment which is to be forwarded to Japan, where the letting of the contracts will be determined on. Mr. Nogami is a guest at the Empire Hotel.

MR. A. O. KUEHMSTED.—The friends of Mr. Armin Oscar Kuehmsted, president of the Gregory Electric Company, Chicago, are congratulating him upon his marriage, November 26th, to Miss Marie Chisolm Gregg, of Chicago. Mr. Kuehmsted is very well known and very popular with the electrical fraternity in the West, and every one wishes him a long and pleasant married life. Mr. and Mrs. Kuehmsted left Chicago immediately after the ceremony for a trip through Cuba, Florida, etc.

MR. RAMON VALDES, of 44 Bond Street, New York, who is primarily interested in the project of the Rio Plata Electric Company, which concern proposes to construct a hydraulic plant of 1,600-hp initial capacity in the Rio Plata mountains, Porto Rico, for the purpose of generating power to be conveyed to San Juan, 17 miles distant, and to build and operate an electric traction system between the towns of Catano and Bayemon, a distance of four and one-third miles, is now in Porto Rico regarding the matter.

MR. GEORGE WESTINGHOUSE is the theme of an interesting article in the London *Daily Mail* by Mr. F. A. McKenzie, who remarks: "How is it that one man, Mr. George Westinghouse, has built up in a generation, a business like this? For two days I have paced his factories striving to learn the secret. It may be told in a few words. Foresight, anticipation of the world's future needs, bold and costly experiments, trained technical skill, the abundant use of labor-saving appliances, and an elaborate system of organized intelligence."

MR. JOHN B. McDONALD, the builder of the New York Subway, is the subject of an appreciative illustrated article in the *World's Work* for December. When Mr. McDonald undertook the problem of the New York Subway and some one said "Difficult job!" he replied: "Difficult? Not a bit. It's cellar digging—just a lot of cellar digging. Put all the cellars in New York in a row and they'd make a tunnel from here to Philadelphia. There's nothing hard about digging a cellar, and a row of cellars isn't any harder. It takes longer—that's all."

MR. JAMES SWINBURNE, president of the English Institution of Electrical Engineers, is well known for his versatility and literary ability. Both are exemplified by a recent contribution to the *Westminster Review* on "Feminine Mind Worship." It is a highly ingenious plea for better educational ideals, alike for men and women, and insists that much of the training that women are now getting enables them to do feminine work previously monopolized by men. Electricity has been a most noteworthy ally of woman in shutting the sterner sex out of the softer jobs.

NEW YORK ELECTRICAL SOCIETY has elected the following new members: W. A. Belden, 8 Westchester Avenue, Bronx, New York; Thompson D. Harbinson, care Portland Cement Company, Stewartsville, N. J.; J. O. Sinkinson, 55 Duane Street, New York City; M. B. Foster, Fuller Building, Broadway and Twenty-third Street, New York City; Leon E. Schmielsewski, care Stanley & Patterson, 93 Liberty Street, New York City; W. C. Andrews, 114 Liberty Street, New York City; Charles R. Pratt, Marine Engine & Machine Company, Harrison, N. J.; Harold Melbin, 217 West Sixty-eighth Street, New York City; E. B. Conrad, 127 Humphreys Avenue, Bayonne, N. J., and A. Frederick Collins, 63 West Twelfth Street, New York City.

MR. H. D. CRITCHFIELD, for several years general counsel of the Federal Telephone Company, of Cleveland, has resigned to accept a position with the Automatic Telephone Company, of Chicago, which is putting in an independent telephone plant in Chicago. Mr. Critchfield has been very prominent in the independent telephone movement in Ohio and the central West, and is one of the best posted men on the subject in the country. He is president of the Ohio Independent Telephone Association, and is closely identified with Judge James M. Thomas, president of the Independent Telephone Association of America. Mr. Critchfield has been succeeded in his position with the Federal Company by Mr. L. Carey, assistant general counsel of the company for some time past.

MR. THOMAS M. MOORE, chief of the Department of Machinery Exhibits of the St. Louis Exposition, has received a cablegram from Lieutenant Godfrey L. Carden, one of his assistant chiefs, now at Berlin, Germany, stating that the steamer has sailed with the Durr boiler entered for the Exposition. This is the first foreign shipment made for the Fair. It is an 800-hp boiler, and Chief Moore says that it will be installed and in service in the Exposition power house in January next if the building is ready for it at that time. Mr. Moore expects to have several other boilers on the grounds in January, including one from Gummersbach, Germany; one from Kiel, and two from Brooklyn, N. Y. He will also have a 200-hp engine supplied by the Skinner Engine Company, of Erie, Pa., which is to drive a generator furnished by the Warren Electric Manufacturing Company, of Sandusky, O. These boilers, engines and generators are all entered as exhibits, and will be kept in operation from the time they are installed next January until the close of the Exposition two years hence.

MR. L. W. STANTON, who has been electrical engineer and superintendent of equipment for the Federal Telephone Company, of Cleveland, Ohio, has resigned his position with that company and opened offices in the same building (The Electric building) as consulting telephone engineer. Mr. Stanton's practical working experience with all classes of outside construction, and his acquaintance with all the latest forms of central energy equipment, together wi[illegible] a thorough technical training, qualify him admirably for his new work, and will help to fill a much felt requirement in independent telephony. Mr.

Stanton has closed several contracts throughout the central West for making a systematic inspection of the plants, and drawing specifications for new equipment. The drawing of specifications for new equipment is especially valuable to the independent companies which are installing modern central energy systems. The experience which Mr. Stanton has gained through equipping, maintaining and operating the various plants of the Federal Telephone Company, will prove of great value to parties who are fortunate in securing his services.

MR. HENRY W. POPE, for the past three years acting general manager of the Bell Telephone Company, of Buffalo, comprising the seven counties around Rochester and Buffalo, has been assigned to the headquarters of the American Telephone and Telegraph Company in New York. Mr. Pope has been in charge of the Buffalo Company during its period of reconstruction, which has spread over the past three years and was finally completed Oct. 4th, by the opening of the new Lockport exchange and the new "North" exchange at Buffalo. During this time the subscribers have increased from some 8,000 to 22,000, Buffalo having 12,000 and Rochester 5,500. A dozen new or reconstructed exchanges have been built and new toll lines completed or greatly increased in capacity. Upon the departure of Mr. Pope from Buffalo he was the recipient of a beautiful loving cup and gold-headed cane from department officials and the clerical force of his office, presented at a banquet given him at the Iroquois Hotel. It may not be generally known that Mr. Pope is again on familiar ground, as he was one of the pioneer telephone managers in New York City

Trade Notes.

THE AUTOMATIC SWITCH COMPANY, recently organized at Waterbury, Conn., has established a factory at Oakville, where it will manufacture electric time switches.

"SIGNS OF THE TIMES."—This is the season for sign lamps, and lamps for decorations. The Electric Appliance Company, Chicago, recommends the Packard sign lamps, and is prepared to make quick shipments.

THE GORDON BATTERY COMPANY, New York, reports business as exceedingly good at present, and that it is working its plant to its full capacity. The Gordon cell is used more than ever before, the demand for it requiring the company to increase its facilities very frequently.

PAWLING & HARNISCHFEGER, of Milwaukee, Wis., have brought out a special bulletin illustrating and describing their standard I beam trolleys for shop equipment, etc., electric traveling cranes and traveling electric hoists. There appears to be a great and growing demand for such apparatus for handling material, and this brochure indicates its latest modifications.

THE COLEMAN MANUFACTURING COMPANY, New York, manufacturers of the Palm air-deflector for electric fans, has opened an office and showroom at 71 Cortlandt Street. This company has recently completed arrangements with some of the largest fan manufacturers in the country to furnish deflectors for their fan motors. It is also receiving many inquiries from supply dealers and the trade generally.

THE DAYTON FAN & MOTOR COMPANY, Dayton, Ohio, has made arrangements with the Diehl Manufacturing Company whereby it has obtained a perpetual license to manufacture fans which embody the principles covered by the Diehl-Bennett patents. This company has enjoyed a very rapid growth, and to-day is doing an extensive export business, the Dayton fan having met with favor all over the world. Its new catalogue containing cuts and descriptions of its 1903 types of fans will be ready for distribution about January 1.

THE EUREKA ELECTRIC COMPANY announces to its many friends and customers that in its headquarters in room 656, in the Auditorium, Chicago, will be found during the telephone convention next week the latest products manufactured by this well-known company. The exhibit will be in charge of Messrs. I. J. Kusel, H. J. Kusel, D. I. Canmann, H. Rosenow, C. W. Robbins, Paul Gardner and others. Handsome souvenirs will be given away. Its exhibit embodied special features of the latest and up-todate improvements in the products of telephone apparatus.

MR. WILLIAM ROCHE, 42 Vesey St., New York, manufacturer of the new standard dry battery, is about to increase his facilities to keep up with the constantly growing demands for these cells. Mr. Roche, on Nov. 7th, celebrated the fifth anniversary of his start in business by giving a dinner to commemorate the event to a select party of friends and associates in business. Well wishes were expressed on both sides. During the evening Mr. Roche presented each of those in attendance with a handsome little present as a token of the occasion.

SUN ELECTRIC MANUFACTURING COMPANY.—On Wednesday, December 10, 1902, will be sold, at public sale, on the premises at West Chester, Pa., the property of the Sun Electric Manufacturing Company, telephone manufacturers, including a three-story brick factory building, 40 by 100 feet, with brick boiler house attached 20 by 34 feet, and about one acre of land, on the line of the P., W. and B. R. R., and, with the same, one 40-hp Ames engine and one 60-hp Ames boiler; also one power elevator and two large fireproof vaults. Also a lot of valuable machinery, all in first-class condition, a quantity of telephone material, the "Sun" patents, office furniture, etc.

HARDINGE BROTHERS, 1036 Lincoln Avenue, Chicago, are not a new firm at all, but have added to their line of work which is the manufacturing of watch makers' tools, tapes, dies and special work such as gear cutting and watch making for which they have the best facilities, the entire "Cataract Precision Lathe" business purchased from A. W. Gump & Co., who succeeded the Cataract Tool and Optical Co. They have, it is claimed, the largest stock of wire or split chuck extant and have been very successful in their business which has been in existence for the past 13 years. They manufacture meter parts and such like where good work is the essential quality. The workmanship is done by experienced and practical mechanics. They will be glad to receive inquiries in regard to their specialties and new lines of work requiring precision.

THE FRINK SYSTEM OF LIGHTING show windows and store interiors by special reflectors continues to prove its value. Latest advices from the manufacturer, I. P. Frink, 551 Pearl St., New York, state that some of their more recent orders were from the following: Max Weil & Co., St. Louis, Mo.; Smith, Gray & Co., Brooklyn; Hecht's Stores, Baltimore; Segelbaum & Co., Braddock, Pa.; Parker, Bridget & Co., Washington, D. C.; J. Keller & Co., Kendallsville, Ind.; G. B. French Co., Portsmouth, N. H.; Goldsmith Bros., Easton, Pa.; Woodward & Lothrop, Washington, D. C.; Gerardi Mercantile Co., Trinidad, Colo.; L. Bamberger & Co., Newark, N. J.; N. Snellenburg & Co., Philadelphia, Pa. These firms added to many hundreds of others using Frink reflectors for window, show-case, and interior store lighting are the very best testimonials. Many of the names represent houses of national reputation; all are representative of their several localities; and whatever has the stamp of their approval may be safely adopted by progressive merchants everywhere. Booklet and full information to solve lighting problems will be sent upon request.

JOSEPH T. RYERSON & SON.—The sixtieth birthday of Joseph T. Ryerson & Son, of Chicago, is commemorated by a special anniversary issue of *Ryerson's Monthly Journal and Stock List.* Advantage is taken to present a number of exceedingly interesting features. Among these are some historical notes and views, which are well worthy of attention. The name of Ryerson has been associated with the iron and steel business in America since its inception. The corporation has lately erected and nearly completed large new warehouses and structural yards in Chicago. The building, of two stories, is 175 by 266 feet in dimensions, 60 feet high, and has an annex one story in height, 112 by 125 feet. Through the entire length of the main building and structural yards, 300 by 600 feet, a railroad track runs, which is connected directly with all lines. Over these tracks are two overhead electric cranes, one for each floor, which are served by trolleys running the entire width of the building. In this warehouse machinery has been installed comprising a heavy electrically controlled plate shear, a powerful cold saw for heavy structural shapes and a combined machine specialy built for shearing, punching or coping lighter beams, bars and angles.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 25, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

714,127. ELECTRICAL MEASURING INSTRUMENT; C. W. Atkinson, Cardiff, England. App. filed May 23, 1902. A float in a body of liquid rises and falls under the fluctuations of current in a coil surrounding it. The float and the liquid in which it rests have equal co-efficiencies of expansion under heat.

714,158. OIL GUARD FOR COMMUTATORS; W. F. Dawson, Schenectady, N. Y. App. filed April 23, 1902. An annular oil guard extends radially outward beyond the line of the commutator surface.

714,159. TOP-HOLE PLUG; Andrew Dickey, Buffalo, N. Y. App. filed Dec. 2, 1901. A plug for a vessel containing molten metal, such as aluminum, sawdust or paper pulp is molded into the shape of a plug, covered with clay and inserted in the top hole, where it becomes converted into carbon.

714,181. TRIPPING ELECTRIC SWITCHES OR CIRCUIT BREAKERS; J. D. Hilliard, Jr., Schenectady, N. Y. App. filed Nov. 13, 1901. An auxiliary source of tripping energy is dispensed with and a circuit provided for this purpose which is normally inactive, but supplied with actuating energy the instant occasion requires it and which must be furnished if the system itself is alive.

714,189. TRAVELING CONTACT FOR RAILWAY TELEPHONES, TELEGRAPHS, OR THE LIKE; A. D. Jones, Louisville, Ky. App. filed April 4, 1902. (See page 910.)

714,201. STORAGE BATTERY; S. Laszcynski, Berlin, Germany. App. filed Feb. 23, 1901. A negative electrode of nickel oxid and a positive electrode of spongy zinc in a solution of aluminates.

714,210. MOTOR REGULATION; R. T. Lozier, New York, N. Y. App. filed April 2, 1900. A motor generator connected with the line is first used to supply current to the main motor and after the speed of the latter has reached a desired value, the motor generator is cut out and the main motor connected direct to line.

714,226. COIL FOR ARC LAMPS; W. H. Northall, Elwood, Ind. App. filed May 1, 1902. The wire of the coil is insulated with asbestos and a tough long fibre to make it heat proof.

741,232. TRANSFORMER, INDUCTOR, ETC.; F. Pichler, Weiz, Austria-Hungary. App. filed Oct. 23, 1901. Heat-radiating plates are inserted between the turns of the coil, the plates being slotted to prevent eddy-currents.

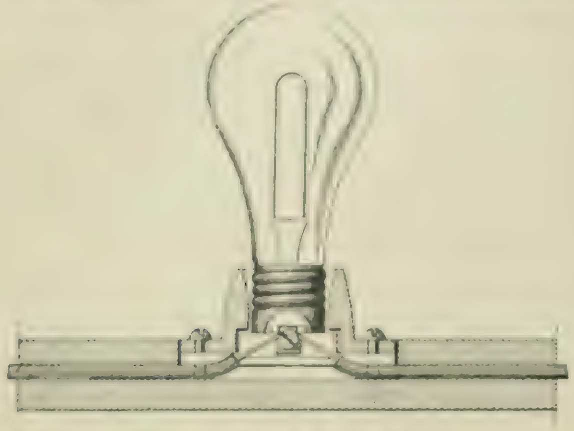
714,233. SIGN ILLUMINATED BY ELECTRIC CURRENT; E. Plancon, Lingevres, France. App. filed April 11, 1902. Geissler tubes in the form of letters are made by forming a groove in a glass plate, placing metal pieces in the groove and covering it with another plate.

714,246. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed Oct. 25, 1901. Instead of a coherer, a pair of plates are arranged in inductive relation and are caused to vibrate by the received currents and thereby control a local circuit.

[illegible] TROLLEY POLE HARP; J. H. Walker, Lexington, Ky. App. filed Jan. [illegible], 1902. A harp of [illegible] form between the members of which [illegible] can be [illegible]. Other features are also designed.

[illegible] CONTACT FOR TROLLEY HARPS; J. H. Walker, Lexington, Ky. App. filed Feb. [illegible], 1902. A modification of the preceding invention.

714,290. ELECTRICAL RECEPTACLE; P. H. Fielding, New York, N. Y. App. filed Jan. 18, 1902. A receptacle in which provision is made for the



714,290.—Electrical Receptacle

wires in the molding to pass into and out of the bottom of the receptacle without cutting and without uncovering that portion of the groove in the molding directly beneath the contacts and binding screws.

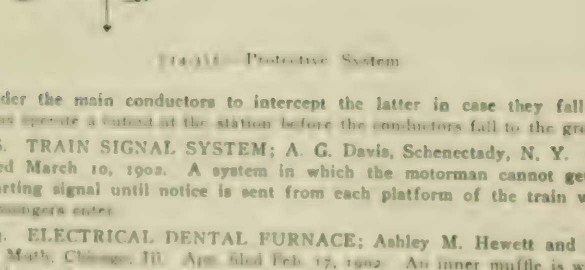
714,291. ELECTRICAL RECEPTACLE; P. H. Fielding, New York, N. Y. App. filed Feb. 20, 1902. A receptacle adapted for fuses in which the latter are housed in a groove formed in the base and covered by an elongated plug formed in the cap and adapted to enter the groove.

714,292. LAMP SOCKET; P. H. Fielding, New York, N. Y. App. filed Feb. 20, 1902. A weather-proof socket in which the case has no mechanical connection with the frame carrying the contacts and binding screws.

714,299. BUTTON FOR ELECTRAPHERS' KEYS, ETC.; H. J. Greule, Mason City, Iowa. App. filed March 4, 1902. The top of the key is dished and covered by a flexible diaphragm.

714,351. INDUCTION MOTOR STARTING DEVICE; A. H. Abell, Schenectady, N. Y. App. filed April 19, 1902. The object is to render it practically impossible to close the main-line switch until the resistance has been inserted in the secondary circuit and to prevent the resistance from being re-inserted while the motor is running without first opening the main-line switch.

714,355. PROTECTIVE SYSTEM; A. H. Armstrong, Schenectady, N. Y. App. filed March 30, 1901. A grounded network of wires is arranged



714,355.—Protective System

under the main conductors to intercept the latter in case they fall and thus operate a [illegible] at the station before the conductors fall to the ground.

714,366. TRAIN SIGNAL SYSTEM; A. G. Davis, Schenectady, N. Y. App. filed March 10, 1902. A system in which the motorman cannot get the starting signal until notice is sent from each platform of the train where passengers enter.

714,373. ELECTRICAL DENTAL FURNACE; Ashley M. Hewett and John C. Math, Chicago, Ill. App. filed Feb. 17, 1902. An inner muffle is wound with a resistance wire.

714,382. REGULATING DEVICE FOR DYNAMO ELECTRIC MACHINES; C. W. Kingh[illegible], Madison, Wis. App. filed Sept. 9, 1899. The regulating device is a coil on the field magnet of the machine arranged to act both as an opposition to the field energizing coil and as a resistance.

714,39[illegible]. STARTING ROTARY CONVERTERS; W. B. Potter, Schenectady, N. Y. App. filed Sept. 7, 1899. An induction motor is used to drive a direct current generator for starting the rotary converters; in this way starting resistances and transformers are avoided.

714,4[illegible]. ELECTROLYTIC CELL; M. C. R[illegible], Schenectady, N. Y. App. filed April [illegible], [illegible]. Rochelle salts in solution is used as the electrolyte.

714,436. HIGH POTENTIAL SWITCH; C. C. Badeau, Schenectady, N. Y. App. filed Feb. [illegible], 1902. A construction whereby the circuit is broken in the upper portion of the body of oil, where the oil is clearest.

714,446. PROTECTOR FOR THIRD RAILS OF ELECTRIC RAILWAYS; H. Brooks, Wheaton, Ill. App. filed June 23, 1902. The protector consists of terra cotta tubing open to one side to admit the contact shoe.

714,452. POLARIZED ELECTROMAGNET; L. Cerebotani, Munich, Germany. App. filed April 25, 1902. A peculiar arrangement of horse shoe permanent magnets and electro magnets to increase the power and mechanical effect.

714,455. LIGHTNING ARRESTER; J. E. Cordovez, Panama, Colombia. App. filed April 19, 1902. Means for adjusting the tension of a spring-supported circuit closing armature.

714,497. RAILWAY ELECTRIC MOTOR COOLING SYSTEM; C. O. Mailloux and W. C. Gotschall, New York, N. Y. App. filed Aug. 26, 1902. A system wherein a cooling agent, such as compressed air or gas, is caused to circulate about the motor in accordance with temperature changes thereof by automatic means. (See Current News and Notes.)

714,498. RAILWAY ELECTRIC MOTOR COOLING SYSTEM; C. O. Mailloux and W. C. Gotshall, New York, N. Y. App. filed Sept. 13, 1902. A modification of the preceding invention.

714,506. TROLLEY; J. Morgan, Ellwood City, Pa. App. filed Aug. 28, 1902. Details.

714,540. TELEPHONE SWITCH; J. A. Warrick, Sheldon, Ill. App. filed Nov. 5, 1901. (See page 910.)

714,577. TELEGRAPHIC OR TELAUTOGRAPHIC APPARATUS; E. K. Gruhn, Dresden, Germany. App. filed April 16, 1901. A ray of light is deflected by a mirror which is caused to change its angular position by the received currents.

714,581. MOTOR HANDLE FOR TOOLS; G. H. Hillyer, Duluth, Minn. App. filed April 29, 1902. A motor and gearing arranged inside of a tool handle.

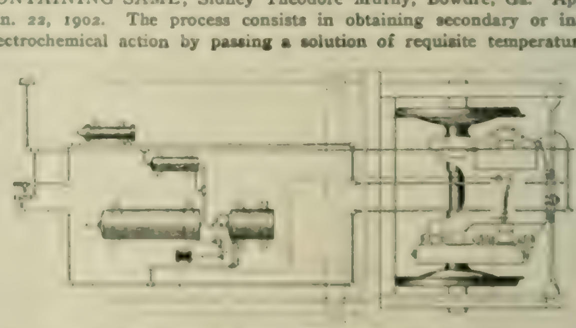
714,589. TROLLEY WHEEL; J. B. Lockerby, Ithaca, N. Y. App. filed Jan. 27, 1902. Details.

714,590. BATTERY DEPOLARIZER; C. E. Lockwood and W. C. Banks, New York, N. Y. App. filed Sept. 5, 1900. A depolarizer composed of a copper plating deposited upon the surfaces of finely divided iron particles and oxidized thereon.

714,593. ELECTRIC SWITCH; N. Marshall, Newton, Mass. App. filed Nov. 2, 1901. The clips have V-shaped bases which are set into V-shaped grooves in the insulating block and held by screws.

714,598. APPARATUS FOR SEPARATING METALS FROM SOLUTIONS CONTAINING SAME; Sidney Theodore Muffly, Bowdre, Ga. App. filed Jan. 22, 1902. A mattress cathode is composed of a cellular carbon plate and cellular porous carbon casings; a filiform packing of lead and zinc composition is within the casings and incloses the carbon plate, which, together with an iron plate anode, form electrodes connected to a source of electricity. All of the parts are enclosed in a fabric cover and there is an insulating frame between the plate anode and the mattress cathode, with means for supplying air to the bottom of the containing receptacle.

714,599. PROCESS OF PRECIPITATING METALS FROM SOLUTIONS CONTAINING SAME; Sidney Theodore Muffly, Bowdre, Ga. App. filed Jan. 22, 1902. The process consists in obtaining secondary or increased electrochemical action by passing a solution of requisite temperature com-



714,498.—Electric Railway Motor Cooling System

bined with warm air to supply oxygen into and through a filiform and partly-soluble composition of lead and zinc inclosed in a porous cellular casing of carbon, together with a suitable plate-anode and comprising electrodes having connection with a source of electricity.

714,600. OUTLET BOX; E. W. Muller, Brooklyn, N. Y. App. filed March 12, 1902. A ceiling box having a central insulated hook for an arc lamp.

714,607. ELECTRIC CUT OUT; H. N. Potter, Pittsburg, Pa. App. filed March 27, 1901. A special angular relation of certain loose parts in a Nernst lamp to prevent vibration when the lamp is operated by high frequency currents.

714,608. TROLLEY GUARD; C. O. Prince, Canton, Ohio. App. filed Sept. 2, 1902. A cross bar below the wheel prevents the pole from rising should the wheel leave the wire.

714,630. APPARATUS FOR SIMULTANEOUSLY TRANSMITTING A NUMBER OF TELEGRAPHIC MESSAGES OVER A SINGLE WIRE; J. Zeigler, Vienna, Austria-Hungary. App. filed May 29, 1900. Relates to the construction of a commutating device.

714,648. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed May 13, 1901. A series of coherers provided with means for successively tapping the tubes to decohere the filings, such means being operated by a phonic wheel.

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ELECTRICAL WORLD AND ENGINEER.

SPECIAL ANNOUNCEMENT TO ADVERTISERS.

The attention of advertisers is directed to an important announcement appearing on page xviii of the advertising section of this issue, on the subject of the new schedule of advertising rates taking effect January 1, 1903.

NOTICE TO ADVERTISERS.

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NEW YORK, SATURDAY, DECEMBER 13, 1902.

CONTENTS.

THE TELEPHONE MOVEMENT.

If any proof were needed of activity in the telephone field, it is afforded by such meetings as that which is taking place in Chicago this week and of which record is made in a supplement to this issue. The exuberant enthusiasm and progressiveness in the independent field, thus finding expression, matches that shown in the earlier days of the art, when, as some will remember, a Bell telephone convention could hold its own as a "hot time" with anything else that has taken place in the shape of electrical gatherings. It has always been a matter of regret with us that the Bell conventions ceased, and we could always see plenty of good reasons for their continuance, even though it be conceded that with concentrated ownership or control the time had gone by for such free and vigorous treatment of the subject as has been seen in Chicago this week. We are glad to note this activity and intensity in a department of electrical industry still so far from being developed up to its possibilities, and so greatly in need of uniformity and standardization. It is perhaps natural that greatest interest in these meetings should be shown in the Western States, where the independent movement has reached its most striking advance. We could, however, hardly expect to see the convention fever maintained at its present height, even there, and the natural drawing together of a great many of the local companies, still separate, must in time bring its inevitable effect. Indeed, it is avowedly the aim of many of the leaders thus to use the conventions for crystallizing consolidations that will make for efficiency and economy; and there can be no doubt that results in this direction will attend their efforts.

Outside of the exchange field, the independents have also tremendously stimulated telephonic activity, and the amount of "isolated" or "interior" work they have done is most creditable. It does not find much illustration at conventions of exchange men, whose interests lie, in reality, rather the other way; but none the less, it is the independent movement that has been so powerful a factor in furnishing the telephone to the trolley road, the factory, the hotel, the mine, the electric light plant, or the office building. The interaction of this upon exchange work will be interesting in due time.

METRICS AND THE MECHANICALS.

We regret to see that so reputable a body as the American Society of Mechanical Engineers should have even temporarily passed under the fanatical domination of the rule-of-thumb contingent, for it thereby becomes, we fear, an object of international merriment. It is to-day probably the only quasi-scientific body on the face of the planet which would so far stultify itself as to go on record as openly opposed to the metric system. To be sure, it did so only by a trivial majority of a rather lean meeting at which the conservative enragés were present in force, but this palliating circumstance will hardly secure the publicity that will serve to lessen the pained astonishment of the scientific public. We earnestly commiserate the minority for the unfortunate position in which it has been put. Father Time and the fool-killer will rescue it at no distant date, and the intemperate vituperation indulged in by the old fogies serves in part as its own corrective. The resolutions which actually passed were in fact rather mildly condemnatory, but those which the saner counsels of the Society tabled, but did not keep from widespread publication, were unique. If the metric advocates wished to retaliate, they might assert that for senile fanaticism,

futile rancor and general imbecility those resolutions stand quite alone. There may be, and are, reasonable differences of opinion as to the wisdom of an immediate and violent change in our system of weights and measures, which, by the way, nobody has seriously proposed; but we certainly did not suppose that five engineers could be found who would go upon record in such extraordinary language and as believing that the so-called "English system" would ever be universally adopted.

"English system" indeed! There is no such thing, nor has there been within the memory of man. It would take more space than we have in our editorial columns to catalogue and describe the weird and irreconcilable systems which have been in use in English shops. We very much doubt whether any member of the American Society of Mechanical Engineers could ever name them off hand, much less explain their relations. It seems as if half the prosperous manufacturers in England had devised independent systems of gauges, admirably supplemented by popular units handed down from mediaeval times. Of these, the barley-corn is about the only one which has not been retained in use to our knowledge, though we should not be in the least surprised to find that it still survives in some form or other. The chief argument advanced by the seventeenth-century section of the A. S. M. E. seems to have been the occasional survival of similar curios among nations using the metric system for the purposes of every day life. Now unquestionably there are some such anachronisms, like the Paris line and the German zoll (Heaven knows which one), but they have no more significance than the use of the double negative among English illiterates. As well abolish the metric system for one, as English grammar for the other. Particular trades preserve their metrological jargon as particular communities adhere to their dialects, but neither fact has the slightest general significance save to attest the persistence of bad habits. So far from any form of English measures making headway in the world's work, every succeeding year finds the metric system making steady progress in commerce and industry. Continental manufacturers sometimes build to English measures for the export trade, just as they make beads of particular sizes and colors for barter in Central Africa, merely as a concession to the idiosyncracies of savages.

This whole rumpus proves the wilful and deplorable ignorance of the rule-of-thumb contingent as to the real provisions of the metric bill now before Congress. It is tacitly assumed that its effect will be to change violently by legal enactment all the measuring equipment of the shops of the country; and on this assumption the aforesaid back numbers found a mighty grievance. Now it is undoubtedly the purpose of the bill to encourage the introduction of a simple international system of weights and measures, but its actual direct effect will be merely to set a good example by the use of the metric system in the transactions of the Government. Any superannuated fanatic who so desires is at perfect liberty to continue his antiquated methods just as long as he wishes. Nobody cares how his shop rules are graduated. He can have them divided to thirteenths of an inch or seventy-ninths of a foot if he likes, with no one to hinder. But if he deals with Uncle Sam, he will be expected to conform to civilized units so far as the results are concerned. This, however, is not, perhaps, the place where the shoe pinches. It takes very little forethought to see that a system used for all official business, and conforming to common international practice, will very rapidly work its way into general use, and when that time comes, the gentleman who deals in barley corns will be, with respect to domestic trade, just where he is now with respect to a large class of foreign trade, seriously at a disadvantage with his more progressive competitors. If he really believed that the metric system would not come into well nigh universal employment, a law such as is proposed would give him no pangs, but the gentleman who deals in barley corns sees the beginning of the end, and squirms. We believe that the best interests of science, the mechanical arts, and commerce will be served by the immediate passage of the proposed measure, that it will be passed in spite of the frenzied ravings of the small group of hide-bound fanatics who oppose it, and that the result will be the success of the similar movement in England and her colonies and the reduction of the so-called "English" system to a position of merely archeological importance. Let the yard, foot and pound be stored with the cubit and span in a Pantheon of departed units, and then be forgotten, except as relics.

Engineering Solidarity.

Not a little has been said lately about engineering solidarity and the great opportunities that exist for the closer working together of men engaged in different fields of engineering work. But we doubt whether a better expression has been given to ideas that are now in the air than the speech made by President Scott, of the American Institute of Electrical Engineers last week in Philadelphia—a fitting place for the utterance of such fraternal sentiments. The occasion was the twenty-fifth anniversary of the local Engineers' Club, and the number of prominent men present, from all branches of the engineering profession, gave more weight than usual to every idea receiving applause and approval.

We have quoted on another page some of the leading passages of the Scott speech, and regret we have not room for more, especially the remarks on "co-operation," which was characterized as "the great discovery of the nineteenth century." Mr. Scott was strong in his emphasis upon its great desirability in these days when, as he put it, the effectiveness of concentration and the economy of largeness are brought out by the events of every day. It is, indeed the truth, that engineers being to-day specialists must therefore work together, and are beginning to do so in ways and to an extent that was little dreamed of once. Indeed, it is impossible to contemplate the future without accepting as a fact this unity of purpose and effort.

Perhaps sentiment in this thing counts for a good deal, and we are willing to admit being sentimental on the matter; but Mr. Scott himself showed incidentally that it is also and largely a question of necessity. Virtually the housing of the poor is a mild problem compared with the housing of the engineering societies, many of which in this city—national bodies—wander from pillar to post—without hope or expectancy of enjoying rooftree or hearthstone of their own. The American Society of Mechanical Engineers has a small house it has outgrown and seeks shelter in an adjoining hotel. A well-known citizen of New York who lately gave the Electrical Engineers a handsome addition to their library characterized the Institute offices as a set of "cubby holes," and the appellation is but too pat and true. These cases are but typical and symptomatic and the evil of crowding grows yearly, while the societies become daily less able to care responsibly for the technical and literary treasures committed to their care. The bodies in question do not need charity, nor would they accept it, but there are magnificent opportunities existing to place at their disposal and in their trusteeship facilties for the common good, the benefits of which would at least equal those afforded by any university in the land.

Measurements of Power in Three-Phase Circuits.

Mr. McAllister's article on page 947 skillfully analyzes a simple case of current unbalance in a three-phase system, and shows how inaccurate may be the results of formulæ which apply to wattmeter measurements when dealing with balanced circuit. The power-factor of a single-phase circuit considered between a given pair of

points therein, is a clear and definite quantity, being the ratio of the real to the apparent power transmitted beyond those points. The same definition may be rigidly applied to a three-phase system, balanced or unbalanced, when a neutral point exists. When, however, the three-phase system has no neutral point, but is provided with circuits in delta, the power-factor becomes more difficult to define and more troublesome to determine. Mr. McAllister's article does good service in pointing out this fact. The article also contains a very pretty explanation of the well-known two-wattmeter method of measuring power in a three-phase system. The explanation does not contain or attempt a rigid proof of the accuracy of the reasoning involved, but a little consideration will convince the reader of the accuracy of the reasoning. As the ordinary method of proof is essentially symbolical and hidden from those unfamiliar with trigonometry, this method is one that will be advantageous to the student of three-phase systems.

REVERSALS OF ELECTROLYTIC POLARIZATION.

We are familiar with the fact that the phenomena of magnetization in iron involve the history of the process. In other words, we know that iron has a magnetic memory. On page 946 appears an article by Mr. W. McA. Johnson, giving an account of some interesting observations on what might be termed electrolytic memory. If an electrolytic cell be charged for a certain period and allowed to discharge we know that it will discharge at the expense of electrochemical energy. This energy has been stored in the cells in the form of anions and cations supported on the anode and cathode. If, however, before we discharge the cell, we reverse the charging current for a brief interval, we shall tend either to dissipate, or to consume the layers of superincumbent anions and cations. If the reversal lasts long enough, the layers will vanish and be replaced by new layers of opposite character and polarity. But if the reversal stops short of this destruction there will be a remanent layer of anions on the original anode neither dissipated nor consumed. Beneath this will be a newly developed layer of opposite polarity.

If the cell be discharged in this state there will be first a discharge from the last formed layer and, as soon as this has been exhausted, the remanent layer of the original charge will become active and will reverse the direction of discharge. In order therefore to develop an electrolytic memory in a cell, its chemical nature should be such that, as described in the article, it is irreversible, and that the new anions cannot consume the old cations. Moreover, its mechanical and physical nature should be such that the old cations can lurk in a safe hiding place near the original cathode, and not readily be dissipated by diffusion and convection. It might be possible to develop a long memory in a cell in this way. The article shows that the memory of the cell experimented upon was clear for half a minute, but after that it became vague and only modified the subsequent action without dominating it.

ELECTRICITY ON TRUNK LINES.

Cornelius Vanderbilt has contributed, as we noted last week, to the *North American Review* a study of this subject from the standpoint of the railway manager which is again worth commending to the attention of our readers. It must be remembered, too, that aside from his official status Mr. Vanderbilt is an engineer whose opinion must command respect. In this case his views are singularly conservative and sane, and while the electrical engineer may find some items for criticism, he will, in the main, agree that the conclusions are sound. Roughly to summarize the points of the paper, Mr. Vanderbilt divides the total expense as follows: Cost of unit weight of fuel, useful work realized per unit, cost of handling trains, cost of repairs to machinery, cost of repairs to roadbed. As to the first item he finds approximate equality for electric and steam operation, save in isolated cases where low grade fuel or water power can be economically used for the electric stations. In work realized per unit of fuel, the result is nearly a stand off with perhaps a slight advantage in favor of electricity. Cost of handling trains should not vary with the motive power, since no hands could be dispensed with safely in electrical driving. As to repairs on machinery, the larger total amount in electrical equipment would offset, or more than offset, any intrinsic gain in favor of the motors, and in repairs to roadbed. Appearances indicate little difference, although the third rail, if used, would be an additional item of maintenance. When it comes to the cost of equipment Mr. Vanderbilt considers that on the two systems the cost of rolling stock, including motors and locomotives, would be about the same, leaving the electric generating and distributing systems as additional items of expense which must justify their existence by increasing the power delivered per unit cost of fuel. The possibility of doing this is held very properly, to depend on the density of traffic on the road, which Mr. Vanderbilt considers to be very rarely great enough on trunk lines, if ever, to give electric operation the advantage.

Mr. Vanderbilt fully recognizes the advantages that may be gained in handling a dense passenger traffic by electric trains, but he is here discussing the desirability of electric traction in the general service of "trunk lines." In this paper he has put his finger with unerring instinct on the weak point of electric traction on a large scale—viz: the losses and expense in the transmitting and distributing system when dealing with traffic of small or moderate density. He falls into the error common among those who are not practically familiar with electric power transmission of somewhat overestimating the losses in the line, and thus exaggerates one factor in his estimates, but not by an amount which at the present time vitiates his conclusions. The loss from prime mover to driving wheel is indeed the most serious obstacle to electric traction on a large scale. When traffic is very dense this loss is relatively of much less importance than elsewhere, and may be far outweighed by the undoubted advantages of electric driving, but it is certain that this loss is one which engineers should strive assiduously to reduce. The major part of it, however, generally lies between the step-down transformers and the driving wheels rather than on the side towards the prime mover. All the recent experiments have been directed to the reduction of this fraction of the loss, either by the use of alternating motors, polyphase and other, or by employing rotary converters or motor-generators on the locomotives, thus doing away with the extensive low tension distributing system. Obviously this procedure is not merely an extension of ordinary trolley practice, but a direct attack along a new line on the more serious problems of the art.

As Mr. Vanderbilt very properly points out, trunk line conditions are not to be properly met by a mere extension of ordinary trolley lines, and the more fully this fact is understood the better for electric traction in general. As we have many times pointed out, there is a large class of interurban roads which must in many of their relations be classed with ordinary railroads, and yet there is a very wide distinction between even these and the big trunk lines which derive and must continue to derive, a very large proportion of their revenue from hauling the country's freight. There is every reason to believe that electric traction will steadily increase and that it will yearly assume a more serious position in general railroad work, but this is far from asserting that the locomotive will soon be a back number. And there is good reason to believe that the locomotive is capable itself of very considerable improvements. As a result of the Zossen tests a determined effort is being made to produce a locomotive especially suited to very high speeds, and the results will throw considerable light on the improvements that may fairly be expected.

Twenty-Fifth Anniversary of the Engineers' Club of Philadelphia.

The Engineers' Club, of Philadelphia, celebrated its twenty-fifth anniversary last week by a banquet, which was a notable affair, not only on account of the attendance and speeches, but also because of the elaborate setting and arrangements, which latter were admirably carried out. The menu and programme was a unique and appropriate conception, being printed on tracing paper with blue-print covers, the front cover carrying an elaborate design symbolic of engineering.

The guests included representatives from the national engineering bodies, a large number of engineering clubs, as well as the Union League and Art Clubs of Philadelphia and the University of Pennsylvania. Among the distinguished guests were Admiral Melville and the venerable John Fritz. The American Institute of Electrical Engineers was represented by President Charles F. Scott. Gen. William P. Craighill, U. S. A., who was to respond to the toast "Our Engineers," was unavoidably absent, having been recalled by telegram received from Washington at Baltimore while on his way to Philadelphia. It was thought that ample seating arrangements had been provided for the banquet, but some twenty members had to be turned away for want of room.

President Henry J. Hartley presided, and Mr. L. Y. Schermerhorn acted as toastmaster and in appropriate terms welcomed the guests. In his remarks Mr. Schermerhorn sketched the history of the Engineers' Club, which grew out of an arrangement between the American Society of Civil Engineers and the American Institute of Mining Engineers, whereby headquarters were established in Philadelphia during the Centennial of 1876 for the convenience of American and foreign engineers visiting the Exposition. At present the membership numbers nearly 500.

Mr. Oberlin Smith was called upon to say a few words expressing regret at the absence of Gen. Craighill, in which he pointed out the great work that army engineers have done. Admiral Melville responded to the toast "Our Navy Engineers," and in his remarks paid a high tribute to engineers in general. The other toasts were as follows: "Our Honorary Members," Mr. James Christie; "Commerce," Mr. Robert W. Lesley; "Engineering and Our Kindred Society," Mr. John Birkinbine; "Our University of Pennsylvania," Prof. Arthur W. Goodspeed; "Our Founders," Mr. Wilfred Lewis; "The Technical Press," Mr. John C. Trautwine, Jr.; "The Union League," Mr. Peter Boyd; "The Engineers of the Twentieth Century," Mr. Charles F. Scott.

Mr. Scott, in his opening remarks, modestly commented on the fact that the honor of responding to the toast, "The Engineer of the Twentieth Century" had fallen to an electrical engineer. He then proceeded as follows:

Besides the new relations to others there will be new relations of engineers among themselves. All that I have said so far emphasizes what we all know, namely, that the several branches of engineering are intensely interdependent and co-related. Take a single instance of large work, the extension of the Pennsylvania Railroad into New York City, the tunnels under the Hudson and East Rivers, the terminal facilities and the electrical equipment and endeavor to name an important branch of engineering which is not essential to this undertaking.

The work of the future demands co-operation, not clannishness—unity not jealousy. Engineers must be specialists, therefore they must work together. The several branches of the profession have their individual interests; they have a larger common interest. As we marvel at what the engineer has done, as we attempt to picture what he may do, we realize the far-reaching responsibilities which confront us. Shall we rise to meet them? We gave to the world the steam engine, the steam vessel, the railroad, the telegraph and cable, machinery, industrial processes, the electrical central station—the fundamental requisites which underlie co-operation. Is it not time that we, too, apply to ourselves the great lesson of the last century? What organization stands before the world as representative of the engineering profession? Has the engineer been accorded the recognition and the reward which are his due? A noted lawyer recently addressed the annual banquet of a local engineers' society containing members of national and international reputation. His remarks were based upon the idea that all engineers were co-ordinate with a common chainman, and they would have been positively insulting but for his air of blissful ignorance. A few years ago a gentlemen of eminence in addressing the American Society of Mechanical Engineers advised its members not to join in a machinists' strike. In what way do engineers present themselves to other professions? In what way do engineers co-operate to advance their own profession by mutual helpfulness and by undertaking measures which advance the efficiency and the usefulness of engineering work? There are national organizations of various kinds, the Civil, the Mining, the Mechanical and the Electrical Engineers, the Architects, the Naval Architects and Marine Engineers, the Engineers in the Army and the Navy, and there are the Chemists, the Electrochemists and others. In general each knows that other societies exist, and they are mutually respectful, but there is some suspicion here and there that the others are a little too exclusive or a little too common, or that they are a bit jealous. These are the murmurings of littleness, not of largeness.

The several engineering professions, like the constituent States, have their representative bodies, their legislatures, but why not an Engineering Congress as well? Why not a national representative body to stand for the profession of engineering, to promote a harmonious co-operation which will strengthen each and elevate all?

An incident of the past year is an auspicious omen. Four great societies have co-operated; they have worked together; they have taken a step which will bring recognition to the deserving individual and credit to the engineering profession; they have founded a medal and at a magnificent dinner they have announced the award of the first John Fritz Medal to the venerable man who has just spoken, John Fritz himself. But not less significant than even the medal is the discovery that the societies can work together, and by doing so they can accomplish worthy ends.

In the vision of the future may we not discern a reflection of the John Fritz Medal in the larger life of the Twentieth Century Engineer? Methinks I see the outlines of the medal taking the form of a magnificent building, the capitol of American engineering. Into this home in the metropolis are gathered the great engineering societies from their scattered lodgings. Here is a great technical library, here are ample assembly halls and comfortable parlors, here are the headquarters of a score of lesser societies, affiliated in their work, but restricted in their scope. I see all over the country innumerable local societies and engineering clubs, no longer isolated but joined together into one great combination. I see them affiliated with the national bodies—sometimes as local chapters—all together constituting a great union. There is individual freedom, but general co-operation. The Engineering Congress representing all the engineering professions and supported by the great union of engineering societies, gives to engineers a rank consistent with the importance of their work; it increases the efficiency of the inter-relations among engineers. An eminent body, it is powerful in advancing the common interests of engineers, and it represents the engineering profession in its relations to other professions, to pure science, to education, to legislation, to public improvements and to the general welfare.

Years ago engineers were individuals of trivial consequence compared with men in the learned professions. Now technical professions are of recognized importance. But even yet the national societies of the profession which has made the nineteenth century an era in the world's history, which has provided the means for the production of unmeasured wealth and which promises yet greater things for the future, have not even a home of their own. Within the week the American Society of Mechanical Engineers who have a little house of their own found it so very little that it was forced to hold its meetings in a large room in a near-by tavern. There were present men through whose work hundreds of millions have been added to the wealth of this country, and their present efforts are to increase the efficiency of the future. Is this right? Is it just?

But may not the fault lie somewhat with the engineers themselves? Have they fully recognized their own strength and importance? Have they shown a disposition to act together, to do large work in a large way? Have they given promise that they would use well the enlarged facilities to increase the efficiency of engineering work?

The men who are mastering the powers of nature will yet rise in the strength of united effort to meet the increasing responsibilities of the coming years. For it is theirs to build the foundation of the new civilization; it is theirs to establish material prosperity—the underlying condition for broader, fuller and higher life.

The end of engineering is usefulness, the characteristic of America is activity; the modern method is co-operation. As engineers of the twentieth century let us be useful; let us be active; let us co-operate.

Recent Methods of Trackless Trolley Operation.

FROM time to time the subject of trackless trolley operation has come up in this country, and a few experiments have been made here. In Europe, where the roads are usually much narrower than ours, and where the laying of trolley tracks meets in many places with strenuous and insurmountable objections on that account, the idea has been taken up far more seriously. At the present moment, two methods are before the European public, one the Lombard-Gerin, partially with polyphase current for a special form of motor trolley with flexible cord, and the other that of Mr. Max Schiemann, of Dresden, with direct-current and regular trolley pole contacts. Both are very interesting and the practical results already obtained would imply that more of this work will be seen in the near future. It will be remembered that in 1899

FIG. I.—TRACKLESS TROLLEY CARRYING PASSENGERS NEAR DRESDEN, GERMANY.

Siemens & Halske brought out in Berlin an automobile omnibus, which besides having overhead wire circuits and trolley pole contacts, was equipped with storage batteries consisting of no fewer than 200 cells. We are not aware that anything has been done with that method since the time mentioned.

The Schiemann system has been operated very successfully in the Biela Valley, near Dresden, running through several villages, and considerable freight is now being hauled over the road. Fig. 1 shows a motor car and a trail car taken on the occasion of a visit to the line by the Dresden Elektrotechnische Verein. The motor car is usually employed for the transportation of light express matter, and the trail car for coal and other heavy goods. The train in actual operation is shown in Fig. 2, taken from a photograph made after a light fall of snow. The train is steered by means of the front wheels of the first car, and it has been found that the wheels

FIG. 2.—TRACKLESS TROLLEY CARS HAULING FREIGHT.

of the second car, being of the same gauge, will track absolutely after those of the first car.

The trolleys are provided with a sliding contact. The motor car has a weight of 4 tons, and is capable of carrying a weight in packages of 1 ton. The trail car weighs 1.5 tons empty and 5 tons loaded, making a total weight of the loaded train of 10 tons. On a level the cars run at a speed of 15½ miles an hour. The controller used is small and like that of ordinary trolley cars. The passenger cars will seat 26 persons. It is stated that the cost of construction is about 25,000 marks per kilometer.

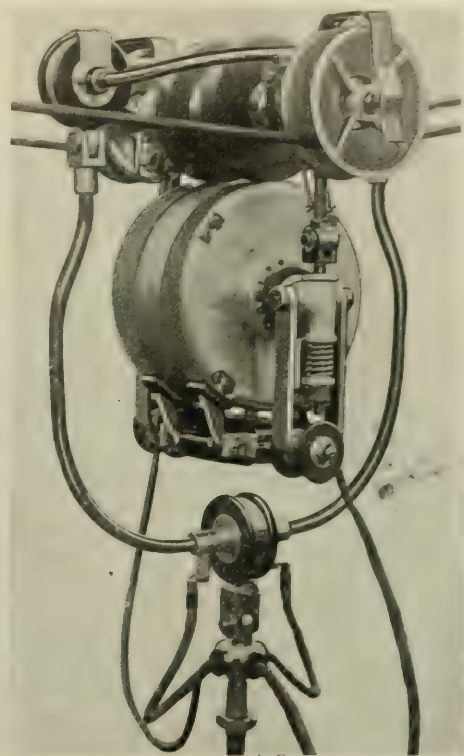
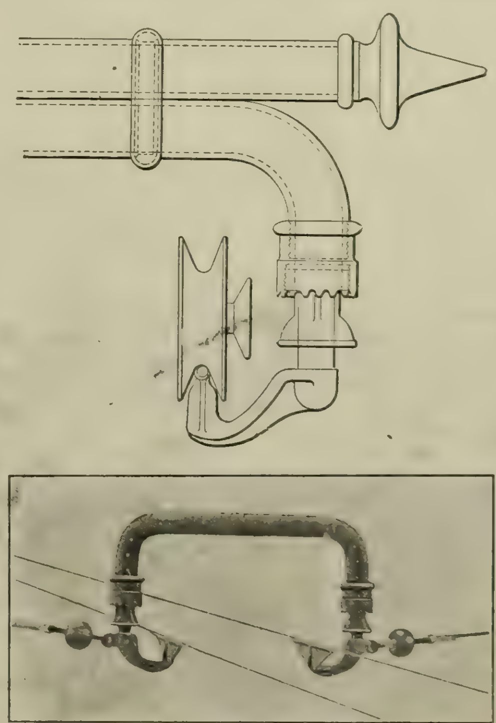


FIG. 3.—LOMBARD-GERIN CURRENT COLLECTOR.

The Lombard-Gerin system has already been noted in these pages, having been brought to attention at the time of the Paris Exposition of 1900, where it was shown. Since then it has been installed from Fontainbleau to Samois, about 5 kilometres, while



FIGS. 3A AND 3B.—DETAILS OF METHODS OF SUSPENDING TROLLEY WIRES.

another and longer line is now being developed along the famous Corniche road in Southern France, from Nice to Monte Carlo. As already stated in these pages, [1] the Lombard-Gerin system has an "auto-trolley" attachment, Fig. 3, which consists of a small three-

[1] ELECTRICAL WORLD AND ENGINEER, Vol. 35, No. 10. March 10, 1900.

phase motor suspended between the two conducting trolley wires, which are set 12 inches apart. The motor is hung in a frame which also carries two trolley wheels. The motor has a revolving field which communicates motion to the trolley wheels. It is of the three-phase type, current being fed to it from the motor of the troller is in the usual place on the front platform and there are electrical and mechanical brakes. The trolley motor is so geared as to give it a speed a little in excess of that of the car itself, so as to lead the way, from which feature it has won the cognomen of the "blind man's dog."

FIG. 4.—CHANGING CONNECTIONS WHILE PASSING.

omnibus, the latter motor being virtually a rotary transformer supplying the current for this specific purpose, besides being a direct-current motor. The armature of the series car motor has three rings, etc., connected to three points in the winding, and in

FIG. 5.—CURVE IN NARROW STREET, SAMOIS-FONTAINEBLEAU LINE.

of variable frequency. The motors are usually built of light cast-
this manner the motor functions also as a three-phase generator
steel and resemble those for ordinary street car work. The con-

The time for the five kilometers between Samois and Fontainbleau, Figs. 4 and 5, is about 20 minutes, and there are now two omnibuses in service. The parent Compagnie De Traction par Trolley Automoteur, owning the system, gives the ratio of expenses to receipts as fifty-eight per cent., and quotes the expense of operation as follows: The electrical energy at 25 centimes per kw-hour amounts to 1,355 francs and 25 centimes, or .161 centimes per car kilometer. The repair expenses of the carriages are given as about 776 francs, or .092 centimes per car kilometer; and the working of the omnibuses, with one man per vehicle, is given as 456 francs, or .054 centimes per car kilometer, while the general expenses amount to 307 francs and 55 centimes, or .036 centimes per car kilometer. This makes a total expense of 2,895 francs, or .343 centimes per car kilometer.

For the line on the Corniche road, Mr. G. Sacco Albanese, of Nice, has obtained a 50-year franchise from the French government. This engineer will obtain current from the Mediterranean Power Company at Nice, at 10,000 volts, transformed at sub-stations at each end of the line and midway to 500-550 volts direct, for the bus motors. The line is to go into operation at the beginning of 1903 with 12 omnibuses each capable of carrying 12 passengers seated and 4 standing. Mr. Albanese estimates the cost of construction for the 20 kilometers of line, the 12 omnibuses, car shops, sub-stations and all accessories at $200,000. Ornamental iron poles are used within city limits and wooden poles outside. The grades along the road are quite heavy in places. A point of interest is that in order to pass and change trolleys, the conductor will not be obliged to mount on top of the car to effect the transfer, where there are no sidings or overhead switches. In the earlier arrangement, as at Fontainbleau, there is a pin contact at the lower end of the flexible cable, to permit of the exchange, but, as we understand it, the trolley standard is to be improved to obviate the awkwardness and delay arising from this cause. Early trolley systems in the United States, as on some of the Van Depoele roads, were accustomed thus to exchange their flexible cord trolleys in passing each other.

Independent Telephony in Buffalo.

By James Malcolm.

THE independent telephone plant being constructed in Buffalo, N. Y., is being installed under the terms of a franchise dated December 13, 1901, which gives the Frontier Telephone Company the right to lay its conduits, and to place poles in all the streets, except the more prominent ones, a total of approximately 75 miles of street, where the company is permitted to set distributing poles in locations first approved by the Commissioner of Public Works. Stipulations are made as to the number of contracts that must be obtained within a certain time and the service rates are fixed. These are for unlimited service $48, $40, $36 and $24 for direct line, two, three and four-party business lines, respectively, and $36, $24, $20 and $15 for direct line, two, three and four-party residence service.

The other terms of the franchise of interest include a guaranty, protected by a bond, requiring the company to maintain competition with the Bell system during the life of its grant, and another guaranty, also protected by bond, insuring the proper repair of streets torn up. The grant expires after forty years from the date of its issue.

During the latter part of January of this year the plans were started for the necessary construction work. It was decided that an ultimate capacity for 30,000 lines was to be taken as the basis for calculations. The building site was located near the theoretical telephonic center of the city, care being taken to so locate this point that in a further development of the system it would not be necessary to install a second office in the business portion of the town. The property purchased for the central office installation is No. 332 Ellicott Street, between Mohawk and Huron streets. Here a building is now being erected to provide accommodation for an 18,000 line, straight multiple, common

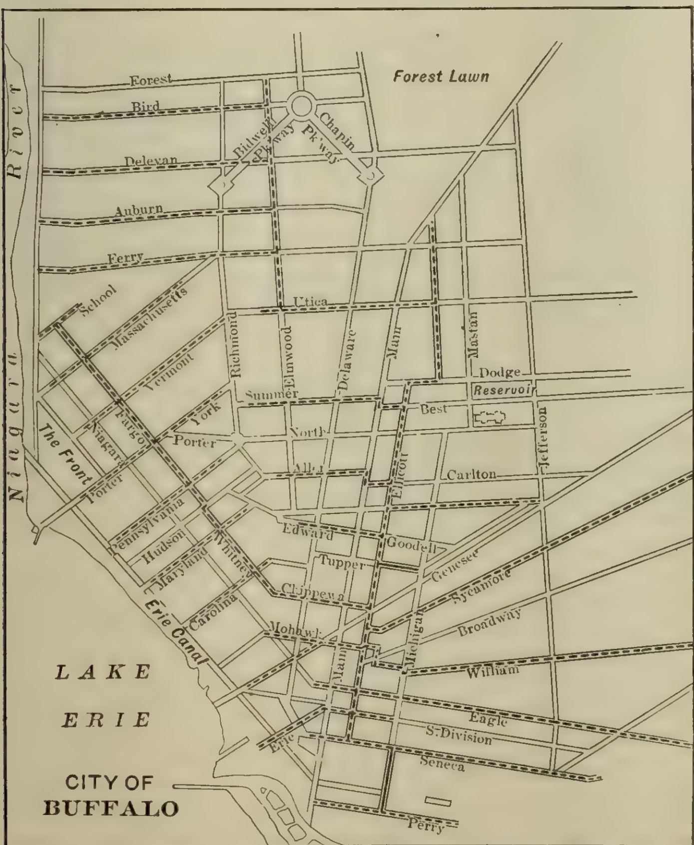


FIG. 1.—MAP SHOWING CONDUIT ROUTES.

battery installation. This building has a frontage of approximately 65 feet by a depth of 132 feet. It is three stories high, and is intended to serve the company's requirements for office room and supply storage. No more room is provided than the company will need for its own purposes, but for these purposes the space provided has been arranged for under a liberal estimate.

The main feature of the building is its switchboard room. The 18,000 line, multiple board above referred to, would require, if set up in one straight line, a room approximately 375 feet in length. Installed in the ordinary U or horseshoe shape, the length of the room required would be approximately 185 feet. Either of these dimensions would be manifestly difficult in a building of ordinary size, so it was decided to put the multiple on two separate floors. Each room, according to this scheme, is approximately 80 feet long by 46 feet wide. The lower one is on the second floor of the building, and the upper one, which

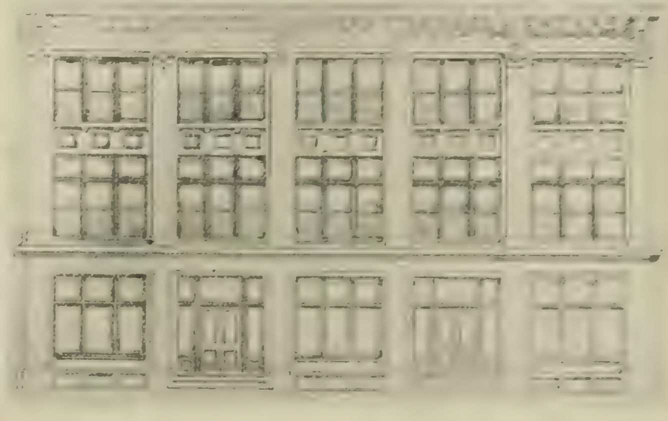


FIG. 2.—FRONT ELEVATION OF BUFFALO INDEPENDENT TELEPHONE EXCHANGE.

is a gallery above the lower, forms the third floor of the building. There will be a skylight in the roof of the building as large as the opening made by the gallery rail, which will light the front of the switchboard on both floors.

It will be noticed that this arrangement, while entailing a slight additional expense for multiple cables, effects so great a saving in the length of the answering jack cables, that it is really an economical plan. The power plant for charging the storage batteries, is in triplicate, two units being driven by motors and one by a Westinghouse gas engine. The underground cables are extended up through the building to a point just under the level of the distributing boards, in which they terminate in the customary standard manner.

The company's conduit system embraces a trench length of approximately 30 miles. The average number of ducts in each trench is approximately 6, or a total of very close to one million duct feet. It was decided that in all of the business district and the more important residence section of the city, the wires should be kept underground as much as possible. The map shown herewith covers that portion of the city in which conduit work is being done. To readers unfamiliar with the city of Buffalo it may be explained that the eastern city limits lie approximately two and one-half miles east of the easterly portion of this map, the northern city line is about three miles north of its upper side, and its southern line three miles south of the bottom of the map. All of this outlying district will be fed for the present by pole lines, but as any one district develops, it is to be entirely and thoroughly rebuilt with an underground system. At least 75 per cent of all the telephone subscribers in the city are located in the district shown by the map. The conduit line has been run as closely as possible along one side of each of the city blocks. In the downtown part of the city, lateral pipes are being laid from conduits directly into the building basements, where cables are to be terminated, so that no overhead work will be necessary. The office buildings are being thoroughly cabled to small terminals on each floor. Further out in town, where each house is surrounded by its yard, or, in other words, where it is impossible to run through the wall from one basement directly into the next, distributing poles are being placed in each block. In these cases the lateral pipe from the conduit is laid through adjoining private property to the distributing pole, so that wires are kept underground until they reach the back of the building and are actually ready for distribution to the subscriber. Experience in several of the largest telephone plants in the country has shown that up to a reasonable limit it is perfectly safe to install cables of 22 gauge wire, instead of the conference standard No. 19 gauge, which was orthodox in all the magneto plants built from 10 to 12 years ago.

The Buffalo system places a limit of 500 ohms circuit resist-

ance on each of its lines. This necessitates the use of No. 20 gauge conductors for reaching a few subscribers located in a zone close to the northern, eastern and southern city boundaries. The average line length in the Buffalo plant will be approximately 5,000 feet, which makes the average line resistance considerably less than half of 500 ohms. The use of small gauge conductors carries with it the possibility of using a large cable unit. The Buffalo unit is 400 pairs. This effects an important economy in the number of ducts in each trench. The poles that are being used for distribution purposes are practically all Idaho cedar, which, to those initiated in the craft, is the standard for symmetry of shape and soundness of timber. The conduit work, which was started early in May, has been very rapidly executed, and will be finished around this time. Most of the poles are in position. The underground cable work has been going on for some little time, and will be finished in about two months.

While the Frontier Telephone Company's system is the first independent work that has been actually undertaken in Buffalo, it is by no means the first attempt to establish a system. Since a number of previous efforts on the part of other people proved fiascos, the Frontier Company's officials naturally felt that their earnestness might be viewed with some skepticism by the public, so after having obtained their franchise, they made their plans, made contracts for all necessary materials and apparatus, and laid the main portions of their conduit system before putting a solicitor in the field. This action seems to have had the desired effect. Several hundred requests for telephone service were received before the company had prepared the necessary stationery on which to record such transactions. The first canvassers sent out met with a warm response to their solicitation, and each of them brought in from one to a dozen contracts per day. The number of contracts on file recently was a little over 3,500, which, by the way, is the number the city requires shall have been obtained before December 31, 1903. While the number of contracts actually obtained is reasonably large for the amount of time and labor expended in getting them, the canvassers' records show that a large number, possibly twice as many contracts as above noted, will be signed up as soon as the Frontier system is in actual operation. Another large number of subscribers will sign for service as soon as the contracts for their present telephones expire.

The Frontier Telephone Company confidently expects to be running in the new year with a subscribers' directory of 6,000 to 7,000 names, and at even a moderate increase, estimates that 10,000 lines will be working in the switchboard within one year from the inaugural date. The Bell Telephone Company, which has been in existence in Buffalo for about 20 years, and which has equipped its system with every form of switchboard from the primeval type to the present standard multiple, lamp signal installation of to-day, has from 10,000 to 12,000 subscribers in its list. It will be of interest to telephone people all over the country to know as time goes on how the service of the Bell Company, with its high grade, small unit central exchange system, will compare with that of the equally high grade, larg unit, single station system of the Frontier Telephone Company, equipped by the Kellogg people, with the plant already noted in your columns.

The officers of the company are: President, E. C. Lufkin; vice-president, John B. Weber; secretary and treasurer, Chas. B. Hill; general manager, Samuel E. Wayland; superintendent, Willbur H. Johnston.

The directors are as follows: Irving A. Stearns, Henry H. Persons, John B. Weber, H. D. Kirkover, Alvan Markle, E. C. Lufkin, Arthur Scranton, Charles B. Hill, William A. Douglas, James M. Thomas, Charles F. Austin, Martin Carey, Fred R. Green and Charles W. Goodyear.

Municipal Street Railways.

A movement toward the municipal ownership of street railways has been defeated at a special election held at San Francisco. A proposition to issue $[illegible] of bonds for the purpose of equipping and operating the Geary Street Railroad was beaten by a vote of 13,180 to 11,334. A two-thirds majority was necessary to carry the measure.

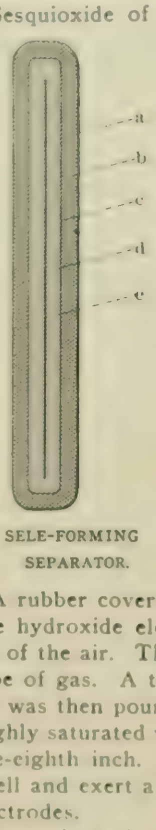
Self-Forming Separator in a Nickel Peroxide Storage Cell.

By A. L. Marsh.

A NICKEL peroxide storage cell has the property of forming its own separator. A small cell was made as follows: The neck was cut from a glass bottle so as to form a containing vessel about 2½ inches long, 1 inch wide and 3 inches deep. A piece of nickel gauze was bent into shape to fit around the inside of the cell.

Next, a negative plate of spongy cadmium was prepared. A thin strip of sheet iron (about 2 x 2½ inches) was perforated from both sides, so as to form projections which would retain the spongy cadmium until fixed in the cell. The cadmium was prepared by electrolyzing with a strong current, a solution of cadmium sulphate, using a stick of cadmium for the anode and a platinum wire for the cathode. The cadmium deposited rapidly in a spongy condition, and was from time to time scraped off and thoroughly washed. This spongy metal was pressed on both sides of the iron plate, thus forming a porous cadmium electrode with a conducting core of iron.

Sesquioxide of nickel (Ni_2O_3) was next prepared. A solution of nickel sulphate was precipitated with caustic potash, and an excess of this reagent added. Nickel hydroxide ($No(OH)_2$) is the precipitate. Bromide was then added in sufficient quantity to change all the green hydroxide to the black hydroxide $Ni_2(OH)_6$. (Chloine, being cheaper, is generally used in place of bromine.) This black hydroxide was filtered off, well washed and then allowed to air dry.



SELE-FORMING SEPARATOR.

To construct the cell the nickel gauze is first inserted. Next the cadmium electrode is placed in the center of the cell and held away from the nickel by small pieces of rubber. The dried but still hydrated sesquioxide of nickel is then packed between the two electrodes and a sufficient amount used to cover them. A copper wire is soldered to each electrode, both the solder and the wire being coated with asphalt paint to protect them from the electrolyte.

A rubber cover was provided for the cell to protect the alkaline hydroxide electrolyte from the action of the carbon dioxide of the air. The cover was provided with a valve for the escape of gas. A twenty per cent solution of potassium hydroxide was then poured into the cell until the materials were thoroughly saturated with the liquid and covered to a depth of about one-eighth inch. The wetting of the nickel oxide causes it to swell and exert a pressure which insures good contact with the electrodes.

In a short time a thin layer of the nickelic oxide (Ni_2O_3), in contact with the cadmium, becomes reduced to the green oxide (NiO) and forms a good separator. The oxide (NiO) being of a flocculent nature and the layer thin, this separator offers only a slight resistance to the electric current.

Perhaps a better form of the cell would be to have the peroxide of nickel electrode surrounded by the spongy cadmium. For a commercial cell cadmium is said to be not a sufficiently abundant metal to use as the negative. Iron is at present the preferred metal for this purpose. The nickel-iron cell has been pretty well covered with patents, but so far as I know the construction to be described below is new.

Since nickel peroxide is of such a nature that it is apt to fall away from the grid unless held in place, this electrode should occupy the middle of the cell and be surrounded by the negative spongy material, which is porous enough to allow the interior portions to keep moist and conductive, and at the same time retains the peroxide powder.

The peroxide plate is then prepared by any method found to be suitable, and in such a way that the nickel grid i entirely covered by a peroxide layer of uniform thickness. This

electrode is then surrounded by a layer of spongy iron or a compound reducible to spongy iron. The whole is surrounded by a perforated envelope which serves as the negative grid or conducting plate and is perforated to give the electrolyte access to the interior of the couple, and to provide for the escape of gas.

The positive and negative grids should be held apart by suitable insulating material to prevent the possibility of shifting of the active materials and the consequent short-circuiting of the cell. The top should be closed by a suitable cement. In the accompanying illustration, *a* is a perforated iron envelope; *b*, spongy iron active material; *c*, insulating layer of nickel oxide (NiO); *d*, nickel peroxide active material; *e*, positive grid of sheet nickel.

This couple would form a unit. A cell of any desired capacity could be obtained by choosing the proper number of couples for each cell. The containing vessel or cell could be made of sheet iron or steel, since the electrolyte would be a 20 per cent solution of potassium hydroxide.

Such a cell would use the least possible quantity of electrolyte, would be strong and compact, and would be easy to repair, since the couples would be easily accessible, could be separately tested and any faulty one readily replaced.

A cell of the above construction would offer the objection that overcharging would tend to dry out the interior portions of the active materials by the decomposition of water. Notwithstanding this drawback, the cell ought to be well adapted to work where dry cells find a use.

Since in the strong cell described, there is nothing added to, or taken from, the electrolyte as a whole, and since it can be recharged when exhausted, this cell ought to have a considerable advantage over the dry cells in present use.

Water Vapor.

By Alfred G. Dell.

THE following contains some observations made in experimenting with rotating disks, which, we think, suggest a valuable application of the same. While it does not pertain directly to electricity, it would, I think, be of value in its applications to delicate instruments used in measuring electricity.

I have found that when the humidity has been reduced in the boxes containing rotating disks, as formerly described, the disks greatly improve in their rotations; in other words, they rotate on using the blowers, as formerly described, with greater velocities and with less forced air from the blowers than when the humidity is higher.

It appeared that moisture collects about the points of the disks and the jeweled bearings, and to a considerable extent retards the velocities of the disks. It seems that any substance in the ordinary humidity of the air is covered with a film of moisture, although it is not readily detected. The following is an application:

Suppose such parts of a measuring instrument as the needles of sensitive galvanometers were inclosed in boxes from which the moisture had been removed; they would to a certainty not only be more constant, but far more sensitive than those exposed to the humidity of the air. While such instruments are generally in boxes, they are not moisture proof, as they must be perfectly sealed up after the moisture has been removed to be so.

The boxes could be placed open in larger air tight vessels with chloride of calcium or some other absorbent, and left there for several weeks, in a warm place if chloride of calcium was used. The covers of the small boxes, or small holes with plugs to fit, could be arranged so they could be closed while in the larger boxes, and then removed and quickly sealed. A high temperature removes the vapor, but I have found it not as effective as an absorbent, and besides the heat might injure the instruments. Such instruments could easily be made air tight, as glass and metal are generally used in their construction. I do not believe all the water vapor can be removed by any known means, but it can be reduced to a minimum.

Electrochemistry in Lithography.

By E. C. Handy.

TO the average reader, lithograph is associated with the printing of gaudy, many-colored posters which are everywhere seen about our great cities; and but few people realize that in order to obtain these most conspicuous heralds of business, a process is gone through which requires exceedingly delicate manipulation. Bill posters and lithographs, as all printers know, are usually composed of many colors of ink, and each color of this ink is printed or impressed upon the paper at separate and individual times, making, therefore, a most expensive process when good work is done, as the paper has to be reprinted many times before it is ready for the customer. Much money and inventive thought have been spent upon methods to reduce the cost of this work, and recently an electrical process for this purpose has been devised.

The first process of lithography is to transfer the "work" or "picture," which has been drawn by the artist upon a species of limestone especially prepared for that purpose, upon a chemically prepared paper which exactly duplicates the original work. These papers can be kept for some time. It then becomes necessary to place the work which rests upon this paper upon a base for printing. The old method was to transfer it upon a flat stone whose surface is hardened, and later etched away so as to allow printing. By this method each individual color, or portion of the whole, has to be put upon different stones—a tedious and costly process.

It has long been known that certain metals, such as zinc and aluminum, can be prepared so as to give a certain surface capable of holding an "image" or "transfer." In many shops zinc is used in sheets reinforced by being strapped to an iron base, and in others aluminum is used. The zinc being more generally known, will be dealt with here.

Ordinary zinc surface is, when polished, smooth as glass, and wholly unfitted for printing; for although it will admit of a transferring of the work, and will hold the ink, it smudges at the very first application of the paper in the press. It has, therefore, been found necessary to especially prepare this surface by roughening it to a certain degree. This roughening is successfully done by exposing the polished surface to the action of a fine, hard, silicious sand or emery upon which marbles are rolled by eccentric agitation for some time. This surface, however, was not found to be as desirable as limestone, and has never superseded it to any extent.

A few years ago a chemist and lithographer discovered that if a copper sheet be plated with a coating of zinc by electrolysis, a beautiful grain or surface suitable for printing could be obtained; but although the discovery was patented it took a long series of experiments to adapt it to the work from a commercial standpoint. In the first place, the "grain" was not smooth and equal throughout, and it was found that this was due to the copper surface not being properly polished. Again a long series of experiments had to be carried through to determine what form of electrolytie and what current density and what gap distance should be used to obtain good results. Finally, a good uniform coating was secured and successfully applied. About this time it occurred to the experimenters that if the coatings were made upon round tubes and a special machine or press constructed, the whole process of printing could be gone through at one operation. This process is now in operation and is being continually improved.

Revolving copper tubes are coated with zinc, transferred upon for different colors, and if the whole process is successfully carried out many thousands of impressions can be secured in one operation of the "multi-press." The copper tubes must be of an extra quality of metal ground to a dimeter of great exactness, and the entire surface must be smooth and free from flaws. These tubes are coated in about one-half hour with a bright granular coating of zinc, which must be cleaned and dried with great care, as even a touch of the finger or a heavy damp breath upon the surface may condemn it for use, as it will take up the oil from the finger, and will be tarnished or etched by the carbonic acid in the breath.

These tubes are then transferred upon and assembled in the press, until they cease to print longer without smudging. They are then returned to the plating department, where they are cleaned with turpentine and then immersed in a bath of dilute zinc chloride, the tube being connected into the circuit as anode, and a discarded anode from another bath utilized as a cathode, which is gradually replenished and

[illegible] the circuit is broken and the tube removed, cleaned and polished with very [illegible]e nitric acid and chalk or pumice powder. It is then ready to be [illegible]d and replated for another operation, and if properly handled can be used daily for a year or more. By this method there is but little loss of material. The principal one is the turpentine which is used to remove the ink, and it has been proposed to put the tube as it comes from the press into a very deep tank. On passing current most of the ink matter will separate, some floating and some sinking; that which floats turpentine can be skimmed off and used again. One great task is to keep the zinc baths free from grease, and neutral; grease spoils the surface for transfer and an alkaline or acid bath seems to affect the surface by etching it, to some extent shortening its life in the press.

This zinc surface being soft, is quite rapidly worn away and other metals have frequently been experimented with, among them aluminum, iron, cobalt, nickel and copper. As yet zinc stands in the first rank as a most useful agent to the lithographer when coated over copper with skillful manipulation by aid of electricity.

The Armature Reaction of Alternators—VI.

By C. F. Guilbert.

PREDETERMINATION OF LOAD CHARACTERISTICS.

THE diagrams which have been published having for their purpose to facilitate the predetermination of load characteristics by graphic methods, may be divided into two classes:

The first class comprise those which involve only the e.m.fs or the flux which they produce. The earliest of this class is the Kapp characteristic, and it comprises those of Behn-Eschenburg and Blondel, as well as the more recent ones of E. Arnold and Picou.

The second class are those which involve only the ampere-turns, and is confined to the well-known characteristic of E. Arnold with its modification, which latter takes into consideration the increase of field magnetic leakage with load.

The third class is much more numerous and comprises the characteristics which involve not only the e.m.fs and flux, but also the ampere-turns. This class comprises the diagrams of Rothert, Heyland, Potier, Niethammer, the more recent one of Bauch and that of myself.

As we have stated at the beginning of this article, our intention is not to discuss the merits and faults of each of the characteristics that we have named. We shall merely enter into the subject far enough to arrive at two characteristics sufficiently exact for practice, one entirely general and the other applicable to alternators with non-saturated armatures, which type is most numerous. We shall not take up the characteristics of Behn-Eschenburg and Arnold, upon which judgment was long ago passed, and which are of little practical use except in the case of alternators having an induction so low in their metallic magnetic circuits that it can be considered as proportional to the m.m.fs which produce it.

CHARACTERISTICS OF THE FIRST CLASS.

These characteristics are generally exact, especially when they take account of the difference of effect of the transverse and direct reactions, as was proposed for the first time by Blondel. The characteristic of Picou, which is none other than that of Blondel with slight modifications taking account of the increase of field magnetic leakage and giving a new determination of distortions, appears to us to be the most exact, and criticism can only be directed at the means proposed for the determination of the value of the flux due to the transverse m.m.f., as well as the reduction of the useful flux resulting from distortion.

The effect of the distortion of the field is, as is well known, to diminish the induction under one pole horn and to increase it under the other. If we consider the tubes of force from the field into the armature, those which pass through the most saturated part of the gap require a supplementary excitation, while those which pass the least saturated portion require on the contrary a diminution of ampere-turns. If the number of supplementary ampere-turns is equal to the decreased ampere-turns, the mean excitation ampere-turns remain the same, and the increase at one side of the axis of a field pole and the diminution at the other side is then obtained through the transverse m.m.f. If, on the contrary, the increased ampere-turns are less in value than those of the decreased ampere-turns owing to diminution of the permeability with increase of induction, the mean excitation should be increased to maintain the same mean flux; or if the excitation remains the same, the mean flux should be diminished. To calculate this reduction of the mean flux it is evidently necessary to make two hypotheses, one on the distribution of the transverse m.m.f. along the polar face, and the other on the distribution of the induction at the interior of the metallic part of the field magnetic circuit.

Picou adopts for the transverse m.m.f. a linear distribution; that is to say, increasing and decreasing proportionally to the distance from the middle of the pole. This rule, which is rigorous for direct-current machines, is not so for alternators, in which case we have to deal with a sinusoidal variation. It is this law of distribution which we shall adopt, though the method to be given for the determination of the transverse flux can easily be generalized.

As concerns distribution of induction in the different sections of the field magnetic circuit, Picou assumes that the distribution remains similar to that in the gap at all points of the field magnetic circuit. This amounts to saying that the distortion extends along the entire magnetic circuit. This hypothesis is evidently not well founded, for there is no doubt that the induction tends to become homogeneous in each cross section of the magnetic circuit according as the distance of these sections from the gap increases. It can thus lead only to an approximate result which becomes less exact as the field is more saturated. It seems to us that we come nearer to the truth by admitting that the induction becomes homogeneous upon its entry into the pole core, or otherwise stated, that the distortion need be considered only with relation to the pole faces. While the hypothesis of Picou leads to values too high, the substitute proposed has an opposite effect.

With this hypothesis it will suffice to apply a construction of the same kind as that of Picou, but not, however, to the curve representing the useful no-load flux load in function only of the field ampere turns, but to the armature characteristic; that is to say, to the curve representing the useful flux in function only of the ampere-turns necessary to cause this flux to traverse the armature, the gap and the parts of the pole piece traversed by the useful flux.

The separation of the armature characteristic from the useful flux characteristic at no-load, or rather the division of these last into two curves, one referring to the armature and the other to the field, and each in function of the m.m.fs necessary to these parts of the magnetic circuit, has been suggested to us by Potier. We have made considerable use of this method in this article, as will be seen later. In the following article the construction will be given to which the above remarks refer.

The Penalty of Fame.

The subjoined, from the *New York Journal*, is extraordinary, anyhow, and shows how the "people" note what is taking place: Since Judge Warren W. Foster imposed a fine of $100 on Nikola Tesla, the electrical inventor, for failing to obey a jury notice, the Judge has received a number of eccentric letters from Mrs. Annie Thierstein, of No. 239 East Fifty-fourth Street. One, which he received recently, was registered to insure its reaching the Judge. It reads as follows: "I must remind again you, Mr. Judge, as to Nikola Tesla, the electrician. He used me as a living telephone for his revolving motion, already since four years, causing ruin to my existence and good reputation. I lose all the parties for whom I do laundry work because the fine people of the West Side complain of the nuisance deriving from the telephonograph. Tesla knows all about the damage done by him for four years. He must give compensation for it, and cannot deny charge as I have witnesses. I desire, Mr. Judge, you would call us both officially as soon as possible. I already sent you three times to assist me. I am not bound to take my own life for want of work and means. Tesla drives me to despair. He is an unscrupulous fellow. He, unconcerned, looks on at his living telephone as it wastes away in misery. I trust, Judge, you won't forget calling Tesla to task." Judge Foster says he does not know exactly what he will do with this "human telephone," but declared his secretary would probably attend to the matter.

Wire and Cable Specifications.

By L. T. COLLINS.

THAT manufacturers of electrical wires and cables are often asked to bid on specifications unreasonable and sometimes absurd, is a fact so well known as scarcely to excite comment. As an instance of this, one of the largest manufacturers of electrical machinery in the world, recently sent out specifications on No. 12 B. & S. cables and smaller, with walls of rubber varying from 2 thirty-seconds to 3 sixty-fourths on which they required a test of 6,000 volts for thirty minutes and 9,000 for thirty seconds under water. These wires were for 500-volt service. As an example of extreme requirements in the opposite direction, one of the large electric lighting companies specified a 12 thirty-second wall of thirty per cent. Para compound on a No. 5 B. & S. stranded cable for a working pressure of about 6,000 volts and a test of 15,000 volts.

The many points to be considered in determining the proper wall of insulation for a given pressure, make hard and fast rules impossible. The manufacturers of electric wires and cables have had the widest experience along these lines, and with full knowledge of the conditions of service, their judgment is of the greatest value. Many users of electric wires and cables have learned this fact, and invariably consult one or more well known manufacturers before drawing up specifications for cables to meet special conditions. The wisdom of this course is shown by the instances cited above. In one an excessive coefficient of safety makes the cable unnecessarily expensive, and gives the manufacturer who uses cheap compounds an unfair advantage. In the other, the coefficient of safety becomes a negative quantity, and the manufacturer must either refuse an order given under such specifications, or ignore them. In the latter case the risk is run of having the goods returned and general dissatisfaction and ill-feeling result.

While writing on this subject, it may be well to call the attention of purchasers of electric wires and cables to the fact, that however carefully they may draw specifications as to the percentage of Para required in the compound to be used, they are in a great measure dependent upon the honesty of the manufacturer. An inferior compound can be made to give a high initial test. The general appearance and elasticity of the compound indicates only in a measure the quantity and quality of the rubber used, and the ash test, while determining the quantity of organic matter, does not show the quality of the rubber, merely the percentage. The consumer has to depend upon the honesty of the manufacturer, who often sees contracts awarded at little more than the cost of materials if the specifications were strictly complied with. For instance, the navy specifications call for a forty per cent. Para compound, but the manufacturer whose figures are based on furnishing such a compound would be sadly left. In awarding contracts the reputation of the manufacturer for turning out good work—a reputation only acquired by years of honest effort—is seldom given proper consideration.

The acme of absurdity seems to have been reached in some of the rules of the National Board of Fire Underwriters. As these rules have a wide influence and are often embodied in specifications, a brief review of the ones specially referred to may help towards a sensible revision.

Beginning with Class D, Section 41, paragraph C, one finds this covers the insulation resistance for National Code wires and cables to be used at not over 600 volts. These are for interior work and are not supposed to be subjected to moisture, except such as may be in the air. Against sudden excessive moisture they are amply protected, as such a condition should be temporary. This rule calls for an insulation resistance of 100 megs. per mile, a reasonable and safe requirement. The test, however, is to be made, *"during thirty days' immersion in water at seventy degrees Fahrenheit."* Clearly, this means submersion for thirty days.

Ignoring the evident absurdity of submitting wires and cables for interior use to thirty days' submersion, while most marine cores receive a final test at the factory after forty-eight hours under water, let us consider some of the difficulties the manufacturers would have to overcome, if this rule was complied with.

There is probably not a factory in this country that has a fraction of the tanking capacity necessary to meet this requirement; to build the tanks would mean a useless outlay of thousands of dollars. Having built the tanks, however, the next step would involve locking up capital in stock, as a thirty days' supply would have to be carried. Assume these difficulties have been overcome and the problem solved of approximating (no exact figures could be made) the demand for the next thirty days, the manufacturer would be confronted with another difficulty. The demand for many sizes of National Code goods is so great, that it is almost impossible to accumulate a large stock of them. Again assume these difficulties have been overcome. Several large and unexpected orders arrive. The stock that has been in soak for thirty days is exhausted. Then a good customer sends in a rush order. Consider the painful position of the manufacturer. He must either refuse the order or offend his conscience by sending his customer stock unregenerated by having had only 28 or 29 days' baptism. Those who know the tenderness of manufacturers' consciences will realize the cruelty of this position. It is difficult to treat such a rule seriously, and one cannot escape the suspicion that it was never intended to be so treated.

If a more liberal interpretation is given to this rule, and one assumes that the intent is to submerge the wires and cables *from time to time* during a period of thirty days, it is no less absurd and almost as difficult to obey.

The above remarks are applicable to the rule regarding fixture wire (46 a) which having only one thirty-second wall of insulation, including braid, is allowed to escape after a seven days' soak.

Now as to pressure test (41 d) we find these wires and cables, which are to be used at not over 600 volts, are required to resist *"Three thousand volts per one sixty-fourth of an inch thickness of insulation."* This test must be made after 72 hours' immersion (41 d, paragraph 2). Assuming that insulation means only the rubber, the pressure would be as follows:

No. 18 B. & S. to 16 B. & S. inclusive	1-32 wall—	6,000 volts.
No. 14 B. & S. to 8 B. & S. inclusive	3-64 wall—	9,000 volts.
No. 7 B. & S. to 2 B. & S. inclusive	2-32 wall—	12,000 volts.
No. 1 B. & S. to 0000 B. & S. inclusive	5-64 wall—	15,000 volts.
No. 4-0 B. & S. to 500,000 c.m. inclusive	3-32 wall—	18,000 volts.
No. 500,000 c.m. to 100,000 c.m. inclusive	7-64 wall—	21,000 volts.
Over 100,000 c.m.	4-32 wall—	24,000 volts.

The impossibility of meeting these tests must be evident to any one familiar, in a practical way, with the manufacture and testing of electric wires and cables. One might as reasonably expect to force a quart of water into a pint measure without something giving away. The same test is applied to wires and cables for voltage between 600 and 3,500 (41 f) viz.: 3,000 volts for every one sixty-fourth wall of insulation.

The only apparent reason for issuing such rules is, that it was thought by requiring a great deal, more would be secured than if less were required. This reasoning is fallacious. Rules that are impossible to obey cannot be enforced, and the condition is the same as if no rules existed. The consequence is that manufacturers of high-grade wires and cables are forced into unjust competition with cheaply made goods, and the blame for losses due to defective insulation falls upon all. Rules like these and specifications that are equally unreasonable, defeat the very object for which they are issued. Why should not so influential a body as the Board of Fire Underwriters set a good example by revising these rules in such a manner that while ample protection is assured, nothing unreasonable is required? Such rules could be enforced, if not fully, at least to such an extent as to make it unprofitable to risk using low-grade compounds. This would mean raising the standard of insulation and reduction of losses to all users of electric wires and cables. If such a condition were brought about, the Fire Insurance companies would be the greatest gainers.

Another Niagara Power Project.

Our Canadian correspondent states that it is proposed to erect another new electric power plant at Niagara Falls. William MacKenzie, president of the Toronto Electric Railway, and Fred. Nichols, president of the Canadian General Electric Company, are at the head of a syndicate which is applying to the Niagara Falls Park Commissioners for leave to set up a power plant at the Canadian Falls. The syndicate wishes a site between the two present power companies, the Canadian Niagara Falls Power Company and the Ontario Power Company.

Electrochemical Oscillations.

By Woolsey McA. Johnson

ELECTROLYSIS by alternating currents has been known for some time. It is due to the irreversibility of the electrochemical system and is greater as the current density and time of oscillation increase. Quite in accordance with the facts known about alternating current electrolysis is the fact that with long unequal oscillations, the discharge curve reproduces the charging curve, and that depolarization current flows first in one direction, then reverses, flowing in the opposite direction.

This fact I discovered about a year ago while experimenting on the question of anode scrap as affected by resistance of alloys present in anode. Results of this investigation were given in a paper read at the Niagara Falls meeting of the American Electrochemical Society.

In this case I had a matte anode, an Acheson graphite cathode and a concentrated NaCl solution as electrolyte. Accidentally the circuit was closed so that the anode was cathode. As soon as the mistake was noticed, the current was changed, and when the voltage reached usual figure of 3.2 volts, the circuit was then broken and the usual depolarization curve taken. In this case, the voltmeter reading fell to 1.5 volts, then to zero and finally reversed until it gave a negative reading of 0.25 volt. This I thought showed that the films of caustic and acid imposed on electrodes, both of which were porous. caused the oscillations. It is analogous to the phenomenon described on page 144, Barker's "Physics"; "If a wire be kept twisted 90° to the right for six hours and then 90° to left for one hour, being allowed gradually to come to rest without oscillation, it will first turn slowly to the right, undoing the effect of the first twist, and then more slowly to the left, undoing the effect of the earlier twist."

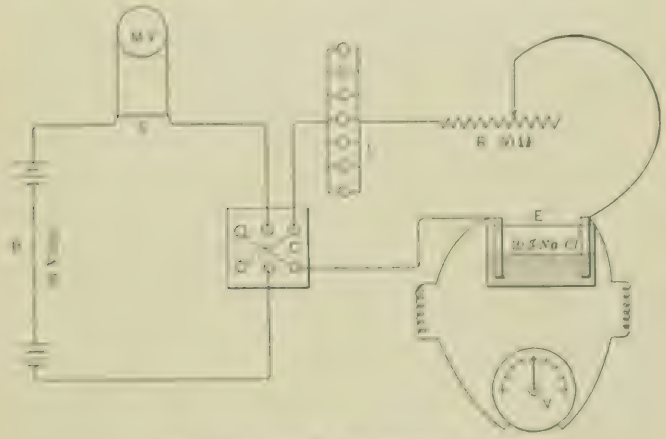


FIG. 1.—DIAGRAM OF CONNECTIONS.

In the past month, I have spent some time in studying this effect of "electrochemical oscillations." The apparatus is illustrated diagrammatically in Fig. 1. The source of current was a battery *B*, or 32 "chloride" cells of 120 ampere-hour capacity. The current was measured by a Weston shunt, *S*, and millivoltmeter, *M V*. The current was reversed by a commutator, *C*. A bank of lamps, *L*, and rheostat, *R*, enabled the current to be kept at a constant value, as the polarization voltage of the electrolytic cell was small as compared with the voltage of *B*. *V* was a dead-beat 3-volt, 135-ohm voltmeter made by Hartmann & Braun, which was quite convenient for taking depolarization curve as it read 3 volts right or left of the zero point. The electrodes were of 1.5-inch round Acheson graphite. The current density of all curves shown in connection with this paper was 10 amperes per square foot.

The method of procedure was first to short-circuit *E* until on open circuit no reading was seen on the voltmeter. The current was then passed for 40 seconds in one direction and then reversed. On breaking the circuit the reading of *V* was taken every five seconds at first and later every 20 seconds. As remarked above, the current was constant because the voltage of *B* was high in comparison with polarization voltage of *E*.

If the time of reversal-current is less than 22.5 seconds, the depolarization curve shows the reversal of the current. (See Fig. 3.) That is, the current first flows in one direction, undoing the effect of the second polarization, and then reverses, undoing the effect of the first polarization.

When the time of the first polarization is 40 seconds and the second 20, this reversal took place at 7 seconds after breaking circuit. When the time of the first was 40 seconds and the time of second 15 seconds, the reversal came in 3 seconds.

When the time of first reversal was 40 seconds and the time of the second was 22.5 seconds, there was no reversal, but the current sank

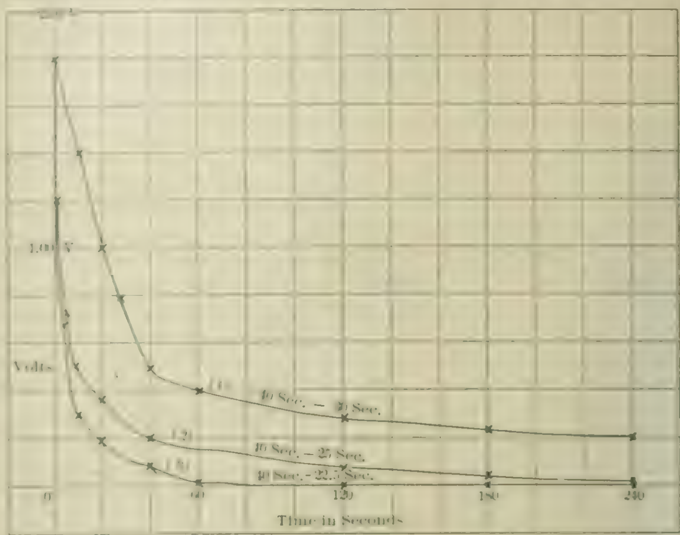


FIG. 2.—ELECTROCHEMICAL OSCILLATIONS.

gradually to zero. Curves 1, 2 and 3 of Fig. 2 show the effect of time of second polarization on the depolarization curve. Curves 4 and 5 of Fig. 3 show the oscillation from 1.5 volts to — 0.43 volt when the period of second polarization is short.

The oscillations depend quite largely on the nature of the electrodes. With metallic or non-porous electrodes, there is no such effect observed at low current densities. The greater the irreversibility of the electrochemical system, the greater is the tendency to oscillate on discharge. With metallic electrodes in an electrolyte of zinc sulphate and copper sulphate, at high current densities such an effect might be observed. The current density should be such that there is gasing at the anode but little at the cathode. We would then have "asymmetric action."

In the case of porous electrodes, there is imposed on the electrodes films of occluded gases. At the anode, for instance, there is chlorine in acid solution, in the pores of the electrode. When this is changed to the cathode, hydrogen in alkaline solution is formed first

FIG. 3.—ELECTROCHEMICAL OSCILLATIONS.

in that part of electrode, "electrically near" the copper leading wire, while "electrically remote," the chlorine in acid solution still exists. Between these two there exists local action, but the speed is not as fast as speed of depolarizing action, consequently, when the hydrogen is used up with the formation of HCl, there still remains some Cl in the acid solution in the outer pores of electrode. This is a very

weak solution and has therefore a low voltage. A corresponding action takes place at other electrode, and the voltage of reversal is only 0.43 volt. This appears to be the only explanation of the above facts that satisfies the experimental conditions.

In conclusion, I would like to express my thanks to Prof. Henry A. Perkins, of Trinity College, who allowed me the privileges of the Jarvis Physical Laboratory for this and other work.

Three-Phase Measurements.

By A. S. McAllister.

THE term "power factor," as applied to alternating-current phenomena, is variously defined as the "ratio of electric power in watts to volt amperes," as the "ratio of true to apparent power," as the "cosine of the time angle between the current and the e. m. f.," etc. In single-phase and in independent two-phase circuits or in any symmetrical and balanced polyphase circuit these terms are synonymous, but in interconnected polyphase circuits carrying unbalanced loads the power factor will have practically as many different values as there are terms by which it can be determined.

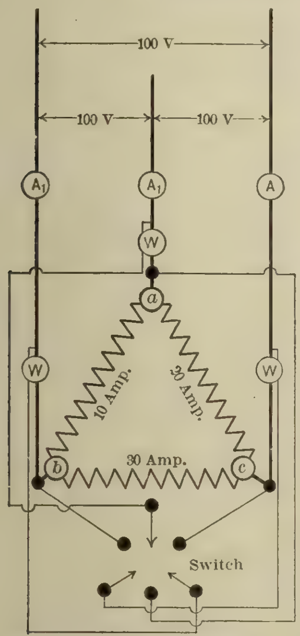


FIG. 1.—TESTING CIRCUITS.

Perhaps the most familiar example of circuits in which such discrepancies in results are found is the three-phase circuit operating on unbalanced loads. An exaggerated case of this kind, selected so as to emphasize the facts just stated, is shown below. In order that all disturbing influences, other than the unbalance of the load alone, may be eliminated from the problem, there has been assumed a non-inductive load supplied from a three-phase circuit having equal e.m.fs between leads.

Fig. 1 represents the circuits and load, and shows the connection of instruments for determining the power factor. As seen, an e.m.f. of 100 volts between leads and a delta-connected non-inductive load of 10, 20 and 30 amperes, respectively, per phase have been chosen. The true power is evidently 6,000 watts, while the power factor per phase is unity.

Referring to Fig. 2, which represents the value and position of the current per phase of the load indicated by Fig. 1, the value of current registered upon an ammeter at C and its relative phase position may be ascertained by making use of the geometrical figure *cdfe*. From the construction it is seen that the current at c is represented in value and phase by the line cf.

In the triangle *cef*, the side cf is equal to

$$(\overline{ce}^2 + \overline{ef}^2 + 2\,\overline{ce}\,.\,\overline{ef}\cos 120^0)^{\frac{1}{2}}$$

or is equal to

$$(\overline{ce}^2 + \overline{ce}\,\overline{ef} + \overline{ef}^2)^{\frac{1}{2}} = \sqrt{1900} = 43.60 \text{ and}$$

$$\sin\phi c = \sin 120^0\,\frac{\overline{eb}}{cf} = .866\,\frac{20.00}{43.60} = .3971$$

$$\phi c = 23°\ 24'.$$

Similarly the current at a is

$$(10^2 + 10.20 + \overline{20}^2)^{\frac{1}{2}} = \sqrt{700} = 26.45 \text{ and}$$

$$\sin\phi a = .866\,\frac{10.00}{26.45} = .3272$$

$$\phi b = 19°\ 6'.$$

Current at b is

$$(10^2 + 10.30 + 30^2)^{\frac{1}{2}} = \sqrt{1300} = 36.05 \text{ and}$$

$$\sin\phi b = .866\,\frac{10.00}{36.05} = .2402$$

$$\phi_b = 13°\ 54'.$$

It is convenient to adopt some method of designating at once each wattmeter and its connection in the circuit. Place, therefore, as subscript to the letter W, which is to represent the reading of each meter, the letters showing the points between which the voltage coil is connected, and place first that letter corresponding to the lead in which is the current coil of the wattmeter. Thus, *Wab* refers to wattmeter having its current coil in lead a and its voltage coil connected across between this lead and lead b.

Wattmeter *Wac* will record *Ia Eac Cos φac*, or

$$Wac = 26.45 \times 100 \times \cos 19°\ 6' = 2{,}500.$$
$$Wab = 26.45 \times 100 \times \cos 40°\ 54' = 2{,}000.$$
$$Wbc = 36.05 \times 100 \times \cos 13°\ 54' = 3{,}500.$$
$$Wba = 36.05 \times 100 \times \cos 46°\ 06' = 2{,}500.$$
$$Wcb = 43.60 \times 100 \times \cos 33°\ 24' = 4{,}000.$$
$$Wca = 43.60 \times 100 \times \cos 36°\ 36' = 3{,}500.$$

It is seen at once that the true value of watts is recorded in each case by the sum of the readings of any two wattmeters with their current coils in separate leads and their free pressure terminals connected to the third lead, thus $(Wac + Wbc) = (Wab + Wcb) = (Wba + Wca) = 6{,}000$, but that the true watts may not be indicated by one wattmeter which has its pressure coil free terminal transferred from first one and then the other remaining lead, thus

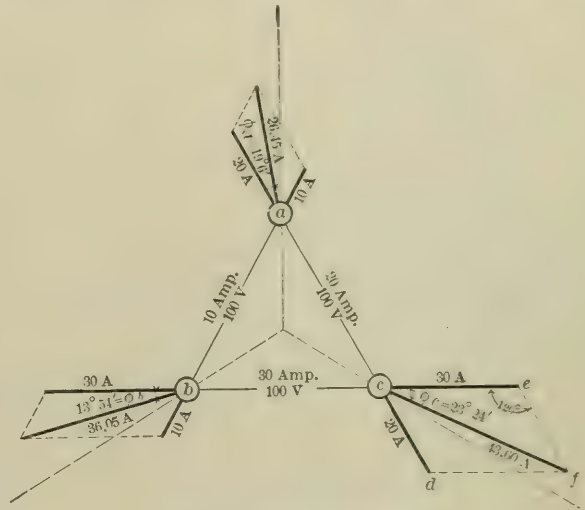


FIG. 2.—CURRENT DIAGRAM.

$(Wac + Wab) = 4{,}500$, $(Wbc + Wba) = 6{,}000$, $(Wcb + Wca) = 7{,}500$.

It has been advocated to determine the angle of lag and the power factor by the ratio of the readings of two wattmeters. That such a method does not give accurate results with unbalanced loads is well appreciated by all. For purpose of comparison, however, results determined by this method are here recorded:

$$\tan\Theta = \sqrt{3}\,\frac{Wbc - Wac}{Wbc + Wac} = \sqrt{3}\,\frac{1000}{6000} = .2886$$
$$\Theta = 16°\ 6'$$
$$\cos\Theta = .961$$

$$\tan\Theta = \sqrt{3}\,\frac{Wcb - Wab}{Wcb + Wab} = \sqrt{3}\,\frac{2000}{6000} = .5772$$
$$\Theta = 30°\ 0'$$
$$\cos\Theta = .866$$

$$\tan\Theta = \sqrt{3}\,\frac{Wca - Wba}{Wca + Wba} = \sqrt{3}\,\frac{1000}{6000} = .2886$$
$$\Theta = 16°\ 6'$$
$$\cos\Theta = .961$$

Since the load has been so selected as to be strictly non-inductive, it is evident that the lag angle indicated does not exist, and that the power factor obtained by this method is in error.

It is to be noted in this connection, however, that the angle of lag obtained by the same formula used above, but substituting the ratio of readings of one wattmeter when its pressure coil is transferred between the two leads, as mentioned above, has, in fact, a physical significance, as here shown:

$$\tan\Theta_a = \sqrt{3}\,\frac{Wac - Wab}{Wac + Wab} = \sqrt{3}\,\frac{500}{4500} = 1925$$
$$\Theta_a = 10^0\ 45'$$

An inspection of Fig. 2 will reveal the fact that this is the angle

between the current at a and the mean voltage between ab and ac, since 16° 54' = 30° − (13° + 6'). Similarly,

$$tan\ \theta_b = \sqrt{3}\ \frac{W_{cb} - W_{ca}}{W_{cb} + W_{ca}} = \sqrt{3}\ \frac{1000}{6000} = .2886$$

$$\theta_b = 16°.\ 6' = 30° - (13°.\ 54')$$

and again,

$$tan\ \theta_c = \sqrt{3}\ \frac{W_{ab} - W_{ca}}{W_{ab} + W_{ca}} = \sqrt{3}\ \frac{500}{7500} = .1155$$

$$\theta_c = 6°\ 36' = 30° - (23°\ 24')$$

A popular formula for determining the power factor of a three-phase load is

$$P.\ F. = \frac{W}{\sqrt{3}\ E\ I}$$

where I is the current per lead wire. Substituting the values found above for I, the power factor is

$$P.\ F._a = \frac{6000}{173.2 \times 43.60} = .795$$

$$P.\ F._b = \frac{6000}{173.2 \times 36.05} = .959$$

$$P.\ F._c = \frac{6000}{173.2 \times 26.45} = 1.309$$

$$P.\ F. = \frac{.795 + .959 + 1.309}{3} = 1.021$$

Using as a value for I the mean current per lead wire,

$$P.\ F. = \frac{6000}{173.2 \times 35.37} = .980$$

Several of the methods used above are obviously in great error, and their use would never be sanctioned in a careful test. Few objections, however, could be raised against the last two methods of averages, though neither gives the true result.

While as concerns the receiver, the power factor of the load is strictly unity, such cannot be considered true with reference to the transmission circuit.

Let R be the resistance of each line of the three-phase transmission circuit, then the copper loss in transmitting to the above receiver is

$$(36.05^2 + 43.60^2 + 26.45^2)\ R = 3,900\ R.$$

For a balanced load, 3,900 R watts would correspond to a load of $\sqrt{\frac{3900}{9}}$ = 20.81 amperes per coil. Hence the effective, non-inductive "power factor" may be taken as

$$\frac{20}{20.81} = .961$$

In the determination of the power factor as the ratio of true to apparent power, the question arises as to what constitutes the apparent power, and the discrepancies in results are due to the various answers which may be given to this question.

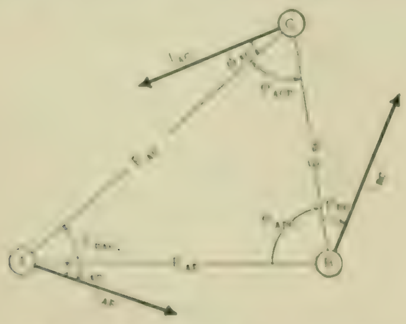


FIG. 3.—PHASE RELATION OF E. M. F. AND CURRENT.

While doubt must ever exist as to the value to be assigned to the apparent power in a three-phase system operating on an unbalanced load, the method in common use for determining the true power is correct for any condition of load, proportion of e. m. fs or relation of power factor of currents, though the methods of proof of this fact, which are based on assumptions of equal currents, equal power factors, or of equal e. m. fs. per phase, are evidently open to many objections. A simple semigraphical proof of the correctness of the two wattmeter methods of measuring power in a three-phase circuit under any condition of service is offered below.

In Fig. 3, let the sides of the triangle ABC represent the relative values and phase positions of the three e. m. fs. of an unsymmetrical three-phase system. Assume the receiver to be delta connected, and let I_{AB} be the current in coil AB, and θ_{AB} be the angle of lag of this current with respect to the e. m. f. of the coil. Similarly, let I_{BC} and I_{AC} represent the value and phase position of the currents in coils BC and AC. No restriction is made as to the values of currents, e. m. fs. or as to the several lag angles.

Let a wattmeter be connected with its current coil in lead at A, and its e. m. f. coil across between this lead and lead C. Also a wattmeter at B, with pressure coil between B and C. Each wattmeter will show a deflection, which may be represented by $W = EI\ Cos\ \theta$, where I is the amperes in the current coil, E is the volts across the e. m. f. coil, and θ is the angle between this e. m. f. and the current I.

For sake of simplicity in explanation, assume, in the first place, the current flowing in coil AB to be absent while measurements are made upon the watts supplied to the other coils, as indicated by Fig.

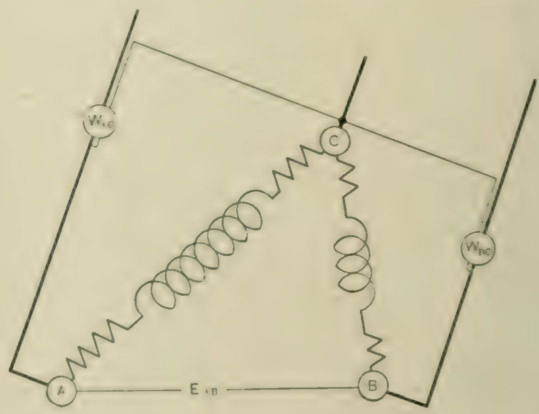


FIG. 4.—MEASURING POWER IN COILS AC AND CB.

4. Evidently the sum of the readings of the meters as connected gives the watts in the two remaining coils, since each meter is connected as though measuring power in a single-phase circuit. Now assume, in the second place, the current to flow in coil AB alone while the currents in the other two coils are absent, as shown by Fig. 5. According to proof given below, the wattmeters as connected now register as their sum the true watts supplied to coil AB. When all three currents flow simultaneously, each wattmeter will show a deflection equal to the sum of its two previous readings, since its

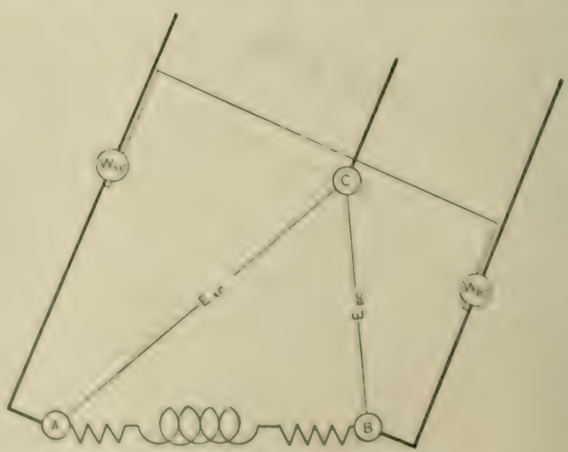


FIG. 5.—MEASURING POWER IN COIL AB.

e. m. f. coil has undergone no change in connection and the two currents causing the former deflections are now superposed or the true energy transferred will be properly recorded by the two meters.

Two wattmeters having their current coils in series with a given single-phase load, and one terminal of the e. m. f. coil of each meter connected to the opposite leads of the circuit supplying power to the load and the other two free terminals connected together and placed at any point of any relative potential compared with that of

the load, as depicted in Fig. 5, will give the true value of energy transmitted.

In Fig. 6, let E_{AB} be the e. m. f. across the load, I_{AB} be the load current and θ_{AB} be the angle between I_{AB} and E_{AB}. Evidently, the watts transmitted are

$$W_{AB} = E_{AB} I_{AB} \cos \theta_{AB}.$$

Now assume a wattmeter connected at A to C. Its reading will be

$$W_{AC} = E_{AC} I_{AB} \cos \theta_{AC}.$$

A wattmeter at B to C will read

$$W_{BC} = E_{BC} I_{AB} \cos \theta_{BC}.$$

From Fig. 6,

$$E_{AB} \cos \theta_{AB} = A F.$$
$$E_{AC} \cos \theta_{AC} = A E.$$
$$E_{BC} \cos \theta_{BC} = B D = E F.$$

and since $AF = AE + EF$,

$$I_{AB} (E_{AC} \cos \theta_{AC} + E_{BC} \cos \theta_{BC}) = I_{AB} E_{AB} \cos \theta_{AB}$$
or $$W_{AC} + W_{BC} = W_{AB}$$

and this value is independent of the position of the point C.

In consequence of this fact, $P-1$ wattmeters may be used to determine the true power in any P—phase system, however unsymmetrical may be the phase relations, provided the free terminals of the e. m. f. coil of each meter be connected to that lead in which no wattmeter is placed.

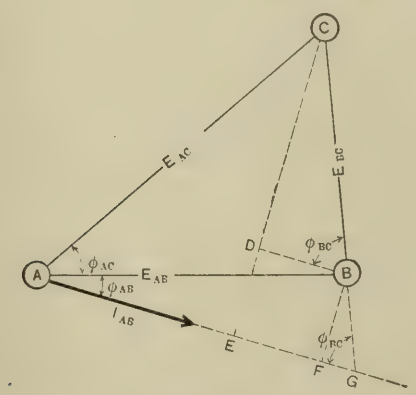


FIG. 6.—GRAPHICAL PROOF FOR FIG. 5.

Operation of Alternators in Parallel.

At the November meeting of the Société International des Electriciens, M. de Marchena read a paper on the speed regulation of alternators running in parallel. According to the author of the paper, parallel running of alternators is very greatly influenced by the regulator action, a fact which has been generally overlooked by preceding writers, at all events, in France, who have given rather too much importance to the question of irregularity during one revolution of the flywheel.

According to M. de Marchena the frequency of pulsating motive power is too high compared with the frequency of the oscillations proper of the alternator for permitting angles of displacement between alternators to attain to a dangerous value. On the contrary, the irregularities of motive power arising from instability of the regulator are liable to produce very considerable displacements, resulting in dephasing or breaking down of alternators.

The author examines the laws which govern centrifugal regulators and particularly the relations which exist between the positions of equilibrium of the regulator sleeve and the variations of speed produced by variations of the force acting on the regulator. He considered the oscillations of the system composed of the governor and flywheel, and the frequency of the first oscillations, that is, the oscillations of the governor; also the influence of the damping effect and the conditions to fulfil for a given damping effect to prevent oscillations of the second class; that is, of the regulator and the flywheel from taking place.

The author gave a formula giving the momentum weight of flywheel to be used for a given work of a governor. He examined afterwards the working conditions of the regulator when the alternator is connected with a network. He showed that the pendulum motions and greatly variable frequencies produced through irregularities of motive power or by the quick fluctuations of load, give rise in the regulator action to oscillations, the amplitude of which depend upon the oscillations proper of this governor, as well as on its damping effect.

He examined in each case the conditions of resonance which may be obtained, and the consequences. In order to obviate these inconveniences, it has, up till now, been the endeavor to realize a very strong damping effect—at least temporarily, for the time corresponding to these abnormal conditions. M. de Marchena approved of Mr. Emmet's arrangement of dash-pot, which he thinks can sometimes give good results. He, however, estimates that it is a more rational solution of the difficulty to entirely suppress the cause of these oscillations by making the governor independent of the influence of the pendulum motions of the alternator.

He, therefore, proposed to run the regulator not by the machine itself, but by the use of an induction motor connected to the network. This motor not depending on individual oscillations of the machine, will not change its speed, and will only act on the regulator when the frequency of the network is modified.

The writer cited a test made with this system in a large hydraulic generating station in the Nice district, including turbines of 1,000 hp each. Special dispositions are employed for avoiding the troubles liable to result from accidental stopping of the motor. The first series of tests gave incomplete results on account of the excessive slip of the induction motor, which was too small. A new series of tests were made, however, with a larger motor, and the results are stated to have been entirely satisfactory. The pendulum motions which were experienced at first entirely disappeared.

It is anticipated that this system is likely to be of general use, and the author expects it to be shortly employed for facilitating parallel running of stations separated by long distances.

Electric Light in Canada.

Mr. George Johnson, of Ottawa, the Dominion statistician, has revised his statistics for publication in respect to the use of electricity for lighting purposes. He shows that the number of companies doing business in electricity, in connection with lighting, has increased from 259 in 1898 to 312 in 1902. The number of arc lights increased from 10,389 to 12,884 during the same period. The incandescent lamps number 995,056, making an increase of 179,380 lamps over last year and 531,441 over the year 1898. Reckoning each arc lamp as equal to ten incandescents, the use of electricity as a light giver, has developed in Canada during the past four years from 565,505 lamps in 1898 to 1,125,896 in 1902.

Of the total 312 companies, Ontario has 195, or 62½ per cent. Ontario cities, towns and villages avail themselves of electricity, as a light bearer, to a much greater extent than the other provinces. There are over 110 of these communities in which electricity is used for lighting, and of these more than a score operate their own lighting establishments. Several cities and towns have more than one plant.

Quebec Province has 3,605 arcs and 340,120 incandescents, or reduced to the standard of incandescents, a total of 376,170 lights, an increase of 218,979 in four years, but of this total the city of Montreal has 208,718. In the whole province there are 52 plants. Nova Scotia's equipment of 409 arcs and 46,475 incandescents, equal to 50,565 incandescents, is distributed among 22 cities and towns, and is supplied by 24 companies. New Brunswick is supplied with the electric light by 11 companies and municipalities. Prince Edward Island's modest share in the total of Canada is three electric light companies with 87 arcs and 11,300 incandescents. Manitoba has six plants, distributing light by 53 arc and 26,635 incandescents; the territories, five plants with 31 arc and 6,081 incandescents, and British Columbia, 16 plants with 770 arcs and 85,135 incandescents.

The Use and Advantages of the Alternating Current for Land Telegraphy—VI.

(Concluded.)

By [illegible]

REFERRING to Fig. 32, page [illegible], when the operator wishes to transmit a signal he may depress the key K, when the trailer t is at any part of its revolution. If the key were to be depressed when the trailer was leaving segment No. 1 and raised again before the trailer returned to this segment, no half wave would be reversed. This,. however, cannot be done, as the trailer revolves at so great a speed that it will make more than one revolution before the hand, having depressed the key, can allow it to raise again. Suppose in transmitting a series of dots, the key is depressed for equal intervals of time, and with equal intervals separating each depression, it does not follow that the dots as received will be of equal duration and equally separated from one another. This will be made clear by referring to Fig. 34, which shows how the letter X, which consists of — ——— — —, may be sent and received.

In row A it is assumed that for transmitting a dot, the transmitting key is depressed for a time equal to 5½ half waves of the current, and twice this time for a short dash. The waves marked I are the only ones which can be modified, as these are the ones which correspond to the passing of the trailer t, Fig. 32, over segment No. 1. The lines drawn under the diagram of the waves have lengths proportional to the times during which the transmitting key is depressed. The half waves will be reversed as indicated in row A, which represents the state of affairs at the transmitting end. At the receiving end the current will be flattened out, somewhat in the manner indicated in row B, when the half waves have been reversed. The lines under the diagram of the waves, row B, show by their length the intervals that the receiving relay, R^1, Fig. 33, is against contact k, that is, they show how the dots and dash of the letter X would appear if received on tape. It will be seen that the first and third dot has been shortened. The dash has been lengthened a little. Now by studying the diagrams here presented it will be made evident that the percentage difference that may occur in the interval of a dot or a dash as transmitted and as received will grow less and less as the number of half waves which correspond to a dot or a dash become greater. Rows C and D show the letter X as transmitted and received when a dot corresponds to 7 half waves. The second dot as received is still only half as long as the first and the third, but D is easier to read than B. Rows E and F show the same letter as transmitted and received when a dot corresponds in duration to the time of 8½ half waves.

Here the inequalities have nearly disappeared and row F is perfectly easy to read. Row G shows the positions of the tongue of the main line relay R, Fig. 33, corresponding to each half wave of the current during the time that the letter X is being received. If the alternating current has a frequency of 104 periods per second, or 208 alternations per second, then rows E and F represent very brief intervals and will correspond to a speed of transmission of about 40 words per minute per operator. This is calculated thus: There are on the average six elements of the Morse code for each letter. If a dot is made equal to 8½ half waves, then about 52 half waves must pass over the line to transmit a single letter. If there are 208 half waves or alternations per second, then four letters can be transmitted per second, or 240 per minute. If five letters and one space is allowed per word, then 40 words per minute can be transmitted by a single operator, provided he has the skill to manipulate the key so rapidly. As shown by rows E and F, of Fig. 34, the signals as received will have practically the same form as the signals sent, and as previously explained, and as indicated in row G, showing the position of the line relay tongue, there will be no harmful influence on the sharpness of the signals, in the case of long lines, due to a "tailing out" or running together of the waves.

The principles, explained above, by which a single operator can transmit Morse signals in one direction, are readily extended to multiplex, duplex transmission. The essential connections for octoplex transmission, are given for a station at one end of the line in Fig. 35.

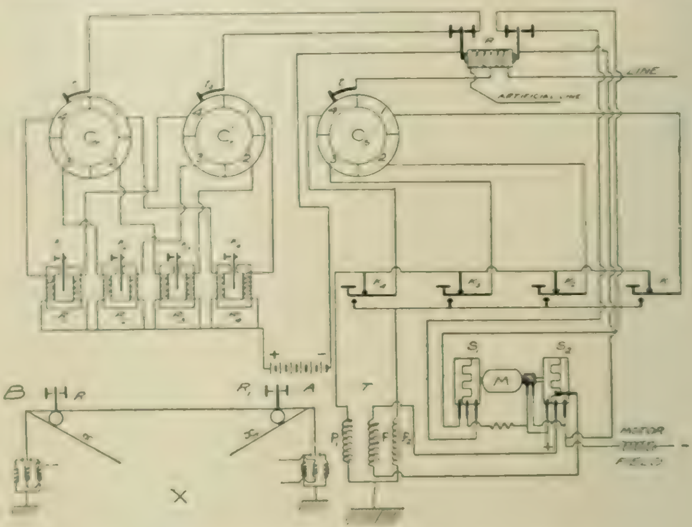


FIG. 35.—CONNECTIONS FOR OCTOPLEX TRANSMISSION.

At the other end of the line the motor which supplies the power to drive the trailers and which furnishes an alternating current by rotating a commutating device, is run at a fairly steady and independent speed. Motor M, shown diagrammatically in Fig. 35, is run in synchronism by any suitable method. The method here shown is the one described above as method No. 3.

We will hereafter designate the stations at the two ends of the line as station A and station B, the motor at station B being run in synchronism with the motor at station A. It is station B that is shown in Fig. 35. All the trailers at a station are mechanically connected to the motor at that station. Thus the trailers, t_1, t_2 and t, also the commutators S_1 and S_2, rotate with the shaft of the motor M. Hence if the motor M runs in synchronism with the motor at station A, all the apparatus at station B will likewise run in synchronism with the apparatus at station A. The line is shown du-

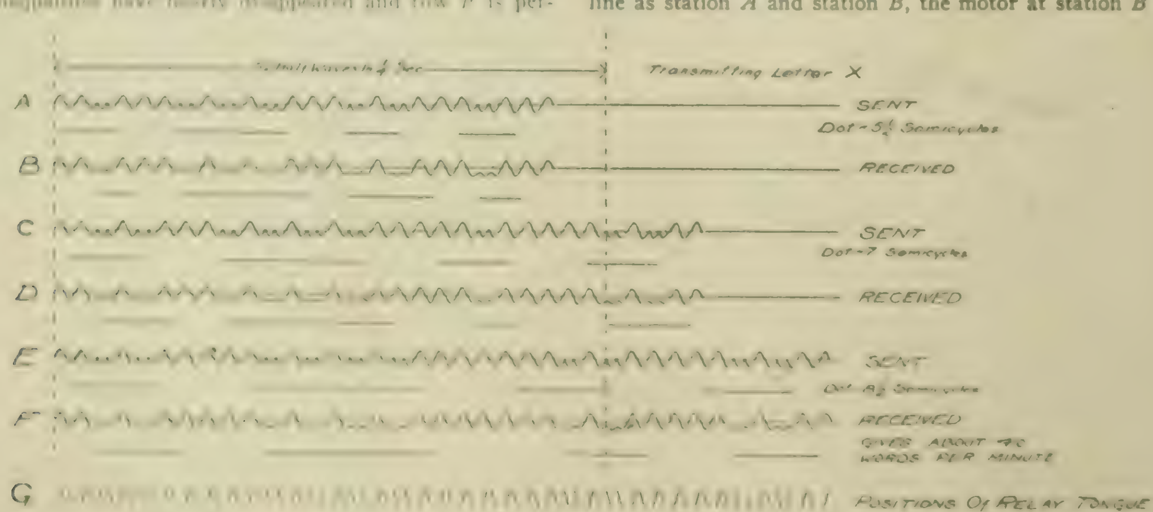


FIG. 34.—TRANSMITTING AND RECEIVING LETTER "X."

plexed. The relay R of station B and R_1 of station A (see Fig. 35) are differentially wound and one of their coils is connected to an artificial line and one to the real line.

C_s is a transmitting or sending sunflower of four segments and C_r and $C_r{}^1$ are two sections of a receiving sunflower. R_1, R_2, R_3 and R_4 are receiving relays, which possibly might be used as four sounders. If not so used the four sounders or tape recorders could be operated by the contacts k_1, k_2, k_3 and k_4. T is a transformer which furnishes the line current from its coils P_1 or P_2. K_1, K_2, K_3 and K_4 are four transmitter keys.

In transmitting each of these keys may be operated at the same time, and at any time. It will be evident by referring to the connections shown in Fig. 35, that a person operating Key K_1 can only reverse the half waves 1, 5, 9, 13, etc., that a person operating K_2 can only reverse the half waves 2, 6, 10, 14, etc., and so for key K_3 the half waves 3, 7, etc., and for key K_4 the half waves 4, 8, etc. Hence each operator in transmitting is absolutely independent of the other operators. The receiving of the signals is primarily on the main line relay R at station B and R_1 at station A, and secondarily on the relays R_1, R_2, R_3 and R_4 at station B, and on a similar set at station A.

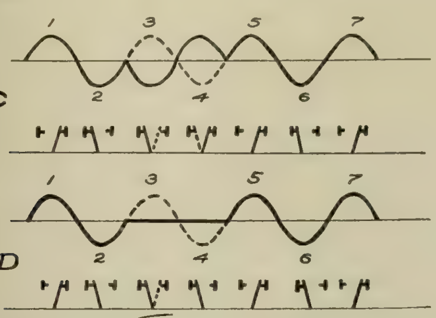


FIG. 36.—EFFECT OF CUTTING OUT HALF WAVES.

An examination of the connections will show that the receiving relays operate independently of one another. To make this plain, however, it must be shown that the relay R is active in effecting two of the relays such as R_1 and R_2, when two *adjacent* half waves are reversed by two operators at station A. If adjacent half waves were cut out instead of reversed, the second half wave cut out would not affect a receiving relay.

Referring to C, Fig. 36, the half waves 3 and 4 are shown reversed, the dotted lines giving their unmodified forms. The corresponding actual positions of the main line relay tongue are shown below in full lines, the positions the tongue would have had, if the half waves had not been modified, are shown in dotted lines. It is seen that reversing the two adjacent half waves 3 and 4 makes two reversals in the positions of the main line relay tongue. In D the half waves 3 and 4 are shown cut out.

Cutting out wave 3 leaves the relay tongue where it was carried by wave 2, and hence in a position the opposite of what it would have had if the half wave had not been cut out. But cutting out the half wave No. 4 still leaves the tongue in the same position it would have had, had the half wave No. 4 not been cut out. Hence we conclude that where adjacent half waves are to be modified it is not sufficient to cut them out, they must be reversed.

Fig. 37 has been prepared to show the modifications that would likely be produced in the line current at the sending end, if at approximately the same time operator A sent the Morse signals for the letter X, operator B the signals for H, operator C the signals for L, and operator D the signals for J. Rows A, B, C and D show the effects produced individually by each operator, and row Y shows the resulting form that the line current would take.

The lines under rows A, B, C and D represent by their spacing and length the moments when the keys are depressed and the time that they are kept depressed in sending the dots and dashes. The four rows of lines X, H, L, and J, under the row Y, representing the resultant modified alternating current, represent by the spacing and length the dots and dashes as they would be received. It is seen that they are not exact reproductions of the dots and dashes as sent, but they are not so different as to make their interpretation at all obscure. It is highly probable that in practice the duration of a dot would be considerable greater than 8½ semi-cycles of the alternating current as represented in Fig. 29, in which case the dots and dashes as received would be much more nearly like the dots and dashes as sent.

It might be supposed that when so many of the half waves are reversed that the synchronism would be destroyed. Practical experiments have been made by the writer which have proved that a very large percentage of the half waves can be modified without destroying the synchronism. Modifying 1-5th of the half waves will produce no visible fluctuations in the steadiness of the synchronism, and a much larger proportion than this can be modified without throwing the apparatus out of synchronism. Of the semicycles represented in Fig. 37, about one-half have been modified, but in the regular course of transmitting so large a proportion as this would not be modified except for brief periods, which would not destroy the synchronism. If, however, any difficulty should be experienced in maintaining the synchronism when a large number of half waves are being modified it is a simple matter to arrange to have a certain fixed number of semicycles used exclusively for the purpose of synchronism. When the apparatus at station B, Fig. 35, comes into synchronism, after being started from rest, there is only one chance in four that the trailers on the receiving commutator will be on a segment of the same number as the trailers of the sending commutator. This being the case it becomes necessary to arrange a device which will allow the trailers of the receiving commutator to slip back, one segment at a time until they rest upon the same numbered segment as the trailers of the sending commutator, or for each operator, after synchronism is established,

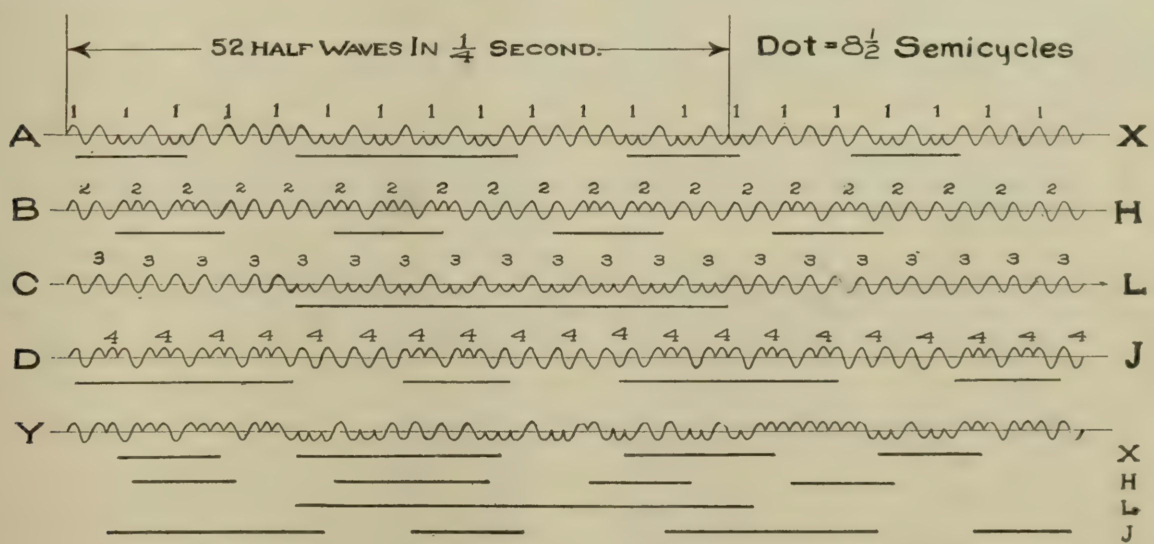


FIG. 37.—EFFECT OF SIMULTANEOUS TRANSMISSION OF DIFFERENT CHARACTERS.

to switch his receiving relay to a segment of the receiving commutator which will correspond to the sender he wishes to receive from. Either one of the above arrangements is easily made and does not need to be described in detail.

It has been shown how, by means of the alternating current, eight messages in the form of Morse signals can be sent over a long line at the same time. The number of messages, however, is not at all limited to eight. For lines of moderate length the frequency of the line current may be doubled, in which case sixteen messages could be simultaneously transmitted as easily as eight. In fact, the system is exceedingly flexible and capable of immense developments. It is, however, not my intention to specify in this article, the details of the above or any other system of telegraphy. In another part of this article it was shown how signals could be made to consist of combinations of modified half waves. Special methods have been fully worked out for receiving the signals so produced and then automatically translating them into printed characters. These methods are mostly due to Professor Rowland. They are exceedingly ingenious and practical, and have all been tested by operating on actual telegraph lines. An account of these methods, though it would be exceedingly interesting, would lead us into long detailed and special descriptions. The methods are mostly described in patent reports on Rowland's Multiplex Printing Telegraph System, to which the reader is again referred.

It would be interesting and valuable to consider the many questions of scientific and practical interest which are suggested when one has once entered upon the field of alternating-current telegraphy. But the writer must, for the time, drop the subject here.

It would be easy to allow the imagination to picture the future possibilities of synchronous alternating-current telegraphy. One sees the whole country run in synchronism and long messages dictated to typewriters and transmitted almost as cheaply as the mails are carried, and received as printed pages. Automatic typesetting machines in numerous cities are operated by a single keyboard from a central news distributing centre. Architects and engineers send diagrams and sketches by telegraph as readily as they now do by mail. Private lines run from all large business offices, and a swift, secret and cheap public telegraphic service replaces the present antiquated, slow and expensive system. But the writer does not address himself to the public imagination, but to the younger generation of scientifically trained electrical engineers who are working hard for better things. He believes that through them will come finally such a clear perception of how easy it is to beat the methods of telegraphy now used, and so stoutly defended by the representatives of the great telegraph companies, that the same rapid progress will come in the field of telegraphy that is seen in all other branches of electrical industry.

Electricity in Manila.

The Philippine Commission has passed an act providing for the granting of a franchise to construct an electric railway in Manila and suburbs, and a franchise to construct and operate a central station. The Municipal Board is empowered to grant the above franchises to the party making the most favorable bid, the bids to be received before March 5, 1903, at the office of the Municipal Board in Manila. Though a city of 300,000 inhabitants, and where the most lowly ride, there are no transportation facilities at present worthy of the name. The present horse railway is entirely inefficient, and transportation at present is almost entirely effected by about 20,000 one-horse two-wheel public vehicles called "caromatas." The present electric light plant is practically loaded up to its capacity, and it is charged that the company refuses to increase its facilities. The charges at present are $1.50 gold monthly for each incandescent light. There is a meter rate, but this is claimed to be about 75 per cent higher than the flat rate. Moreover, the company refuses to connect up installations when the wiring has been done by others than themselves, even after being approved by the city authorities. It is charged that the telephone company is similarly inefficient, with the result that there are only about 400 subscribers in the whole city, while it is believed that 5,000 could be obtained if a telephone plant were established under enterprising management.

Chicago Meeting of the American Institute of Electrical Engineers.

A meeting of the local members of the American Institute of Electrical Engineers was held at the rooms of the Western Society of Engineers in the Monadnock Block, Chicago, on the evening of December 2. From the spirit shown at that meeting, it would appear that the Chicago branch is about to enter into a new era of activity and interest, and that the local meetings there, which have heretofore been held irregularly and with uncertain attendance, will hereafter be held with certainty and well attended. In spite of most discouraging weather, the attendance was good, both in quantity and quality, forty-seven being present.

Before commencing the discussion of papers a session was held for the transaction of business, looking toward the establishment of a local branch of the Institute on a more permanent basis than heretofore. Local honorary secretary, R. H. Pierce, called the meeting to order and made a few explanatory remarks regarding the recent policy adopted by the Institute as regards local meetings. He stated that heretofore the reason for the lack of interest and attendance in the Chicago branch of the Institute was due to three things: In the first place, it was frequently the case that the papers to be read did not reach the members until the time of meeting, so that there was no opportunity to look them over and come prepared for a discussion. In the second place, the papers were frequently on subjects in which there were but few Chicago members interested, sometimes being too abstract and mathematical, or on some special branch of the art which but one or two members would feel competent to discuss. In the third place, the discussions were supposed to be confined to the papers read, and if the papers read did not appeal to many of the members, there was sure to be a lack of interest. These objections, however, Mr. Pierce said, were being removed by the present methods of the Institute. As regards getting the papers on time, in advance of the meeting, he was convinced that the proper course was to hold the Chicago meetings after those in New York. There would then be a certainty that the papers would be on hand before the meetings. As regards the nature of the papers presented, it was evident that this year the papers were of more general interest, and of a nature that could be discussed by a larger percentage of the membership than heretofore. This in itself would insure a larger attendance and better discussion at the meetings. It was further intended that the local organization should take up matters of local interest, if the papers were not of a nature which would require the full time of the meeting for their discussion.

It was voted to appoint a committee of seven, with the local honorary secretary an ex-officio member, this committee to have charge of matters pertaining to the local organization, and especially to look after the attendance. The committee appointed consists of G. A. Damon, of the Arnold Electric Power Station Company; Peter Junkersfeldt, of the Chicago Edison Company; James Lyman, of the General Electric Company; H. H. Wait, of the Western Electric Company; A. S. Hibbard, of the Chicago Telephone Company; K. B. Miller, of the Kellogg Switchboard and Supply Company, and J. R. Cravath, of ELECTRICAL WORLD AND ENGINEER.

After the reading of the papers on variable electric speed control, which were presented at New York November 21, an interesting discussion was taken part in by various members.

B. J. Arnold brought out the point that, while the direct driving of every machine tool in a shop was ideal in some respects, the investment called for with this practice was in many cases so great that the interest more than counterbalanced the saving in power due to the use of electric drive as against shafting. As a matter of actual practice, when it came to the equipment of a machine shop having a large number of small tools, true economy lay in grouping these machine tools on short sections of a line shaft, each section to be driven by an electric motor. The capacity of motors required by the grouping system would be but a small fraction of the total motor capacity required if each tool had its individual motor. In regard to equipment of trunk-line steam roads with electricity, as suggested in the paper of H. Ward Leonard, he did not wish to advocate any one system as against another, but he did wish to emphasize the ab-

solute necessity of doing away with substations with rotary converters in such work. His investigation of steam railroad trunk-line service recently, had convinced him thoroughly that it was absolutely useless to think of equipping steam trunk lines with a system requiring rotary converter substations. The investment in substation machinery to take care of the enormously fluctuating loads which would be thrown upon it by heavy trunk-line trains, and the attendance required at these substations would make the cost of operation prohibitive. Some system must be evolved to eliminate the rotary converter substations.

George B. Foster pointed out that where machine tools were electrically driven from individual motors the saving by the use of electric drive lay, not in the elimination of line-shaft losses, but in the ability to regulate the speed of large machine tools more accurately, to work it to its full capacity, and to get more work from a machine and its attendant. Where this was so, the question of the extra investment was a minor consideration.

Mr. Arnold, in explanation of his previous remarks, said that he indorsed the truth of Mr. Foster's statement that in some cases the greater output obtained from a machine tool by having it direct driven, overweighed all other considerations, and threw the balance in favor of the direct-driven tool, even if the interest on the investment more than wiped out any saving due to line-shaft losses. In previous remarks he had referred more especially to small machine shops, doing miscellaneous work. In a large manufacturing plant, with large machine tools, where it was important to drive each one at its maximum capacity, there was no question but that direct driving was the thing.

E. Gonzenbach referred to a concrete case which he had occasion to figure upon recently. This was the shop equipment of the Aurora, Elgin & Chicago Railway. For this shop, about $6,500 worth of machine tools were to be put in. To drive each one of these directly by an individual motor would have called for the investment of $4,000 in motors. The aggregate motor capacity for such direct driving would have been 35 hp. By grouping these tools on two line shafts, he was able to cut the motor capacity to two 5-hp motors. Of course, this was not a manufacturing plant, but only a small plant for general repairs on an interurban electric road. Referring to Mr. Arnold's remarks as to the cost of operating a steam trunk line electrically, with rotary converter substations, he indorsed Mr. Arnold's views, and referred to the present difficulty of getting competent men to take charge of substations. The substation attendant, being alone, was dependent entirely upon his own resources in times of trouble. For this reason his position was even more responsible than that of the ordinary attendant in the main power house, because in the power house there is usually a chief engineer to look to. At the present time there seemed to be a dearth of competent substation attendants, except at very high prices. On a road operating heavy trains from rotary converter substations, it is very important to avoid bunching of trains, if the investment in substations is to be kept down to a reasonable point. Even with the short trains, on the Aurora, Elgin & Chicago Railway, the substations had a capacity of 6,000 kw, while the main power station had a capacity of only 3,000 kw, the extra capacity in substations being required simply because of the occasional bunching of trains on the road.

Mr. Arnold said that he considered a fair average for locomotive repairs was 4.1 cents per locomotive mile.

Professor D. C. Jackson summed up the situation in regard to machine tool driving by individual motors as against the grouping system, by saying that the selection of an electric shop equipment was a matter of engineering common sense. If there were a lot of miscellaneous tools operating intermittently, the sensible thing to do was to group them into sections on line shafts, these sections to be driven by motors. In this way the investment in motors would be kept down, and the line-shaft losses would not be excessive. On the other hand, for large tools in a manufacturing establishment, direct driving with provisions for varying the speed to suit exactly the work to be performed on a machine, was the most economical, because of the greater output obtained from the machine tools.

H. H. Cutler criticised the Leonard system of variable speed control, not only on account of the cost and complication, but because it is sluggish in acceleration. It was impossible, he said, to vary the shunt field of the generator on the motor-generator used with sufficient rapidity to make quick acceleration, and this was what was wanted in coal hoisting and many other classes of work. He advocated for this a plain series motor, with rheostat in the circuit.

The paper by Mr. Lozier, he said, emphasized the increase in output with independently driven tools on a multi-voltage, but this was not by any means peculiar to the multiple voltage system. He was in favor of omitting all complication incidental to the multiple voltage system, and leaving the motor alone to run at its normal speed and best efficiency, obtaining the changes in speed of the tool by the use of gears. Reduction in the speed of a motor while requiring from it the same output, meant an enormous increase in the size of the motors required. Something could be learned, he thought, from gasoline automobile makers, who produce a motor of minimum weight and cost, and obtain a variable speed by means of gears. Fine adjustments of speed could be obtained at any gear ratio by a variation of the field strength of the motor. Such variation, to the amount of 15 per cent, could easily be obtained. For driving fast newspaper presses he advocated a double-motor equipment, one small motor with slow speed gear for threading in the paper, and a large motor for operating at full speed.

In response to a question as to whether the cost of gearing to secure variable speed by mechanical means was not greater than the extra cost of electric motors required for wide variation in speed control, he thought that the cost was certainly in favor of the gears. He cited cases where, with a mutliple voltage system, motors six times as large as would have been necessary with mechanical speed control were required to operate a certain tool at slow speeds. In regard to the cost of gears, Mr. Arnold thought that for new tools where the gears were made a part of the tool, that the gears would probably be cheaper than the additional cost of motors and equipments for variable speed by electrical means. For old tools, for which gears would have to be specially adapted, the extra motor capacity and equipment might be the cheaper.

Mr. George A. Damon, in a communication after meeting, said that there was no doubt but that the individual motor was gaining favor, as the advantages of its use became more generally understood, and as investors began to appreciate the dividend-earning capacities of investment in electric-drive equipment. It would be instructive to determine under what circumstances a separate motor on each machine would be justifiable. If the shop was to have an entirely new equipment of tools, the use of a separate motor for each machine should be carefully considered. Nearly all tool builders are now accommodating their products to driving by an individual motor. With the higher cutting speed made possible with the individual drive, and with the deeper cuts allowed in new steel and other materials, it did not seem unreasonable to expect the new tool, which has been designed with these conditions in view, to have an output at least 50 per cent. greater than a tool for the same class of work than the former belt-driven type. But it often happened that the shop tool equipment includes a number of tools which have already been used in an old shop, and which were poorly adapted to direct connection to individual motors. To put an individual motor on each lathe would sometimes require at least six times greater investment than to drive a group from a line shaft.

The tendency at present seemed to be to arrange the old belt-driven tools in groups, allowing a ten to twenty hp motor for each group. If the shop was to be run on a piece-work or premium system of compensation for its mechanics, then the use of elaborate systems of speed control might be justified. If each operator had a constant incentive to keep the output of his machine up to its full capacity, and it were possible to vary the output by changing the speed by easy steps, through a wide range, then the efficient results attained through the operation of the tool at all times, at highest permissible speed, might make the question of extra investment insignificant. On the other hand, there were situations in which an easy method of controlling the speed may be a disadvantage. For a large printing establishment it was once found necessary to design a device to lock the speed controllers, so that if the press was run at all it was operated at a different speed, which speed was determined by the foreman for each job. This way it was made impossible for the feeders to loaf. This incident emphasizes the idea that if full advantage is to be taken of electrical control, the operators should also be worked up to their highest efficiency.

Telephone Cables—II.

By [illegible]

[illegible]

ONLY the electrical properties of [illegible] received attention, but certain mechanical characteristics are essential to permit of installation and to preserve the cable in working order. The integrity of the cable depends on the integrity of the sheath, which must be of sufficient strength to withstand without rupture all the manipulation necessary to transportation and erection.

The thickness of the lead sheath varies slightly with different makers, but experience has shown that for 25 pair and less, 1-16 inch is sufficient, from 25 pair to 50 pair 5-64 inch, from 50 pair to 150 pair 3 3-2 inches, and over 150 pair ⅛ inch. To economize weight aerial cables are usually made of slightly thinner sheath than underground, and of No. 20 gauge instead of No. 19.

Early cables were supplied with sheaths of pure lead, but frequent corrosion was experienced, to obviate which an alloy of about 3 per cent tin was substituted, or a subsequent wash of pure tin was applied, after the wire was enclosed in the pipe, by drawing the completed cable through a bath of melted tin. Of the two processes, the lead-tin alloy yields the most desirable results in the ducts, though with it is somewhat more difficult to secure a sheath absolutely free from pinholes and cracks. The addition of the tin has been found so beneficial that little cable is now made without it. Cable of No. 19 gauge is somewhat easier to splice than that made of smaller wire, chiefly because there has been much experience with this size, and cable makers know exactly how to handle it, so with small gauges greater care must be exercised till more experience is gained. The strength of the cable is limited to that of the lead pipe, for the loose core of paper-covered wire possesses no resistance in any direction. Much care is therefore essential in handling so fragile a structure as a 2½-inch lead pipe, ⅛ inch in thickness, and several hundred feet in length. When placed on reels if too long lengths are used the inner layers are crushed by the weight or tension of the exterior ones. A sudden or sharp bend will produce a kink in the sheath that flattens the contained circuits together, and is likely to rupture the paper and produce a lot of "shorts," or even may develop a crack in the lead that will pass undetected until the entrance of moisture causes the entire cable to utterly fail.

In erecting cable, either aerial or underground, the cable should be drawn off the reel directly into place ,and not pulled over rough pavements or gravelly roads, where injury to the sheath is almost inevitable. It is claimed that the sheath of cable so placed as to be exposed to constant vibration (on bridges, for example) will gradually crystallize and rapidly deteriorate to a point of no longer affording protection to the circuits. As most instances of this nature when carefully analyzed are found due to defect in original materials, or workmanship in manufacturing, little apprehension on this score need be entertained under all ordinary circumstances.

SPLICES AND TERMINALS.

Owing to the hygroscopic and fragile character of the paper insulation, special care must be observed in terminating and joining cables, in order to keep the main body moistureless. Each piece of cable as delivered by the manufacturers has some 3 feet or 4 feet of each end boiled in paraffine, after which the lead of the sheath is turnd over and soldered; in this condition the cable will keep indefinitely. When two pieces are to be joined the sheath is stripped away from each end for 18 inches or 2 feet. Then a piece of lead pipe an inch or 1½-inch larger than the cable and about 2 feet long is slipped onto one of the cables. The paper from individual wires is then stripped off, and each wire in one cable twisted to its proper mate in the other, the wire joint being protected by a paper sleeve. When all the pairs are then connected the lead sleeve is slipped over the splice and one end "wiped" onto the sheath of one piece of cable, the splice is then "boiled" out by being immersed in boiling paraffine for some little time, after which the remaining end of the sleeve is wiped onto the sheath of the other cable and the splice is complete. Full details of this method will be found under the head of "*Specifications for Cable Splices.*"

Cable Heads.—The termination of the cable is a much more difficult matter in order to secure complete immunity from moisture for here the individual wires must be brought out in such a way as to be utilized in any desired manner. There are two general types of terminals—*The Cable Head* and *The Pot Head*. The cable head consists of some sort of an air-tight box, or receptacle, to which the sheath of the cable may be soldered, and inside of which the circuits may be fanned out and attached to pins or studs extending through the sides of the box, thus affording exterior connection to each cable wire. After the cable sheath is attached to the head and the wires connected to the terminals the head is sealed up.

The Pot Head method consists in splicing onto the paper cable an auxiliary cable, long or short, as circumstance may indicate, made of wire insulated with some non-hygroscopic material (say, rubber), and covering the joint with a lead sleeve, wiped onto the cable sheath, which is subsequently filled with a rubber compound such as Chatterton's. The cable head is the older plan, somewhat easier to successfully install, has the advantage of affording an excellent opportunity to test circuits, and lends itself to the easy at-

FIG. 11.—CONNECTING CABLE AND OPEN-WIRE LINES.

tachment of protectors; but takes up a great deal more room, and is much more expensive. The cable head presents itself in a legion of different forms. The plain head or one unequipped with protectors, Fig. 7, is most usually made as a rectangular iron box about 6 inches or 8 inches wide by 4 inches or 5 inches deep, and of varying lengths sufficient to accommodate the different sizes of cable. In one end a piece of brass pipe is threaded, to which the cable sheath is to be soldered, and through which the cable pairs pass to the interior of head. Along the two opposite sides a series of insulated pins (often in the form of binding posts or supplied with a pair of threaded washers) corresponding to the number of cable wires are placed, to which, on the inside, the cable pairs are soldered, and from which on the outside the circuits are extended. One face of the head is in the form of a cover supplied with rather heavy bolts to draw it firmly against a rubber gasket making an airtight joint. A very neat and compact, though somewhat expensive design, as it is made of rubber, is shown in Fig. 8, also illustrating the cable in place. Fig. 9 shows a cable head supplied with pro-

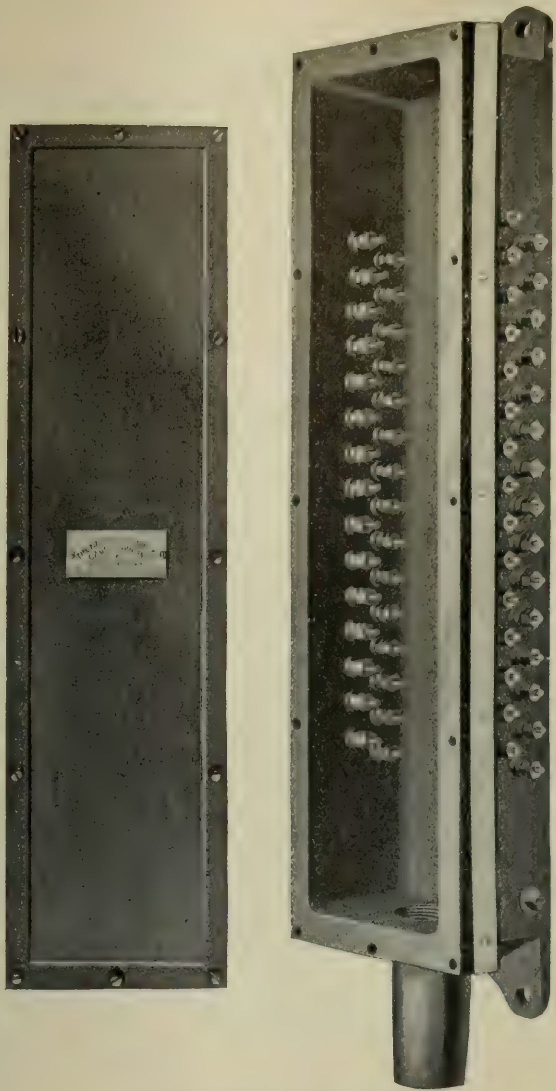


FIG. 7.—PLAIN CABLE HEAD.

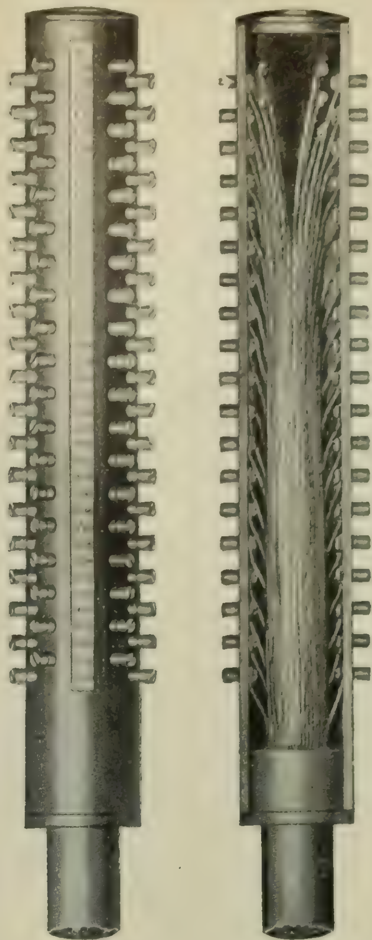


FIG. 8—CABLE HEAD.

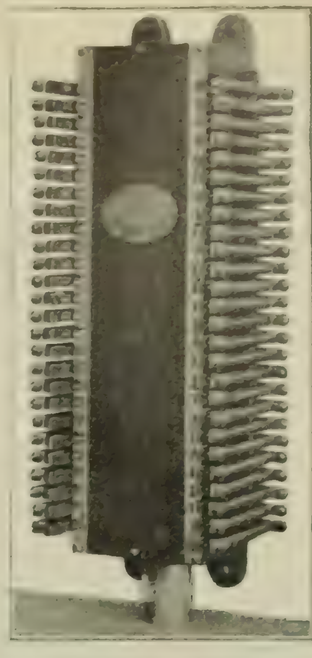


FIG. 9.—CABLE HEAD WITH PROTECTORS.

TELEPHONE
CABLE HEADS,
ETC.

ABBOTT ARTICLE.

FIG. 10.—CONNECTING CABLES AND OPEN-WIRE LINES.

FIG. 12.—"TROUBLE-INVITING" TYPE OF CONSTRUCTION.

[illegible] a set of carbon plates and fuses, suitable for an office terminal in connection with an unprotected distributing board. Modern practice, however, strongly tends toward making the

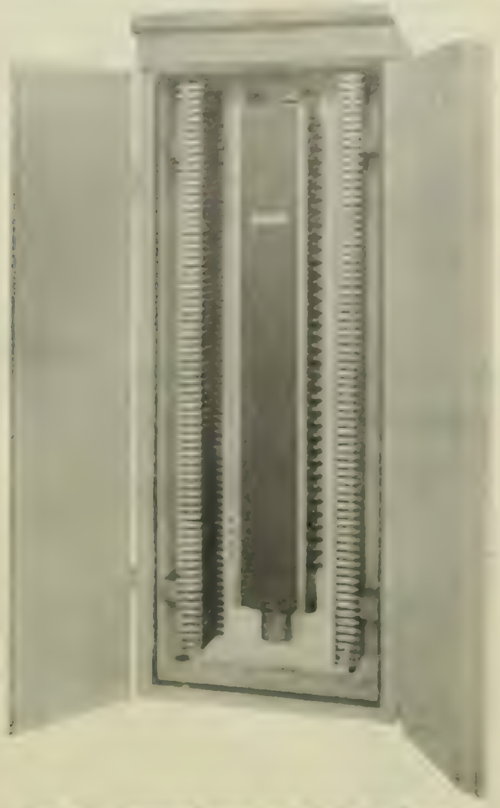


FIG. 13.—INTERIOR VIEW OF CABLE POLE BOX.

cable endings in central offices as simple as possible, and concentrates all protection on the main distributing board.

Where cables run into open wire lines the head must be placed

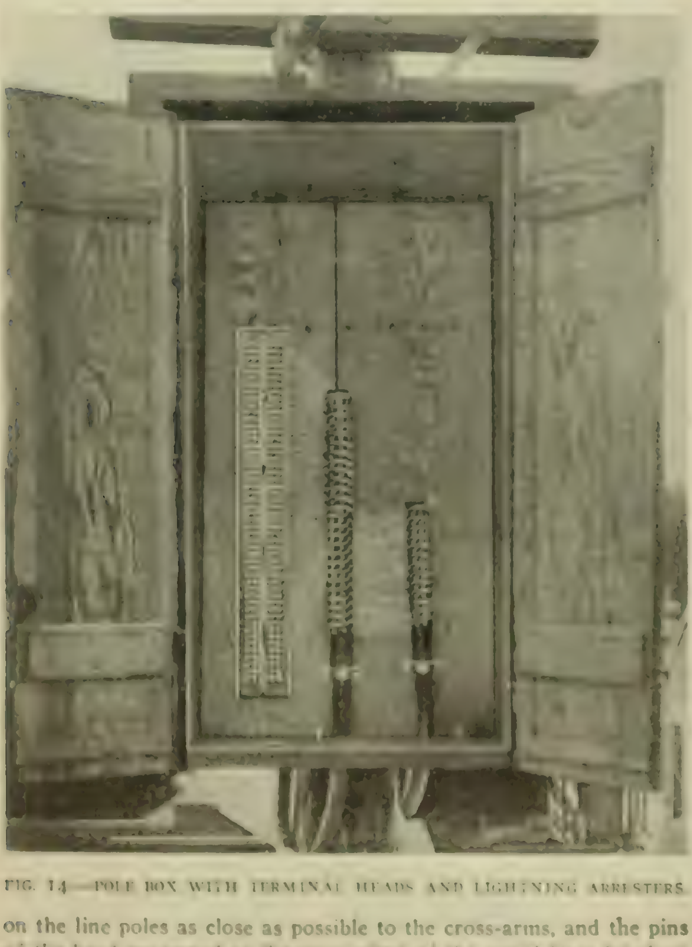


FIG. 14.—POLE BOX WITH TERMINAL HEADS AND LIGHTNING ARRESTERS.

on the line poles as close as possible to the cross-arms, and the pins of the head connected to the open wires of the aerial lines by short lengths of rubber-covered wire, called "bridle wires" or "jumpers." It is usual to enclose the head in a box provided with doors, to protect it from the weather, and house the fuses and lightning arresters that must be inserted between the cable head and the open wire to guard the former from atmospheric electricity, and accidental crosses with other electric wires. To facilitate the duties of linemen, a platform or "balcony," as it is technically termed, is built just below the cable head. The general method of connecting cable and open-wire lines as represented by examples in good practices, is shown in Figs. 10 and 11, showing a neat and orderly arrangement of circuits, and two varieties of cable boxes. In Fig. 11 the forms of rubber jumper wire connecting the cable to the open wire are seen extending on either side of the cross-arms. Fig. 12 is the type of construction usually found in middle-sized towns, and is an excellent example of "what not to do." No design is displayed in the wiring on the contrary everything is at "loose ends." The cable hangs in a sharp bend; and in general the whole pole presents a *strong* temptation to the "trouble devil." The details of cable pole box construction are shown in Figs. 13 and 14. If the head shown in Fig. 9 be employed it is simply bolted to the back of the box, and the jumper forms attached to the ends of the fuses and run down through holes in the bottom of the box (to prevent the entrance of water), and up to the cross-arms. If plain cable heads are used (Fig. 7 or 8) the box must be made larger and the

FIG. 15.—POLE-TOP TERMINAL.

protectors placed on strips attached to the back of the box, as shown in Figs. 13 and 14.

A very ingenious pole terminal is shown in Fig. 15, designed to be placed as a cap on the top of the pole. From Fig. 15 it is seen to consist of a heavy iron pan provided with a water-tight cover. The cable enters through a hole in the bottom, to which the sheath is soldered, while the terminal pins project through the circumference of the pan. After being secured in the place on the top of the pole, a copper cover is dropped over the entire terminal, thus effectually shielding it from the weather.

The head is secured to the pole by cutting off the top square and bolting thereon the spider shown at the right hand of Fig. 15. On this the head is attached, the spider also serving to hold subscribers' lines when house distribution is made directly from the cable head. Figs. 16 and 17 show this head as it appears in practice.

FIG. 16.—POLE TOP IN POSITION.

Present practice is tending strongly toward the wider employment of cable in all cases, and it is now common to extend aerial cable from block to block, placing a distributing pole in each one,

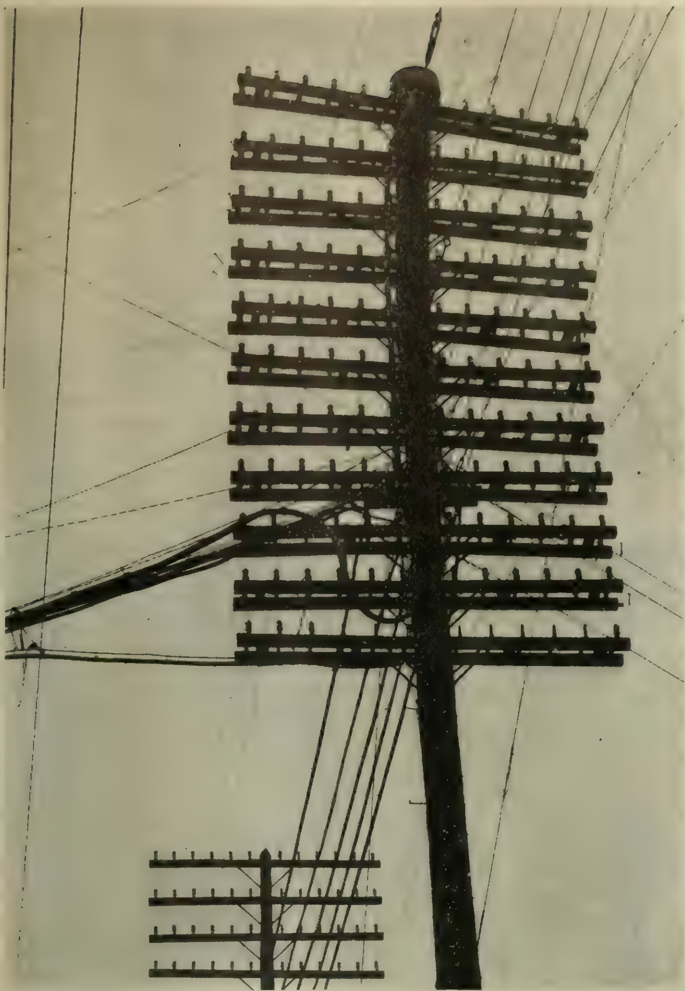


FIG. 17.—POLE TOP IN POSITION.

FIG. 18.—EXAMPLE OF DISTRIBUTION IN A BLOCK.

having a cable head into which sufficient pairs are taken by a Y splice to serve the block, and from which the subscribers' drop wire hang in single spans to each house. By this means, rights of way questions are entirely avoided, and a method of distribution at once cheap to install and easy to maintain secured. Fig. 18 is a good example of the general features of this practice, while Fig. 19 shows the detail of distribution.

FIG. 19.—DETAIL OF DISTRIBUTION.

Canadian Long Distance Transmission.

The city of Montreal is rapidly enlarging its supply of electrical energy, in order to meet the constantly increasing demand for electricity for light and power purposes. The result of this increasing demand is shown in the fact that the Lachine Hydraulic & Power Company is now bringing electricity from Shawinigan Falls, eighty-five miles distant from the city. The transmission line is already completed and the power houses at the Montreal and Shawinigan ends are finished. At the beginning of the new year one of the longest of transmissions will be in operation and will be conveying 8,000 electrical hp into Montreal. It has been a big undertaking, but it has been carried out with remarkable expedition.

Some 4,500 cedar poles have been planted for the support of the three aluminum conductors which are strung upon them. Each conductor consists of six three-eighths-inch wires twisted together. A special insulator of porcelain has been used.

At Bout de l'Ile the river is spanned and the island of Montreal reached by means of a heavy steel cable, suspended above the water from two steel towers, one on each shore. The span is 1,800 feet in length. The current is brought into the city at 50,000 volts. At the distributing station the current is stepped-down to 2,000 volts and the 8,000 hp will be delivered to the Lachine Power Company at that pressure. One of the interesting features of the work, to Canadians, is the fact that domestic aluminum is used. It is the first output from the factory of the Northern Aluminum Company, the Shawinigan branch of the Pittsburg Reduction Company. It is expected that this Shawinigan plant will, in a few years, be the largest aluminum-producing plant in the world. Although a long transmission has never been tried in a climate as severe as that which prevails in this part of Canada, yet there is no doubt entertained as to the success of the present enterprise.

The Manufacture and Laying of the Vera Cruz-Frontera-Campeche Cable for the Mexican Government.

Of the [illegible] total of roughly [illegible] of submarine cable laid across the oceans of the globe, by far the greatest share has been made and laid by Great Britain. In recent years the strategic advantages of submarine cables in case of international disputes have been clearly exhibited, and the manufacture of cable has been taken up to some extent in France, Germany and Italy. Within the last few years submarine cable has been manufactured by industrial corporations in the United States. One company alone has made about 2,000 miles of cable for the United States Government, which the Government has laid, with a cable ship of its own, among the Philippine Islands.

This year a contract was taken by The Safety Insulated Wire & Cable Company, in competition with European manufacturers, to make and lay a cable under specifications from the Mexican Government Telegraph Department, to connect the ports of Vera Cruz, Frontera, and Campeche in the Gulf of Mexico. The contract length of this cable was 472 nautical miles, or 544 statute miles. This cable has recently been made and laid, and since it is the first cable made in America for foreign owners, and also the first cable of any considerable length laid by an American cable manufacturing company, the story of its manufacture, shipment, and delivery on the selected sea bottom route may be of interest.

FIG. 1.—CABLESHIP "YDUN."

FIG. 2.—FORWARD DECK AND PAYING OUT GEAR, STEAMER "YDUN."

FIG. 3.—BOW SHEAVES WITH CABLE IN STOPPERS.

The engineering specifications for the manufacture of the cable were drawn by Mr. Ira W. Henry, vice-president of the Safety Company. The contract specified the nature and length of the cable, the details of its parts, in relation to sizes, qualities and tests, the equipment of the cable-houses, or terminal buildings which the company was to erect, the depths of water in which the cable was to be laid, and many other particulars. The cable was manufactured at the Safety Company's works at Bayonne, on the water front of New York Bay.

Inasmuch as the details of size and construction differ considerably in different cables, according to the depth of ocean, topographical conditions, and the views of the engineers who draw up the specifications, the particular process of manufacture to be described applies in detail only to the Mexican Gulf Cable here considered.

The electric conductor of the cable consists of a strand of nine tinned copper wires—eight wires of the same size spiralled about a larger central wire. A stranded conductor is not only more flexible than a single-wired conductor, but is also less liable to accidental discontinuity by rupture.

The stranded conductor is run, in mile lengths, through a machine which lays on a thin seamless coating of pure rubber gum. This gives the first insulating coating. The strand thus coated then passes through a second machine, in which it receives a thicker seamless coating of vulcanizable rubber, or a material containing over 40 per cent. of rubber. This completes the insulating covering, and the conducting strand has then been converted into rubber core. The core is vulcanized in its outer coating, by immersion in a hot bath for a suitable time. The finished core is then taped, and joined together in five-mile lengths. This rubber core will stand knotting, scraping and rubbing remarkably well. It is mechanically stronger in these respects than gutta-percha core. Whereas gutta-percha core lasts indefinitely under water, but oxydizes slowly in air, vulcanized rubber core, made in this manner, will last indefinitely either in water or in air. Moreover, it is not injured or affected by exposure to relatively high temperatures, such as the temperature of boiling water.

The five-mile lengths of core are then subjected to 5,000 volts of alternating-current pressure for five minutes, to make sure that the core contains no cracks or incipient defects. It is also tested for insulation by battery, and for capacity and conductor-resistance. After undergoing these tests while immersed in water, the core is ready for being converted into cable by the process of armoring.

An armoring machine consists essentially of a long series of vertical revolving disks carrying spindles. The disks are separated by troughs. The core passes through the series of disks through central apertures, and through the troughs between them, receiving from the spindles at each disk a layer, in spiral form, either of jute, or tape, or steel wire. In the troughs it receives coatings of compound of tarry character and appearance. On entering the machine, the core passes through the centre of two disks in succession, and receives two layers of jute, laid on in opposite directions. Then it passes through the

center of a disk which lays on 16 steel wires, each galvanized, compounded and taped. The next two disks apply two more servings of jute in opposite directions, after which the cable receives a coating of preservative compound, and a final coat of talcum to make its surface non-adhesive. Thus the core, steadily entering the machine at one end, comes out as continuous finished cable at the other, ready for shipment or coiling away in steel tanks, where it can be kept and tested under water. The dielectric strength of the insulator is tested by the application of 1,000 volts of direct-current pressure, and the usual insulation, capacity and conductor-resistance tests are applied by battery.

As each of the 16 armor wires will withstand about 1,000 pounds pull before breaking, the breaking stress of the cable is in the neighborhood of eight tons. This is with the deep-sea cable, for laying in relatively deep water. Near the shore, and in shallower water, a heavier cable is used, or a "shore-end type." This shore-end cable is made by passing deep-sea cable through another armoring machine, where it receives an external sheathing of 18 galvanized steel wires, as well as external servings of jute and compound. The breaking stress of the shore-end cable is thus raised to about 20 tons.

The shore-end cable has a diameter of about 1⅔ inches, and weighs 6½ long tons to the nautical mile, in air. The deep-sea cable or lighter cable, has a diameter of about 1 1/9 inches, and weighs 2½ long tons per nautical mile.

As the Safety Company did not possess a cable-ship of its own with which to lay the cable, it was necessary to charter a vessel for this purpose. There was considerable difficulty in securing a suitable vessel. The total weight of the cable was 1,500 short tons, and its total coiling space was no less than 28,000 cubic feet. The cargo space available on an ordinary steamer of 1,500 tons carrying capacity is commonly 80,000 cubic feet, or nearly three times more than the cable would occupy. But in the ordinary cargo steamer the space is arranged in such a manner that but little of it is available for stowing cable. In order to be paid out safely, the cable must be coiled away in large tanks, nearly the breadth of the ship in diameter, and these must be open cylinders from the top to the bottom; whereas the ordinary ship has "between-decks" that are continuous fore and aft, except for relatively small hatches. Enlarging these hatches sufficiently to allow the tanks to be erected involves cutting

FIG. 4.—SETTING MARKING-BUOY AT SEA.

steel beams, stringers, diagonals and hatch combings, at considerable expense to remove and subsequently restore. If no deck cutting is attempted, then it would probably require a 10,000-ton ship to receive the 1,500 tons of cable.

After a number of vessels had been examined with a view to equipment as cable ships, without success, they secured, under contract, the steamship *Ydun* (Captain Christiansen). The construction of this ship was well adapted to the purpose. This vessel had no 'tween deck, forward or aft; so that below her main deck she was built like a huge steel box. Consequently, in order to make room for the four cable tanks required, it was only necessary to remove some vertical steel stanchions and compensate for their strength by some trusses and tie rods close to the under side of the deck. The steamer is 240 feet long, with a beam of 25 feet, and a carrying capacity of 2,000 tons.

The cable tanks were made of wooden crib cylinders. In each tank the crib was formed of a circular row of 12-in. x 8-in. vertical timbers, 2½ ft. apart, at their upper ends. They were supported laterally by ties between them, and by other ties to the sides of the ship. They were also girdled by steel ropes, drawn tight by wedges, driven and

FIG. 5.—LANDING SHORE END AT CABLE HOUSE AT FRONTERA.

nailed. In the center of each tank, a timber conical frame or cone was erected. In addition to the tanks, eight extra cabins had to be built below the bridge to accommodate the cable-laying staff, and a testing room had also to be built. On deck, the large cable-winch or picking-up-and-paying-out gear was erected. This carries a six-foot steel drum around which the cable passes either into or out of the ship. It has a double horizontal engine to drive it, when picking up at either of two speeds; while a brake is attached for use in paying out. This cable gear occupied 17 ft. x 11 ft. of deck space. It was built to specifications by the Lidgerwood Manufacturing Company, and was the largest and strongest cable gear that has yet been built in America. Besides the gear, large bow-sheaves had to be mounted over the stem, a smaller pair of sheaves at the stern, a dynamometer to indicate the tension on the cable, and various guide sheaves to lead to and from the various tanks. This alteration and equipment was carried out at the Robbins' Dry Docks in Brooklyn, N. Y.

The electrical equipment of the vessel consisted of a small steam-dynamo for incandescent lighting, 400 cells of battery, two D'Arsonval marine reflecting galvanometers, rheostats, Wheatstone bridges, portable testing sets, and a complete Morse signalling outfit. Nearly all of the electrical testing instruments were furnished by Messrs. Leeds & Company, of Philadelphia.

The *Ydun* was handed over to the Safety Company under charter for the reception of cable in her tanks at Brooklyn, on the 19th of August. At that moment lighters loaded with the cable from the Bayonne factory were waiting alongside, and the coiling of the cables from the lighters into two of the tanks commenced forthwith. All the cable was coiled on board the ship by the 2nd of September, and the vessel left Brooklyn with the cable, cable-staff and crew, on the 3rd of September, bound for Vera Cruz. That port was reached safely and uneventfully on the 13th. Here the ship was joined by the representative of the Safety Company, Mr. Ira W. Henry, accompanied by the Mexican Government officials, Messrs. A. Parra, Inspector General of Mexican Telegraphs, and Capt. D. Almedo, engineer, with two assistants, who attended the laying of the cable on behalf of Senor Camile A. Gonzales, the Director General of the Mexican Government Telegraph Department.

The cable house for receiving the cable was landed in sections, and erected in the adjoining bay north of Vera Cruz harbor, well above high-water mark, and about two miles from the town. Arrangements were made to secure a lighter and steam launch to land the end on the beach. Two miles of shore-end cable was coiled in the lighter, and this was then towed by the launch round to the north bay. The lighter anchored outside the surf in about four feet of water, near the beach, and with the aid of men, boats and mules, the end of the

[illegible] into the cable house. The steam launch then towed the lighter slowly seawards along the selected course, and the lighter paid out the two miles of cable as she went, buoying the sea end in 10 fathoms of water, at a position where the ship could readily come in and reach it.

[illegible] the *Ydun* left Vera Cruz harbor and came round to the buoy over the sea-end of the north bay. The sea-end was soon picked up, and after speaking and testing through the cable to the cable house, the deep-sea cable in one of the tanks was spliced on. Shortly after sunset the splice was finished. The ship swung round on her course seawards, and commenced laying the cable towards Frontera, steering during the night by the bearings of the lighthouses in the neighborhood.

After steaming steadily for two days and nights at an average speed of nearly four knots, the ship arrived off Frontera, and came into water sufficiently shallow to call for a change from deep-sea to shore-end cable. Here the cable was cut and buoyed, about nine miles from Frontera beach. Released from the cable, the ship steamed at full speed to Frontera, and anchored near the mouth of the River Tabasco.

Here the Frontera cable house was landed and speedily erected on a suitable site near the beach and lighthouse. With a steam launch and lighters, two short diverging shore-ends were laid out from the cable house, and their sea-ends buoyed. The ship then picked up the western sea-end, spliced on heavy cable to it, and paid out to the Vera Cruz end buoy, nine miles out to sea. Reaching this buoy, the Vera Cruz end was picked up and found to be in good electrical condition. The cable paid out from the tank was then cut and spliced on to the Vera Cruz end, thus making the final splice and completing communication between Vera Cruz and Frontera, within thirteen days after first reaching Vera Cruz. The final tests of the cable, 234 nautical miles in length, were completed the same night from Frontera cable house.

After completing the shore-end of the Campeche section, by laying it out to sea for a distance of 8 miles from Frontera, the *Ydun* steamed directly to Campeche, in order to lay the cable from the port back towards Frontera and to make the final splice at the position of the shore-end buoy.

Campeche is a difficult port to enter with cable owing to the shallowness of its waters. When the *Ydun* anchored off the town in 15 feet of water at low tide, she was eight miles from the wharf, and was scarcely visible from the beach. In order to avoid anchors in an expanse where all is anchorage, it was necessary to lay the cable in a considerable detour. Added to this, there was no steam launch to be had in the port, the last existing one having blown up. There were also no lighters. In order to effect a landing, it was necessary to convert a sailing boat into a lighter by removing her mast, and to engage a schooner to act as tug. As the schooner could only tow the lighter when the wind was fair, it was necessary to await fair winds before towing the lighter inshore, or laying out seawards. However, by taking advantage of each change of wind, the cable house was landed and the shore-end buoyed seven miles out to sea at a position where the ship could reach it at high tide, within six days after reaching Campeche. On October 4 the ship spliced onto the shore-end and commenced paying out cable towards Frontera.

Up to that time the weather had been favorable, but on the following day a change set in for the worse. After about 120 miles had been paid out, it was blowing a gale and the ship could not keep her course. The cable was, therefore, cut and buoyed. Every hour brought more violent weather, until it was evident that the vessel was in a severe cyclone. In the early morning of October 7 the ship passed through the centre of the hurricane into a region of comparative calm wind but confused sea. Large numbers of land birds, varying in size from humming birds to large storks, alighted on the vessel at this time, having been caught in the centre of the hurricane and carried violently out to sea. After two hours' respite, the storm again struck the vessel from the opposite direction, and continued with violence for the day following. Although struggling against the wind with all the steam-power available, the steamer drifted very rapidly towards the shore. Fortunately the weather abated sufficiently when the ship was close to land to permit of the ship's holding her own, with both anchors out, and the engines going full ahead.

After lying at anchor for a day to let the storm go by, and to refit the ship, a run was made back to the position in which the cable had been cut and buoyed. The buoy, however, was nowhere to be discovered. Finally it was necessary to abandon further search for the buoy, and to grapple for the cable. A grapnel was put down, and the cable was hooked on the first drag. It was brought up to the surface on the afternoon of October 10, and the ship soon spliced it on to Campeche end. Paying out then recommenced. On the following day the buoy on the end of the heavy Frontera section was reached, and the final splice let go. This completed the laying of both cables within 38 days of the *Ydun* leaving New York Bay. On proceeding to Vera Cruz, the cable was taken over by the Mexican Federal Telegraph Department, and found to operate at a satisfactory hand speed by Morse system over the 450 miles from Campeche to Vera Cruz.

The entire engineering charge of the cable-laying expedition was given to Dr. A. E. Kennelly, Professor of Electrical Engineering at Harvard University, who also served as inspector for the Mexican Government during the manufacture of the cable. With him were associated on the ship the Safety Company's engineering staff, consisting of Mr. G. M. Haskell, chief electrician; Mr. Wm. H. Rodier, cable superintendent; Messrs. R. O. Smith and Thomas Bayne, assistant electricians, and Messrs. John Lind and Julius Bernstein, assistant engineers. The navigation and management of the ship were carried out by Captain C. Christiansen.

Meeting of the American Society of Mechanical Engineers.

At the meeting in New York City last week of the American Society of Mechanical Engineers almost a score of papers was presented, of which, however, but one had a direct relation to electrical engineering, read by Mr. Walter I. Schlecter and entitled "Fly-Wheel Capacity for Engine-Driven Alternators."

After outlining the principles governing the design of fly-wheels for engines driving alternators, and showing how the displacement angle for a given case may be determined by calculation or graphically, it is established that the limiting value of the displacement of phase in the electrical circuit is 2.5°, which corresponds to a cross-current of about 10 per cent. of the full-load current, and a torque equal to 10 per cent. tending to pull into step one of a pair of alternators in parallel. A formula is given for determining the weight of a fly-wheel which will limit the displacement to a value approximately equal to 2.5, the formula taking account of the various unbalancing factors and allowing a reasonable increase for overload. A table gives a comparison of the weights of fly-wheels on engines in a number of large plants, one column giving the actual, and another the calculated, weights. In some cases the fly-wheel is lighter, and in others heavier, than the weight which the calculations indicate as the correct weight.

"The Use of a Surveying Instrument in Machine Shop Practice" is the title of a paper presented by Mr. Charles C. Tyler, which describes methods for lining up large work by means of a dividing and levelling instrument similar to that used by surveyors. The method is explained with reference to its application to the machining of the 5,000-kw alternators built at the Westinghouse works for the New York Elevated Railway.

In a paper entitled "Rotary Pumps," Mr. John T. Wilkin described a pump of this type which he has designed. It is stated that rotary pumps of this kind have been made having capacities of 35,000, 40,000 and 50,000 gallons per minute, which are operating satisfactorily under heads of from 8 to 25 ft.; and that two plants are now under way, one consisting of four 35,000-gallon pumps direct-connected to Corliss compound condensing engines and to work under a head of 35 ft.; and the other two, 70,000-gallon pumps to work under a head of 10 ft. The efficiency as determined from indicator cards taken from engines operating rotary pumps has been found to range from 80 to 84 per cent.

A new oil-testing machine and some of its results was the subject of a paper by Mr. Albert Kingsbury. The apparatus was devised with especial reference to the conditions under which the effects of viscosity and those of body may be investigated independently of the effects of either.

The test journal has its axis vertical; it is suspended from the spindle by means of a flexible coupling and runs between two opposed bearings in a cylindrical cup or case, which may be filled with the oil to be tested if a "bath" is desired. The load on the bearings is provided, by means of a helical spring of 900 pounds capacity, with screw adjustment and with a device for quick application or removal of the load without disturbing the adjustment. This spring is en-

closed in a horizontal tube attached to the side of the oil case. The cup has a cover with a small hole for the insertion of a thermometer.

The cup and attached parts are borne on a hollow vertical spindle 1⅜ inches in diameter, turning freely in a sleeve supported from the frame of the machine; the spindle extends about two feet below the sleeve and is suspended from a fixed bracket by a tempered steel wire passing through the spindle to its lower end. In testing, these suspended parts turn freely to a position where the torsion of the suspension wire balances the friction at the test journal, and the angle of torsion, which may be as great as 270°, is read from a graduated disk. The suspended parts being counterbalanced, there is no appreciable pressure of the spindle against its sleeve; and when the oil in this bearing becomes evenly distributed, there is no error from friction. At the same time, the viscosity of the oil serves the purpose of damping the oscillations which arise from variations in speed or friction at the test journal. This mode of suspension gives large indications for very small frictions at the test journal, while a helical spring placed on the extension of the spindle is added for tests involving great friction.

For tests involving friction due to viscosity only, the test journal used is 1⅜ inches in diameter, running in two brasses, each having an arc of 120° and 2 inches long; while for comparing oils with respect to body or oiliness, the best results are obtained with a journal about ¼ inch in diameter running between two brass bearings 1 inch long.

The results of this method of testing for body show that the mineral oils as a class have much less body than the animal and vegetable oils. For example, in a body test of a mineral oil and a lard oil having viscosities 98.9 and 83.7 respectively, as determined by the Dudley pipette, the lard oil, although the less viscous, gives very decided evidence of greater body, by its much smaller friction. On the other hand, certain cylinder oils, wholly or largely mineral, and exceeding lard oil greatly in viscosity have also greater body than lard oil. The experiments showed that body is in some way related with viscosity, but that the relation must be quite different in the mineral and the fixed oils.

Mr. Frank Richards discussed in a paper the subject of gift propositions for paying workmen. He considers that the so-called "bonus" and "premium" plans both ignore the strictly business relation of employer and employee, though the latter is the better of the two; but that it is unfair in only giving the workman a half or a third of the price for the excess of work. It is his view that for everything a workman can do there is a fair and equitable price, whatever the difficulty of determining that price, and that when the man does the work he should get the price. The piece which by extra exertion he does last brings as much or more profit to the proprietor as the first piece that is done, and it does not appear why the man should not have his pay the same for each. No one can assert that the premium plan gives him this. It does not appear that the premium plan, or any other *gift* proposition, offers or suggests a permanent or satisfactory solution of the problem of equitably adjusting the wage to the work.

The lengthiest communications presented at the meeting were the final report of the committee appointed to standardize a system of testing steam engines, and a printed discussion of the same—the two occupying 133 pages of the *Transactions*. The report enters into the minute details of engine tests, giving instructions for all the different operations together with forms of record.

The "Metric System" was represented by a paper by Mr. F. A. Halsey, associate editor of the *American Machinist*, which opens with a statement of the overwhelming evidence lately given before Congress in favor of that system, followed by the expression, printed in italics, "It is up to us"—the application apparently being that the society should, by an adverse expression of opinion, overweigh such evidence. The arguments adduced against the system are principally those which the older generation of engineers have made familiar, accompanied by a running criticism of testimony given before the House Committee, and a collection of odds and ends gathered from the most heterogeneous sources and supposed to bear against the system. The paper concludes with a line in display type, "What are you going to do about it?" Many able engineers trained in the school of the past are sincerely opposed to the metric system, but we doubt if few of these will read this undignified presentation of their cause without wincing. The paper was followed by a lengthy discussion, one of the features of which was a sharp criticism of the paper by the editor of the *American Machinist*, with whom the author of the paper is associated editorially.

In view of the desperate fight of an element in the society has been making against the metric system, and also the manner in which this element was suppressed at the Boston meeting in the spring, it was expected that it would be represented in full force at the New York meeting. This appeared to be the case, but on a test vote a majority was arrayed against it.

The duodecimal system was advocated in a paper by Mr. Sidney A. Reeve, who proposed wiping out the numerical past and starting *de novo* with a system based on the dozen instead of the antiquated ten. He would add two new numerals, *dek* and *eln*, to follow ten, get even with that obnoxious word by rechristening it *doz*, and continue the warfare by changing the related teens to dos-two, dos-three, etc.; the twenties, etc., to twodz-one (21), fidze-one (51), etc. One section has for a head, "Think in Dozens," in which the statement is made, "The task in attaining familiarity with duodecimal numbers does not lie so much in learning the duodecimals as it does in forgetting the decimals." By this system the dollar would contain 12 bits of 8⅓ cents each, the bit 10 groats and the groat 10 grets. A reading of the paper leaves one in a quandary as to whether it was written in all seriousness, or intended to be taken as a satire on the metric system, or was perpetrated as a practical joke on the Society of Mechanical Engineers.

Lighting the St. Louis Exposition.

Mr. Henry Rustin, chief electrical and mechanical engineer of the St. Louis Exposition, in a memorandum on the subject of lighting, remarks:

The results which can be accomplished by artistic arrangement of lights are numerous, and additional possibilities are created by combining lighting with fountain displays. The vista, as seen from the north end of the main court, will be closed by the Cascades in front of Festival Hall; here all efforts will unite for creating a maximum spectacular effect in architectural gardening, fountain display and light. At night the scene on the main court will be an effect which, for lack of a better term, may be called nocturnal architecture; in that the placing of myriads of points of light, in outlining the structures, in face-lighting entire surfaces, or in accentuating prominent architectural features, will produce an appearance in the structures that is entirely different from the daylight scene. This effect, achieved in milder manner at the entrance to the Grand Court, will lead with ever-increasing intensity up to the main effect at the Cascades. The general style of architecture adopted by the Exposition presents unusual opportunities for display lighting. The color of the buildings is, in the main, white and the full value of each lighting unit is reflected.

Much attention is being given the question of supports for lighting about the grounds to prevent their being obtrusive. It is a difficult matter to provide the necessary amount of lighting for walks and avenues without accumulating a forest of lamp posts. Arrangements have been perfected, however, in which it is only necessary to place a few posts at long intervals, and, at the same time, keep the unit of illumination of small candle-power.

The scheme adopted leaves the vista almost entirely free from any obstructions to the sight. A certain amount of illumination will be placed on posts about the waterways in order to take care of the traffic of small boats. These lights, however, will be kept very low.

While decorative illumination will be general throughout the grounds, certain portions will be featured, to a greater extent than has been possible at previous expositions. The portions which will receive particular attention will be the avenue leading towards the Government Building and the Government Building itself. This structure rises to considerable prominence in that it is situated on a high hill. The chief display, however, will be made in front of Festival Hall, covering the entire territory known as the Cascades. This will be a stretch of artistic architectural and landscape composition something over a thousand feet in width and over five hundred feet in depth, and at three different points immense cascades of water will tumble down, making a total plunge of one hundred feet.

As arranged, this Cascade at night will be saturated with light of varying colors, and the entire surroundings of architecture and foliage will be bathed in the same shades of color as the water effects. This will not be accomplished by means of stage lights or

searchlight effects, but will be produced on the structures themselves as if they had each become light-giving.

The Exposition has provided itself with facilities for the supplying of an immense amount of electrical energy. This will be distributed in the usual manner to the several points of consumption; the major portion of this energy has been apportioned to the producing of a picture in light.

An ample portion of electrical energy has been apportioned for the use of the exhibitor, the concessionaire and for the Foreign and State Buildings section; the total of the electrical service so apportioned is considerable, and in variety includes service for every known commercial electrical work, such as charging current for batteries, current for series alternating, and direct-current arc lamps, current for all varieties of direct and alternating-current motors, service for multiple direct-current and alternating-current arc lamps. This latter service presents quite a variety of alternating-current voltages and frequencies, as well as a good variety of direct-current voltages.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

SEPARATION OF NICKEL AND COPPER.

The Canadian Copper Company, of Cleveland, as the assignee of Mr. David H. Browne, has secured control of one of the simplest cyclical methods yet offered for the electrolytic separation of copper and nickel from their alloys. The alloy, substantially freed from sulphur, is in part granulated and in part cast into anodes, the proportions so treated depending upon the composition of the material. The granulated portion is then subjected, in a leaching tower, to the simultaneous action of free chlorine and a solvent for cuprous chloride. The solvent, preferably brine, is flooded continuously over the alloy, and by removal of the cuprous salt exposes fresh surfaces of the alloy to the action of the chlorine.

The resulting solution of cuprous and nickel chlorides in sodium chloride is then electrolyzed with anodes of copper-nickel alloy, whereby copper is plated out at the cathode, and the solution becomes enriched in nickel. It is stated that *all* of the copper may be plated from the solution under these conditions—a seeming inadvertence, since copper-bearing anodes are used. Finally, this nickel-bearing solution, after purification and concentration, is electrolyzed at moderate temperatures with insoluble anodes, for recovery of the metal, the evolved chlorine being conducted to the leaching tower.

TREATMENT OF GOLD-BEARING SOLUTIONS.

Three distinct electrolytic methods have been used for the precipitation of gold from cyanide solutions. The first depends upon local currents between the constituent metals of an alloy composed of zinc and lead, or zinc and other metal far removed in the electromotive series; the second, upon local currents between fragments of zinc and carbon or between fragments of zinc and carbon plates; and the third upon electrolytic action instituted and controlled by current from an outside source, as for instance in the Siemens-Halske method employing anode plates of iron and cathodes of lead, the latter either in plate form or sub-divided by turning or otherwise.

Patents recently issued to Sidney T. Muffly, of Bowdre, Ga., cover, as process and apparatus, an odd combination of these three known methods. An alloy of zinc and lead in proportions of 80 parts zinc to 20 of lead, in the form of turnings, is used in conjunction with plates of porous carbon—the galvanic couple so formed being given the form of a filter for the gold-bearing solutions. In addition, this entire element, both alloy and carbon, is made the cathode of an external circuit. As a further feature warm air is injected into the filter bed.

The patent description belongs to the too familiar class which asserts but does not explain. Thus the advantages of the arrangement are said to be "a perfect and constant polarization of the compound molecules of solution," "a polarization of the solution," and "an abundant amount of oxygen to enable the molecules of the solution to more rapidly exchange their atoms." As a whole, its perusal is not profitable.

In general, however, it may be said of the method that the controlling elements in the separation of gold are well understood; that cathode surface and current density control here as elsewhere, and that the proper conditions can be secured with less complication of parts than in this system.

Independent Telephony in New York State.

Mr. B. G. Hubbell, president of the Consolidated Telephone Company and of the Inter-Ocean Telephone and Telegraph Company, was interviewed recently in Elmira, N. Y., as to the results of independent work. After recapitulating what had been done in Grand Rapids, Toledo, Rochester and other cities, he said: "New York has been the last State to take up the independent telephone development. During the last two years, however, many millions of dollars have been invested in this State in the independent telephone business. To-day there is hardly a city, town or village in this State that does not have an independent telephone system, either in operation or under construction. I think I am safe in saying that the independent telephone business is one of the most active enterprises in the State to-day in respect to the capital being invested for extensions. The Inter-Ocean Telephone & Telegraph Company has many hundreds of men at work in all parts of Central and Western New York, building long-distance lines to connect the independent exchanges in all cities and towns in that section. There are over 30,000 telephones operated by independent companies in Central and Western New York that will be soon connected in a large and comprehensive long-distance service. I think I am safe in saying that within a year from to-day the independent companies will give a subscriber very many more telephonic connections in Central and Western New York than can be gotten from competing telephone lines. The prominent business men of this section are investing heavily in independent telephone securities. In each community in which these companies operate a financial following has been obtained that will give the independent telephone companies a permanency in its business that will be greatly to its financial benefit. The independent telephone business is not, strictly speaking, a competitor to the Bell company. In towns where the Bell company has operated for fifteen to twenty years and has been able to secure not more than 200 or 300 subscribers, the independent interests within a year or two are able to secure 800 to 1,000 subscribers. There are, therefore, some 600 to 800 telephone users in these towns who have never before had a telephone, and with whom the Bell Telephone Company has never dealt. There is enough of this new business to support the independent interests without interfering with the Bell subscribers, and without entering into competition in any way with the Bell company for that particular business. The telephone business is so active, there is such a tremendous demand for telephone service, that no one company can expect to serve the entire needs of the public. If the Bell company had been able to serve the public's needs there would not have been this universal and successful competition."

New Equipment for the Study of Illumination.

In view of the recent discussion with regard to the relative value of candle-power and illumination measurement, brought out by the advent of the Nernst and other new forms of lamps, the following description of an equipment for the study of illumination now being installed in the electrical engineering department of the Ohio State University, may prove interesting.

A frame about 14 by 8½ ft. is suspended by pulleys to the ceiling, so that it can be raised to the height of 10 ft. from the floor, and around the under side of this are placed two lines of ordinary window shade rollers; upon the inner line of these rollers are hung curtains of black cheesecloth, and upon the outer, curtains of some suitable white cloth. Upon the upper side of the frame are placed upon opposite sides similar lines of rollers, the one with the black and the other with the white cloth.

By this means it is possible to change from a room in which there will be practically no reflection to one of the same size, in which the reflection will be a maximum, and this without changing any of the other conditions of the room.

In this way the comparative value of any two different kinds of illuminant or of different sorts of shades or reflectors, can be determined both for conditions of highly reflecting walls and non-reflecting walls. It will also be possible to easily replace one or both of these sets of rollers with rollers covered with cloths of different colors. Again by using the white curtains alone, the effect of a room with dark walls and a light ceiling can be studied; or by using two adjacent white walls and the white ceiling, the conditions in the corner of a large room can be approximated.

This arrangement is also particularly adapted for carrying out Mr. C. F. Scott's suggestion for the study of illumination by comparison of two entirely similar rooms lighted with different illuminants. This will be accomplished by putting a piece across the middle of the room and hanging shades upon it, similar to those forming the walls and ceiling; there will thus be two rooms about 7 by 8½ ft., which will be exactly similar in all respects, and which can further be transformed from light to dark or from dark to light walls at will. By changing the height of the frame, it is also possible to study the effect of height of ceiling.

It would unquestionably be desirable to have this room larger, but all the space at present available has been utilized. It is hoped, however, that in the future a larger space may be obtained.

New Telephone Patents.

Almost since the days when the bridging bell first rendered party lines satisfactorily operative, inventors have attempted to improve upon this system, having in view two specific results—first, the elimination of the code ringing, and second the provision of a secrecy device. One of the four telephone patents of the patent issue of December 2 refers to such a party-line system, it being that numbered 714,759, covering improvements in the system originally specified and claimed in patent 609,173 of August 16th, 1898, issued to the same inventor, Mr. A. F. Swan, of Bayonne, N. J. As the substance of the original invention and that under present consideration are essentially involved, the system in its present status will be described as a whole, irrespective of the limits of the two patents.

In Fig. 1 is shown two of the subscribers' stations of a three-party line, the apparatus being so disposed that the circuits may be readily drawn. In the lower part of the figure are developments of the selective drums at the three stations.

Referring to the circuit, *26a* is an electro-magnet in series with the line. This magnet has associated with it an armature, *26*, and this, through an escapement to which it is linked, serves to rotate the selective drum *11*. Disposed around the drum are the radial pins *13*, engaging a cam contact lever *16*. Normally the drums at all stations are in such a position that the pin engaging the contact arm has forced this latter to the extreme right, so that the contact *18* is closed at each station. The circuit may then be traced through each station, involving successively the contact cam *14*, the push switch *37*

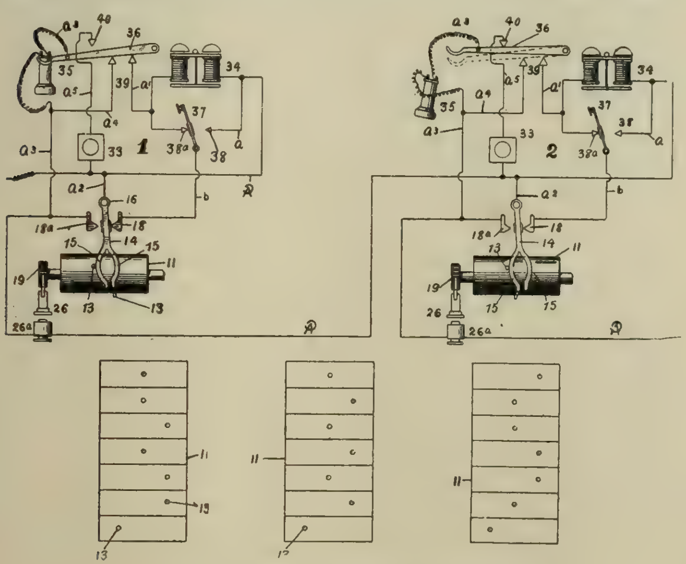


FIG. 1.—SWAN TELEPHONE SYSTEM.

and the hook switch *36*. When the selective drums are turned one step, the contact cam at station 1 is held midway between contacts *18* and *18a*, while those at stations 2 and 3 are thrown to the left against the contact *18a*. Thus stations 2 and 3 are short-circuited from the line. Similarly the second position of the selective drums cuts out stations 1 and 3, and the third cuts out 2 and 3. By a different arrangement of the pins steps are provided so that 1 and 2 may use the line to the exclusion of 3; 1 and 3 to the exclusion of 2; and 2 and 3 to the exclusion of 1. These steps are clearly indicated in the developments.

There are several points about this system which would apparently weigh heavily against it in practical working. For example, the work of the central office operator would be greatly increased, for much time would be required to step along the drums and then, after conversation, to return them to zero. Again, the system is a series one and not only would it be difficult to overcome inductive disturbances, but the impedance of the operating electro-magnets would greatly affect the efficiency of the lines. Finally, the operating electro-magnets must necessarily be adjusted to limits—that is, must not respond to the ringing current nor to that feeding the transmitters, but they must respond to the selective current.

A second of the patents of this issue is entitled "Joint for Telephone Transmitter Arms," granted to C. T. Mason. The invention consists in the substitution of a cone-bearing clamping device for adjusting the angle of the transmitter, to replace the present almost

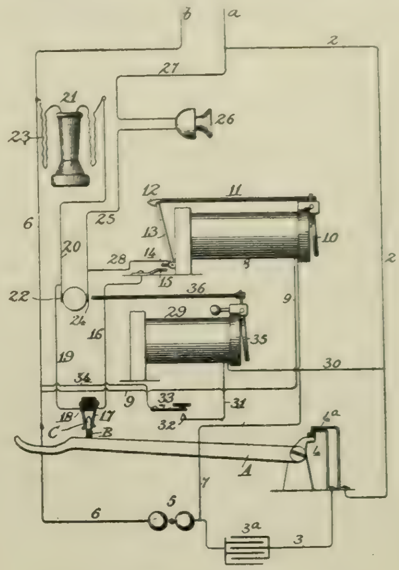


FIG. 2.—EGAN PAY TELEPHONE.

universal design where the clamping nut must deflect the wings of the transmitter holder in order to secure the pivoted transmitter arm. This new clamp not only permits of easy adjustment of the transmitter, but also saves considerably in the cost of manufacture, as no contact is required between the wings of the support and the transmitter arm, and consequently these parts do not have to be accurately fitted.

Both of the remaining telephone patents are issued to one inventor, C. E. Egan, of Durham, N. C. The first of these covers a "pay telephone," being a slot pay-station apparatus having a coin ejector; while the second describes a novel form of polarized bell.

In the pay-station device provision is made for receiving calls at all times, for making calls on the deposit of the proper coin in the slot, and for the return of the coin in case the call, for any reason, fails. The circuit of this pay station is shown in Fig. 2. When a call is received, the current for the polarized bell divides between the drop *8* and the bell *5*. This causes the drop shutter to fall, closing the contact *15*. On the other hand, when the call is answered the rising receiver hook closes contacts *17*, *18*, thereby completing the talking circuit. When the receiver is returned to the hook the drop shutter is automatically returned to the vertical position, opening the contact *15*. As this drop relay is enclosed in the case of the instrument, it is not possible to operate it by hand. Neither can it be operated by the condenser discharge, for as soon as the hook switch raises, the condenser circuit is broken at the contact *4*. Now, when it is desired to make a call from the station, the receiver is raised from the hook, and the hook switch ascending closes the lower end of the coin slot in such a manner that the coin in its fall will be retained in the slot between and complete the electrical circuit of the springs *25*, *26*. Thus, the circuit of the transmitter and receiver is completed.

Upon the return of the telephone to the hook, the coin is deposited or returned, according as the call was completed or not, the ultimate course of the coin being under the control of the central office operator through the agency of the electro-magnet *29*, which serves to switch the coin into the proper slot.

The principle of Mr. Egan's ringer is well shown by Fig. 3,

wherein one leg of the double iron core [illegible] is provided with the usual wire helix, while the other carries a condenser x. This condenser is formed by rolling up alternate sheets of foil and insulating material. The armature of the bell carries in addition to the hammer, two springs, one designed to close a contact at d and the other to give a

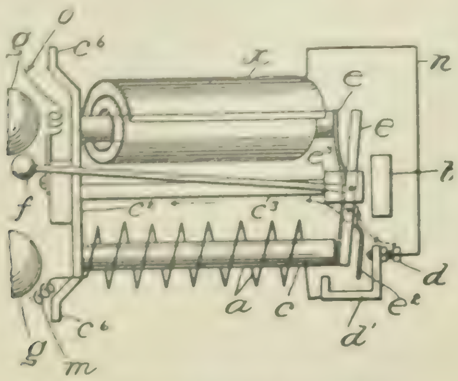


FIG. 3.—EGAN TELEPHONE SIGNAL BELL.

permanent bias to the armature, so that it will always come to rest in the same position.

The action of the bell is as follows: When an impulse of the proper direction passes through the coil and into the condenser, the armature responds almost immediately, short-circuiting the condenser and thereby allowing the full force of the current to be spent in the magnet coil. Upon the reversal of the current with the next impulse, the same action takes place except that the stroke is begun with the condenser cut out and completed with the condenser cut in. Thus we have the result that while the condenser, required on account of the use of central energy signals, is normally in the bell circuit, it is cut out the major portion of the time of actual operation of the bell, resulting in a louder and better ringing.

CURRENT NEWS AND NOTES.

MEETING OF UNDERWRITERS' ASSOCIATION.—The Underwriters' International Electric Association has been in session during the week in New York, and at well-attended meetings has under discussion a number of topics, including interior conduits, switch-boxes, high-voltage circuits, etc., as well as the reports of committees and other business

NEW YORK ELECTRICAL SOCIETY.—In spite of the inclement weather on November 25, Mr. A. Frederick Collins's interesting lecture on "Wireless Telegraphy" brought out a large audience of members of the New York Electrical Society, at the room of the American Institute. The next subject to be discussed by the society is one most attractive to those interested in improvements in machine shop equipment. On Wednesday, December 17, Mr. Charles Day, of the engineering firm of Dodge & Day, Nicetown, Philadelphia, Pa., will lecture on "The Requirements of Machine Tool Operation," with special reference to the motor drive.

SYNTONIC WIRELESS TELEGRAPH SYSTEM.—Five patents granted December 2 to John S. Stone, of Boston, relate to a wireless telegraph system in which the sending and receiving stations are tuned to a given frequency. At the sending station a resonant circuit is in inductive relation on the one side with the antennæ, and on the other side with the usual induction coil key circuit. The receiving station on similar circuit is in similar inductive relation with the antennæ and with the coherer circuit. If the capacity and inductance of the resonant circuit at the receiving station be properly proportioned to those of the sending station, the former will respond only to signals sent out by the latter. If there are a number of sending stations with different resonant circuits, a receiving station can adjust its resonant circuit to respond to any one of these.

CORNELL CLUB IN LONDON.—A cable dispatch from London of December 6 says: The first American university club in England was organized to-night at a dinner in the Trocadero restaurant. It is composed of graduates of Cornell University and is named the Cornell Club. It starts out with a membership of forty. It is significant of the practical value of American training that nearly all the members of the club are permanently engaged in London in mechanical, electrical and engineering work. The president is Oliver Shiras, who is with the Westinghouse company. The vice-president is Charles Spofford, a director of the District Railway. The secretary is S. B. Fortenbaugh. The directors are E. A. Carolin, of the General Electric Company; W. C. White, of the White Automobile Company, and F. H. Fayant. The club will take a prominent part in the reception and entertainment of the Cornell crew if it comes to Henley for the annual regatta.

ELECTRIC STEERING GEAR.—Two patents on systems of motor control for electric steering gear were granted recently, one to Harold W. Buck and the other to Maxwell W. Day. In the former a pilot motor is employed to control the circuits of the steering motor, and in turn is controlled by a switching arrangement operated conjunctively from both the steering wheel and rudder. A multiplicity of wires form a rheostatic arrangement geared to the rudder head connected with an electro-magnetic device, the function of which is to act on the switch controlling the pilot motor, which switch is geared to the steering wheel, in a manner opposite to the action imparted by the steering wheel; that is, a motion of the switch in one direction following a movement of the steering wheel, is immediately counteracted by the rudder head and electro-magnetic mechanism. The Day patent relates to a modification of the same invention, the pilot motor with its rheostatic control of the rudder motor being replaced by the Ward Leonard system of control.

FESSENDEN SYSTEM OF WIRELESS TELEGRAPHY.—Two patents were granted December 2 to Prof. Reginald A. Fessenden, one on a method of multiple and multiplex selective signalling by electro-magnetic waves, and another on a current-operated receiver for electro-magnetic waves. In the form of receiver described, a slowly rotating magnetic field produces a slowly rotating magnetic flux; the field and flux are constant in amount, but the flux lags normally behind the field. A winding connected inductively to the antennæ on the one hand, and in relation with the rotating field on the other hand, receives the current due to signal waves, the passage of which current reduces the above-mentioned lag; this variation of lag between the direction of the flux and the field generates a voltage which is used to produce an indication. The primary of the transmitting induction coil contains two or more make-and-break mechanisms which can be independently operated at predetermined but different rates. At the receiving station are two or more wave-responsive devices in circuits tuned to the periods of the transmitting make-and-break mechanisms.

THURY 25,000-VOLT, DIRECT-CURRENT DYNAMO.—Our Paris correspondent sends us the following additional information relating to the 25,000-volt Thury direct-current dynamo used with the St. Maurice-Lausanne transmission plant described in our issue of October 25. The armature is stationary, the revolving part being a bipolar field magnet, which is separately excited. The armature has a 48-coil Gramme winding, each coil having 500 turns of 0.2 sq mm wire, the armature resistance being 700 ohms. The slots are 1 in. deep and ¾ in. wide, and the bore of the armature is 24 in. The external diameter of the armature core is 40 in. and the width of the armature 12 in. The machine will generate 1 ampere at 23,000 volts. The most interesting part of the machine is, of course, the commutator, the sections of which are separated by air insulation. As the pressure between the commutator segments may be as high as 750 volts momentarily, means of avoiding sparking are essential. An air blast to blow out the sparks is produced by a fan mounted on the main shaft of the machine. By this arrangement the blast is stronger the faster the speed of the machine—i. e., the higher the voltage. In addition to this, condensers are connected between adjacent sections. There are 96 commutator segments, so that the difference of potential between each is 500 volts. It is found that the air blast is only needed when the current exceeds 0.3 ampere. The current is collected by brushes which rotate with the field magnets and are connected to two highly insulated slip rings.

NOBEL PRIZES.—A dispatch from Stockholm, Sweden, dated last Sunday, stated that Nobel prizes were to be distributed on Wednesday of this week, as follows: Professors Lorenz and Zeeman were to divide the physics prize; Prof. Emil Fischer, of Berlin, was to receive the chemistry prize; Prof. Mommsen, the literary prize; Major Ross, of Liverpool, the medical prize, and Prof. De Martens, the peace prize. This announcement is at variance with the first dispatch cabled to this country and which was noted in our issue of last week.

ADVANTAGEOUS STRIKES.—In speaking of the possibility of labor troubles in the West, a high railroad official said that there was not the slightest possibility of strikes there. Continuing, he expressed the following opinion of the present system of train orders: An occasional strike by the telegraphers I sometimes believe is a good thing. It teaches the trainmen what they can do without orders, and leads to reform of the present system of a useless multiplicity of train orders. The railroads are practically all equipped with the block signal system now where there is danger of collision, and I believe that it would be just about as well to do away with the elaborate train order system now in use. Each train could then be run upon its rights. There could be no mistakes in the interpretation of train orders, and the men in charge of trains would feel their responsibility more, and follow rules absolutely.

WESTON INSTRUMENT PATENT DECISION.—Judge Coxe, of the United States Circuit Court of the Southern District of New York, has handed down a decision in an infringement suit instituted by the Weston Electrical Instrument Company, which sustains in unequivocal terms two Weston patents on alternating-current instruments, one being a reissue patent dated June 28, 1892, the date of the original application being January 18, 1890; and the other a patent subsidiary to this dated March 8, 1892. The defenses with respect to the earlier patent were lack of patentability, non-infringement and invalidity of the reissue; and lack of invention and abandonment with respect to the later patent—all of which points were decided in favor of the complainant. Judge Coxe held that Weston was the first to make a successful commercial voltmeter for measuring alternating currents, and this his device is to-day recognized as the standard instrument. There was, strictly speaking, no prior art, no practical commercial instruments prior to Weston's, and none entitled to be considered as anticipations. The Kelvin balance, Siemens dynamometer and Cardew hot-wire voltmeter were dismissed, the first-mentioned as being merely a laboratory instrument, the second as a complicated and sensitive device having the same fault, and the third as defective, inaccurate and liable to get out of order. While there were other instruments, they have since been relegated to the scrap heap of the art.

LETTER TO THE EDITORS.

Variable-Speed Motor Control.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with much interest the resumé in your issue of the 29th of November, 1902, of the various papers and the discussion on variable-speed control, at the November meeting of the American Institute of Electrical Engineers.

The subject considered is one of considerable interest and importance and one on which a large amount of time and ingenuity has been applied with more or less success. I desire to call attention to one method of variable-speed control, which seems to be entirely overlooked by those engaged in discussing this subject, and one which to me appears to be the only method which most nearly fulfills all the requirements of variable electric speed control.

It may be stated generally that the best method of speed control is that one which gives the widest range of speed change at the highest efficiency with the greatest simplicity of mechanism and at the least first cost. All of the methods enumerated and discussed in the various papers presented appear to fail to meet these requirements in one or more particulars, as do also several other methods not mentioned. Particularly is this so as regards efficiency and simplicity.

President Scott said "That the speed of a direct-current motor depends upon the number of turns in series on its armature, the strength of its field and e.m.f. applied to its armature. In practice speed changes are effected by varying one of these three conditions or by combinations of them." The method of speed regulation to which I desire to call attention is a form of field regulation, but not in the sense in which this is generally understood.

The accepted method of field regulation and one of the methods of variable-speed control most used, consists in varying the resistance of the field magnet windings by the introduction into or withdrawal from the field circuit of more or less of a highly resistant wire or other conductive material, and by so doing varying the strength of the magnetizing current and thus the strength of the magnetic field.

This method is limited in range of speed variation and not of the highest efficiency, although simple in form and of low first cost. Only about 40 per cent. advance in speed is permissible before the field strength becomes so weak and the sparking at the commutator so great that the motor is in danger of being seriously injured or destroyed. The power output of the motor is also very materially reduced as the field is weakened. This method is also step-by-step and not gradual in its operation.

There is another way in which the strength of the magnetic field can be varied which is almost entirely free from all these objections. Quite a large range of speed variation, from 65 per cent. to 120 or 130 per cent. advance in speed is attainable, at the highest efficiency at all rates from the lowest to the highest speeds, in a very simple manner and at a low first cost. The motor gives a constant brake horse-power at all speeds, there is no sparking at the commutator at any speed and the method is so gradual and even in its operation that any speed from the lowest to the highest, to a fraction of a revolution can be obtained as desired.

I refer to the method of changing the reluctance of the magnetic circuit by increasing or diminishing the amount of magnetizable material in this circuit, and so increasing or diminishing the strength of the magnetic field that the magnetizing current remaining constant at all times.

A motor of this type does not differ materially in its make-up from the ordinary motor, except as regards its polar construction. One of the poles comprises a pole shoe of common form, integrally connected with a cylindrical shell, over which the magnetizing coil is wound, and within which is a solid core of high permeability and of a cross-section relatively large as compared with the conducting area of the enclosing shell. By means of a hand wheel this inner core or "plunger" is adjustable in a direction radial to the center of the armature, and is so proportioned that a slight variation in its position within the magnetized shell produces a very considerable difference in the reluctance of the magnetic circuit of which the plunger forms a part.

When the plunger is adjusted so that its inner end comes in contact with the pole shoe, the magnetic circuit is most complete and of a minimum reluctance, and, since the m.m.f. of the field coil remains constant, the volume of magnetic flux becomes a maximum and the speed a minimum, or normal. As the plunger is drawn away from contact with the pole shoe a column of air is interposed which gradually increases the reluctance of the magnetic circuit as long as the plunger continues to be withdrawn. When the plunger reaches the limit of its outward motion the reluctance of the magnetic circuit, and hence the speed becomes maximum.

It will thus be seen that the air-gap between the polar face and the armature always remains fixed and constant, the air-gap inside the pole being the element which is varied; and that as the magnetic flux is diminished by the outward movement of the plunger, the remaining magnetic flux is forced more and more in the direction of the pole tips, thus furnishing a magnetic field at all times of sufficient intensity to insure sparkless commutation.

To those familiar with the action of field-regulated shunt motors of ordinary type, a variation in speed of 100 per cent. by a corresponding variation of the magnetic flux would seem impossible of realization on account of the difficulty of securing sparkless commutation when the field strength of the motor is so abnormally reduced, but in the type here considered these objections are overcome, and the motor operates sparklessly under very wide variations of speed.

In regard to the fineness of speed adjustment, it is evident from the principles of the machine that there is no speed between maximum and minimum which cannot be obtained by an appropriate adjustment of the hand-wheel. It should be understood that while the motor carries its full load sparklessly, at any imaginable speed within its range at practically maximum efficiency, it will also carry any

lower load with a consumption of power corresponding with the actual work done. As the speed regulation is effected solely by varying the reluctance of the magnetic circuit no controller or rheostat or resistance of any kind is used in the regulation of the speed, all electrical circuits and connections remaining unchanged through the entire range of speed.

This method of variable-speed control is susceptible of other arrangements and variations, but the principle involved, that of varying the reluctance of the magnetic circuit by varying the amount of magnetizable material in such a circuit, gives a very wide range of speed change, at high efficiency, in a very simple manner and at low first cost; and also enables the motor to carry its full load without sparking, at any desired speed within its range, with an efficiency practically as high at one speed as at any other, and this without the use of any controller or rheostat whatever. It would therefore seem that this method is one which most nearly fulfills all the requirements of variable electric speed control.

New York. E. R. KNOWLES.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Variable Speed Three-Phase Motors.—BEHN-ESCHENBURG.—An illustrated description of induction motors built by the Oerlikon Company for changing the speed. The method consists in a combination of windings that can be grouped alternately so as to give either one number or double that number of poles, with the arrangement of two sets of independent windings having different numbers of poles. Thus, if one winding is arranged for grouping to give either 12 or 6 poles, and the other to give 8 or 4 poles, speeds corresponding to 12, 8, 6 or 4 poles will be available. In the first variable speed induction motors of this company the Gramme ring inducing winding is used, while in recent years drum windings have been employed. The winding has symmetrically arranged coils, as in the case of a direct-current armature, and is divided into 6 p groups of coils, p being the smallest number of pairs of poles employed. These groups of coils are changed over from p pairs to 2 p pairs of poles by a change-over switch, every two groups of coils belonging to one-phase being coupled in parallel for p pairs of poles, and in series for 2 p pairs of poles. For motors whose torque can be lower at high speed than at low speed, another variation is possible by changing from star connection to mesh connection, which gives a lower torque with good efficiency and power factor. The change-over switch itself is a combination of two ordinary three-pole switches. The small number of leads and terminals in combination with the simple, easily inspected winding, similar in every way to the winding of a direct-current armature, is said to form the principal point of novelty in the system. A considerable economy can be obtained by changing the poles in the case of three-phase motors which have to be started and stopped often, as in haulage or traction motors; on such machines the power expended in starting is of considerable importance; by increasing the number of poles while starting, the power lost in starting resistance in the induced winding, for a given torque, can be reduced to a quarter or half the original value, according as the number of poles at starting is four times or twice as large as the normal. The economy of starting can in this way be made equal to that of the series-parallel control of direct-current motors, while at the same time using standard types of motors. The results of tests of a small motor of this type are given. The different numbers of poles used were 12, 8, 6, 4 respectively, with star connection in the first four cases and mesh connection in the last two cases; the number of revolutions was 500, 750, 1,000, 1,500, 1,000, 1,500; the load in hp 3.5, 4, 7, 8, 3.5, 4; the torque in kgm 5.5, 4.1, 5.2, 4, 2.75, 2; efficiency at full load 72, 73, 85, 86, 86, 80 per cent.; efficiency at half load 70, 72, 82, 86, 82, 75 per cent.; power factor at full load 0.7, 0.82, 0.85, 0.92, 0.89, 0.92; power factor at half load 0.5, 0.65, 0.7, 0.83, 0.8, 0.88; no load current in amperes 11, 9, 8.5, 6, 2.8, 2; starting current 30, 30, 130, 135, 43, 45; heating after three hours' run at full load 30, 30, 40, 40, 35, 35° C. For a speed range of 1 to 2 these motors occupy the same space, have the same weight, the same output, the same efficiency and the same power factor as the standard single-speed motor, while for a 1 to 4 speed range the size and price increases only slightly. The author finally compares the speed variations obtained with these motors with those of modern direct-current shunt-wound motors; the chief difference is said to be that the three-phase motor works with approximately the same magnetic flux in the air-gap with all numbers of poles, and therefore can have a greater load and a better efficiency at the higher speeds, while the direct-current motor can only increase in speed through a reduction in the magnetic field, so that no increase in load or efficiency is possible.—Lond. *Elec.*, November 21.

Shaped Magnet Poles.—DAVIES.—An illustrated article on special shaped magnet poles and the way they affect commutation. To obtain a sparkless machine, several points should be attended to; first, the initial magnetic induction in the air gaps under the polar horns should be as high as possible, so as to afford a good reversing field; the way to do this is to reduce the polar arc to a certain proportion which gives the best results; the angle to be embraced by each pole-piece is usually made about 140° in a two-pole machine, about 68° in a four-pole machine, about 44° in a six-pole machine, and so on. Furthermore, it is essential that the cross-magnetization of the magnet pole-pieces brought about by the reaction of the armature on the field magnet, should be minimized as far as possible; for this cross-magnetization results in a weakening of the reversing field; this cross-magnetization may be prevented to some extent by increasing the reluctance of the path taken by the cross-magnetizing flux, which may be accomplished either by having a slot of moderate width cast in the magnet cores and pole-pieces, or by making the pole-pieces of cast iron. Another requirement is that the field in which the armature revolves must be magnetically rigid and not easily distorted, as otherwise every slight fluctuation of the load requires an alteration in the position of the brushes; there are several ways of modifying the shape and general design of the pole-pieces so as to impart a stiffness to the field; either the pole-pieces may be bored out so as to give a greater length of air gap at the tips of the poles than in the middle, so that the pole-pieces are non-concentric with the armature; or they may be bored out concentric with the armature in the usual way and the tips planed off afterwards; or the polar horns of opposite polarity are bridged across with a web of metal of the same kind as the pole-pieces, and of comparatively small section; or the pole-tips which are on one side of each pole only are made to point in the direction of rotation of the armature in dynamos and in the reverse direction in motors. A strong field is always desirable; yet if the field under the polar horns under which commutation takes place is too sharply defined, the neutral line on the commutator will also be sharply defined, and there will be a difficulty in setting the brushes so as to avoid sparking; to avoid this difficulty, each pole should have a fair amount of magnetic "fringing."—Lond. *Elec. Rev.*, November 14.

REFERENCE.

Armature Frames.—An illustrated description of riveted, wrought-iron, armature frames, introduced recently by Siemens & Halske for large alternators.—*Zeit. Ver. Deut. Ing.*; *Eng'ing News*, December 4.

POWER.

Water-power in Electrical Supply.—ADAMS.—An article in which he first discusses the variations which may be expected in the capacity of a water power during the several months of a year; curves from actual practice are given. He then deals with the case in which the total daily flow of water is equal in capacity to the total daily output of electrical energy, and discusses how far the water power can then be devoted to the development of that energy; this of course requires storage either of water or of electrical energy in storage batteries. He finally discusses what percentage of the yearly output of energy can be derived from water where this power is sufficient

to carry the entire load during a part of the year; he points out the different factors which must then be considered, and from an example in actual practice he concludes that comparatively large variations are to be expected in the value of the energy developed by water power in per cents of the total output of electric supply systems in different half years; but, in spite of these variations, the portion of electrical loads that may be carried by water power is sufficient to warrant its rapidly extending application to lighting and power in cities and towns.—*Cassier's Mag.*, December.

Electricity from Refuse.—Goodrich.—An abstract of a paper read before the Manchester section of the (Brit.) Inst. Elec. Eng. on "Electricity from Refuse; the Case for the Modern Destructor." He said that immense strides have been made in the last fifteen years. Continuity of high temperature is the essential for securing steady steaming, and in designing a destructor, combined with an electric plant, this is the cardinal point to be borne in mind. After quoting Highfield's advocacy of erecting cells in pairs so that one should always be working at its maximum, while the other is being charged and clinkered, he advocated as an excellent way of obtaining steady steaming and complete combination, the Mestrum system of continuous grate with divided ash pits; this is described and illustrated. Statistical data are given from 160 destructor plants in Great Britain and Ireland, 45 of which are in combination with electricity works. He says that efficient data are available to show that with a well-designed and well-managed plant at least "30 units per ton of refuse" burned may safely be relied upon throughout the whole year. Though continuous destruction of refuse is more economical and satisfactory; yet he thinks that the gain from the utilization of the power for lighting purposes quite justifies keeping it back and burning it only during the hours of electric lighting.—Lond. *Elec. Times*, November 20.

REFERENCES.

Turbines.—Thurso.—A very long and profusely illustrated article on modern turbine practice and the development of water powers. He first discusses the development of the turbine, and then the present American turbine practice with some remarks on the causes of lack of progress among American turbine builders. He finally takes up the modern turbine types and their construction in general, including turbines for low heads, medium heads, and high heads.—*Eng'ing News*, December 4.

Hydro-electric Plants in the Alps.—De La Brosse.—The third part of his serial. In this part he discusses various electro-chemical power houses; those in France are chiefly in the region of the Alps. He first gives a list of 17 power houses, of together 74,000 hp, a large portion producing calcium carbide, besides chlorates, aluminum and sodium. Some notes are added on various installations.—*Elec. Age*, December.

Electric Cranes.—Williams.—An article giving some notes on electric crane design and a wiring diagram showing the connections for a three-motor crane on a 220-volt circuit.—*Am. Mach.*, November 27.

Traction.

Electric Tramways.—C. and B. Hopkinson and E. Talbot.—A long abstract of a paper read before the (Brit.) Inst. Civ. Eng. The nature of the load on a tramway generating station is discussed and it is shown from actual records to what extent increasing the number of cars results in making the load more uniform. With 70 cars or more the load was so nearly constant that the steam consumption per unit was substantially the same as though it were constant and equal to the mean. Hence in a station of this size, equalization of the load by means of a storage battery is of no use as regards economy, though in a small station it may be of great value. A storage battery equal to replacing one-third of the generating plant for half an hour, should, however, be installed in a direct-current power station for the purpose of replacing a generating unit in case of break down and for running cars at night. The simplest method of transmitting the power to the cars is to make the trolley wires an electrically continuous network, and to feed the current into it at various points. In practice, however, it is found necessary to divide the trolley line into sections insulated from each other, each section being fed at one point. The points of division in the center of a city are determined by consideration of safety; in the outer districts, questions of economy and the necessity of keeping the variations of line-potential within limits, may enter The principles were illustrated by reference to Newcastle-on-Tyne; there was no objection to the line-potential occasionally dropping 100 volts below normal; and this led to the result that a 2½-minute service of cars could be worked up to a distance of 2 miles from a feeding point. The most economical size of cable was next considered; the mean current density should rarely exceed 300 amperes to the square inch. This entailed a mean drop of potential of about 13 volts per mile of feeder, and feeders could be carried to a distance of 1 mile or 1½ miles without boosting. The loss in the trolley wire in supplying ten cars on 1 mile of double track from one end, was between 2 per cent. and 4 per cent. of the power given to the cars. The conclusion was that on the outer sections the line might be divided into sections 2 miles long. The most important requirements in a motor car for use in city tramway systems, are that it should be capable of rapid and well-sustained acceleration, and that it should be able to go up hill quickly. These requirements can be fulfilled only by motors capable of traveling on the level at speeds far above what is allowable in practice. Curves are given showing the acceleration of the car from rest with various motors and under various conditions. A mean acceleration of 3 feet per second up to a speed of 10 feet per second can be obtained with motors of a type found to be satisfactory in Leeds and Newcastle. The authors discuss at some length the problem of the return circuits.—Lond. *Eng'ing*, November 21.

Safety of Surface Contact Systems.—Paul.—An article in which he criticizes the safety devices used in magnetic surface-contact systems. The cause of numerous accidents with the Diatto system in Paris has always been traced to the fact that the studs remained alive for a time after the cars had passed over them. As a means of safety in the Dolter system, both ends of the car are fitted with an earthed skate, which strikes each stud, short-circuiting it, should it have remained alive, the short circuit causing the fuse in the surface contact to melt. The author points out that such a contrivance interferes with the proper working of the system, and tends to reduce rather than to increase its safety as far as road traffic is concerned. Thus, supposing that a stud has remained alive and that the earthed skate strikes it, producing a short circuit, it does not follow that the fuse will melt; the time during which the earthed skate is over the stud is so very small that the fuse may fail to go, unless it be designed to blow with a very small current excess; in the latter case, however, it will be liable to go when the current is a high one, in starting a car for instance, or over heavy grade cuts. The proportioning of the fuses to meet all the conditions of working is a very difficult matter. Repeated trials have proved that fuses 10 by 1 mm in section proportioned for a fusing current of 60 amperes and a load current of 30 amperes, have not been blown when the short-circuiting skate has struck a stud that had remained alive. Moreover, supposing that the fuse in one of the contact boxes has melted, many days may often elapse before attention is called to the dead stud; the traffic may not suffer any interruption, but as soon as a car passes over such a stud, a break in the current always occurs at the neighboring stud, and this at the full intensity of the current which the car requires corresponding to its load; it means a cutting out of 30 to 40 amperes at 500 volts in the very small space which separates two contacts; the arc thus produced would have disastrous effects. Experience has shown that when a leakage occurs from the studs to the rails, the contacts in the apparatus open out only slowly, and sparking occurs owing to the residual magnetic flux. With low-current losses the magnetic blow-out will extinguish the arc, but the evil is not prevented from originating. When cutting out suddenly with the full car current the blow-out is not sufficient, and the arc will remain for some time if leakages exist on the street level. The author believes that, on the basis of the experience already gained, the only systems which meet the case are those with electro-magnetic surface contacts, containing perfect acting safety devices so arranged that the contacts are positively controlled and work sparklessly.—Lond. *Eng'ing*, November 21.

Electric Launches.—Dreihardt.—An illustrated description of the electric launches exhibited at the International Self-propelled Boat Exposition at Wannsee, Berlin, 1902. Three electric launches were exhibited by the Accum. Fab. A. G. Hagen, which company is said to have installed 75 electric boats in the last five years. The number of cells in these boats is either 40 or 80, in order to be able to charge the battery directly from a 110 or 220-volt station; boats with 200 cells have sometimes been made for charging from 550-volt stations. The charging is nearly always done at constant voltage and variable current, which enables one to complete the charge more quickly and with less attendance. The controller is handled by the attendant at

[illegible]. The [illegible] has a length of [illegible], and is driven by a [illegible] pole [illegible] motor of [illegible] with 1,200 revolutions per minute; the weight of this motor is 1,000 kg. The battery contains 80 cells, each having [illegible] positive [illegible] and [illegible] negative [illegible] plates. The capacity is [illegible] ampere hours for a [illegible]-hour discharge. The maximum charging current is 150 amperes, the maximum discharging current is 265 amperes. The total weight of the battery is 7,000 kg. The controller gives six different speeds; at the first three speeds the battery is connected in two groups in parallel; for the other three speeds all the cells are in series. The other speed variations are produced by connecting the four-magnet coils of the motor all in series, or in two groups connected in parallel, or all connected in parallel. The speed of the vessel varies between 9.5 and 17 km per hour. The two smaller vessels which were exhibited by the same company are also described.—[illegible], November [illegible].

INSTALLATIONS, SYSTEMS AND APPLIANCES.

REFERENCE.

Central Station Statistics of Switzerland.—LORENZ.—A long article with map, giving essentially the same statistical data as the article abstracted in the Digest December 6. The map shows that nearly the whole northern and western parts of Switzerland are covered with a network of transmission lines and that only comparatively few lines are required to close all the meshes of this network. Many water powers are not yet utilized.—*Zeit. f. Elektrochemi*, October 30.

ELECTRO-PHYSICS AND MAGNETISM.

Electrical Conductivity of Metals and their Vapors.—STRUTT.—An account of experiments in which he tried to bridge over the enormous gap between the electric conductivity (specific) of liquid mercury and mercury vapor. Mercury vapor is an insulator, while liquid mercury is a conductor. Since the liquid and saturated vapor are indistinguishable above the critical temperature, one or both of these must undergo a remarkable change of electrical properties as that temperature is approached. Attempts to predict the critical temperature of mercury seem to lead to results altogether inconsistent with one another; attempts to observe the critical temperature of mercury and arsenic in quartz tubes, failed; in both cases the critical temperature lies above a dull yellow heat; up to a full red heat the conductivity of saturated mercury vapor remains of quite a different order of magnitude from that of the liquid, the latter being 10 million times as great as the former. But on the other hand, the conductivity of the saturated vapor is immensely greater than that of the vapor at atmospheric pressure; for the former was found to have a specific resistance of the 7th power of ten times that of the liquid, and the latter more than four times the 14th power of ten times that of the liquid. Thus the vapor at atmospheric pressure has a resistance about four times the 7th power of ten times that of the saturated vapor, both at a full red heat; this ratio is of quite a different order from the ratio of the densities of those vapors. It seems likely that as the critical temperature is approached the vapor begins to conduct freely, while the liquid changes its electrical character to a much less extent. The conductivity of saturated arsenic vapor at a bright red heat is of the same order as that of mercury, and obeys Ohm's law, at all events up to a voltage drop intensity of more than 100 volts per cm.—*Phil. Mag.*, November; abstracted in *Am. Jour. Sc.*, December.

Resistance of Lead Sulphide.—VAN AUBEL.—An account of measurements of the change of the resistance of lead sulphide with the temperature. While Streintz found that compressed galena powder diminishes in resistance as the temperature rises, thus behaving like an electrolyte, the present author observed the opposite behavior in a cylinder of fused lead sulphide, chemically pure. The resistivity diminishes constantly as the temperature is lowered down to the temperature of liquid air.—*Comptes Rendus*, November [illegible]; abstracted in Lond. *Elec.*, November 21.

Conduction of Electricity in Flames.—LENARD.—A description of a phenomenon which he calls "visible wanderings of ions in flames." A Bunsen flame is placed in a horizontal electric field. If now a bead of some salt is brought into the flame, as for spectrum analysis, it is seen that the comet-shaped strip of luminous vapor runs slantingly towards the negative electrode. The "wandering" only sets in when the bead is brought into the interior of the flame. In the outer mantle the vapor ascends vertically.—*Ann. d. Phys.*, November 11; abstracted in Lond. *Elec.*, November 14.

Absorption of Electric Waves by Gases.—LECHER.—A description of an experiment which proves that the rings in an exhausted glass tube, produced by J. J. Thomson in an alternating electric field, are not due to electrostatic charge, but to an absorption of electric waves by the gas. The present author winds a bifilar wire coil and a simple wire coil round the same tube, and sends strong electric oscillations through both. In spite of the high charge of the wire in both cases, a ring is only formed inside the simple coil. He describes a method of studying the electrical conductivity of gases by observing the luminous phenomena thus produced. It consists practically of a vessel resembling a Bunsen ice calorimeter, the secondary coil being placed in the interior and the primary coil outside, with the gas or electrolyte in question filling the space between them. He finds that at a pressure of about 0.1 mm the air conducts much better than the best electrolytes. Such a pressure exists at a height of about 40 miles in the atmosphere, and it is therefore evident that the upper atmosphere very likely absorbs long Hertzian oscillations coming from the sun. It also explains the electric discharges often accompanying the fall of meteorites.—*Phys. Zeit.*, October 10; abstracted in Lond. *Elec.*, November 14.

Chemical Effects of Canal Rays.—G. C. SCHMIDT.—An account of an experimental investigation in which he endeavored to find whether positive ions in gases exert an oxidizing action. This might be expected, as the negative electrons in cathode rays are known to have a strong reducing effect, which has been explained by the assumption that the negative electron satisfies a positive valency of the metallic atom, so that this acquires a lower valency than before. By an argument based on analogy, it might be expected that canal rays, which are assumed to consist of positive ions associated in some way with neutral atoms, would exert an oxidizing action; the author did not, however, find any well-defined oxidizing action. There is powerful decomposition, but it depends upon the nature of the gas and the compound whether the decomposition results in an oxidation or in a reduction. Solid solutions which show luminescence under cathode rays show the same under canal rays, but it decreases rapidly owing to the decomposition, which is indicated "by the spectrum of the glow becoming whitish." If the gas in the tube is oxygen, and an oxidizable body is in it, the latter is oxidized; if, on the other hand, the gas is hydrogen, the latter reduces any compound capable of reduction. The most typical reaction for canal rays is the decomposition of sodium compounds; it takes place even when only traces of sodium are present, and is revealed by the *D* line.—*Ann. d. Phys.*, November 11; abstracted in Lond. *Elec.*, November 14.

Magnetization and Conductivity of Iron and Nickel.—BARLOW.—An account of measurements of the change of resistance shown by ferro-magnetic metals on magnetization; he studied this property in iron and nickel. He gives an equation for the "fractional increase of resistance" in fields not exceeding 450 units; in strong fields varying from 1,000 to 11,000 units, the fractional increase of resistance for longitudinal magnetization in nickel wire is practically constant and equal to 0.017. In still higher fields this value decreases slowly to 0.010. The transverse effect also called the "longitudinal Hall effect" is negative in strong fields.—*Proc. Roy Soc.*, October 17; abstracted in Lond. *Elec.*, November 21.

REFERENCES.

E. M. F. of a Thermocouple.—PONSOT.—A note in which he applies the thermo-dynamical principle to the theory of thermo-electricity.—*Comptes Rendus*, October 27; abstracted in Lond. *Elec.*, November 21.

Bismuth.—LOWNDS.—An account of an experimental investigation of the Hall effect, the ratio of the electric and thermal conductivities parallel and normal to the principal crystalline axis, and the change of the electric resistance of crystalline bismuth in a magnetic field.—*Ann. d. Phys.*, November 11; abstracted in Lond. *Elec.*, November 21.

ELECTRO-CHEMISTRY AND BATTERIES.

Alkali Industry.—J. B. C. KERSHAW.—The first part of an illustrated article on the present condition of the alkali industries. In the United Kingdom the capacity of two plants will be increased, and it is estimated that the output will then amount to 12,800 tons of bleaching powder and 18,000 tons of soda crystals per year. The Western Point works have paid a dividend of 6 per cent. for last year. Over 7,000 hp will soon be devoted to the electrolytic decomposition of salt in that country. Should the whole of the chlorine liberated

from the salt be converted into bleaching powder, the aggregate production of this chemical by the ton electrolytic plants will be about 25,000 tons yer year. In Germany, the group of electrolytic alkali works under the control of the "Elektron" appear to be working satisfactorily. The new Aussig "bell" process is being operated at one of the works, and it is probable that in course of time it will be generally adopted by all the works under that control. The maximum output of this group of works is 25,000 tons caustic potash and 40,000 tons bleaching powder per year; and the electrolytic works of the Solvaz Company, at Osternienberg, add about 5,000 tons to the latter total. The German home demand for bleaching powder is, therefore, more than covered by the output of the electrolytic plants, and the development of the export trade in bleaching powder is essential for the maintenance of the German electrolytic alkali industry. The total exports in 1900 amounted to 25,953 tons.—Lond. *Elec.*, November 14.

Explosion in a Storage Battery Plant.—SCHOOP.—An account of two serious accidents which recently happened in German storage battery plants, due to explosions on account of the use of electrically produced hydrogen and oxygen for soldering purposes. These gases are now said to be used for that purpose generally in German accumulator plants. The writer recommends excluding organic substances from contact with oxygen and to use water only for lubricating the valves, and to be very careful in holding the receptacles for oxygen and hydrogen particularly separate so that any mixture of gases by carelessness is excluded.—*Elek. Zeit.*, November 6.

Lead as Anode in Sodium Hydroxide Solutions.—ELBS AND FORSSELL.—An account of an experimental investigation of the behavior of lead as anode in sodium hydroxide solutions and of the electrolysis of sodium hydroxide solutions containing lead oxides. The principal results are as follows: A lead anode dissolves in sodium hydroxide. In the electrolysis of sodium hydroxide solutions, containing lead oxides with inert anode, the primary electrolytic action at the anode is the discharge of lead oxide and oxygen, while lead peroxide is secondarily formed; hence the amount of peroxide formed per coulomb increases considerably with increasing temperature; moreover the speed of formation of the lead peroxide depends greatly on the material of the anode. Lead peroxide has, like platinum and some other metals, the property to occlude oxygen. —*Zeit. f. Elektrochemie,* October 2.

Reduction by Calcium Carbide.—NEUMANN AND VON KNEGELGEN. —Two articles of a polemic nature. It is known that calcium carbide may be used for the reduction of metallic oxides and salts. These two authors have reached different conclusions concerning the formula representing the process; von Knegelgen's formula requires considerably less carbide for the process, thus making it less unlikely that it may have a practical application. Neumann assumes that carbon monoxide is formed primarily, while von Knegelgen assumes the primary formation of carbon dioxide. Neumann's paper is to be found in *Zeit. f. Elektrochemie,* October 2; von Knegelgen's paper in the same journal, October 9.

Potential of Amalgams.—REUTER.—An account of an experimental investigation of the electromotive behavior of potassium amalgams. His results correspond with those of Haber and Sark. The results are plotted in the form of a curve which shows a characteristic large jump at the point corresponding to the alloy Hg_{12} K. The potentials have about the position on the curve which they should have according to Berthelot's rule. The potential of pure potassium and pure sodium is lowered considerably by slight additions of mercury.—*Zeit. f. Elektrochemie,* October 16.

REFERENCES.

Dusseldorf Exposition.—DANNEEL.—Continuations of his illustrated serial on electro-chemical exhibits at the Dusseldorf Exposition. Several instruments of Hartmann & Braun and electric laboratory furnaces of Heraeus are described and illustrated, and some data are given on power gas installations.—*Zeit. f. Elektrochemie,* October 16, 23.

Electro-chemical Engineering.—As a supplement of the *Centralblatt f. Accum.* there is now being published *"Elektrochemische Technik,"* which is a reportorium arranged in alphabetical form of new articles, papers and patents concerning electro-chemistry, electrometallurgy and electric plating.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Influence Machine.—WOMMELSDORF.—An illustrated description of a new type of influence machine which combines the advantages of former types with the possibility of producing a greatly increased quantity of electricity. The ebonite cylinder holds nine armature discs, separated by ebonite rings. Alternating with these discs are the exciter discs. Each armature disc consists of two equal ebonite discs adhering to each other, and holding between them a number of metallic sectors, which appear through sectors cut in the ebonite. These discs are there for the purpose of collecting the free electricity from the surface of the dielectric and should be made of some thicker material than the ordinary tin foil. The machine produces an internal current of air, which has the double advantage of pumping out the ozone and of producing a slightly lower atmospheric pressure. The location of the armature discs has the effect of doubling their capacity. The machine is said to be specially suited for x-ray apparatus to be used on the battlefield.—*Ann d. Phys.*, November 11; abstracted in Lond. *Elec.*, November 21.

REFERENCES.

Compensator.—EDELMANN.—An illustrated description of a compensator for precise measurements with combined sliding and plug contacts. The sliding contact is used for rough adjustment, while the plug contacts serve for the exact adjustment.—*Elek. Zeit.*, November 10.

Electric Meters.—ZIEGENBERG.—The first part of an illustrated article on electric meters. The author first discusses in general the different types of meters, and then begins to describe some improvements made in recent years in motor meters.—*Zeit. f. Belencht.*, November 10.

Determining the Specific Gravity of Liquids.—An illustrated description of a new "araeo-pyknometer" devised by Raikow, which enables one to determine the specific gravity of the same small quantity of a liquid easily at different temperatures. The instrument is a modified form of hydrometer; the liquid to be measured is placed in it, and the apparatus is then floated in water at the desired temperature.—*Centralblatt f. Accum.*, November 1.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telephony.—COLLINS.—An illustrated article on his system of wireless telephony. He uses long electric waves, produced by means of low-frequency, high-potential currents. The primary of his sending induction coil is in series with the transmitter, battery, variator and key; the terminals of the transformer are connected to the earth and to a compensating capacity; bridged across the terminals of the secondary is a Leyden jar condenser; the receiver is formed of a closed circuit, which has the telephone, a single dry cell, and the secondary of a transformer, in series; the primary of the transformer is earthed as in the case of the transmitting secondary of the induction coil. He succeeded in transmitting speech over three miles, the articulation being clear and loud enough for commercial purposes. He proposes to equip vessels with his system for communication with the shore.—*Elec. Rev.*, November 29.

REFERENCE.

Wireless Telegraphy.—The first part of a summary of some recent wireless telegraphy patents. The first is a patent of Prof. Fleming and the Marconi Company for an apparatus producing electrical oscillations of very high frequency and also great energy, for the purpose of accomplishing long-distance wireless telegraphy. Another patent of the same inventors relates to an apparatus designed to overcome the danger due to a sudden make or break in the primary circuit of an alternating-current transformer. Another patent to Fleming relates to apparatus designed to obviate the opening and closing of the primary circuit in order to cut up the trains of waves into signals. Another patent of the Marconi Company, which is described, relates to a device to syntonize or tune the transmitting and receiving apparatus to each other, so that signals cannot be received by any other instrument; this method has already been referred to in the Digest. A patent of Blondel's system with monotelephones is then discussed at length.—Lond. *Elec.* November 14, 21.

MISCELLANEOUS.

REFERENCES.

Fused Quartz.—An illustrated description of chemical apparatus which is now made commercially of fused quartz. The price is still rather high. It is said that such apparatus can be heated up

[illegible]

Electric Kitchen.—COLLMAN.—An illustrated article describing [illegible]

[illegible]

New Book.

[illegible] Twenty-fifth Convention, [illegible] New York; James Kempster Printing Company. 720 pages, illustrated.

As a contribution to technical literature, the present volume of the *Proceedings* of the National Electric Light Association is by far the most valuable of the series to date. In fact, in this respect it compares favorably with any of the volumes of the *Transactions* of the American Institute of Electrical Engineers, with the advantage that all of the material is of an essentially practical character. The [illegible] "Question Box" department, which covers 163 pages, and includes consideration of 71 questions and answers relating to matters of practical interest to the central station man. In the entire range of electrical literature we know of no contribution to the operative side of electrical engineering that compares at all with that here given in intrinsic value.

The other contents are with some few exceptions also of live interest and highly practical in character. The most notable contributions are the several papers and discussions on rates, on lamp efficiency from the operative standpoint and on polyphase distribution in cities. Other papers of intrinsic value are on protection of long-distance transmission lines, meters, liquid fuel and 220-volt lamps. Prof. Mathews' annual report of work on arc lamp photometry forms another contribution of the highest value to this subject. The association is to be congratulated that in carrying out its purposes as a body of central station men banded together for business purposes, it should at the same time be a source of such excellent contributions to technical literature.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary Ralph W. Pope, 95 Liberty Street, New York. Meetings: December 19th, "Braking and Traction Brakes," J. D. Keiley and R. A. Parke; January [illegible], "Telephone Exchanges"; February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES, Secretary, W. H. Johnson, Philadelphia, Pa.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

Maximum Demand Indicator.

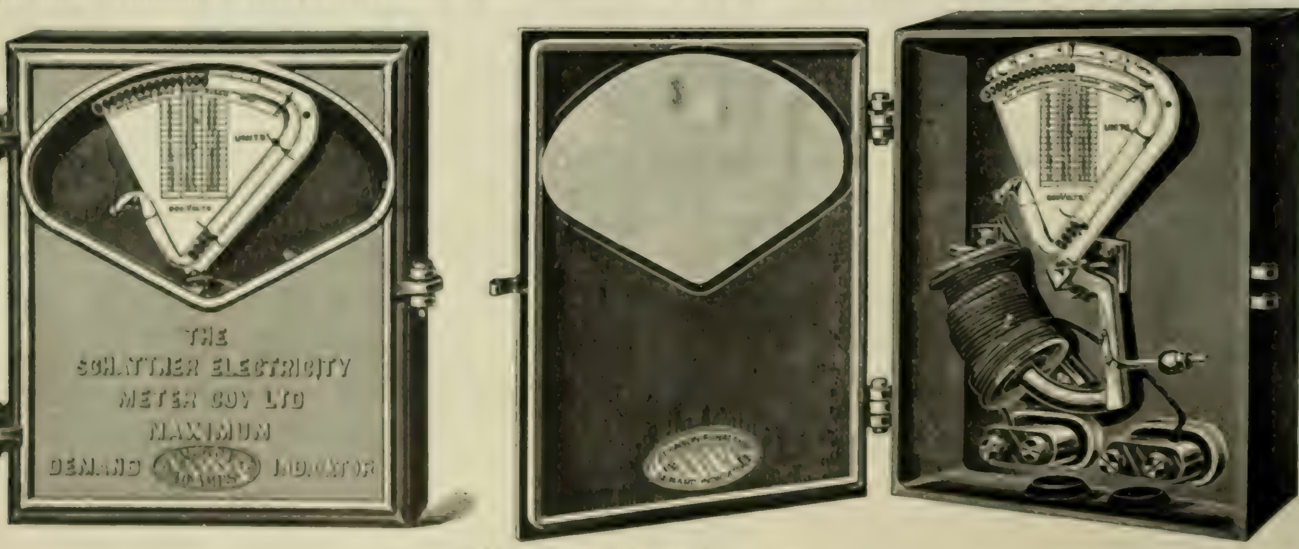
The accompanying illustration shows a new type of maximum demand indicator, which recently has been very largely adopted by English central stations. The inventor is Mr. E. B. Schattner, whose name is well-known in connection with the art of electric meters. The instrument is manufactured by the Schattner Electricity Meter Company, Upper Street, Islington, London.

The instrument is extremely simple in construction, and consists essentially of a metallic frame pivoted at the center, and carrying at one end a cylindrical iron core entering a solenoid, and at the other end a glass tube and scale. As will be seen from the engravings, one part of the glass tube is bent to the arc of a circle concentric with the pivot of the frame. The tube contains a number of steel balls, and is filled with glycerine or oil.

When current is passing the core is sucked into the solenoid, and the frame is tilted to the right of its pivot; any balls to the right of the highest point of the curved portion of the tube then slowly slide down and pass around the bend into the lower limb of the tube, where they remain. If at any time the frame is tilted by the solenoid still further to the right, one or more additional balls will be caused to descend into the tube. Consequently, when the meter is to be read, it is merely necessary to count the balls contained in this tube in order to determine the maximum current that flowed in the period since the meter was last set.

The tube is filled with oil or glycerine, the viscosity of which determines the speed at which a ball passes through the curved portion of the tube. A time element is thus introduced which prevents a ball descending into the lower limb if the higher current is merely momentary. According to the viscosity of the oil chosen, this leeway may vary from less than a minute to ten or more, and the time element can be made still larger by the use of glycerine as the fluid in the tube. Changes in the temperature of the fluid merely act to change this time element, in the selection of which there is considerable latitude. The balls, which are of steel and highly polished, are of the same type as those used in bicycle bearings.

The upper part of the sector carrying the tube is graduated, and in reading the sector is moved so that the end of the line of the balls remaining in the curved tube comes below a point projecting down from the case, when the maximum amperes that had passed in the circuit can be read off on the scale. There may also be printed on the scale a table giving the charging rates.



MAXIMUM DEMAND INDICATOR

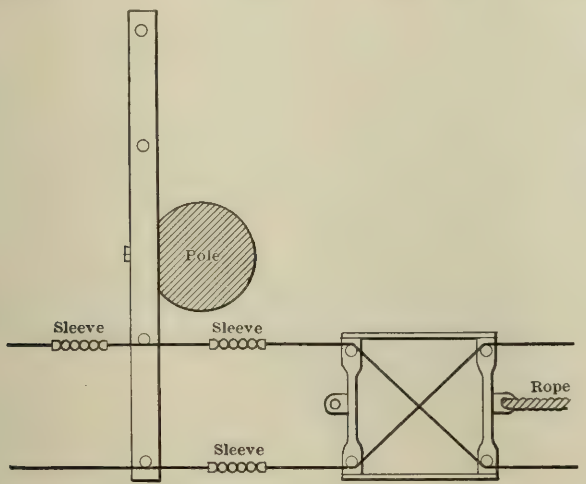
The tube is supported in the sector by three light wire clips; to reset, the tube is removd and tilted until all the balls are returned to the curved portion, when it is reclipped in the frame. The coils of the solenoid are so wound as to give as nearly as possible a uniform pull, and the range of the pull is such that one ball goes down for every quarter of an ampere in the middle of the scale, and for every half ampere on the remainder of the scale. To set the scale to zero, there is an adjustable weight on an arm projecting from the pivoted frame.

Transposition of Line Wires.

The method of transposing telephone and other line wires in general use at present consists in cutting in on the cross-arm or pole. The materials used for such a transposition are two full and six half sleeves, two transposition pins, two pairs of transposition insulators and about six feet of wire. When it becomes necessary to renew cross-arms or poles, the transposition has to be cut out and then replaced, while it often occurs that linemen working on poles step on a transposition, thereby causing a short circuit on the line which is often difficult to locate.

In a patent recently granted to James O'Brien and John Mattmore, of 12 Burgher Avenue, West Brighton, Staten Island, New York, it is claimed that these disadvantages are obviated by a system whereby the transposition is cut in at a pole and then by the aid of a rope is moved to any desired point between the poles.

The material used for a transposition consists merely of three full-



METHOD OF TRANSPOSING LINE WIRES.

connector sleeves and a short piece of wire. There is by this method no interference in renewing cross-arms or poles nor in pulling up slack wires, and danger of short-circuiting the line at the transposition is obviated. The principles of the method are plainly indicated in the accompanying illustration.

Annual Meeting of Electrical Trades' Society.

The seventh annual meeting of the Electrical Trades' Society was held at the Astor House, New York, December 9th. The president's address and the reports of the secretary and treasurer showed the society to be in a very flourishing condition. It was decided that, beginning with next year, the annual meeting will be held in the evening and will be followed by a dinner, thus blending the business and social sides very agreeably. A committee composed of J. H. Dale, J. J. Gorman and R. E. Gallaher was appointed to promote the success of this new procedure. The officers elected for the ensuing year were H. A. Reed, president; J. H. Dale, vice-president; A. P. Eckert, secretary and treasurer; and the following directors: F. V. Bennis, R. E. Gallaher, J. P. Marshall, J. J. Gorman, and H. R. Shwartz. R. E. Gallaher was appointed delegate to the National Board of Managers, which convenes at Cincinnati in March.

New Hand Microtelephone.

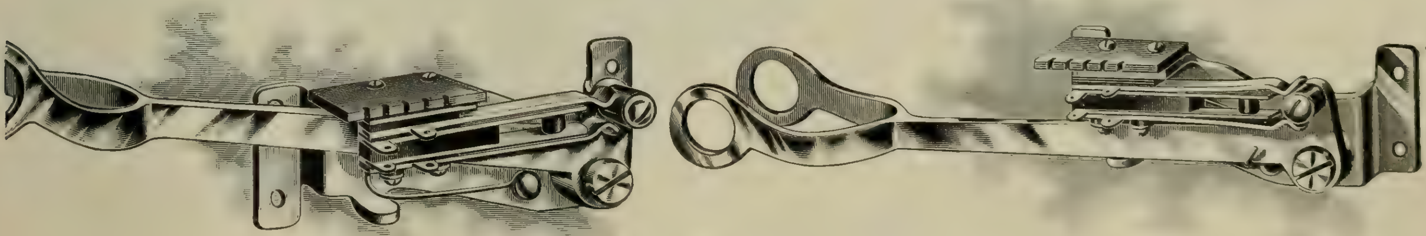
MICROTELEPHONE.

This instrument is intended for use in place of an ordinary desk telephone or where a hand telephone is desired. It is made up in the best possible manner and can be wired for use on any system. It is fitted with hard rubber handle, hard rubber mouthpiece, long-distance transmitter, bipolar watchcase receiver in nickeled bronze shell, silk conductor cord, and terminal block, on which is mounted the induction coil. In the type shown, a presser switch in the handle is arranged to do all the necessary switching, thus doing away with a hook switch, as used in other types of instruments.

A similar form has no switch in the handle, the necessary switching being done by means of a hook switch on which the hand microtelephone is hung when not in use. This apparatus is being put on the market by the Connecticut Telephone & Electric Company, of Meriden, Conn.

A New Telephone Hook-Switch.

In Figs. 1 and 2 are shown two perspective views of a new hook-switch recently placed on the market by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. The hook is of the long lever type and mounted on a heavy brass frame fastened with bolt and nut. The hook lever forms no part of the circuit, but all contacts are made by the springs mounted upon the lug on the side of the frame, as shown. The downward movement of the hook causes a hard-rubber insulated pin, attached to the lever, to be drawn in between the springs, thus disengaging the springs and breaking contact, as shown in Fig. 2, and making contact when the hook is released, as in Fig. 1. A stop is provided at the lower edge of the frame to prevent the downward movement of the lever, below the proper point. The springs are made of German silver of good length, and all contacts are pure platinum; pure hard-rubber strips are used to insulate the springs from each other and the frame. At the top of the lug, upon which the springs are mounted, is fastened a strip of hard fibre with the front edge slotted, through which the wires are brought down to the springs, thus keeping them separated and reducing the chances of short-circuiting to a minimum.


FIGS. 1 AND 2.—TELEPHONE HOOK-SWITCH.

Increase of Traction by Magnetism.

[illegible] of experiments [illegible] Honey, of Tacoma, Wash., to increase the traction between car wheels and rails by means of [illegible]. Mr. Honey's experiments have been so suc[illegible] pany has been formed, with headquarters at Chicago, for equipping electric cars and locomotives with apparatus for increasing traction. On a fifteen-ton, double-truck car at Seattle, Mr. Honey's latest apparatus increases the traction between wheels and rails 350 per cent., with an expenditure of 2½ hp of electrical energy. The importance of this to electric roads in the way of in[illegible] braking power on a slippery rail can hardly be overestimated.

It also has an important application in increasing the traction of locomotives, both steam and electric, because by so increasing the traction of a locomotive, it greatly increases the useful work which the locomotive can perform, because the work done by most locomotives is limited by their traction in starting a train.

The magnetic effects produced are somewhat remarkable. An idler wheel is used on the rail just outside the car wheel for completing the magnetic circuit from car wheel to rail and back to the truck frame or axles. The idler is carried on an arm, one end of which has a bearing on the axle just inside the car wheel. This arm has the magnetizing wire wound upon it. The Magnetic Equipment Company, of Chicago, controls the patents on the apparatus and is about to go ahead with the manufacture of it on a large scale.

A Countershaft Geared Motor.


GEARED MOTOR.

With the increasing tendency toward the direct application of electric motors for machines requiring power in any considerable amount, conditions often require the direct attachment of the motor to a slow-running shaft. In many such cases it is desirable to make the whole speed reduction, or at least a considerable part of it, at the motor itself. The easiest way of accomplishing this is by the use of a motor having the countershaft as a part of the machine. The cut herewith shows a type of motor for this purpose as manufactured by the Crocker-Wheeler Company, of Ampere, N. J.

The motor possesses certain features of the standard semi-inclosed machine, a prominent one of which is the ability to revolve the end plates one-quarter or one-half revolution, retaining the oil wells beneath the shaft in case the motor is semi or completely inverted. The support for the countershaft bearings is part of the motor frame, and being placed near the base of the motor, gives great rigidity to the countershaft. It will be noticed that each end of this support has projecting lugs for holding down bolts, which permit of a very solid attachment for the entire frame of the machine. It is possible to give a speed reduction as high as 8 to 1. The above motor has met with great success wherever used, as it possesses those features most needed in the work for which it is intended, namely, compactness and strength.

Enameled Steel Lamp Shades.

The Federal Electric Company, of Chicago, which manufactures electric signs of enameled steel, has been so impressed with the strength and fine appearance of the white enameled steel ware used in its sign work, that it is now offering lamp shades of the same ware. The enamel is of the highest grade, giving a surface fully equal to porcelain. These shades are especially applicable to electric cars, and places where a porcelain shade is liable to be broken. When used with a car cluster, which involves the removal of the cluster before the shade can be removed, they are especially desirable because they are practically indestructible, so that there will never be any necessity of taking the cluster apart to renew the broken shade. The shade can be tapped with a standard pipe thread so that it can be screwed directly to the iron pipe of a fixture.

The Butler Drill Chuck.

We illustrate herewith a new drill chuck which has recently been placed on the market by the Butler Chuck Company, Greenfield, Mass. This chuck differs in construction and principle from any heretofore made, and the results obtained from its use are said to be very satisfactory. Its distinctive feature is the enormous grip which is obtained upon the drill or other tool it is holding.

Fig. 1 shows the chuck in two sections, with the working parts exposed. It consists of an arbor sleeve, cap, plug and three jaws. The arbor and sleeve appear at the left, the cap, plug and jaws at the right in Fig. 1. The arbor or shank can be turned to any taper desired. The end of the arbor, or that portion which enters the knurled sleeve, has on its surface a right-hand thread. The center of the arbor is bored and tapped to receive the left-hand threaded plug corresponding to the thread on the surface. Around the arbor revolves the knurled sleeve to which is rigidly attached the conical cap. The sleeve and cap

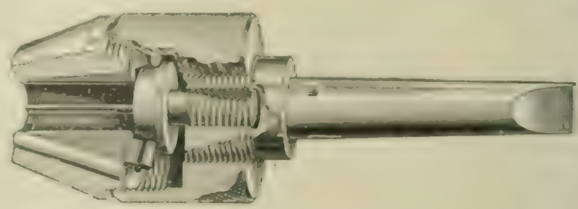


FIG. 1.—DRILL CHUCK.

work together, except when assembling or dismantling the chuck. Within the conical cap are three oblique converging channels which guide and support the jaws. Above the cap, in Fig. 1, is shown the left-hand threaded plug, on the lower face of which are three horizontal converging channels, in exact relation to those in the cap and into which are placed the upper flanges of the jaws.

The jaws are wedge shape forgings, on the back and top of which are circular flanges to correspond with the channels in the cap and plug. When the chuck is assembled, the plug is screwed into the arbor and the sleeve screwed firmly to the cap. Thus by revolving the body of the chuck to the right, it travels up the arbor at the same time the plug travels down into the


FIG. 2.—DRILL CHUCK.

cap, forcing the jaws out with just half the revolutions usually required, also confining the travel of the body to a very short distance. The friction rests on the plug, which is of small diameter, and the grip of the hand in tightening the chuck is greatly multiplied through the differential screw. By the aid of this same feature the resistance of the work continually tends to tighten the grip. The chuck is made of steel throughout, such parts being hardened as are subject to severe wear.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was decidedly firmer, with small offerings, closing at 6 per cent. for all dates, with a commission in addition in some cases. The stock market was dull and heavy in tone, owing to the renewed high rates for both call and time loans. Little interest was taken in the market by the public. The traction stocks receded after showing strength on exaggerated reports about the scope of the Manhattan deal. The latter sold off in spite of the declaration of a dividend which puts the stock on a 6 per cent. basis, and the action of the directors in reference to a forthcoming issue of rights to the present stockholders. The industrials were dull and generally heavy, although United Steel stocks held fairly well. Amalgamated Copper was sold by Boston houses on statements that there is a renewed accumulation of the metal in the hands of producers. In Brooklyn Rapid Transit 208,645 shares were sold at prices ranging from 64 to 67¾, closing at 64¼, a net gain of ⅜ point. Met. St. Ry. closed at 139¼, a net loss of ⅝, after having reached 145¼, the closing figure being but ¼ point above the lowest of the week. Manhattan lost 8¾ points net, closing at 147¼, one-quarter point above the lowest figure, the highest being 157⅛. General Electric was dull, closing at 176½, a net loss of 2½ points. Westinghouse, both issues, was inactive, closing at 200 for the common and 206 for pfd., being net losses of 6 and 2 points respectively. Western Union dropped ¾ point net, closing at 87¾. Following are the closing quotations of December 9.

NEW YORK.

	Dec. 2.	Dec. 9.		Dec. 2.	Dec. 9.
American Tel. & Cable..	89	88	General Electric	177	178
American Tel. & Tel...	159	160	Hudson River Tel.....	—	—
American Dist. Tel.....	35	34	Metropolitan St. Ry....	141½	139¾
Brooklyn Rapid Transit.	64⅝	64⅜	N. E. Elec. Veh. Trns..	⅛	—
Commercial Cable	170	—	N. Y. & N. J. Tel.....	162	163
Electric Boat	20	22	N. Y. E. V. T. Co....	—	10
Electric Boat pfd......	37	37	Tel. & Tel Co. Am....	—	—
Electric Lead Reduc'n..	3½	3⅜	Western Union Tel.....	87¾	87¾
Electric Vehicle	4	3½	Westinghouse Com.....	200	195
Electric Vehicle pfd....	11	10	Westinghouse pfd......	205	200

BOSTON.

	Dec. 2.	Dec. 9.		Dec. 2.	Dec. 9.
American Tel. & Tel..	160¾	160⅛	Western Tel. & Tel. pfd	—	98½
Cumberland Telephone .	—	126	Mexican Telephone	2	2
Edison Elec. Illum....	—	—	New Eng. Telephone...	137	137
General Electric	178½	—	Westinghouse	101	—
Western Tel. & Tel....	—	25	Westinghouse pfd	102	—

PHILADELPHIA.

	Dec. 2.	Dec. 9.		Dec. 2.	Dec. 9.
American Railways.....	52¾	—	Phila. Traction	97¾	97¾
Elec. Storage Battery...	79	79	Phila. Electric	8¾	8½
Elec. Storage Bat'y pfd	—	—	Pa. Elec. Vehicle	—	—
Elec. Co. of America...	9½	9½	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	Dec. 2.	Dec. 9.		Dec. 2.	Dec. 9.
Central Union Tel......	—	—	National Carbon pfd....	100*	97
Chicago Edison	175	—	Northwest Elev. Com..	—	—
Chicago City Ry.......	211	208¾	Union Traction	14¼	13½
Chicago Tel. Co........	—	—	Union Traction pfd	45	45
National Carbon	30*	26			

* Asked.

DIVIDENDS.—The directors of the General Electric Company have declared a regular quarterly dividend of $2 per share upon the common stock, payable Jan. 15. Chicago Telephone Company has declared the regular quarterly dividend of 2½ per cent., payable Jan. 2. The directors of the Commercial Cable Company have declared the regular quarterly dividend of 1¾ per cent. and an extra dividend of 1 per cent., payable Jan. 2. The directors of the Manhattan Railway Company met last week and increased the dividend on the stock from 4 to 6 per cent. by the declaration of a quarterly dividend of 1½ per cent., as compared with payments of 1 per cent. each quarter since 1896. From 1891 to that time 6 per cent. per annum had been paid. The directors of the Detroit United Railway Company have declared the regular quarterly dividend of 1 per cent. on the capital stock, payable Jan. 3.

GENERAL ELECTRIC.—Previous to the declaration of the regular dividend of $2 per share on General Electric a few days ago there were rumors, says the *Wall Street Journal,* that an increase in the rate might be looked for. It is now rumored, notwithstanding that no such action was then taken, that the stock is not unlikely to be put on a 10 per cent. basis three months hence. Insiders discourage all such expectations. Among people in touch with the company's affairs it is said that while business is fully up to the limit of the company's capacity, and while profits are satisfactory, the latter are not quite as large as they might be, nor as large as it was estimated they would be, at the time when taken. Large increase in wages is a main reason assigned.

STOCK EXCHANGE TELEPHONES.—When the New York stock exchange moves into its new building, members will be taxed for the privilege of having a private telephone booth on the floors of the exchange. This is an innovation, as heretofore there was no tax, except $50 a year for the telephone boys' card. Hereafter, however, the members will have to pay a tax ranging from $350 to $100 a year according to the place of the booth. Members have received a notice from the governing committee requesting them to make application for booths, giving a diagram of the booths, and the price for the various situations.

INDIANA LIGHT AND TROLLEYS.—The Indiana Company, capital $1,000,000, with $500,000 paid in, filed papers of incorporation last week in New Jersey to construct railways and electric light plants in Indiana. The incorporators are Thomas Dolan, Randall Morgan, Franklin H. MacMorris, Clinton N. Latourette and George H. Martin. Most of these incorporators are Philadelphians.

ILLINOIS ELECTRIC VEHICLE.—The liquidation committee of the Illinois Electric Vehicle Transportation Company, at Chicago, has arranged to wind up the affairs of the company by the payment of $1.50 per share to the stockholders. The par value of the shares was $5 each. About $260,000 was recovered from the total investment.

CHICAGO EDISON STOCK.—To meet cost of general improvements, the Edison Company will issue $2,276,901 new stock at once to shareholders at par. This will leave $133,429 in the treasury. Payments will be made in four installments on Feb. 2, May 1. Aug. 1, and Nov. 1. This raises the total capital of the company to $9,866,000.

DETROIT EXTENSIONS.—Directors of the Windsor, Sandwich & Amherstburg Electric Railway, controlled by the Detroit United Railways Company, have authorized a $600,000 mortgage to secure an issue of 5 per cent. bonds to be applied to the completion of the system from Sandwich to Amherstburg.

PARIS GAS AND ELECTRIC.—A corporation intended to absorb all the gas and electric companies of Paris is being formed, it is stated, by A. N. Brady and W. C. Whitney. The capital of the corporation will be $50,000,000, with the stock about equally divided between American and French capitalists.

NEW YORK & QUEENS ELECTRIC.—Application has been made to the New York Stock Exchange to list New York & Queens Electric Light & Power Company $342,000 additional first cons. mortgage bonds of 1930.

HUDSON RIVER POWER.—A Saratoga dispatch announces that the Hudson River Power Company will, on Dec. 23, consider a proposition to increase its capital stock from $2,000,000 to $5,000,000.

SIEMENS & HALSKE COMPANY, of Germany, has taken up for the whole of Europe the Pupin "loaded" telephone cable patents owned here by the American Bell telephone interests.

Commercial Intelligence.

THE WEEK IN TRADE.—The advent of seasonable winter weather has stimulated trade in winter goods, and retail trade in general has assumed its usual seasonable aspect. Cold weather from now out is needed to insure the large movement of corn expected, as the result of active export and home demand. *Bradstreet's* summarizes the trade conditions as follows: "The year's approaching end finds prices well up to the highest point in eighteen months, though meats, an important element in food supplies, are steadily declining on good receipts. November bank clearings showed small gains over the same month last year, no doubt being curtailed by mild weather limiting crop movement and retail trade, but the 1902 total (eleven months) is now only half of 1 per cent. below 1901, with prospects that the deficiency will be more than made up in December. Business failures are smaller than a year ago in number and much smaller in liabilities, and the year to date shows the smallest number for ten years past. The efforts of the railroads to break the freight blockade have been partially successful. and the situation, here, at least, is mitigated, though not entirely relieved, with the result that fuel supplies are larger and industry surer of being uninterrupted than for some time past. Railway gross earnings thus far reported for November are heavily in excess, at least 10 per cent., of the same month a year ago. Next to the expectations, already partly realized, that an enormous holiday business will be done, the most notable feature is the practical unanimity of opin-

so that a large spring trade is in prospect, ground for this being furnished by the unprecedented volume of such business already booked. The feature in foreign trade is the turn in the tide of iron exports, which have at last begun to expand after fifteen months of scarcity, high prices and trifling shipments. Iron trade conditions are quieter, in keeping with seasonable changes. Foundry iron is slightly lower for next month's delivery. Increased furnace capacity would seem to guarantee more liberal supplies of iron next spring, and there would really seem no real chance for foreign iron, imports of which for October were smaller than for September, while exports were larger, a significant indication of the foreshadowed change in foreign trade currents. Steel rails are still actively in demand. Hardware is still quite active, a feature being liberal ordering for next spring's delivery. Among the other metals, tin and copper are stronger. Prices of copper here advanced as a result of the advance on the London market. Quotations are normal, Lake being 11.50c.; electrolytic and casting stock 11⅜c.; Standard 11.50c. The exports of the metal for November aggregated 10,520 tons, which is the smallest for any month this year, so far. The business failures for the week ended December 4, as reported by *Bradstreet's*, numbered 185, as against 182 the previous week and 237 the same week last year.

THE STANDARD UNDERGROUND CABLE COMPANY has about completed the erection of the largest and most modern plant in this country for rolling copper rods, drawing all sizes and shapes of bare wire and insulating weatherproof wires and cables. This plant is an addition to its large underground cable factory and rubber insulated wire and cable factory at Perth Amboy, N. J. The rod mill was started successfully on November 25 and the wire mill will be in full operation immediately. The company is prepared to furnish bare rods and wire in any quantities, the capacity of the rod mill being 3,000,000 lbs. per month and the wire mill 2,000,000 lbs. single turn. The weatherproof factory will be in full operation by Feb. 1, 1903, with a capacity of 500,000 lbs. of wire and cables per month working single turn. The sales department staff has been largely added to on account of this new departure and the general increase of business. The general sales department, with headquarters in Pittsburg, together with the branch office managers at New York, Philadelphia and Chicago, remain the same. Mr. A. B. Saurman, who has represented the company in Boston for the past few years, goes to San Francisco, where he is associated with Mr. C. F. Sloane, the Pacific Coast sales agent of the company; Mr. Saurman devoting his attention exclusively to the interest of the company on the coast. The Boston office is now in charge of Mr. Frank Clarke Cosby, formerly the representative in St. Louis. The New York office force is augmented by the presence of Mr. H. P. Kimball, formerly with the Williamsport Electric Company. Mr. R. M. Hirst, for several years connected with the Philadelphia office, will devote most of his time to the trade in that territory. The Pittsburg office will have two men constantly on the road; Mr. A. A. Anderson, who has been with that office for several years, and Mr. McBride, formerly with the Pittsburg Reduction Company. Mr. J. R. Wiley at the Chicago office will be assisted by Mr. E. J. Pietzcker, formerly with the American Steel & Wire Company.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has included among its shipments of engine type generators for the month of November, one 400-kw for the Stephen Girard Building, Philadelphia, Pa.; one 100-kw; one 125-kw for the Missouri Pacific Railway, McKees Rocks, Pa.; one 200-kw for the Penna. Malleable Company, McKees Rocks, Pa.; one 200-kw for J. L. Mitchell, Philadelphia, Pa.; two 50-kw for the Liveright & Greenwald Building, Philadelphia, Pa.; two 100-kw for the McClintic-Marshall Construction Company, Pottstown, Pa.; one 300-kw for the Grand Crossing Tack Company, Chicago, Ill.; one 400-kw for the Lake Construction Company, Erie Co., Pa.; one 250-kw for the Wilmington City Electric Company, Wilmington, Del.; one 225-kw for the Pine Bluff & Western Railway, Pine Bluff, Ark.; two 150-kw; one 200-kw; one 75-kw for the Woodward & Lothrop Building, Washington, D. C. The company reports that its new mill building is now being occupied, enlarging its floor space by 60,000 sq. ft., giving increased facilities for prompt deliveries on large orders.

PRICE OF COPPER.—The well known copper trade expert, H. L. Casey, says: "On December 1st there was 135,000 tons, or 300,000,000 lbs., of copper in this country, which is the largest amount ever carried at this date. Before January 15th, copper will sell below 11 cents per lb., and next year it will sell as low as 10 cents. I am positive that a big sale of copper is pending, and that a block of 60,000,000 lbs. will change hands within the next month. During the year 1903 we are going to witness a sharp cut in the prices of nearly all finished materials. Finished steel is selling much too high, and prices cannot be maintained many months. Only a few years ago steel rails were selling at $14 per ton. They are now $28, but they must go back to $14 or $18."

BALL ENGINE ORDERS.—Mr. W. M. Buchanan, Odell, Ill., has recently purchased a 150-hp direct-connected engine from the Ball Engine Company, Erie, Pa. C. C. Hengle, Jr., & Bros. Co., of Louisville, Ky., have recently purchased a direct-connected unit for electric purposes. The Ball Engine Company furnishes the engine and the Bullock Electric Manufacturing Company the generator. The Magnus Metal Company, of Chicago, is installing an electric power plant consisting of 150-hp vertical engine and 60-hp horizontal. The engines, which are direct-connected to Milwaukee Electric Company generators, were furnished by the Ball Engine Company. The Ball Company has recently installed a 125-hp engine in the electric plant of the City of Farmville, Va. The Lord & Burnham Company, Irvington, N. Y., has recently installed a 100-hp engine, purchased from the Ball Engine Company.

TELEPHONY AT BLOOMINGTON, ILL.—The independent telephone exchange at Bloomington, Illinois, which was established nearly seven years ago, is being greatly enlarged by the Equitable Construction Company, of Chicago. A large amount of cable is being placed underground as well as aerial and the exchange is being re-equipped with International lamp signal central energy multiple switchboard and long-distance central energy telephones. The exchange is being built with a capacity for 2,400 subscribers, and it is said, when completed, it will be one of the best constructed and most modernly equipped exchanges in the independent telephone field. The apparatus will be built by the International Telephone Mfg. Co., of Chicago.

MESSRS. ROSSITER, MacGOVERN & CO., New York, have purchased the entire equipment of the 25th Street power house of the Metropolitan Street Railway Company, New York, comprising 4,000 kw in generators. Three years ago this apparatus, which consists of 850 kw units, was considered the finest obtainable, but the rapid march of improvement has rendered it unavailable for present purposes. Most of this equipment has been sold to the Massachusetts Electric Companies and will be installed at the power house at Lowell, Mass. It will be recalled that Messrs. Rossiter, MacGovern & Co. bought the 146th Street station equipment of the Metropolitan Company last year.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Oakland Transit Consolidated, located at Oakland, California, for the installation of a battery of chloride accumulators to be used on its railway system. The battery consists of 264 cells having a capacity of 550 kw, and in connection with a booster is to be installed at the center of distribution of the system, about two and one-half miles from the generating station. It is to be used to reduce the amount of feeders otherwise necessary and to regulate the fluctuations of load on the generators at the power house.

CONTRACTS PENDING FOR MEXICAN LIGHTING PLANTS.—The City of Tampico, Mexico, is to have a new electric light plant. A company has been formed in Tampico for the purpose of building and operating the works. The capital of the undertaking is $200,000. It will be more than a year, however, before the new plant is in active operation. In the meantime the present owners of the existing plant are perfecting plans for a considerable increase in capacity. The equipment will be purchased almost immediately in the United States.

THE K. & B. COMPANY is the name of a new company, established at 56 N. 7th Street, Philadelphia, for the purpose of manufacturing yellow pine cross arms, locust insulator pins, electrical moulding and ceiling blocks and dealing in switchboards, panelboards, motors and generators, railway equipments and special electrical supplies. The members of the company are Mr. Richard L. Binder, formerly manager of the engineering department of Vallee Bros. Electrical Company, and Mr. W. H. G. Kirkpatrick.

SUPPLY OF COPPER.—The *Wall Street Journal* says: "The production of copper by the Greene Consolidated Copper Company is now at the rate of 60,000,000 pounds a year. This is according to official statements. It comes to us from excellent authority that the General Electric Company now owns a sufficient amount of Greene Consolidated so that from now on the Greene will supply the company with all the copper it needs."

TELEPHONE SERVICE FOR MEXICO CITY.—M. G. Ribson, general manager of the Mexican Gas and Electric Light Company of the City of Mexico, has submitted to the municipal authorities a proposition for the construction of an extensive telephone service.

TELEGRAPH CONTRACT.—As the first result, presumably, of George J. Gould's election to the directorate of the Kansas City, Mexico and Orient Railroad, the Western Union Telegraph Company has made a contract with the Orient Railroad to conduct its telegraph business for twenty-five years.

YOUNGSTOWN, O., PLANT TO BE ENLARGED.—The Youngstown-Sharon Railway & Light Company, of 46 Wall Street, is about to considerably enlarge its Youngstown, O., plant. The existing equipment is capable of developing 2,400 hp. The boilers are of Babcock & Wilcox build, fitted with Roney mechanical stokers. The pumps were furnished by the Blake branch of the International Steam Pump Company. The engines comprise Harrisburg & Green-Wheelock cross compound types and Williams vertical machines. These engines are direct coupled to Westinghouse alternating current, 2,200 volt, two-phase, 60-cycle generators. The initial plant was installed by Sanderson & Porter, of 31 Nassau Street, New York, which engineering concern is acting as consulting experts in the matter of the new extension also. Contracts have already been placed for two 400-hp Babcock & Wilcox boilers; a 1,000-kw, 100 r.p.m. alternating current generator of Westinghouse manufacture, to be direct-connected to a Green-Wheelock horizontal cross-compound engine of 28-in. x 50-in. x 48-in. dimensions. A 12-in. x 7½-in. x 12-in. Blake feed pump has been ordered. A 75-kw Westinghouse exciter unit for direct coupling to a Westinghouse compound engine will also be installed. The Cleveland Crane & Car Works, of Cleveland, O., will furnish a 15-ton crane for its engine room. Orders have also been closed for a constant current transformer for a street lighting system of 450 lamps, 7½ ampere, and six 100 special lights. This portion of the plant will be furnished by the General Electric Company. A new engine room building, 60-foot square, is to be erected. Contracts have yet to be awarded for a 10-ft. x 180-ft. self-supporting steel stack, with steel boiler flue, and for a water softening plant of 4,000-hp capacity. With the new additions, the plant will have a capacity of about 3,000 kw. Two thousand kw will be transmitted to Sharon, 17 miles distant, for the purpose of lighting that city. The remainder of the power will be utilized for operating the electric railway running between Youngstown and Sharon, and also for working the Sharon and Newcastle road. The length of the electric lines is about 33 miles.

LARGE GAS ENGINE AND ELECTRIC EQUIPMENT.—The Atlantic Refining Company's works at Philadelphia, controlled by the Standard Oil Company, are to be converted from steam to gas engine and electrical equipment. The plant will have a capacity of 1,440 kw. There will be four gas engines of 550-hp capacity each, and two of 50 hp each. Two of the larger engines will be built by the Westinghouse Machine Company, of Pittsburg. The other four are to be manufactured by the Alberger Company, of Buffalo. The 550-hp machines will each be direct connected to 360-kw generators, to be built by the General Electric Company. There will be two exciters of General Electric make to be direct connected to the smaller gas engines. The General Electric Company has also been awarded a contract for some 75 three-phase alternating-current motors, varying from 5 hp to 150 hp, to be utilized for operating pumps and other machinery. The Deane branch of the International Steam Pump Company, 114 Liberty Street, New York, has been allotted a contract for 20 pumps, triplex vertical. William E. Quimby, Inc., has taken a contract for ten screw pumps. A 2,800-gallon pump will be direct connected to a 150-hp motor, and will be used for the bulk loading of oil tank steamers. The other Quimby pumps are to be chain driven. The switchboard, which will have four sets of bus bars so as to permit of separate or parallel operation of the generators will be furnished by the General Incandescent Arc Light Company. The contracts for the wiring and the transmission machinery have not yet been decided upon. The plant, which is expected to be completed early next summer, will be the largest gas engine equipment operating alternating generators in parallel hitherto contracted for. Mr. John S. Griggs, Jr., of the electrical engineering firm of Chas. Henry Davis & Partners, is acting as consulting engineer for the Standard Oil people in the matter.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material and machinery from the port of New York for the week ended December 5: Antwerp—36 pkgs. material, $1,841. Amsterdam—1 pkg. machinery, $187; 4 pkgs. material, $101. British Poss. in Africa—155 pkgs. material, $23,005. Brazil—137 pkgs. material, $5,763; 129 pkgs. machinery, $16,749. British West Indies—59 pkgs. material, $1,114. British Australia—148 pkgs. machinery, $17,910; 122 pkgs. material, $6,113. Cuba—26 pkgs. material, $940. Chili—5 pkgs. material, $61. China—34 pkgs. material, $878. Central America—4 pkgs. material, $26. Egypt—3 pkgs. machinery, $118. Ecuador—14 pkgs. material, $95. Genoa—7 pkgs. material, $90. Havre—2 pkgs. material, $685. Hanover—2 pkgs. material, $177. Halifax—1 pkg. material, $21. Hayti—3 pkgs. material, $110. Ipswich—4 pkgs. machinery, $594. London—64 pkgs. machinery, $6,735; 71 pkgs. material, $4,334. Liverpool—69 pkgs. machinery, $2,106; 34 pkgs. material, $2,490. Mexico—2 pkgs. machinery, $42; 68 pkgs. material, $5,255. New Zealand—1 pkg. material, $5. New Castle—1 pkg. material, $52. Peru—11 pkgs. material, $415; 37 pkgs. machinery, $6,816. Rotterdam—2 pkgs. material, $50. Stockholm—4 pkgs. material, $1,721; 3 pkgs. machinery, $862. Southampton—152 pkgs. material, $1,582. U. S. Colombia—55 pkgs. material, $961.

SOME HARRISBURG ENGINE ORDERS.—MacKenzie & Quarrier, of 203 Broadway, New York, the recently formed concern which handles the business in the East for the Harrisburg Foundry & Machine Works, have taken one order for two 250-hp standard engines, each for direct connection to General Electric generators of 160-kw capacity, to be installed in the new plant of the Barber Asphalt Paving Company at Warner, N. J. The machinery will be utilized for lighting and motor load. The Scranton, Pa., Electric Construction Company has requisitioned for a 50-hp standard simple engine for direct coupling to a 35-kw generator of General Electric manufacture. This outfit is intended for lighting purposes. Another order just to hand calls for two 100-hp standard tandem compound engines belted to alternating generators of 60-kw capacity each, to be furnished by the Stanley Electric Manufacturing Company. This equipment is to be installed in an electric lighting plant at Huntington, L. I.

EQUIPMENT FOR EXTENSION OF PORTSMOUTH, N. H., PLANT.—The electrical engineering and contracting firm of Sanderson & Porter, Bank of Commerce Building, Nassau Street, New York, has just let contracts for an extension of the Rockingham County Light & Power Company's plant at Portsmouth, N. H. The additional equipment will consist of one 2,000-kw 13,200-volt, three-phase, 25-cycle generator of General Electric build to be direct connected to a Westinghouse 36 in.x76 in.x54 in. 83 rpm vertical engine. This machinery is intended to furnish power for an extension of the operations of the New Hampshire Traction Company which anticipates the installation of additional sub-station equipment and transmission lines. The New Hampshire Company will give out the contracts for the sub-station machinery direct from its Boston offices, 60 State Street.

POWER AT MEDINA, N. Y.—A new power development and transmission project is being promoted for the vicinity of Medina, N. Y., by A. L. Sweet, of that village. The project is extensive, and will be one of the largest of its kind in the locality. A gorge runs through Medina, and there are several dams in its course. These are owned by companies controlled by Mr. Sweet, and he will remove all but the Medina Falls dam. About a mile below this point he will erect a still larger dam, 540 feet long and 52 feet high. This will create a reservoir of large proportions, from which water will be taken to supply wheels in a power house to be built. The natural conditions are said to greatly aid the project. The trees and brush on the reservoir site are being removed, and a service building is being put up on the power house site.

CAMBRIDGE, MASS., ELECTRIC LIGHT COMPANY has decided to displace the direct-current power distribution system at present installed, by an alternating-current system. This action is being taken after a long and exhaustive investigation into the comparative merits of the various types of direct and alternating current motor apparatus now upon the market, made by the electrician of the company, Mr. W. R. Eaton. The company has recently purchased from the Westinghouse Electric & Manufacturing Company 99 induction motors, which will take care of the bulk of the power service, comprising every possible use of electric power in a city of this kind, from public works to small tailoring establishments. The order comprises 11 motors of 1 hp; 26 motors of 2 hp; 9 motors of 3 hp; 19 motors of 5 hp; 25 motors of 7½ hp, and 9 motors of 15 hp.

TELPHERAGE COAL PLANT.—The Nashua, N. H., Light, Heat & Power Company has put in a telpher system from the United Telpherage Company, of New York City, to handle coal from the spur track in the gas company's shed to the boiler rooms of the electric lighting plant. It is the first telpherage system in the State and reduces greatly the cost of handling the coal. About 75 tons a day will be regularly transported. The buckets are of 500 pounds capacity. If pushed to its full capacity the line could take care of 15 tons an hour.

CONCORD, N. H., HYDRAULIC PLANT.—The Concord Electric Company, of Concord, N. H., whose plant at Sewall's Falls, on the Merrimac River has just undergone extensive repairs by Sanderson & Porter, 31 Nassau Street, New York, is considering the question of a large increase in the capacity of its power house. It is proposed to install a 3,000-hp additional equipment.

LIGHTING SYSTEM FOR NEWBURGH, N. Y.—The Newburgh (N. Y.) Light, Heat & Power Company's plant is to be equipped with a street lighting system consisting of 300 lights capacity, 6 6/10 amperes alternating lamps with constant current transformer and accessory equipment. The contract was secured by the General Electric Company.

General News.

THE TELEPHONE.

[illegible]—The [illegible] Telephone Company [illegible] building long distance lines [illegible].

BOISE, IDAHO.—The Rocky Mountain Bell Telephone Company has purchased the telephone line [illegible] owned by the [illegible] Consolidated Mining Company and which runs from Boise to [illegible] Springs on the Boise river.

CHICAGO, ILL.—The Chicago Telephone Company made a net gain in [illegible] of [illegible].

CHILLICOTHE, ILL.—The capital stock of the People's Telephone Company [illegible] has been increased from [illegible] to [illegible].

[illegible], ILL.—The [illegible] Telephone Company, which has [illegible] in this city during the past year, is arranging to open an exchange. [illegible] are engaged in stringing wires and placing telephones [illegible].

NEW CASTLE, IND.—The Central Union Telephone Company will expend $7,000 for additional cable and improvements in this city.

FRANKFORT, IND.—The city council has granted a franchise to D. A. Coulter and Eli Marvin to construct and operate a telephone plant.

CRAWFORDSVILLE, IND.—The Crawfordsville Co-operative Telephone Company has been incorporated by Charles R. Beck, George W. Bowers, Charles V. Hodkins, Clarence Williams and William Sinnett.

[illegible], IND.—The [illegible] County Telephone Company's system is in operation. The company has 1,400 subscribers to begin with and the local and independent system will in a short time connect with the long distance [illegible].

LAFAYETTE, IND.—The telephone system of this city is undergoing important changes which will result not only in an improved service, but wide extensions of the lines and in better facilities of every kind. The cost of the improvement is estimated at [illegible].

[illegible], IND.—The Municipal Telephone Company has secured [illegible] amounting to about $100,000 and a contract will be closed at once for the construction of the plant. It is stated that as soon as the municipal plant is in operation, a large number of Bell telephones will be discarded.

INDIANAPOLIS, IND.—The Arlington Telephone Company, of Arlington, Rush County, has filed articles of incorporation, with a capital stock of $4,000. The directors are J. M. Cross, Charles Sampson, J. P. Downey, J. S. [illegible] and Robert H. Moore. The company will construct and operate a telephone plant at Arlington.

EVANSVILLE, IND.—Owing to the fact that the ordinance giving the Cumberland Telephone Company 90 days in which to remove its poles and wires [illegible] until a month after its passage by the [illegible], the company will have until December 17 in which to close up. Nearly $70,000 worth of stock in the Municipal Telephone Company, of Evansville has been subscribed. Mayor Covert says one week more will raise the required amount and the construction company that is expected to do the work of constructing the municipal plant will take what stock remains unsold. Work, [illegible] will begin soon. During the week the Cumberland Company submitted a proposition to the mayor, that matters of rates to telephone patrons and of compensation to the city for the franchise be left to referees, one to be appointed by the Cumberland Company, one by the city, and these two to select a third, their report to be accepted by both parties. The mayor ignored the proposition for the reason that it leaves all other competing companies out. The mayor says the Cumberland Company seems unable to comprehend that it had lost the Evansville field; that its franchise had been revoked; that its poles and wires were allowed to stand by sufferance only to serve the people until Evansville [illegible] for a new telephone service. The Cumberland Company stands with the same and equal footing with other petitioners for the franchise and by no [illegible] can it retain its present advantage after December 17. Evansville is in a position to offer the exclusive telephone service of the city to the company presenting the best terms, but there must be but one system [illegible].

BOWLING GREEN, KY.—The Southern Electrical-Construction Company is to build an independent underground telephone system here.

LEXINGTON, KY.—The Independent Long Distance Telephone & Telegraph Company has filed a mortgage to the National Trust Company, of Louisville, to secure an issue of [illegible] per cent. first mortgage gold bonds. The property mortgaged includes the plant at Louisville with lines through sixteen counties in Kentucky and three counties in Indiana, with all branches and equipment.

OWOSSO, MICH.—The Union Telephone Company is building a line from Flint to Holly.

SAGINAW, MICH.—The Valley Telephone Company has made a contract with the Alma Telephone Company for the construction of a line from Flint to Holly connecting with the Alma company. A connection will also be made with the Oakland Telephone Company, giving Oakland county connection with the northern part of the State.

DETROIT, MICH.—The merger ordinance permitting the consolidation of the two [illegible] independent telephone companies, has passed its third reading in the council. The time for the raising of the money for the purchase of the two companies, the People's and the Co-operative, should the special committee [illegible] decide to buy—was extended from 60 days [illegible].

NORTH BRANCH, MINN.—The Maple Leaf Telephone Company has incorporated with a capital stock of [illegible].

BILLINGS, MONT.—The Rocky Mountain Bell Telephone Company has [illegible], thus giving a second line of communication between that city and Billings.

OMAHA, NEB.—The Vail Telephone Company has been incorporated with $10,000 capital by J. M. Glynn, H. Stuck and others.

NEW YORK, N. Y.—The John Street exchange of the New York Telephone Company was burned out in some inexplicable manner last week, and has been put in service again by dint of very hard work. It will be some time, however, before the effects of the damage can be entirely wiped out.

CHARLOTTE, N. C.—The Southern Bell Telephone Company has purchased a site here on which the company will erect a three-story building to be used as an exchange.

ELMORE, OHIO.—The Ottawa County Telephone Company has increased its capital stock from $30,000 to $36,000. Improvements are being made.

XENIA, OHIO.—The United States Telephone Company is building a line into Xenia, touching Yellow Springs. It will furnish long distance connections for the new exchanges at these points.

CLEVELAND, OHIO.—It is generally believed that the Federal Telephone Company will pay the July coupons on its bonds about the middle of December and there is every indication that the January interest will be paid on time.

WELLINGTON, OHIO.—A rate war has broken out between the Wellington Home Telephone Company and the Central Union Telephone Company. The home company has 350 telephones, while the Bell Company has only 150, but the latter is making rapid gains.

HAMILTON, OHIO.—The Hamilton Home Telephone Company expects to commence furnishing service about January 1. A Kellogg switchboard, with an ultimate capacity of 3,000 lines, has been installed. The company will give long-distance service over the lines of the United States Telephone Company.

NEWARK, OHIO.—Material has been ordered for an exchange at Pataskia, and this will be built as soon as the Utica exchange, now under construction, is completed. Both exchanges will be operated in connection with the Newark Home Telephone Company. The Newark Company is expending about $50,000 in improvements and extensions.

OTTAWA, OHIO.—The secretary of the Columbia Telephone Manufacturing Company of this place has filed a report with the district court, giving the assets of the company as $40,197 and the liabilities as $38,172. Several creditors have brought suits for settlements. Local people plan to reorganize the company and continue the business.

CANTON, OHIO.—Directors of the Stark County Telephone Company, one of the leading properties of the Federal Telephone Company, have decided to spend $100,000 in improvements. The system at Alliance will be improved and about 1,000 additional lines will be strung in Canton. Much new cable work will be installed and the rural lines and village exchanges will be improved.

SALEM, OHIO.—The Columbiana County Telephone Company will spend $100,000 in improvements during the next few months. From 800 to 1,000 new subscribers will be taken care of at once and the various exchanges in the county will be enlarged. The company will make a connection with the Beaver Township Telephone Company, giving that service.

ROSEWOOD, OHIO.—The Champaign Telephone Company has elected the following named officers: M. E. Weimer, president; C. H. Espy, vice-president and treasurer, and T. H. Heck, secretary and manager. The above, with W. H. Fledderjohn, Peter Weimer and N. L. Stremble are directors.. The company has purchased the toll lines from St. Paris to Springhill and will install automatic exchanges at Springhill and Millerstown. Construction work is to start at once.

CLEVELAND, OHIO.—As soon as possible after the new city government goes into effect, the Cuyahoga Telephone Company will apply for a change in its franchise to permit it to increase its rates. The maximum price will probably be fixed in the new ordinance on a basis of 10,000 telephones with the right to make additional charge for each 1,000 new lines installed. The demand for telephones has increased very rapidly during the past year and at present the company is operating over 10,000 lines. This number could easily be increased by a considerable figure. President Dickson, of the company, is quoted as saying that the company originally planned for 5,000, and with that number of subscribers could make good money at the present rates of $36 and $48, but with double that number, at the present time, the company admits that it is impossible to make anything.

COLUMBIA, S. C.—The South Carolina Telephone Company has just completed rebuilding the line between Camden and Sumpter, S. C.

OGDEN, UTAH.—The city council has granted a franchise to the Utah Home Telephone Company. The directors of the new company are Gov. Heber M. Wells, J. H. Smith, Geo. T. Odell and Elmer B. Jones.

LEHI, UTAH.—Lehi City has granted to Reed Smoot, Jesse Knight, C. E. Loose, George Havercamp and S. R. Thurman the right of way franchise for the construction and operation of a system of telephone and street railway upon the streets of Lehi.

EASTVILLE, VA.—The Diamond State Telephone Company has bought the Peninsular Telephone Company and the Onancock Company and will have control of the whole telephone business on the Eastern shore of Virginia and Maryland. It will make improvements in the service here.

TIGARDVILLE, WASH.—The Tigardville Telephone Company, capital $1,000, has been incorporated by John Gaarde, C. F. Tigard and E. J. Goodman.

BELMONT, W. VA.—A telephone system to connect at this point with the Belmont system is to be built from Centerville.

PARKERSBURG, W. VA.—The West Virginia Western Telephone Company will build lines to Elizabeth and Gransville. Much new work is being done in Parkersburg.

ELKMOUND, WIS.—The Elkmound Telephone Company has incorporated with a capital stock of $5,000. The incorporators are C. A. Silkworth, W. A. Mau and J. E. McCoy.

LARAMIE, WYO.—Telephone wires have recently been strung to Holmes, Centennial, Pollock and many important ranches in Centennial Valley. A new line will be built at once from Garrett's to Sybille and another to Tie Siding.

ELECTRIC LIGHT AND POWER.

GRIFFIN, GA.—An election will soon be held on the question of a $100,000 bond issue for sewerage, improvement of water and lighting systems, etc.

SAVANNAH, GA.—The Savannah Electric Company proposes to expend $40,000 extending its road at West End. Geo. J. Baldwin, the president, has asked for a franchise.

LEWISTON, IDAHO.—The city council has closed a contract with the Westinghouse Electric & Mfg. Company for a 200-hp motor at a cost of $3,300 for the new water works plant. A contract was also closed with C. C. Moore & Co., for a Deane pump of 2,500,000 gallons capacity at a cost of $3,627.

EDWARDSVILLE, ILL.—At the annual meeting of the Edwardsville Electric Light and Power Company three old directors—C. H. Fisher, G. H. Watterau and Henry Wiebusch, all of St. Louis—were re-elected and two new members—Ole Petersen, of St. Louis, and A. A. Tebbe, of Washington, Mo. The latter two replaced Frederick Gut and C. A. Vallette.

MARTINSVILLE, IND.—The city council has repealed its action granting a franchise to E. O. Tompkins, of Indianapolis, for an electric lighting system.

BLUFFTON, IND.—A company of local citizens and representing $25,000 capital has been organized to erect an electric lighting plant. The city is to pay a rental of $2,500 a year.

KOKOMO, IND.—George F. McCulloch, president of the Union Traction Company, and H. N. Stillwell, president of the Indianapolis Northern Traction Company, have applied for a franchise for an electric lighting plant at this place.

FARIBAULT, MINN.—The machinery at the State Farm is driven by electric power transmitted at a pressure of 2,200 volts. Mr. A. R. Tracy, the electrical engineer, has just raised the voltage of the line from 1,100 to 2,200 volts. The farm machinery is operated by a 12-hp single-phase motor, which has put the old steam engine out of business.

ST. LOUIS, MO.—The electrical subway for the cables to supply the electric current for the Louisiana Purchase Exposition has been completed. The contract was let in two sections. One section has wooden shelves at the sides to carry the cables, and a passageway through the center for the linemen engaged in repairs. This subway is 8x8 feet in cross section and is 4,200 feet long. The Barwick Construction Company built it, completing it early in the summer. The second section was completed last week. This section passes under the lagoons and had to be built water-tight. There are 540 feet of this. The entire cost was $25,985.

RALEIGH, N. C.—The Raleigh Ice and Electric Company will operate its ice-making machinery by electricity, power to be derived from the new $80,000 power plant at Milburnie on the Neuse river.

ALBANY, N. Y.—The Otsego Light, Heat and Power Company, of Oneonta, has been incorporated, capital $100,000. Directors: Edward C. White and Herbert T. Jennings, Mount Vernon, Charles V. D. Peek, New York.

FREMONT, OHIO.—The Fremont Electric Light Company has sold out to the Logan Natural Gas Company.

ELYRIA, OHIO.—The Citizens' Gas & Electric Light Company, Elyria, Ohio, is adding to its electrical equipment, etc.

NORTH AMHERST, OHIO.—The village authorities are taking steps to establish the municipal lighting plant authorized at a recent election.

CINCINNATI, OHIO.—The village of Home City is debating the question of installing a municipal lighting plant. The plan is generally favored.

IVORYDALE, OHIO.—Proctor & Gamble, soap makers, contemplate the erection of a large central power station. The company has just purchased additional land adjoining its plant and it is believed it will be used for the purpose mentioned.

ELYRIA, OHIO.—The Citizens' Gas & Electric Company is enlarging its steam capacity and is preparing to install three 250-hp. Babcock & Wilcox boilers. They will be fitted to burn natural gas. The company will make a number of other improvements to its system.

TOLEDO, OHIO.—The Central Heating & Lighting Company has proposed an ordinance to secure a franchise for lighting and heating. The company offers to put up a bond for $20,000 to bid for the city lighting at $68 per light and to pay to the city two per cent. of its gross receipts after January, 1908.

AKRON, OHIO.—A property owner has applied for a franchise to enjoin the Northern Ohio Traction Company from furnishing light to the city under the contract recently made by the council. It is claimed the city commissioners did not advertise for proposals for lighting the city, thereby depriving property owners of the benefits of competitive bidding.

CINCINNATI, OHIO.—The city will shut down the electric lighting plant at Linwood which was acquired several years ago when the village became part of the city, and which has since been operated by the water works department. The Cincinnati Gas & Electric Company has extended its service to that part of the city, and the old plant will be dismantled.

CONNEAUT, OHIO.—The Pittsburg & Conneaut Dock Company is preparing to erect a power plant with a view to operating all the ore-unloading machinery and the haulage system used in moving freight cars, by independent n.. .s supplied from the station. Work of installing the plant is to start at once. Pittsburg contractors will put up the plan.

MILLERSBURG, OHIO.—The Millersburg Electric Light Company controlled by Mt. Vernon people, has sold out to a Cleveland syndicate headed by O. P. and M. J. Van Sweringen, who will take possession December 15. The new company will improve the plant and will install a hot water heating system for the purpose of supplying business men and citizens with heat.

CLEVELAND, OHIO.—Prominent business men in the down-town section of the city have taken under advisement a plan proposed by Professor C. H. Benjamin, the former smoke inspector, for the establishment of a central lighting and heating station in the heart of the city. It is proposed to operate the plant on the co-operative plan. It is pointed out that several of the largest buildings are already heated from a single plant.

ERIE, PA.—The Edison Electric Light & Power Company has been awarded the contract for street lighting for five years, the price being sixteen cents per lamp per night for enclosed arcs.

THE ELECTRIC RAILWAY.

DENVER, COLO.—Mayor R. R. Wright, Jr., and eleven aldermen have been sentenced by Judge John I. Mullins, of the District Court, to serve four months in jail for contempt of court in disregarding the injunction issued by Judge Mullins to restrain the enactment of an ordinance granting a franchise to the Denver City Tramway Company. The ordinance which was passed over Judge Mullins's injunction grants the Denver City Tramway Company a franchise to run for twenty years, and permits the collection of a five-cent fare on all the street car lines of the city for that period. Efforts were made by a minority of the board of aldermen to correct these features of the bill, but the majority refused to permit any changes to be made.

NEW ALBANY, IND.—The New Albany, Paoli & French Lick Traction Company has been granted a franchise to operate over the streets of this city.

INDIANAPOLIS, IND.—The Consolidated Traction Company, of Indianapolis, has been incorporated with a capital of $300,000 to build a system northwest of the city.

INDIANAPOLIS, IND.—The Indianapolis & Northwestern Traction Company has been incorporated with a capitalization of $3,000,000. This company is a reorganization of the Indianapolis, Lebanon & Frankfort Traction Company and will construct a line to Lafayette. Tucker, Anthony & Co., of Boston, are the financial backers of the enterprise.

NEW CASTLE, IND.—The New Castle & Muncie Traction Company has been incorporated to construct and operate street railways in the cities and towns of New Castle, Mt. Summit, Springport, Oakville, Cowan, Muncie, Alexandria, Hartford City, Portland, Bluffton, Marion, Ft. Wayne, Cambridge City, Keystone, Dunreith and Connersville and to connect and operate interurban lines between said cities and also supply them with electric light, power and steam heat. E. T. Ice, F. W. Nixon, C. B. While and C. C. Hunt are the promoters. The home office will be in New Castle.

COVINGTON, KY.—The Union Light, Heat & Power Company has brought suit against the city to enjoin it from issuing $75,000 of bonds for the erection of a municipal lighting plant. The case is an appeal from a lower court. A resolution has been adopted by the city council to repeal the franchise of the company for alleged failure to supply certain lights.

SYRACUSE, N. Y.—It is announced that the Syracuse Rapid Transit Company will build a line to Oswego at a cost of $1,000,000.

GREENSBORO, N. C.—The city has granted a franchise to the company projecting a trolley line to connect High Point, Greensboro and Winston. F. E. Darlington and Geo. Cohen, of Philadelphia, and others are interested.

DELAWARE, OHIO.—A project is on foot for the construction of an electric railway from Springfield to Delaware by way of Mechanicsburg, Milford, Catawba and Marysville.

HUDSON, OHIO.—The Hudson Improvement Company, recently organized by business men, has arranged with Youngstown parties to install an electric lighting plant, franchise for which has been secured.

CLEVELAND, OHIO.—Now that its affairs are assuming normal condition, the Everett-Moore syndicate is planning to again push the project of the Illinois Central Traction Company. J. B. Hanna, former secretary of the Cleveland City Railway Company and one of the members of the Everett-Moore syndicate, is president and general manager of the company which had secured a number of valuable franchises and rights of way in Illinois, shortly prior to the Everett-Moore embarrassment.

WILKESBARRE, PA.—A New York syndicate is making arrangements to take control of the Wilkesbarre and Wyoming Valley Traction Company, which operates several lines from this city. The same syndicate has also assumed control of the Reading, Pa., and Wilmington, Del., traction companies. President Rigg, of the local company, is the head of them all.

COLUMBIA, S. C.—The Lexington and Columbia Railway Company has applied for a franchise here. The company proposes to connect Columbia and Lexington by trolley.

LEGAL.

MARCONI-DEFOREST.—The DeForest Wireless Telegraph Company filed its answer last week in the United States Circuit Court to the suit of the Marconi Wireless Telegraph Company for infringements of patents. The attorneys for the De Forest Company are Fish, Richardson, Herrick & Neave and Edmund Wetmore. They set up that Marconi's devices for wireless telegraphy were anticipated by Edison, A. E. Dolbear and other inventors.

[illegible] of patent [illegible]

NEW INDUSTRIAL COMPANIES.

THE INTERNATIONAL WIRELESS TELEGRAPHY COMPANY, of [illegible] are Isaac Neberger and A. W. Rose, of New York, and M. J. Kenny, of Summit, N. J.

THE MISSOURI ELECTRICAL CONSTRUCTION COMPANY, for the [illegible] J. Rodgers.

PERSONAL.

JAMES M. DODGE.

[illegible] DODGE, who was last week elected president of the American [illegible] Engineers, was born June 30th, 1852, at Waverly, [illegible] Prof. James [illegible] celebrated scientist, and [illegible] Dodge, a well-known author for many years editor of [illegible] Mr. Dodge [illegible] Cornell with the class of '71 [illegible] his junior year at that institution. He then went to Rutgers [illegible] special course in [illegible] for a year. He served his [illegible] with John Roach, the famous ship builder, in New York and at Chester. He then became connected with the Ewart Manufacturing Company, of Chicago, builders of link-belt machinery. Since that time Mr. Dodge has been very prominent in that branch of manufacturing. He is now president of the Link-Belt Machinery Co., of Nicetown, Philadelphia, of the Dodge Coal Storage Co., and of the Dodge Stair-[illegible] Franklin Institute, of Phil[illegible] He has [illegible] machinery. Mr. Dodge has not been himself particularly active in the electrical field, but he is an enthusiastic convert to motor driving and his shops at Nicetown contain a [illegible] while he takes a keen and most intelligent interest in electrical development. His son, Mr. Kern Dodge, is a member of the American Institute of Electrical Engineers and is already widely known for his work in connection with electrical power transmission for tools [illegible]

MR. WILLIAM FAHNESTOCK, the well-known Wall Street financial leader, [illegible] of New York.

PROF. DR. F. HABER, of the Technische Hochschule, Karlsruhe, Germany, is still in this country studying electrochemical developments and is now making [illegible]

MR. WILLIAM STARK SMITH, of the Browning Manufacturing Company, Milwaukee, Wis., paid New York a visit the early part of this week on his [illegible]

MR. R. S. MASON has been appointed consulting electrical engineer of the [illegible] installation.

MR. EDWARD DURANT, electrical engineer for the city, at Ward's Island, New York, has resigned and has accepted a position as electrical engineer for the big Gould steam yacht *Niagara*, sailing this week for a long winter [illegible]

[illegible] returned [illegible]

[illegible] of Switzerland, [illegible]

[illegible] Wheeling Steel [illegible] Foundry Company. He and his friends have also purchased the Pittsburgh Engine & Foundry Company and will manufacture gas engines under the Kirker patents.

MR. C. H. MACKAY, president, and George G. Ward, vice-president of the Commercial Cable Company, W. H. Baker and E. C. Bradley, vice-presidents of the Postal Telegraph Company, started last week for San Francisco to see the beginning of the laying of the new Pacific cable to connect this country with the Hawaiian and Philippine Islands.

MR. SAMUEL INSULL, president of the Chicago Edison Company, has sailed for England, accompanied by Mrs. Insull, so as to arrive in time for the Christmas holidays which will be spent with friends. Mr. Insull has recently been doing some very hard work in connection with the various electric lighting properties under his management and ownership.

TOWNSEND-MULFORD.—At Plainfield, N. J., on Dec. 3, Miss Margaret May Mulford, daughter of Mrs. Margaret A. Mulford, and William Raymond Townsend, both of that city, were married at the home of the bride's mother in East Fifth Street. The Rev. Dr. W. C. Snodgrass, pastor of the First Methodist Episcopal Church, officiated. The bridegroom is in the auditing department of the Metropolitan Street Railway Company, of New York.

MR. H. P. WHITNEY.—It is announced that Harry Payne Whitney has retired from racing and has sold out his interest in race horses to his partner, Herman Duryea. Mr. Whitney's withdrawal from the turf was occasioned by the earnest wish of his father, W. C. Whitney, that the son should more seriously devote himself to affairs of business in connection with the various electrical and other interests with which their names are associated.

SIR HIRAM MAXIM is, according to a dispatch from London, soon coming to the United States, where he intends to remain for about two years in the hope of finding a cure for a troublesome throat complaint, which is the result of an attack of bronchitis and laryngitis six months ago. He will also prosecute experiments with the view to building a flying machine. The experiments will, the dispatch states, be conducted in Connecticut or on Long Island.

MR. O. W. BRAIN, electrical engineer of the Sydney City and Suburban Tramways, Sydney, Australia, is now on a visit to the United States. He has come here for the purpose of inquiring into the best American traction and lighting methods and securing data regarding equipment, etc., for submission to the New South Wales Railway Commissioners who operate the Sydney system with a view to their letting contracts, shortly after receipt, for considerable extensions. An article in these pages last week described the plant.

MR. CHARLES T. YERKES, who is building an underground road in the English capital, was one of the passengers on the Deutschland in port this week. He will be in this country until after the holidays, attending to his American interests, and will then return to London, where he is building some 50 miles of tube railway. One branch, the Baker Street and Waterloo, will be finished in about eighteen months. This branch is seven miles long, and is a double "tube." The Metropolitan system will be equipped with electricity in about fourteen months.

MR. L. W. MILLER, treasurer of the Goudey-McLean Company, of 88 Maiden Lane, New York, export sales managers for a number of American manufacturers of electrical machinery, supplies, etc., who has been in Europe inspecting the various branches of the company for some months past, will reach London shortly from the Continent and will make his headquarters at the company's agency in the British metropolis—the Associated American Electrical Manufacturers, Limited, 47 Victoria Street, Westminster, S. W., for the next three or four months.

MAJOR A. C. LOTBINIERE, deputy chief engineer of the Mysore Government, India, who has been on a short visit to this side, sailed for Europe Saturday last on the Cunarder *Campania*. He carries with him considerable data regarding further American equipment, which, subject to the approval of the Mysore authorities, will mean the placing of further important contracts in this country in connection with the increasing from 4,000 hp to 10,000 hp of the Cauvery Falls transmission plant, the initial electrical equipment of which was furnished by the General Electric Company.

HON. CHARLES ALGERNON PARSONS, F. R. S., to whom the British Royal Society has just awarded its Rumford medal "for the successful application of his invention of the steam turbine to industrial purposes, and in navigation," is a brother of the Earl of Rosse and a son of the builder of the famous Birr telescope. When Mr. Parsons built the *Turbinia*, in 1896, she was the first vessel to be propelled by the steam turbine. At the present time there is only one turbine-engined war-vessel in the world. This is the British destroyer *Velox*, and she has the distinction of being also the fastest vessel in the world.

MR. GEORGE W. RISTINE, of Chicago, has been appointed to the management of the St. Louis Exposition's Transportation Department on the recommendation of the Committee on Transportation. He will take charge of all transportation business within the province of the committee, including "all business pertaining to the transportation of property or persons in connection with the preparation for, and the holding of the Exposition." The Department of Transportation is distinct from the Department of Transportation Exhibits, which has been organized with Willard A. Smith as chief. Mr. Ristine will have charge of matters relating to rates, operation of tracks, and all business with transportation companies outside of exhibits.

MR. E. C. PLATT, the well-known treasurer of the Postal Telegraph Cable Company, has sustained a sad and sudden loss in the death of his daughter, Miss Edith Hunter Platt, aged only 19, of heart failure. She had suffered from heart trouble for some time, and the indirect cause of her death was probably the excitement accompanying her introduction into society, which took place on Friday evening last week at a coming-out party given in her parents' home, in Brooklyn. Miss Helen Lynne, a friend of Miss Platt, remained in the house over night. On Saturday morning she went into her friend's room and found her groaning and apparently suffering great pain. A doctor was summoned, but Miss Platt was dead before he arrived.

MR. GEORGE W. MASCORD, chief mechanical engineer of Edward Lloyds, Limited, of London, the publishers of "Lloyds Weekly" and the "Daily Chronicle," sailed for Europe Saturday last on the *Campania*. Mr. Mascord had been on this side for about four months seeking ideas for the erection and equipment of an electrically operated newspaper printing plant to be built in the British metropolis by his principals. It will be the largest plant of its description in Europe. Before completion, it is to cost nearly $750,000. Mr. Mascord has taken estimates over with him to Europe as regards the electrical machinery. Immediately after his arrival on the other side the matter will be brought up by his directors and the contracts determined on.

Trade Notes.

THE FT. WAYNE ELECTRIC COMPANY, Fort Wayne, Ind., will spend $65,000 in adding another story to its factory.

THE ACME ELECTRICAL APPLIANCE COMPANY, of St. Louis, has increased its capital stock from $5,000 to $10,000, all the increase being paid.

MAGNETO-GENERATOR.—Some important parts about the new Stromberg-Carlson magneto-generator are given in a neat folder (bulletin No. 2) recently issued by the Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill.

DOWN-DRAFT FORGES.—The Buffalo Forge Company, Buffalo, N. Y., describes and illustrates a very complete line of down-draft stationary and heating forges for industrial works. These forges are of the most modern design, and the variety represented is rather striking. The features and dimensions of each style are briefly given.

THE ELECTRICAL MATERIAL COMPANY, of Baltimore, Md., has issued a catalogue of "All Things Electrical." This is a comprehensive title, but the contents of the catalogue, which has nearly 250 pages, indicate that it is well chosen, since every department of electrical application is represented. The catalogue is copiously illustrated, price-lists of each article being given.

INDUSTRIAL RAILWAY CARS.—The Atlas Car & Mfg. Company, Cleveland, Ohio, manufactures a complete line of cars and other equipment for industrial works. In two catalogues of recent issue the company illustrates its products very effectively. It does not confine itself to standard sizes, but builds cars of any style and size to suit the requirements of its customers.

GENERATOR CALLS.—It is reported that the International Telephone Manufacturing Company, Chicago, is having a large demand for its new generator-call telephones, especially for country party line and long distance toll line use. It is said that this instrument embodies in the construction of the parts, many new features that are of vital importance to the durability and efficiency of a telephone plant.

THE ELECTRIC APPLIANCE CO., Chicago, selling agent for Guttmann alternating current wattmeters, announces that although it is shipping hundreds of these meters every week, it is still, owing to the increased facilities at the factory, able to keep up with its orders and make prompt deliveries. It desires to give wide publicity to this, as the rapid growth of its meter business during the past three years has not always found it in this enviable position.

CASE ENGINES.—The New Britain Machine Company, New Britain, Conn., in an artistically gotten-up pamphlet describes very fully the features and advantages of the Case automatic high-speed engine. The subject is well illustrated by handsome wood-cuts, half-tones and line drawings of complete engines of various styles and parts. Several of the illustrations show engines driving electric generators, centrifugal pumps, ventilating fans, etc.

HARRISBURG ENGINES.—President W. R. Fleming, of the Harrisburg Foundry and Machine Works, has issued the following: "It is our pleasure to announce that the interests of this company centering in and about its New York office, 203 Broadway, and at present under the capable management of Mr. W. P. Mackenzie, having prospered and expanded beyond expectation, will be conducted, on and after November the first, by the firm of Mackenzie and Quarrier, to whom we with pleasure extend our continued confidence and patronage."

MARCONI FICTION.—The story tellers follow hard on the heels of the inventors. An extremely clever bit of fiction à la Marconi is "Mr. Potter's Vacation," by Herbert D. Ward, in the December *McClure's*. It is the history of a great battle in stocks fought from the deck of an ocean liner. One thousand miles of ether were kept hot for two days with long range orders to buy and sell. Mr. Potter won, of course, but the author was probably guilty of irony in speaking of the trip as a vacation. *Harper's Weekly* for Christmas has also a good Atlantic Marconi story.

ELEVATING AND CONVEYING MACHINERY.—The trade literature of the Jeffrey Mfg. Co., Columbus, Ohio, is always interesting, on account of its completeness. The company's products are so varied that to completely catalogue them requires a good-sized volume. The latest catalogue issued by this company contains no less than 372 pages, exclusive of the four-page index at the back. Everything manufactured by the company in the line of power transmission machinery and labor-saving appliances is illustrated, and on many pages are shown views of actual operative installations. The size of the catalogue is 5½x7¾ inches.

USE AND CARE OF STORAGE BATTERIES.—The Columbus Storage Battery Company, Columbus, Ohio, has just issued a 32-page pamphlet containing a short treatise on the use and care of storage batteries, together with a catalogue of small storage cells manufactured by this company. A description of the construction of the Columbus storage battery elements is well illustrated. Other illustrations show the methods of connecting storage batteries for different purposes. The pamphlet is deserving of a place in electrical libraries on account of the complete and general information it contains on the subject of care and use of storage batteries.

THE LIVING AGE as it enters upon its sixtieth year and 236th quarterly volume still maintains the high standard of literary excellence which has characterized it from the beginning. It presents in an inexpensive form, considering its great amount of matter, with freshness, owing to its weekly issue, and with satisfactory completeness the best essays, reviews, criticisms, serial and short stories, sketches of travel and discovery, poetry, scientific, biographical historical and political information, from the vast field of foreign periodical literature. The following list includes some of the writers represented in a single year's numbers of the Living Age: Algernon Charles Swinburne, Sir Gilbert Parker, A. T. Quiller-Couch, The Bishop of Ripon, Augustine Birrell, Mrs. Alice Meynell, W. B. Yeats, Andrew Lang, Katharine Tynan, Maxwell Gray, Sidney Lee, Herbert Paul, Sir Edwin Arnold, Edmund Gosse, George Meredith, Fiona Macleod, Maurice Mæterlinck, Hilaire Belloc, Sir Wemyss Reid, John Buchan, Sir Rowland Blennerhassett, Eugene Melchior de Vogue, Leslie Stephen, Lord Rosebery, Paul Bourget, W. L. Courtney, Professor Edward Dowden, Henry Lawson, Arthur Christopher Benson, Max Beerbohm, Jane H. Findlater, Owen Seaman, W. E. Heneley, The Hon. H. H. Asquith, Pierre de Coubertin, William Watson, W. S. Lilly, Maxime Gorky, G. M. Trevelyan, Sir Lewis Morris, John Morley, Emily Lawless, Theophile Gautier, Prince Kropotkin. This review of contemporaneous literature is issued at $6 a year, or 15 cents for single copies, by the Living Age Co., of Bromfield Street, Boston.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 2, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

714,680. PAY-TELEPHONE; C. E. Egan, Durham, N. C. App. filed April 22, 1902. (See page 963.)

714,681. SIGNAL-BELL FOR TELEPHONE SYSTEMS; C. E. Egan, Durham, N. C. App. filed Sept. 17, 1902. (See page 963.)

714,695. ELECTROMAGNETIC TRACTION INCREASING DEVICE; A. A. Honey, Tacoma, Wash. App. filed April 1, 1902. A bar of iron pivoted on the axle at one end and carrying a truck at the other, is surrounded by a magnet coil which can be thrown into circuit at will, to increase the traction by bringing the truck into engagement with the rail and establishing magnetic attraction between the two and between the car wheel and the track.

714,716. COMBINED CURB AND CONDUIT; F. Lappin, Washington, D. C. App. filed May 12, 1902. The curb is hollow and provided with internal supports for the conductors and with a cover.

714,718. OVERHEAD CONDUIT FOR ELECTRICAL SERVICE WIRES; F. C. Locke, Boston, Mass. App. filed May 31, 1902. Hooks strung upon a span wire receive a number of service conductors.

714,721. ARMATURE WINDING FOR ELECTRIC MOTORS OR DYNAMOS; R. Lundell, New York, N. Y. App. filed Jan. 23, 1902. The coils are laid upon the surface of a drum armature in two or more layers, the adjacent inner and outer coils of the different layers being connected in sequence to consecutive commutator bars.

714,734. ELECTRIC BLOCK SIGNAL; E. M. North, Brooklyn, N. Y. App. filed March 22, 1902. A switch lever and semaphore combined, are moved mechanically by the pressure of the car wheel on a push rod.

714,746. ELECTRIC RAILWAY SYSTEM; W. Robinson, Boston, Mass. App. filed Jan. 15, 1898. Electro-magnetic devices for automatically energizing the sections of the working conductor and cutting them out after the car passes.

714,756. METHOD OF SELECTIVE ELECTRIC SIGNALING; J. S. Stone, Boston, Mass. App. filed Feb. 8, 1900. (See Current News and Notes.)

714,760. ELECTRIC ANNUNCIATOR DROP; E. G. Thomas, Cambridge, Mass. App. filed March 29, 1900. Details.

714,769. CARBON HOLDER FOR DYNAMO ELECTRIC MACHINES; C. Zabel, B. Zabel and W. Zabel, Edgewood Park, Pa. App. filed Oct. 28, 1901. Details of construction.

714,775. ELECTRICAL PROCESS OF LOCATING RUNNING WATER IN THE EARTH; F. H. Brown, Los Angeles, Cal. App. filed March 31, 1902. The vibrations caused by running subterranean streams are transformed into electrical pulsations which are detected by telephone.

714,786. CONTROLLING ELECTRIC MOTORS; M. W. Day, Schenectady, N. Y. App. filed Sept. 26, 1900. (See Current News and Notes.)

714,810. THERMOSTAT; T. Vesconte, Minneapolis, Minn. App. filed Feb. 11, 1901. A bulb with a liquid-containing department has a diaphragm, the movement of which makes it break an electric circuit. The liquid contained may be sulphuric ether.

714,811. BRUSH HOLDER; D. Litchfield, Schenectady, N. Y. App. filed April 30, 1901. Instead of the current passing through the entire brush spring, it is shunted by a conductor to a point of the spring near where the latter bears on the carbon brush.

[illegible] [illegible] A. [illegible], [illegible] the field.

[illegible] [illegible] OF SELECTIVE ELECTRIC SIGNALING; J. S. [illegible] Current News and Notes.)

[illegible] APPARATUS FOR AMPLIFYING ELECTROMAGNETIC SIGNAL WAVES; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1902. (See Current News and Notes.)

714,833. METHOD OF AMPLIFYING ELECTROMAGNETIC SIGNAL WAVES; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. (See Current News and Notes.)

714,834. APPARATUS FOR SELECTIVE ELECTRIC SIGNALING; J. S. Stone, Cambridge, Mass. App. filed Oct. 4, 1902. (See Current News and Notes.)

714,851. RAILWAY AND CAR AND MAGNETIC APPLIANCES THEREFOR; A. C. Alertson, New York, N. Y. App. filed April 8, 1902. Magnets carried on the car have their poles presented to an iron rail so placed that the attractive force tends to lift the car from the track, and decrease the running friction.

714,861. PROCESS OF ELECTROLYTIC SEPARATION OF COPPER AND NICKEL; D. H. Browne, Cleveland, Ohio. App. filed Jan. 27, [illegible] are placed in a "tower" and [illegible] water from the top and a stream of free chlorine from the side. The resulting cuprous and nickel chlorides run into another receptacle containing a nickel-copper anode and by electrolysis the copper is plated on the cathode and the chlorine combines with the copper and nickel of the anode, forming cuprous chloride and additional nickel chloride, which latter after being freed from traces of iron and copper is heated and introduced into a nickel-plating apparatus, where the nickel is deposited and the chlorine drawn off to supply the "tower."

714,862. CONTROLLING ELECTRIC MOTORS; H. W. BUCK, Niagara Falls, N. Y. App. filed Nov. 17, 1900. (See Current News and Notes.)

714,869. CONNECTOR; G. W. Cravens, Schenectady, N. Y. App. filed May 1, 1901. Two cup-shaped devices made separable and carrying corresponding contact parts.

714,881. CLAMPING FINGER; W. L. R. Emmet, Schenectady, N. Y. App. filed May 7, 1902. A gutter-shaped finger intended to be placed against the outer plate of the laminations of an armature to stiffen it.

714,891. TRANSFORMER AND MEANS FOR WINDING SAME; E. R. Gill, New York, N. Y. App. filed May 4, 1899. An arrangement of a divisible spool and a divisible gear for winding the core after it is assembled.

714,893. ELECTRIC CURRENT REGULATOR; J. W. Hammond, Fredonia, N. Y. App. filed July [illegible] Details.

714,904. ELECTROMAGNETIC DEVICE; J. S. Hodges, Troy, N. Y. App. filed April 4, 1902. An arrangement whereby the attraction of a magnet is maintained during the time of reversal of the current.

714,905. ELECTROMECHANICAL CLOCK; S. H. Hoggson, New York, N. Y. App. filed [illegible] Details.

714,927. RHEOSTAT; F. Mackintosh, Schenectady, N. Y. App. filed May 21, 1901. Resistance grids coated with insulating heat-refractory enamel are clamped together with heat-radiating plates between them.

714,928. PLUG AND RECEPTACLE; N. Marshall, Newton, Mass. App. filed Nov. 7, 1900. A face plate having a hinged door carries plug-sockets supported immediately behind the door with which connection is made by plugs after first swinging the door open.

[illegible] MEANS FOR PREVENTING BREAKDOWN OR HIGH POTENTIAL WINDINGS; W. S. Moody, Schenectady, N. Y. App. filed

[illegible] Electrical Process of Locating Running Water in the Earth.

April 26, 1902. The admission of high potential current to a winding, is [illegible] by the inductance of the winding, so that there is an appreciable interval before the inner portions of the winding are raised in potential in accordance with its terminal points. To prevent breaking down of the [illegible] the terminal is [illegible].

[illegible] MEASURING ALTERNATING ELECTRIC CURRENTS; M. E. [illegible], Ridgway, Pa. App. filed Dec. [illegible]. A second field coil [illegible] its current independently of the second field coil and a closed armature in inductive relation to all the coils.

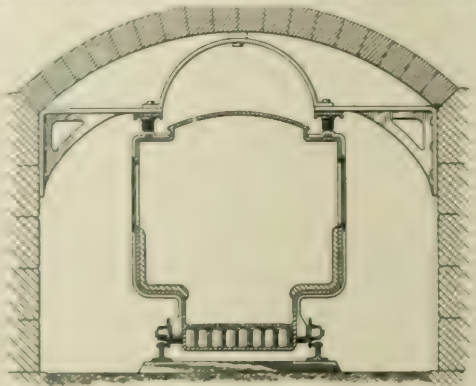
[illegible]016. MANUFACTURE OF SPONGY LEAD PLATES FOR SECONDARY BATTERIES; H. W. [illegible] London, Eng. App. filed Jan. [illegible] oxidize the organic substance and convert the lead oxide into porous peroxide and then passing the current in a reverse direction to reduce the [illegible] to spongy lead.

715,[illegible]. MEANS FOR SYNCHRONIZING MOTORS; F. E. Case, Schenectady, N. Y. App. filed Feb. 11, 1899. Motors in series with means [illegible] in electromotive force of any motor above that of the others for diverting current from such motor to the others.

715,036. TROLLEY HARP; H. S. Doyle, St. Louis, Mo. App. filed Aug. [illegible] between which the wheel is mounted arranged with nuts to screw up and down to alter the spring pressure.

715,043. CURRENT OPERATED RECEIVER FOR ELECTROMAGNETIC WAVES; R. A. Fessenden, Manteo, N. C. App. filed Aug. 27, 1902. (See Current News and Notes.)

715,058. ELECTROMAGNETIC BRAKE; F. Haber, Washington, D. C. App. filed April 21, 1902. To obtain an extended movement of the brake lever



714,851.—Railway and Car and Magnetic Appliances Therefor.

under the action of a magnet, the lever carries a series of armatures, one above the other, which successively come to rest against the head of the magnet.

715,071. ELECTRIC TROLLEY PROTECTOR; W. W. Hoffman and F. W. Powers, West Lafayette, Ind. App. filed April 18, 1902. A spring retractor acting upon the trolley rope.

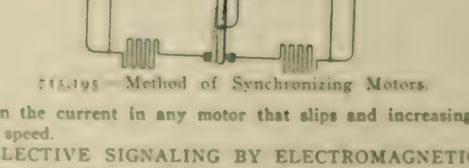
715,126. RECTIFIER FOR SINGLE OR POLYPHASE ALTERNATING CURRENTS; A. Nodon, Paris, France. App. filed April 30, 1902. An electrolytic transformer comprising an electrolyte, a vessel for containing the same, an electrode made of an alloy of ninety-five per cent. aluminum and five per cent. zinc, and another electrode made of iron, or its alloys, and terminals connected with said electrodes.

715,160. MAGNETIC SEPARATOR; C. Scholl, Goppingen, Germany. App. filed Sept. 13, 1901. Details.

715,170. HOT WIRE ELECTRIC METER; R. S. Stewart, Detroit, Mich. App. filed April 26, 1902. A pointer is suspended horizontally from two wires, the current in which lengthens or shortens the wires and so alters the angle of the pointer.

715,190. TROLLEY CATCHER; E. M. Zwing, Philadelphia, Pa. App. filed Aug. 30, 1902. The quick upward movement of the trolley releases a brake which then acts upon the trolley rope.

715,195. METHOD FOR SYNCHRONIZING MOTORS; F. E. Case, Schenectady, N. Y. App. filed Feb. 11, 1899. Consists in simultaneously cutting down the current in any motor that slips and increasing it in those of lower speed.



715,195.—Method of Synchronizing Motors.

715,203. SELECTIVE SIGNALING BY ELECTROMAGNETIC WAVES; R. A. Fessenden, Manteo, N. C. App. filed Nov. 13, 1902. (See Current News and Notes.)

715,209. FACE PLATE FOR ELECTRIC COUPLINGS; N. Marshall, Newton, Mass. App. filed Nov. 7, 1900. Details.

715,220. METHOD OF MEASURING ALTERNATING ELECTRIC CURRENTS; M. E. Thompson, Ridgway, Pa. App. filed Dec. 30, 1896. The method of obtaining a magnetic field in quadrature with the impressed electromotive force, which consists in lagging a current derived from said electromotive force, producing thereby a lagging primary magnetic field, producing independently of said primary magnetic field an auxiliary magnetic field, and combining such primary and auxiliary fields to form a resulting field of the required phase relation.

Second Convention of the Interstate Independent Telephone Association.

THE second convention of the Interstate Independent Telephone Association of the States of Illinois, Indiana, Ohio, Michigan, Wisconsin, Minnesota, Iowa, Missouri and Kentucky, began Tuesday, December 9, at the Auditorium Hotel, Chicago. The first morning was given over to registration of delegates and visitors, and inspection of the manufacturers' exhibits at the hotel.

TUESDAY'S SESSION.

President H. C. Raney, of Fairfield, Iowa, called the first session to order Tuesday afternoon, and J. E. Keelyn introduced Hon. Lawrence E. McGann, comptroller of the city of Chicago, who represented the mayor in a few words of welcome to the convention.

In welcoming the convention, Mr. McGann said that he hoped and was certain of good results from it. The use of the telephone was but in its infancy. All out over the country the farmers were awakening to a new life as a result of the coming of the telephone. He hoped for good results from the convention, not only to the telephone interests in particular, but to the public. The generosity of the American people in the granting of great municipal service privileges had been so large in years past as to intoxicate men of wealth. They have become accustomed to extraordinary returns from public service companies. The very existence of the independent telephone convention indicated competition which was welcome.

President Raney responded to the welcome in behalf of the independent telephone men of the United States represented at the convention. He said, among other things: For that welcome we return our most sincere thanks. And yet I think that, without egotism, or without undue exaltation, we may say that such welcome is not unworthily bestowed. We are here as the representatives of a business interest which, in the nine States represented in this convention, speaks for an investment of at least $100,000,000. We represent the customers of business interests in your city, which employ $10,000,000 of capital, furnish labor to 15,000 of your citizens, and which do an annual business of $20,000,000.

But we are entitled to credit, not only as customers of great business interests in your city, but also for the work we are doing among the people of the States we represent. Ten years ago the telephone business was in the hands of a gigantic and grasping monopoly, and the blessing and convenience of its use was limited to the favored few. To-day, as the result of our efforts to give to the common people the benefits of inventive genius and business push, the telephone is an article of household use, almost as universal as the table and the stove, and almost as essential to the family welfare.

The work of the convention has to do in the first instance and directly with telephone business from the operator's standpoint. In immediate results from a financial standpoint it may more directly affect the business of the manufacturers and supply men. But if they have special opportunities to induce us to do business and get our money, we will at least have the opportunity of knowing what is on the market, and finding out what is most adapted to our wants, and where we can get it the cheapest. The active work of the convention readily divides itself into three parts or heads: First, our business relations with the general public. Second, our business relations with each other; and third, our business relations with and standing in the financial world.

First: As to our relation to the general public. We must remember that we are of the people; that our business had its origin in the needs of the people and in their attempts to supply these needs. It is for this reason that the independent telephone movement has always had the moral as well as the financial support of the mass of the people. In this fact we find the secret of past success and the guaranty of future greatness. It is, therefore, of the utmost importance that we preserve intact the cordial relations heretofore existing between the people and the independent telephone movement.

In our relations to each other, as operators, there is vast room for education and improvement. If there is any special source of danger to independent telephone interests, it is found in the want of harmony and co-operation among telephone men.

The inducements, which the business has offered in the way of returns on investments, and the opportunities for acquiring rights and privileges having a great future value, such as franchises and rights of occupancy on highways, have aroused in some men a spirit of avarice and greed for territory that has led to serious complications, which, unless speedily settled, will work untold injury. In other cases there seems to be a disposition to exact harsh terms for privileges granted, and a general tendency to want to do business on the "Keep all you can get" plan.

There is room for all, and we must respect each other's territorial rights. In granting privileges and concessions, we must not lose sight of the benefits received; and should make our grants on an equitable basis. If it is the good fortune of some company to control the business in some important center, just such an equitable arrangement should be made with other companies, asking admittance to that center. We should do all in our power to enhance the value of each other's property instead of attempting to destroy that value by demanding unfair connecting contracts. Especially must we abandon the "Keep all you can get" plan of doing business. There is no other business in the world involving anything like the same amount of capital, where such loose business methods and practices are permitted, as in the telephone business. Each company is entitled to receive the pay for the service, which it renders, either in use of line or operator's services.

The time has certainly come when improved business methods are demanded among telephone operators. No company should be asked to furnish service without just compensation. Neither should one company receive the compensation for the service which some other company has rendered. In my judgment there is an imperative demand for some accurate method of settling joint business between companies furnishing a joint service.

It would seem that the ordinary telephone man would see at once that a long-distance connection would add to a good local business—the one thing needful to its highest and continued success—and that such a connection would give much to, and take little away from, the business of the local company. That instead of being competitors they would be mutually helpful; and yet there are telephone men who either by reason of jealousy or want of business foresight, will turn down an opportunity to enter into such a contract on the most flimsy pretext. I would urge very emphatically a more careful consideration of our duties and obligations to each other.

In the third place, we must look carefully to our relations to the financial world. In the earlier history of the independent telephone movement, the financial question was not a serious one. As a rule, the local company could find abundant local capital for all its wants. A comparatively small amount was required to start an exchange in the town or village. But the almost universal experience of the small company has been that in order to protect the investment already made, it must extend its service to adjoining towns, and frequently over a county, in the way of a toll service. In most instances this has been followed by the necessity of building farmer lines. Hence, in many instances the financial question has become a serious one, even to the small companies; and when it comes to attempting to occupy the larger cities and build long-distance lines the difficulty has increased. Investments along these lines have been in the past, and are yet very largely, experimental in the financial world.

Independent telephone stocks and bonds have in the past had no established standing, financially. Our special enemies, the Bell company, have been very active in their efforts to injure us along this line. They have talked "natural monopoly" and "infringement suits" and other scarey things until men with money hesitated. They have followed this with misrepresentation and misstatement of actual conditions. (Mr. Raney here quoted a circular issued by a prominent Bell officer.) Such statements, as I have quoted above, made by

our enemies, are known to be absolutely false. I do not know of the failure of a single telephone company in the State of Iowa. And I know none which are making less money than the "Iowa Bell," judging by appearances.

The financial standing of each individual company is a matter of its own; and we must, and can afford to leave that to its own management. But as an organization we can make sure that the public in general, and especially the financial public, are fully informed as to the truth concerning our business. And when the truth is known, there will be no doubt in regard to the general financial standing of independent telephone companies.

The proposing and discussion of plans and details of procedure along the lines I have suggested, belong to the work of this convention and will be presented, as the different topics on the programme are taken up. I have no doubt but that they will be ably presented.

Secretary E. M. Coleman, of Louisville, read his report, which gave an outline of the work carried on by him in advertising the association and soliciting new members during the past year. The report showed that the secretary felt greatly hampered by the lack of funds in the association treasury. The financial provisions for the present convention had been made largely by the Chicago supply and manufacturing companies. An official handbook and souvenir of the Interstate Association was started with the idea of having it come out at the time of the convention, but this idea was later changed, and it was to be published about January 1, 1903, and contain a full report of the proceedings of the present convention, together with portraits of officers and other matter. This would not only advertise the convention, but bring some money into the treasury from advertising in its pages.

The secretary urged the establishment of a clearing house for the settlement of telephone toll charges between different companies. He also urged the establishment of an information bureau to disseminate information regarding independent telephony, so as to counteract the reports that the Bell interests were industriously circulating, which tended to destroy confidence on the part of the public and investors in independent enterprises. In the nine States represented in the association there are 3,000 independent exchanges. The investment is over $300,000,000. The telephone industries of Chicago turn out $20,000,000 worth of independent telephone apparatus per year.

The treasurer's report was postponed, pending action upon it by an auditing committee.

A nominating committee of one from each State was appointed, consisting of W. Guy Jones, of Columbus, Ohio; Dr. H. S. Herr, Ottumwa, Iowa; W. F. Goodrich, La Crosse, Wis.; William Robinson, Muskegon, Mich.; L. A. Frazee, Connersville, Ind.; E. S. Hull, Salem, Ill.; W. F. Hall, Clinton, Mo.; H. K. Cole, Owensboro, Ky.

An invitation extended by the Illinois Telephone & Telegraph Company to visit its great system of tunnels under the business part of Chicago, was accepted. These tunnels are to serve as conduits for the cables of an immense telephone exchange, to be operated on the automatic system, without operators.

B. F. Wasson, of Clinton, Ill., moved to exclude from membership in the association all companies using Bell transmitters or receivers. This motion started an extended discussion on the matter of admitting companies having any traffic arrangements whatever with the Bell company. Some members were opposed to allowing any company in the association which had any business with the Bell company in the way of toll-line connections. Others thought that since in some cases toll-line connections could be made only over the Bell lines, that companies operating under such arrangement should not be excluded. It was argued that only the use of Bell telephone apparatus would stamp a company as practically allied with the Bell interests. Those favoring no business relations whatever with the Bell company argued that the existence of any kind of an agreement, either oral or otherwise, by which business was exchanged with the Bell companies, would have the effect of discouraging the building of independent toll-lines, because the necessity for them would not be so strongly felt, and that the result would be to restrict the independent telephone industry. They argued further that the owning and operating of toll-lines by independent companies gave them a very strong hold upon the situation, and that independent interests could not afford to have this hold weakened by interchange of business over Bell toll-lines. It appeared that several members of the association, although loyal independent men, were acting as terminal companies for Bell toll-lines, in cases where there was no Bell exchange, and in other cases were using Bell exchanges as terminals where there was no independent exchange.

After an animated discussion, it became apparent that the subject was an important one, and far-reaching in its effects on the independent telephone business, as it involved matters of general policy. It was, therefore, referred to a committee.

The matter of excluding manufacturers who sold apparatus for a second independent telephone exchange in a town, was also discussed briefly, and finally referred to the same committee. This committee, which was later appointed by the chair, consisted of H. H. Robinson, J. S. Bellamy, William J. Bell, W. J. Buck, J. P. Ware, L. A. Frazee, M. Savage, J. W. Layne and A. L. Tetu.

It was then suggested that some gentlemen connected with Bell interests were in attendance, and the question arose as to what policy the convention should adopt in allowing them at the sessions. Some favored admitting anyone who wished to come, since there was nothing the independent telephone had to fear at present. It was finally moved, however, to have a committee on credentials to pass upon everyone entering the convention hall if they thought best. This committee, which was appointed by the chair, consisted of Messrs. Cole, Rex and Conklin. The convention then adjourned until Wednesday afternoon.

WEDNESDAY'S SESSION.

Wednesday morning was given over to inspection of the exhibits and visits to the manufacturing establishments of the city. Wednesday afternoon the convention again assembled, and the first order of business was a consideration of the report of the committee appointed the day previous, to consider the matter of whether independent companies having traffic arrangements with the Bell companies or using Bell apparatus should be admitted to membership in the association. The committee also considered the question of admitting manufacturers of independent telephone apparatus who would sell material for a second independent exchange in a territory already served by an independent exchange. The committee reported a resolution against admitting manufacturers who were guilty of this, where a reasonably efficient service was already being given by an independent company.

A resolution was also presented to the effect that no company using Bell apparatus could be considered as friendly to independent telephony, and should be excluded from the association.

Another resolution drew the line even closer, and recommended the exclusion from the association of all companies having traffic exchange arrangements with Bell companies, except in certain isolated cases, which might be passed upon by a committee of the State Association.

Mr. Seeborn, of Ashland, Ky., who was one of those who would be most affected by this resolution, expressed himself as willing to abide by the decision of a committee as to his eligibility for membership, as provided by the resolution, and said he thought other independent companies having Bell connections would be willing to do the same.

Mr. Tetu favored using the Bell toll-lines only where no other line existed, and as a temporary expedient, where it could do no possible harm to independent interests.

The resolutions were finally unanimously adopted.

George N. Bandy, of Des Moines, read a paper on "Measured Service." It was, in part, as follows:

As the discussion which follows the reading of a paper is generally more valuable than the article itself, I will be as brief as possible and endeavor not to tire you by submitting a long and exhaustive argument as to why telephone service should be charged for on a meter basis rather than a flat rate.

The pioneers in the telephone field, who, by the way, were the various Bell licensees, not having at the time the telephone was first brought into commercial use apparatus by which the number of calls could be accurately recorded, adopted the expedient of charging for the service an arbitrary rate per month, having a higher rate for business than for residence telephones. This practice still largely obtains among the independent companies, but the Bell licensees are breaking away from that custom as rapidly as possible; especially is this true in the larger cities.

There are several reasons for making the change. It yields a large income per telephone, increases their list of subscribers, and last,

but not least, rids their patrons of that intolerable nuisance known as a deadhead, who uses your service in many cases more than a regular subscriber without paying therefor, and 99 times out of 100 not only fails to show his appreciation of the convenience by thanking the company or subscriber, but is loudest in his denunciation of what he is pleased to call "the rotten service" the company is furnishing.

I believe that the majority of our subscribers would welcome a change from the present flat rate system to the "pay-for-what-you-get" principle. It may be, however, that the apparatus for recording the number of calls is not sufficiently perfected to warrant our making this change, but as necessity is the mother of invention, I confidently believe that if it is shown that the apparatus now available for this purpose is not efficient, some one will soon place on the market an instrument that will meet our requirements.

In charging for telephone service on the meter basis, it may be necessary, of course, to have the subscriber guarantee a certain number of calls per month. The guarantee as to minimum number of calls per month to be varied to suit local conditions. No calls to be recorded unless the number or party called is obtained. All incoming calls free.

These are merely brief suggestions for your reflection. There are various ways offered by others for accomplishing a similar purpose. An idea laid down by a prominent telephone man as long ago as 1895, has been adopted for practice by a number of telephone companies. It has later become the rule in some foreign countries. It is to first charge a flat rate, covering a reasonable amount for the subscriber's station maintenance then a charge additional for the service, or a switching rate of so much per call, varying from two to six cents for exchanges.

This subject must have an important bearing on our future, we ought now to begin to learn all about it. It is possible that some here have had actual experience with it, and, no doubt, many others can give us good ideas or information regarding it. I have thought it best to simply call attention to some of its points rather than give specific data at this time. I hope the discussion may indicate your desires and prepare the way for future action, remembering that "as the twig is bent, the tree is inclined."

In discussing the paper, Mr. Conklin, of Aurora, Ill., did not favor measured service, because, as he expressed it, it was a tack of the Bell company to meet independent competition, and it was a notable fact that a Bell exchange had never been able to prosper in a place where there was good independent service. He considered that a flat rate with unlimited service was the most popular, and therefore one of the things which made independent telephony successful. Measured service would, to be consistent, he thought, compel discrimination between subscribers having long and short lengths of line to maintain. This was not practical, so that, on the whole, he thought flat rate the better, because it was easier to adjust and more popular.

A paper by Dr. H. S. Herr, of Ottumwa, Iowa, on the "Sliding Scale of Rates" for the telephone, was read by his daughter, Miss Herr, in his absence. Its gist is as follows:

The flat rate system incorporated into many of the franchises granted to different independent companies by city and town councils has been the direct cause of more poor service, poor construction and poor maintenance than any other cause that I can think of at the present time, because of the fact that none of the independent companies were aware when they began business that to maintain a telephone system it would cost more per telephone to care for five hundred than for a lesser number. And, therefore, they soon found themselves paying out more money for maintenance and operating than they were receiving. A very popular price among promoters, and a catchy price for the public is a rate of $1 per telephone, this being considered an adequate amount in telephone systems under most favorable conditions for from 30 to 500 subscribers. That is not a sufficient amount to conduct the business and maintain the plant when the number is more.

A large number of telephone exchanges that in the beginning, when their subscribers were few in number, gave excellent service, are now giving very poor service, because expenditures consume all the receipts, and there is nothing left for repairs or maintenance. And unless financial relief comes by means of advanced receipts, a very short time will put them out of business.

The eagerness of the independent telephone people to right this wrong done the public in charging exorbitant rates by the company holding the original patent upon the telephone, was the prime cause in promoting independent or opposition telephone companies. They, like the hardware or grocery men, counted that the more service they could sell the greater would be their profit, prices always being the same. One hundred barrels of sugar, or one hundred barrels of nails can be sold by the merchant for less money per barrel than one, two or three barrels, and still the merchant would make greater profit on his investment by selling the large number at the same price than by selling the small number at the same price. And thus the pioneers of independent telephony, when they turned their attention to the telephone business, thought if they could sell the service of a thousand telephones they could make the rate the same, or even less, than if they sold the service of only one-quarter or half that number. The comparison between sugar, nails and telephone business is not a fair one. When a barrel of sugar is sold, that is the end of it. When a telephone service is sold it is only the beginning. Forever after there are wires to be taken care of, trouble to chase, lightning and electric currents that burn up the instruments to be switched off, and the more telephones you have the longer distances are necessary to reach the subscribers, and many other things must be done. When nails and sugar are sold, the merchant receives all his cost and profits; when a telephone is placed, only a small portion of the cost is paid in the service, and years are required to balance accounts. But to give telephone service to one thousand subscribers, a central apparatus must be provided at a cost of no less than one hundred times as much as the central apparatus will cost to give service to one hundred subscribers. Ten exchanges of one hundred subscribers at $1 and $2 a month will be a handsome return to the owners, where one, with one thousand subscribers, at a cost of $1 and $2 per month will be a positive loss without any provision for maintenance. Still, in each case, a thousand subscribers are served. But this is sufficient to show cause for this paper.

By the sliding scale of rates for telephone companies is meant a scale of rates based upon the number of connections given subscribers in any one system. The importance of such a rate is well understood by the older companies, as shown by the sliding scale of rates as used by the American Bell Telephone Company at the advent of independent telephone companies.

The value of the telephone to the users is in the number of subscribers who can be reached in any one system, and it is no more than just that the telephone company should receive a proportionate share of the value that the telephone is, to those using it, whether for business or pleasure. And it is also fair to the users of the telephone that they should not be required to pay more than is necessary for good maintenance and good service with a fair profit to those who have invested their money in the telephone system. This equality can only be accomplished by the sliding scale of rates. If cost of future maintenance was always known, it would be an easy matter to incorporate rates in telephone franchises. But as this is not the case, it remains a question whether or no it is wise to do so. I am of the opinion that there will be no difficulty along this line if telephone companies will do a fair and honorable business and make their rates proportionate to the service rendered, with a fair dividend for money invested. By maintaining reasonable charges, there would be no danger of competition, unless it should be by some one trying to break a weaker company in order to obtain entire control and produce a monopoly in such a manner as to exclude others forever, and then return to the prices charged during the life of the fundamental telephone patent.

What the sliding scale of rates should be necessarily varies with the conditions under which the company must operate. In small companies, where it is not necessary to use tall poles or aerial cable, or conduit work placing the cables and wires underground, the rate can be less than in cities where all this is required. But no company can do business successfully under the most favorable conditions in an exchange not to exceed five hundred at a rate averaging less than $1.50 per month, for all telephones. This is usually accomplished by charging $1 for residence telephones, and $2 for business telephones. Above that number it will be necessary to advance the rate a certain small per cent. as the number of subscribers are increased.

A number of telephone companies in the State of Iowa have been asked if, in their experience, they found the average cost of operating, including all expenses per instrument, increased or diminished with the number of telephones installed, and what would

as the number approximately at which a $2 rate for business and a $1 rate for residence on a full metallic system would be profitable. The manager of the Des Moines Mutual Telephone Company placed the number at four or five hundred. Waterloo Telephone Company, Dr. Bennett, manager, placed the number at four or five hundred. Fort Dodge Telephone Company made the maximum number at eight hundred. The Home Telephone Company, of Oskaloosa, at two hundred and fifty. In Iowa City a citizen's committee was appointed by the Commercial Club to investigate the proposed increase of rates by the Johnson County Telephone Company. After thoroughly investigating they reported that it was unprofitable for the company to do business at a $1 and a $2 rate with six hundred telephones in operation, one-half of which were business telephones, and the other half residence telephones. This committee publicly announced that they were opposed to a raise of telephone rates when they were first placed upon the committee. But after their investigation they were convinced of the necessity of raising the rate to $1.50 and $2.50 until the number reached one thousand subscribers; thereafter 25 cents additional. Same rate to be maintained until the members reached one thousand five hnudred, when another 25 cents should be added. This is a fair concession by the committee appointed for Iowa City.

The Interstate Telephone Association should take some action to show its diapproval of the conduct of many independent telephone promoters in making a flat rate for an unlimited number for service for all time to come, when asking for franchises. This is untenable, because the cost of telephone construction and maintenance varies too much in different cities of the United States, particularly the maintenance, which will average 50 per cent more in some cities than in others, and it is unwise to place the cost of maintenance at less than 10 per cent in any case. More than this, the Association should do all in its power to enlighten town and city councils on this subject, so that they will scrutinize more carefully the franchise asked for by telephone company promoters, since such promoters generally organize these companies by issuing stock and bonds, and then construct the cheapest plant possible, taking their profit and leaving the stockholder and bondholder to take care of the situation, who soon find, to their disapopintment, that they were caught in an unprofitable investment, and the council is in the awkward position of having required conditions of their telephone company which cannot be carried out, excepting at a great loss and final bankruptcy. City councils are generally selected from the best men of the city, from various trades and business. They want to do the fair thing in such matters, but how can they, when they do not understand the business? It is our duty, as an association, to agitate this question, and furnish proof of the correctness of our position, so that the value of telephone properties may not be destroyed, and many men financially ruined or injured by unwise legislation, either by the city council or by State legislatures.

Legislation on this subject is sure to come, and we need not fear it, if we do our duty in this matter. Every business man wants every other to succeed. And they will come to our support, if they understand the situation. They all want first-class telephone service, and that, like good goods, cannot be bought at the price of shoddy. Above all, *be honest* with your people. Make your statements plain and truthful, and you will have a hearing which will bring you success.

This paper seemed to meet with much approval, from the sentiment expressed, and will no doubt be given a wide circulation by the telephone men.

Mr. Glanden, of Pike County, Ill., said that he had used the sliding scale in connection with exchanges in his county, with great success. The plan was to start with a rate of 50 cents per month per subscriber, until the exchange had more than 50 subscribers. As soon as 50 subscribers was exceeded, the rates were raised one cent per month for each subscriber added. In this way the number of subscribers was increased easily with great rapidity, and the justice of increasing rates with an increase in the number of subscribers was felt by all.

In a paper on toll rates, Mr. H. H. Robinson, assistant general manager, United States Telephone Company, after sketching the history of long-distance rates from the earliest days, described the manner in which the initial rate system, which is now almost universally used, was devised. Assume a toll-line property, consisting of 30 miles of pole line, 10 miles of which consists of the very best construction, 40 30-ft. 7-in. top poles to the mile, with an ultimate capacity of 50 wires and a present capacity of 20. We will suppose that the second 10 miles represents the average construction of 30 25-ft. 6½-in. top poles to the mile, with an ultimate capacity of 20 wires and a present capacity of 10 wires; the third 10 miles to consist of a 25-ft. bracket line, built upon the cheapest possible specifications, and used presumably as a feeder to reach some small town. We wish to discover what rate we can safely make per minute-message-mile and show a profit on our investment.

Our first section will cost us approximately $950 per mile, or $9,500; our second section will cost approximately $500 per mile, or a total of $5,000; our bracket line $150 per mile, or $1,500, giving us a total investment for this imaginary property of $16,000. Figuring interest at 5 per cent. and depreciation at 5 per cent., our fixed charges will be $1,600. Operation and maintenance, including taxes and general expense, and extraordinary maintenance, may be safely figured at 10 per cent. more. We must, therefore, earn $3,200 per annum on the $16,000 investment before we can show any profit for stock.

We cannot, as in an exchange proposition, base our prospective earnings upon our number of subscribers, and our average earnings per subscriber, for toll business is strictly a measured service, and no matter how good our facilities, we cannot handle business until it is offered. The telephone day averages from four to seven hours per day, according to locality, and from several hundred peg counts which I have examined, the circuit load varies from one-half message per circuit mile per day to three messages per circuit mile per day. As we wish to be conservative, we must adopt the minimum figures if we would have a safe rate.

Now this little imaginary system of ours contains 310 circuit miles. On the basis of one-half a message per circuit mile per day, we would handle 155 three-minute messages per day per circuit mile, and if these messages averaged ten miles, as they probably would, we would handle 1,550 message-miles per day. To reduce this to minute-message-miles we multiply by three, which gives us 4,650 minute-message-miles per day, or 1,674,000 minute-message-miles per year. Now we have seen that we must earn at least $3,200 per year in order to cover our interest, depreciation, operation and maintenance, so by dividing $3,200 by 1,674,000 minute-message-miles, we find that we must charge and receive .0019 of one cent per minute-message-mile. The Bell Rate Conference decided upon .002 of one cent per minute-message-mile, and the result of our little computation shows that by charging that rate we will still have .0001 of one cent per minute-message-mile to spare, on the basis of the most conservative figures we can possibly use. Please bear in mind that aside from the estimate circuit load, the figures which I have used are selected arbitrarily and mean nothing except to demonstrate the line of thought.

This basis of computing rates is being used to-day by nearly all of the larger independent toll-line companies and is found to be profitable. As to the future, it is difficult to anticipate the readjustments which are bound to come as labor and material increase in cost; but improvements in operating and advances in the art will more than offset the increases in construction and maintenance. For the present, we stand in urgent need of uniformity, for there is no one branch of the business where the lack of it is so sadly felt as in this great question of toll rates. In nearly every other part of the business, details of operation have an effect upon the local situation only, but their effects on toll-line service are as far-reaching as the country itself.

After the reading of this paper the chair introduced Professor W. E. Goldsborough, chief of the electrical department of the Louisiana Purchase Exposition, who spoke very earnestly and enthusiastically for a few moments regarding the prospects in his department of the coming World's Fair, and urged the co-operation of independent telephone men to impress the public with the importance of independent telephony.

Upon the close of his short address, Mr. Layne, as a representative of the State of Missouri, offered a resolution in favor of holding the convention in 1904 at the Louisiana Purchase Exposition. This resolution was referred to a committee, since it involved a change in the constitution of the association, which requires that the conventions be held in December.

"Restrictions by Municipal Authority" and "Synopsis of the Law" in different States were the subjects of reports by the following gentlemen: Ohio, W. F. Laubach, Akron, Ohio; Iowa, U. S. Alderman,

Nevada, Ia.; Wisconsin, J. C. Harper, Madison, Wis.; Minnesota, E. E. Webster, Minneapolis, Minn.; Michigan, J. B. Ware, Detroit, Mich.; Indiana, E. W. Pickhardt, Huntingburg, Ind.; Illinois, M. Savage, Champaign, Ill.; Missouri, H. Linton Reeber, St. Louis, Mo.; Kentucky, D. L. Pendleton, Winchester, Ky. Some of these reports were read by title only.

The president announced the appointment as auditing committee of Messrs. Frazee, Valentine and Doble. Upon motion the president appointed a committee on toll-line rates, to report the next day, consisting of Messrs. Hutchins, Robinson, Presson, Rex and Layne.

The meeting then adjourned to visit the tunnels of the Illinois Telephone and Telegraph Company. The delegates making this visit were greatly impressed with the magnitude of the undertaking and the provisions being made for independent telephony in Chicago.

Thursday's Session.

The first business on Thursday morning was the adoption of a resolution to hold the 1904 meeting at the St. Louis Exposition, with the date to be decided later by the Executive Committee—the constitution to be amended for the purpose.

A. L. Hutchison, of Weyauwega, Wis., read a paper favoring the establishment of a clearing house in each State, for checking up toll-line messages between different companies and striking a balance at regular intervals of the amounts due. A single telephone company, doing a business over its own wires exclusively, can check its own business and know that every station is collecting and counting full service rendered. But with independent telephone companies swarming over the country, all having more or less joint business with each other, their business transactions become as complex as the business transactions between individuals, and we have a problem which calls for the simplest solution possible. Transactions of business between connecting telephone companies are without a parallel, even in the joint traffic arrangements between railways or joint message arrangements between telephone companies. A system for taking care of the business of connecting telephone companies is demanded, which will fill the following requirements: It must have a uniform method of ascertaining the rate between any two points, which should be based upon the air-line distance between those two points, without regard to the actual mileage of the wires over which the message passes. There must be also a uniform system of dividing the fees received among the connecting companies. It is not the province of this paper to say what the basis of the division of fees should be, or what should be the schedule for determining the air-line rates for joint messages, but to urge the necessity of a uniform system that shall be recognized by every independent telephone company in the United States. There should be at least one central office for clearing purposes in each State. It should receive reports at regular intervals of the toll-line messages passing over the lines of each company, in every case where the message does not begin and terminate on the same company's line.

In outlining what should be the duties and responsibilities of the central office in each State, Mr. Hutchinson made use of his own personal experience in conducting such an office in Wisconsin. The central office should be a clearing office in the true sense of the name. All joint messages should be reported to it. The original record slip should be compared with the receiving record slip; and if more than two companies are involved, the checking slip should be made use of where the terminal records do not agree. All stations should report to the clearing office at least four times a month, as the earlier an error is detected the easier it is corrected. The errors should be corrected, and the stations in error notified of the correction at once. The clearing house must open an account for every station with every other station to which a message has been transmitted. At the end of the month the separate station accounts must be brought together, and all companies having joint business with each other must be included in a single statement. The balances between the several companies in the single statement must then be brought together, and the clearing office must then designate what amounts are payable and to whom payable, to balance the accounts of all companies included in the statement.

While to those not familiar with the system of the State Telephone Clearing Company, of Wisconsin, all this work would seem to be a complex and laborious task, yet several months' experience with the system of that company has demonstrated that it is simple, absolutely correct, and so flexible that it may be adapted to the conditions of any schedule or traffic arrangements between connecting companies.

I recall one statement for October which showed a total of 738 messages, with a total revenue of $128 divided among 18 companies. Here 12 drafts, amounting to $13.89, paid by 6 of the 18 companies to the other twelve companies, settled the entire business for the month.

The cost was one cent per message to any company sharing in the fee of any message; and if each company had attempted to check and settle its own business with each of the other 17, it would have required reports from each of the other 17 companies, and would have necessitated a report to each of the other 17, making 17 monthly balance sheets for each company.

The clearing company should be a company distinct in itself, and not a mutual affair. The mutual telephone company that starts out to do business by compelling every subscriber to be a stockholder, soon finds it advantageous to take in subscribers who are not stockholders. As the clearing company is not a company that demands the investment of any considerable capital, and as its duties are to serve all alike, it should be as distinct from the operating company as the factory which manufactures the instruments. The nature of its business is such that the responsibilities are confined to correcting the errors of operating companies, and in apportioning the fees and making correct reports of the same.

The clearing company should handle no funds, but it should draw drafts against debtor companies for such amounts, and payable to such companies, as shown by the statements to be due. The time has gone by when connecting companies can operate successfully by allowing each company to retain what it collects as its share of joint toll business, and with the construction of connecting links, upon which little business originates, and the vast network of wires owned by hundreds of companies, the clearing company becomes a necessity.

The Committee on Toll Rates made no report, but Mr. Hutchison introduced a resolution that the Executive Committee and the secretary formulate a schedule to be used where there is an interchange of traffic between companies, and if not inconsistent with previous contracts. The Wisconsin Association toll rates were cited as an example.

Mr. H. E. Rolston presented a paper on the enforcement of message time limit, but it was read only by title.

Col. J. D. Powers, of Louisville, Ky., read a paper which was most enthusiastically received on "Independent Telephone Securities as an Investment," from the banker's standpoint. There was a great deal of interest in this paper, and the reception awarded it showed that it "went to the spot" and echoed the opinion of the independent interests, as well as being regarded as an able expression of their strongest views on the subject. Col. Powers said that the standing of the securities of any company depended primarily upon the character of the individuals in it. It depended also on the general character of the business, which was an important element. He contrasted the methods of railroad financing twenty years ago when "wrecking" was so common, with the policy of to-day, when Mr. J. P. Morgan, the greatest "Captain of Industry," pursues persistently constructive instead of destructive methods.

Independent telephony was an outcome first of intolerable conditions rather than an attempt to establish a new and sound investment. But now that the movement was so well started people would not turn back to the old former condition of monopoly. To make good telephone securities, construction must be first class, with everything carefully figured out. They must beware of wind and water; and one was likely to cause the other. They must get down to solid earth and stay there. Independents were severely criticised for having frequently established too low rates. If the convention could bring about a general increase in telephone rates it would aid more than anything else in putting their securities on a good footing. Even with the present rates, not more than one per cent. of the companies would default on their obligations.

The permanent existence of two companies in any given locality was not necessarily impracticable or to be considered so. The Western Union and Postal Telegraph Companies were cited as examples of two companies in the same field. Two rival companies were not inconsistent with ample security for the stock issued. No one company could now secure an entirely clear field to itself, and it is probably best for progress that one company should not have it all. There was undeniably an actual and permanent increase shown in independent telephone business. Hence the securities must be regarded as sound. Bell subscribers were given as one million and

the independents as already two millions, in spite of the former's age in the field.

A motion was unanimously carried to print Col. Powers's paper in pamphlet form for the use of independent companies. One member engaged 1,000 copies for immediate use.

Mr. J. W. Layne, of Carthage, Mo., also presented a paper on independent telephone securities as an investment from the standpoint of the small investor. He referred to the changed conditions whereby capital was now available in each locality for enterprises formerly financed in the East or in Europe. Because of abundant local capital, owing to the accumulations during prosperity, and the discrimination against independent securities by larger banking houses due to Bell influences and prejudices the raising of home capital was commended as much easier.

Mr. J. J. Nate, one of the veterans and "warhorses" of the independent telephone movement, read a long paper on the Berliner patent and the Bell claims of infringement, and went over the various points in the patent litigation now pending.

Mr. C. B. Doble presented a resolution against the purchase by any independent telephone company of any supplies from the Western Electric Company because of its ownership and control by Bell telephone interests. This was carried.

In a paper with this title, "Suggested Methods for Improving Long-Distance Telephony," Mr. Charles E. Hull, after condemning the hap-hazard manner in which so many independent telephone companies have installed and are managing their systems, offered suggestions as follows for securing needed "local" long distance communication rather than purely "long distance" telephony:

1. That the present system of lines connecting individual exchanges be continued and improved.

2. That companies be formed along a given route to build metallic standard construction lines to operate in conjunction with the already established exchanges. The stock in the company to be subscribed by connecting systems.

3. That encouragement be given to the formation of entirely independent long distance companies who will connect on favorable terms with individual exchanges.

From correspondence resulting from inquiries addressed to telephone companies, Mr. Hull considers that the general sentiment seems to be that whichever of these ideas appears best, or a combination of the three, will be readily adopted by all concerned, excepting building standard construction. The most practical suggestion for improving present conditions is that new lines be run under present conditions on the same poles as now with no telephones on, and that these lines terminate in open jacks on the respective switchboards of the different companies or stations. All calling should be done over present lines. When a so-called through message is to pass several switchboards, operators are to be notified to connect the new line by means of these open jacks. This would be at best a makeshift, but certainly would be a vast improvement on present conditions.

The second plan presents some complications which will be hard to overcome. The theory is a good one. It is believed that practice will demonstrate that it will be a difficult matter to adjust the different ideas and conditions which will be brought into such an organization. It would seem strange if any two stockholders in such a company would come under similar circumstances.

The practical system for the advancement of the independent telephone movement would, it seems, be a combination of the three ideas above suggested.

There is a great deal of purely local telephoning that is offered subscribers so cheaply that no long distance company could undertake it. Under this head comes free county service. Lines of the long distance company could be run to the main office of such a company with the understanding that all incoming lines from other stations be of standard construction. Better still, the long-distance lines should touch each exchange. Through business should be given the long distance company direct and local business remain with the home company.

A resolution was passed thanking the manufacturers for their handsome entertainment of the delegates; Colonel Powers for his paper on investments; the Illinois Telephone and Telegraph Company for the trip to their tunnel; to the secretary for his efforts in promoting the success of the Association and convention; to the Louisiana Purchase Commission for the invitation to the Exposition in 1904.

An invitation was received from Mr. R. B. Wattress, the secretary of the Citizens' Business League, of Milwaukee, Wis., to hold the next convention in that city. This was referred to the Executive Committee for attention.

On the recommendation of the Nominating Committee the following officers were duly elected: President, C. E. Hull, Salem, Ill.; vice-president, L. A. Frazee, Connersville, Ind.; secretary, E. M. Coleman, Louisville, Ky.; treasurer, J. W. Layne, Carthage, Mo. The Executive Committee named by the State delegates is as follows: Iowa, H. S. Herr; Ohio, W. Guy Jones; Wisconsin, A. L. Hutchison; Minnesota, E. H. Moulton; Illinois, A. B. Conklin; Missouri, W. T. Hall; Kentucky, D. Pruitt; Indiana, O. Rex; Michigan, J. B. Ware.

A banquet was given as a finale to a very successful convention at the Auditorium on Thursday evening, when 600 guests were present and a most enjoyable time was spent. The convention thus closed a memorable week.

Exhibits at the Convention.

The convention was notable for the large number of telephone supply companies making parlor exhibits at the hotel. Of course, many of the largest independent telephone factories are located in Chicago, and for that reason there was not the necessity for parlor exhibits that there would have been if the convention had been held in any other city. All the Chicago telephone manufacturers made ample provision for getting exchange owners and superintendents to visit their extensive plants. President Raney's address gives some idea of the extent of the manufacturing interests in Chicago.

Cook & Nolan, Chicago, exhibited a unique automatic fire alarm central station call and water supervision system.

The Warner Electric Co., Muncie, Ind., showed the Warner pole changer and several specialties. T. W. Warner was in charge.

W. H. Anderson & Sons Co., of Detroit, exhibited samples of contractors' tools, and its very popular cable reel jack, Mr. Anderson being present.

F. B. Cook, Chicago, showed the Cook pole top terminal, the Cook main distributing rack, heat coils, line fuses, lightning arresters, lock nut cable terminals and specialties.

The Automatic Electric Co., of Chicago, had as its chief exhibit its new factory with a capacity of a telephone equipment a minute. Here the automatic exchange apparatus for the new Chicago company is being made. H. D. Critchfield has recently connected himself with this company.

The Standard Pole and Tie Co., of New York, was represented by Fred. L. Merritt, secretary and treasurer of the company, who had his headquarters at Room 660, where, assisted by W. E. Mitchell, of the same company, he showed delegates samples of juniper poles and Florida pine cross-arms free from all knots or blemishes. The great height of this company's timber enables it to furnish large amounts entirely free from knots.

The Kellogg Switchboard & Supply Co., of Chicago ran an automobile service between its factory and the hotel. The factory has recently been very much enlarged, and is one of the model manufacturing plants of the city. Kellogg manufacturing methods are so thorough that it gave the company's numerous representatives great pleasure to pilot visitors through and show prospective customers the system and workmanship that goes into Kellogg apparatus. The Kellogg Company is specially noted for the high grade of engineering talent and superintendence in all departments. The largest multiple board ever ordered will be built by this company for St. Petersburg, Russia.

The Stromberg-Carlson Telephone Mfg. Co., had headquarters at the Auditorium, where a few products were exhibited, visitors received, and arrangements made to take delegates in carriages to the company's immense factory on the west side. Messrs, Stromberg, Carlson and Steiger were, of course, among the prominent men at the convention. The representatives who looked after visitors were William Bowen, R. B. Tyler, A. J. Rousseau, J. J. Nate, Paul Drelyers, E. L. Brown, G. H. Pierce, A. B. Hewitt, A. B. Smith, E. C. Lewis, G. E. Knight, Ed. Carr and F. L. Martin, advertising agent. The exhibit which was made at the factory office was decorated with palms and cut flowers. Carriages ran every half hour between the hotel and factory. Fine souvenir paper weights were given away.

The Manhattan Electrical Supply Co., of Chicago, was represented by Arthur O. Einstein.

The Gordon Battery Co. showed a line of Gordon cells. Mr. E. M. Deans, Western agent, was in charge.

The McRoy Clay Works, Brazil, Ind., showed an assortment of its well known conduits. Mr. McRoy was present.

The Fowler-Jacobs Co., Chicago, was represented by John H. Fowler. The concern is a large dealer in cedar poles.

The Dey Time Register Co., of Chicago, exhibited the Dey register. J. H. Wilson and R. G. Pelton were in attendance.

The Controller Co., of America, presented an automatic pay station of entirely new design. George L. Moselle was in charge.

Maltby Lumber Co., Bay City, Mich., was represented by A. Maltby and I. A. Maltby. This company is well known to users of poles.

The E. E. Nagle Tie Co. had no exhibit, but Mr. A. T. Nagle, of Chicago, distributed circulars describing the company's line of cedar poles.

The Central Telephone & Electric Co., St. Louis, Mo., represented by James S. Canning, C. H. Wallis and H. J. Joys, showed a line of telephone material and switchboards.

The Fisk-Newhall Telephone Mfg. Co., Chicago, showed a very complete line of telephone equipment, featuring a new combination jack and drop. Mr. Fisk was in charge.

The Allen-Hussey Co. showed a non-interfering, non-communicating telephone outfit with 25 stations connected, and the Duplex desk telephone holder. Frank Heffron was in charge.

American Steel & Wire.—The Chicago office of the American Steel & Wire Company was represented by C. S. Knight, A. J. Hess, Burley Ayres and N. H. Van Sicklen, all well known to the telephone trade.

W. J. Barr, of Cleveland, manufacturer of telephone arms for the manufacturing trade, showed his complete line of arms and a new central energy cabinet in cast iron, which seemed to meet with favor among the manufacturers.

The Illinois Electric Specialty Co., of Chicago, exhibited a thermostat fire alarm system, direct reading ohmmeters, pole changers and duplexers. T. B. Pelton, president, and H. R. Ruh, electrician, were in charge.

The H. B. Camp Co., New York and Chicago, showed its usual line of vitrified clay conduits, among them being what they claim to be the only nine-way conduit on the market. Mr. J. A. Hammett, of the Chicago office, was in charge.

The Williams-Abbott Electric Co., of Cleveland, was represented by L. Sands and F. H. Lincoln. They showed a two-hundred-line restoring magneto board, a new transmitter which attracted considerable attention, and a full line of telephones.

The National Carbon Co., of Cleveland, showed its well-known line of Columbia dry cells, Solar, Ravenna, Laclede and Hercules batteries, also a line of carbon specialties, and a new auto cell for ignition of gas engines. M. H. Moffett was in charge.

The Lindsley Brothers Co., of Chicago, exhibited small sections of Michigan and Idaho poles, and photographs of their forests and plants. G. L. Lindsley, Chicago; C. P. Lindsley, Spokane, Washington, and E. A. Lindsley, Menominee, Mich., were in attendance.

The Farr Telephone Co., of Chicago, represented by E. W. Hurst, had a general line of telephone supplies, and called particular attention to a new intercommunicating set and a new special bridging instrument for country lines. The exhibit was arranged on a large board.

Ruber & Watson, Chicago, dealers in poles, had a unique exhibit consisting of a complete steam railway. A miniature steam locomotive hauled a train of cars loaded with poles around a circular track, while surrounding the track was a pole line with cross-arms, pins, braces and wires installed. H. D. Watson and E. W. Reber were in charge.

The Standard Underground Cable Co. had a case showing its various styles of paper, weather-proof and rubber-covered cables, and exhibited with pride the first reels of copper wire turned out in its recently completed copper mill at Perth Amboy, N. J., said to be the largest in the country. P. H. W. Smith, J. R. Wiley, E. J. Pietzcker, Arthur Anderson and W. M. Rogers were in charge.

The Chicago Pay Station Co., of Chicago, was represented by J. C. Finch, manager, and G. H. Morganstein, sales manager. They showed the regular line of pay stations and among the novelties presented were a new counter for toll messages, or counting poles, a new time stamp for keeping track of trouble complaints, and a new telephone holder for desk purposes which was shown for the first time.

The American Electric Telephone Co., of Chicago, showed one section of a 12,000-line multiple central energy lamp line board, also a new type of express switchboard, a self-contained desk set, a new type of relay, and a four-party line system of telephones. A new transmitter was shown in parts, the chief feature being the carbon which was carbonized hard coal. P. C. Burns, O. M. Light, J. G. Ihmsen, Max W. Zabel, H. K. Murrey, S. W. Baer, and R. E. Pickerill were in charge. The exhibit was a very large one, and occupied three rooms.

The North Electric Co., of Cleveland, had one of the most extensive exhibits. The switchboards shown included a 100-line magneto call, a 200-line magneto call, a 400-line target signal, having toll section, and a lamp-signal switchboard, with 200 local lines and 30 magneto calls installed. The company's supervisory telephones attracted considerable attention among the smaller managers. There was the usual large exhibit of various types of telephones. F. F. Sapp, W. J. Knight, J. F. Davis, George P. Pratt and L. G. Bowman were present.

The Western Telephone Mfg. Co., Chicago, a recent reorganization of the Western Telephone Construction Company, showed the Western Express 200-drop magneto board, a 200-capacity visual signal board, a section of a central energy lamp signal multiple board, the Western Special telephone, with a new switch hook and a new carbon lightning arrester. A field signal service outfit for army use was also shown. The magneto board had lamps for clearing out signals, a novelty for this type of board. H. S. Pringle, James Keelyn and W. G. Peacock were in charge.

The Swedish-American Telephone Co., Chicago, had a comprehensive exhibit in one of the parlors, and showed its various types of instruments in numerous patterns and finishes. A new central energy board with 200 lines was in operation, and among other new features was an improved gravity hook and new line magneto apparatus. Pink carnations worn by hundreds of delegates and supply men testified to the fact that the Swedish-American exhibit was very popular. A. V. Overshimer, E. B. Overshimer, R. L. Scott, F. M. Ferguson and C. H. Macklin represented the company.

The American Electric Fuse Co. held forth in the South Parlor and showed a complete line of protective apparatus, wire joints and fuses, the American cable office terminal, the Rolfe distributing board and the Rolfe self-restoring heat coil, with improved design of rack. The rack is mounted on slate so there is no danger of cross circuits or leakage. All insulators are of lava, giving double insulation from the iron of the frame. The rack has vertical and horizontal wireways consisting of glass enameled rings, giving the best of insulation. The solder on the Rolfe heat coil melts under undue current, and as soon as the circuit is broken the solder immediately hardens in its original shape and the fuse may be placed in position by hand. The device was shown in operation and the cartridges were frequently used up to 200 times without being rendered unfit for service. F. G. Jones, president; J. A. Kenney, general manager, and Chas. A. Rolfe, the inventor of several of the company's devices, were in attendance.

The Electric Appliance Co., of Chicago, had an exhibit which was notable for unique features in the way of advertising novelties. Footprints in the halls led visitors to Room 612, the company's headquarters, while outside in the open space in front of the hotel was traced in the snow in huge letters, a sign calling attention to the fact that the company held forth in the room mentioned. E. C. Brown, S. A. Roll, P. R. Boole, S. A. Dinsmore, J. B. McMullen and J. A. Bennett, represented the company and demonstrated its line of Noxem receivers and telephone supplies, and in addition there were the exhibits of several concerns affiliated with the above. Among them were the Warner Electric Company, Muncie, Ind., represented by Mr. Warner; the Crescent Company, Chicago, manufacturer of soldering material, represented by James McGill, and the Whitney Electric Instrument Company, Penacook, N. H. The latter showed the Whitney measuring instruments and the Sage direct reading ohmmeter for resistance measuring and testing.

The Valentine-Clark Co., Prentice, Wis., was represented by F. L. McGillan.

The Varney Electric Supply Co., Indianapolis, jobber and manufacturer, was represented by A. A. Mans and F. D. Rusling.

The W. G. Nagel Electric Co., Toledo, showed the Ready pay-out reel, cable cars, construction tools of all kinds, and a new duct rod which can be coupled in horizontal position for instantaneous use. H. E. Adams was in charge.

The Calculagraph Co., New York, showed their well-known device called the Calculagraph, a recording meter used in keeping track of the length of conversations over toll lines. Henry Abbott, president of the company, and Paul C. Wilson explained the advantages of the device.

G. H. Miller, representing the Miller Anchor Company, Norwalk, showed a new form of guy wire anchor which attracted favorable comment. The anchor can be installed in a very small hole, and it is claimed the gripping surface is much larger than that of the majority of anchors on the market. It is claimed that the rod will break before the anchor can be pulled from the ground.

The Wittenburg Cedar Co., telephone poles, the Dearborn Electric Company, Chicago, soldering specialties and supplies, the American Carbon Company, Noblesville, Ind., Jones & Winter, Chicago, the Guarantee Telephone and Engineering Company, the McDermott Manufacturing Company, Chicago, and the Vought-Berger Company, La Cross, Wis., had representatives at the convention.

The Chicago Telephone Supply Co., Elkhart, Ind., displayed a common battery switchboard, common battery instruments, bridging telephones, desk sets, etc. A new six-bar generator and a long-distance solid-back transmitter have just been brought out. A feature of the transmitter was a metal auxiliary diaphragm claimed to be non-infringing. The rear electrode was adjustable. G. A. Briggs, president; S. A. Du Vall, engineer, and L. G. Le Bourvean were present.

The Mountain State Electric Co., of Wheeling, W. Va., showed line cable terminals for underground and aerial work. The company is preparing to introduce a new selective system known as the Selectaphone. It can be installed on any system already in use and by it the operator can lock out all subscribers except those talking. At the same time a red signal is displayed announcing to the various subscribers that the line is busy. Frank B. Hull and Arthur F. Pool were present.

The New Haven Novelty Machine Co., New Haven, Conn., showed the Novelty sleeve of the sliding type, consisting of a brass shell attached with lead gasket unions to each end. The sleeves are made for plain joints, various types of branches, and affords an easy and inexpensive method of examining cable joints. The device attracted much favorable comment. H. Grant Thompson, president, and Charles Luke, superintendent, demonstrated the joint and were more than pleased with the interest shown.

The Eureka Electric Co., Chicago, had its chief exhibit at its factory and an automobile operated between the factory and hotel every half hour. The company showed a new solid-back, non-infringing transmitter. There were a number of common battery system telephones in actual operation. Five varieties of competitive transmitters were connected up, showing the relative merits of the talking circuits. A new intercommunicating factory system was featured. I. J. Kusel, H. J. Kusel, D. L. Camnann, A. J. Robbins, D. Currel and Paul Gardner were in charge.

Nungesser Electric Battery Co.—Orange and red were the prevailing colors in the room occupied by the Nungesser Electric Battery Company, Cleveland, which displayed its well-known line of batteries in an effective manner. The 1900 battery for telephone work and the new No. 3 battery for closed circuit work were featured. The latter is designed for central energy telephone systems, and it is claimed that owing to its high current capacity, 600 ampere-hours, it will be found a most economical battery. H. G. Robbins, secretary, and Thomas G. Grier, Chicago, were in attendance.

The F. Bissell Co., Toledo, had an excellent exhibit of pole houses and cable terminals, manhole covers and guards, pole seats, boat swing chairs, cable trolleys and sections of poles complete, with cross-arms, alley braces, and cable cross-arms. The company handles the Nernst lamp and showed a sample designed for illuminating telephone exchanges. Fred Bissell, president; C. W. Hamilton, sales manager; N. S. Bissell and M. S. Walker were in attendance. The Bissell Company is advocating for universal use among the independent people, the "Independent" sign, which is employed by a number of leading companies.

The Holtzer-Cabot Electric Co., Brookline, Mass., through its Chicago branch, showed its popular line of goods, including direct-connected motor generator outfits for charging storage batteries, loud-ringing extension bells for noisy places, gas engine igniters, magneto-bells, generators and ringers, A. C. and D. C. motors, dynamotors for party-line ringing, the Ness automatic telephone system, the Hotelphone outfit for hotels, linemen's testing sets, etc. A motor direct-connected to a howler and busy-back attachment drew attention to the room. E. R. Harding, western representative, with a force of assistants, entertained.

The International Telephone Mfg. Co., Chicago, was represented by Henry Shafer, president; Wm. E. McCormick, vice-president; John C. Burmeister, secretary; R. N. Stiles, treasurer; D. L. Barry, sales agent, and D. A. Clithero, counsel. The exhibit included central energy and magneto call telephones of various styles and types. The transmitters are equipped with carbon electrodes and it was claimed it was impossible for them to become packed or deadened. The switch was so constructed that there was no scraping except at contact points. The receiver was of the double-pole, adjustable, horseshoe magnet type, with diaphragm clamped to the metal ring, thus avoiding depending on rubber shells for holding its adjustment. The new arm was mounted on a sub-base, so it could be unlocked and conveniently opened to test the coils.

The Sterling Electric Co., Lafayette, Ind., had a large representation in the persons of W. E. Doolittle, president; H. A. Taylor, vice-president and secretary; S. B. Fowler, electrical engineer; F. E. Ritchka, assistant general manager; H. T. Doolittle, purchasing agent; E. M. Johnson, chief installer; Evan Shelby, G. W. Metcalf and Miss Ethel Henderson. The exhibit occupied two rooms and included telephone apparatus of all kinds. There was a section of a common battery lamp signal multiple switchboard and power board, with main distributing frame and protectors; also an Ideal 100-line board designed for small exchanges. It was of the automatic restoring visual type, with pilot lamps and flash light transfers. It was equipped with party line keys by which the operator could call any one of four subscribers without disturbing the others. There was also shown a large line of common battery and magneto telephones.

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CONTENTS.

MOONLIGHT TABLES.

As our readers are aware, this journal has for some years past made a practice of publishing, early in December, moonlight tables for street lighting work, to be used in the ensuing year. These tables have always been compiled for us by Mr. H. W. Frund, a well-known electric light manager. With the present issue we furnish as a Supplement, in the familiar form, Mr. Frund's tables for 1903, his own table and the standard moonlight system appearing side by side. We are glad to know that this effort is much appreciated, as evidenced not only by the inquiry for tables, but by their frequent appearance on the walls of electric lighting offices and central stations. Extra copies may be obtained on application to the business department of this journal.

MANHATTAN ELEVATED ELECTRICS.

As all our readers who live in New York are aware, and as many of them who live outside have also learned, the electric third-rail system of the Manhattan Elevated Company went very rapidly and thoroughly to pieces last week, during the occurrence of a rather ordinary sleet storm, which, under usual conditions, would not have attracted much attention. But the wonted hardships that New Yorkers endure were so intensified during the recent episode and the comment created has been so unfair to electricity as a motive power, we are constrained to enter a strenuous protest, rather from a sense of duty than because we want to say anything. It is not our common practice to rail at corporations charged with great public functions, but on the contrary, to defend them very frequently from the complaints that are laid against them. But in the present instance when a great transportation system by woeful lack of foresight and energy allows the cause of electric traction to suffer criticism for which there is no warrant, we do not propose to stand by and acquiesce quietly. In our opinion the misery inflicted on hundreds of thousands of New Yorkers was wholly unnecessary, and we hardly wonder that many people have looked for a malign explanation of what happened. We have heard it suggested that owing to the presence of New York Central influences in the Manhattan management, there was great willingness to let the public see that the third-rail method was quite uncertain and unreliable in times of stress. Such an idea ought to be dismissed, even if it chimes in with the Central's elaborate procrastination over changes in the tunnel. Another theory handed around in electrical circles is that the Manhattan managers have been far too busy fostering profitable stock deals to see to it that the proper equipment and necessary supplies were secured in time from the manufacturers, whom other electrical service companies have been persecuting with pertinacious demands for material. We mention these things merely to show what sinister interpretations people are willing to proffer when suffering from evils that appear to them absolutely unnecessary and very easily prevented.

When we remember and recall how magnificently Mr. Vreeland has handled the Metropolitan Street Railway system in New York in violent snow and sleet storms, catching the flakes even before they could reach not merely his third rail, but his fourth, below the level of the swimming streets, it is too late for the Manhattan people to convince us or anybody else that the third rail is a failure on a track free from every possible obstruction and accessible to the promptest removal of, and prevention of clogging by, ice or snow. The third rail will yet be improved upon, but we insist that it is a splendid success

[illegible] already approved in Chicago, Boston and other places. There are various forms of third rail, and the tardy discovery on the Manhattan system that one of the simplest styles can be knocked out by a trivial "cold snap" is altogether too preposterous to be allowed for a second. If there are better methods, for sectional operation, for housing the rail, or for scraping the contact head,—and we can readily believe in such improvements—we still contend and insist that there was no excuse for the frightful inconveniences caused last week. Those inconveniences are after all but in keeping with the record of the past—the miserable station management, the wretched lighting, the incessant delays, the quick interruptions of the express service, and half a dozen other features of gratuitous discomfort. It has been said that the parsimony of Mr. Sage was largely to blame for all that; but now that he is happily removed from further opportunity of distressing his fellow-citizens, it is devoutly to be hoped that others, if equally responsible, will disappear under the new regime. We are entitled to expect better things.

Atomic Dimensions.

In our correspondence columns this week appears a letter from Mr. Ridout, referring to our editorial comments on his recent paper. We are glad that he likes the term "bicron" for $\mu\mu$, the billionth of a metre, or 10^{-9} metre, to match and correspond in the descending scale with the well-established micron, the millionth of a metre. Similarly we may use with advantage the "tricron," or $\mu\mu\mu$, for the trillionth of a metre, or 10^{-12} metre. Both these terms "bicron" and "tricron" are badly needed in microphysics, and they are self-explanatory. It is convenient to use them first and to ask philologists about them afterwards, because philologists as a class protest against the introduction of any new term, and new terms must be had in a growing science and art.

Improvements in Arc Lighting.

We note with interest that the development of arc lighting by means of carbons charged with relatively volatile substances is being steadily pursued abroad. In this country little has been done along that line save in a purely experimental way, yet we know of few directions to which earnest work could be devoted with better prospects of success. Certain it is that such arcs can reach an efficiency much higher than is found in current practice, and with great advantage to the color of the resulting light. And there is good reason for this. As we have more than once pointed out, attempts at improving the efficiency of illuminants have proceeded along two diverging lines. On the one hand, recognizing the low efficiency of the light given by incandescent solids at ordinary high temperatures, there has been steady effort to find substances so refractory that they can be carried without immediate danger of disintegration to a temperature much higher than usual. This results in an increased proportion of radiation within the limits of the visible spectrum. To this class belong the iridium lamp in various modifications, the Nernst lamp and the arc between refractory pencils similar to the Nernst glower. There is no doubt that by such means the efficiency of the light can be greatly increased, perhaps nearly or quite doubled. Against the process stands, aside from the mechanical difficulties which have been encountered, the very high intrinsic brilliancy of the resulting light, rendering absolutely necessary for most purposes the use of much denser shades and more elaborate diffusive devices than are necessary with ordinary illuminants. This is equivalent to a lessened efficiency.

If one has two lights, one of so low intrinsic brilliancy that it can be used unshaded, the other so brilliant that it requires a heavy opal shade to make it bearable, the latter must have nearly double the efficiency of the former in order to have practical efficiency. For to give a unit of light, say, a single candle-power, the same working value in each case, the intrinsic brilliancy of the two sources including shades must be equal, at least if they are in any sense within the field of vision. Otherwise, in the presence of the brighter light the eye will be automatically stopped down at somewhere about f 6 in ordinary illumination. The extent to which the iris shuts or opens depends on the maximum intensity of the stimulus; that is, on the maximum luminous intensity within the field of vision. In very dim light the iris may open to f 4, or even wider, while in the presence of a very brilliant source of light it will close to f 16, or so. Thus when one is driving along a dark street and approaches an arc lamp, the eye is reduced to a condition of uselessness as regards the faintly illuminated objects outside of the immediate range of the arc. It is even worse than the similar photographic case, because one cannot correct the under exposure by adroit development. Thus gaining luminous efficiency by pushing up the temperature of the incandescent source results in certain inconveniences and losses in the application of the light that tend to limit the practical usefulness of the method. The real gain is in this case far less than the apparent gain.

The other plan for increasing luminous efficiency is to employ sources of light which are characterized by selective radiation, thus causing a greater proportion of the total energy to be concentrated in the visible spectrum. In this category fall vacuum-tube lamps and the arcs which we have under consideration. The two categories are not absolutely distinct, for there is a minor degree of selective radiation in the substances of which the Nernst glower is formed, and the common enclosed arc is strongly selective as regards the rays photographically active, but the main difference is fully preserved, nevertheless. The vacuum tube, with its discontinuous spectrum, is highly efficient, but as ill luck will have it, the only form yet commercial is very bad in color. Now the effect of incorporating metallic salts in the carbons of an arc is to su[illegible] on the radiation of the glowing carbon a strongly selective ra[illegible]tion due to the metallic vapors, resulting in a very considerable increase of efficiency without proportionally increasing the intrinsic brilliancy. In theory, therefore, it is an admirable plan, and the results already obtained show a very high efficiency. The dubious factors to be dealt with are the uniformity of the results and the unusual mass of matter volatilized. The former implies careful attention to the details of manufacture, and the latter will undoubtedly require a good deal of experimentation to avoid smudging the lamp with metallic oxides, particularly if such electrodes are ever to be used with enclosed arcs. This means very careful choice of the volatile substances and plenty of hard work in reaching a commercial result. But the light is so efficient and can be made so excellent in color, that it is well worth exhaustive investigation. The more volatile the active substances the lower will be the intrinsic brilliancy and the greater the danger of smudging, so that the experimenter is between two fires. Still, there seems an excellent chance of a good commercial result and we hope that the American workers will do their full share.

Self-Denying Ordinances.

The report which we gave in our eight-page Supplement last week of the independent telephone convention in Chicago contained a good many features of interest and importance, quite aside from technical questions which somehow do not yet come

up very prominently in these meetings. Doubtless as the commercial problems get settled those of an engineering nature will loom up more conspicuously, and with the greater speed as the campaign is pushed to secure capital. We are glad to note the emphasis laid upon good engineering work by those who spoke as to the claims of independent telephony for investment. The necessity for solid, enduring construction and for the use of the best apparatus has never been more strenuously advocated than it was last week by those who discussed investment in telephony by the banker and by the small investor. We fear that some of the seed will not fall on ground that is receptive; but there has of late been great improvement in general construction and some of the independent exchanges are not to be surpassed.

In view of the fierceness with which many of the independent exchanges have insisted upon their right to have access to Bell circuits, under common carrier law and principles of equity, it is rather astonishing to see the case "given away" by the self-denying ordinance adopted at Chicago, pledging the members of the Association to purge it of all managers who exchange business with the Bell system. Apparently the rights and welfare of the public are clean forgotten by those who but a year or two ago were posing as the heaven-sent deliverers of the public from a tyrannical monopoly. If, now, managers who, to facilitate the business of their customers, are willing to exchange with rivals shall be boycotted and bounced, we do not see that the independents acting that way are one whit better than the folks they were lately denouncing. We are reminded of the Puritans who came to New England to escape persecution and became very harsh persecutors themselves, and we deplore the appearance of such a spirit in the independent ranks. In the early days of electric lighting there was somewhat the same tendency as between incandescent and arc lighting companies, but it was long ago obliterated by the march of events and by a larger, wider conception of what are the duties of an electric light company, and what are the rights of the public to enjoy every facility and assistance that can be afforded. We know that there are many thoughtful, liberal-minded men in the independent telephone field who see that it ill becomes them to deny rights and privileges which they have themselves been vehemently claiming but a moment ago.

Another outcropping of commercial jealousies is seen again in the resolution not to deal with a well-known manufacturing concern because it is owned and controlled by American Bell interests. This is somewhat like the action taken earlier in the year by the National independent telephone body, at its Philadelphia convention, and is, of course, a frank and avowed boycott. It is also in keeping with the proposal to discipline the independent manufacturers who insist on selling an exchange system in a place where one already competes. Obviously a wide field of conjecture and controversy is here opened up, and the parallel with the electrical history of the recent past in light and power is again rather strikingly close. Even when such policy is wholly righteous, it is hard to enforce with full severity, and if not carried out logically it generally fails. Here also the public views with quick suspicion and animosity such movements, as in restraint of trade; and we hardly think it will regard favorably the action of those it has been backing up pretty vigorously as the advocates of an open-door, free-for-all policy. Besides, it might be claimed that the apparatus had been bought from the concern first named, because it was at once the cheapest and best, enabling service to be given reasonably. The case of manufacturers selling rival systems in places already blessed with competition is slightly more complex. Usually such competition leads to low rates at first, but after a time consolidation sets in and then the investment and the price of service are loaded with the cost of the junk pile. On the other hand, absence of competition has an undeniable tendency to cause the degeneracy of a system, and the problem is to set the point where efficiency shall be maintained at the highest pitch with least effort on the part of capital and labor.

MAGNETIC DECLINATION TABLES.

The United States Coast and Geodetic Survey has recently issued a book containing magnetic declination tables and isogonic charts for 1902, as prepared by Mr. L. A. Bauer. This volume is quite a compendium of facts relating to terrestrial magnetism and is of great interest to the student of magnetism. It brings into prominence a number of facts that are difficult to discover amid the vast array and maze of modern magnetic literature.

The tables are particularly interesting in their data of secular variations, which variations may be due to secondary electric currents, generated within the earth's mass, by its rotation about an axis not coincident with the magnetic axis. Considering the earth as a conducting mass, and also as a permanent magnet, if the earth's rotation axis and the magnetic axis were one and the same, then, by symmetry, the electromotive forces of the "unipolar" dynamo type, induced in the rotating mass, would be symmetrically distributed about the globe, and would balance one another in such a manner that no electric currents would flow, in the absence of conductors to join the northern and southern polar regions. But with the magnetic and rotational axes eccentric, the induced electromotive forces in the mass of the earth would not balance, and would establish a set of eddy currents in the earth, the distribution depending upon the local conductivity. The effects of these eddy currents would be to modify the original inducing flux distribution, to influence whatever permanent magnetic distribution might exist, and to affect compass needles on the surface to a greater or less extent. The general deductions seem to be that the earth's magnetic flux distribution, which compass needles obey, is partly of a steady or permanent type, like that of a bar magnet, partly due to electric currents in the earth, which may be subject to fluctuation, and partly due to external or cosmical influences, such as auroral currents or electric currents in the rarer regions of the atmosphere, where the air is supposed to be a good conductor, at an elevation of, say, fifty miles.

A very interesting indication has been evolved as the outcome of recent elaborate magnetic surveys of England and France. The charts of isogonic lines, when carefully drawn, show some local wrinkles, like "faults" in geological strata. A very noticeable line of kinks in isogonals appears near Paris. By analyzing the charted distribution into a uniform distribution, and a superposed irregularity, the irregularity takes the form of a ridge or line of virtual magnetic matter having a definite geographical contour. It is stated by Professor Rücker in a passage quoted from his report of the British Survey, that these magnetic ridges correspond, in general, with observed masses of basalt rock. Although basalt is not itself a sufficiently magnetic substance to account for the whole magnetic protuberance, yet it would appear likely that magnetic rocks underlie and accompany the basaltic obtrusion; so that the magnetic charts may be found capable of yielding valuable geological inferences. Another interesting fact is that some remarkable automatic magnetic records from the magnetic observatory at Cheltenham, Md., seem to indicate sudden disturbances of a magnetic, as distinguished from a seismic nature, about the times of the first and second eruptions of Mont Pelee in Martinique.

The Sleet Break-down of the Manhattan System.

[illegible] York last week, when the most important branch of [illegible] transportation system was crippled and a great pro[illegible]nvenienced for several days by a thin [illegible]ird rail of the Manhattan [illegible]eated was sufficiently serious [illegible] to up-town residents and the [illegible]yes, it was recklessly exag[illegible]ch, with their accustomed [illegible]tem was demonstrated to be an ignominious failure, and that the steam locomotive was to be [illegible]d on the Manhattan.

It is now fully recognized that the urban transportation facilities of New York have become inadequate to handle properly the passenger traffic under normal conditions, and the breakdown of the Manhattan system last week gave a foretaste of what is in store for the New Yorker if a remedy be not soon found. The addition of the underground system will but mitigate the evil temporarily, as in a few years the increase of traffic will repeat the situation. The crippled electric service was supplemented by all of the locomotive power [illegible]t as the schedule could not be maintained, the crush at the stations and in the cars was tremendous. To relieve somewhat the crisis, passengers were permitted to enter some of the cars through the windows when the aisles and platforms were jammed solid, and on one morning train an engine tender was seen crowded with passengers. The personal inconvenience to passengers became often actual suffering owing to the pressure of the crowds, and was always a lamentable spectacle of indecency as regards the opposite sex.

The trouble was brought on by a fall of sleet, which produced and maintained a thin insulating coating of ice on the conductor rail. When the film first began to form, the contact shoe was able to remove it partially, but in constantly slipping from the iron to the ice, the interruption of the current which followed in each case gave rise to great arcs. During this period the high structure

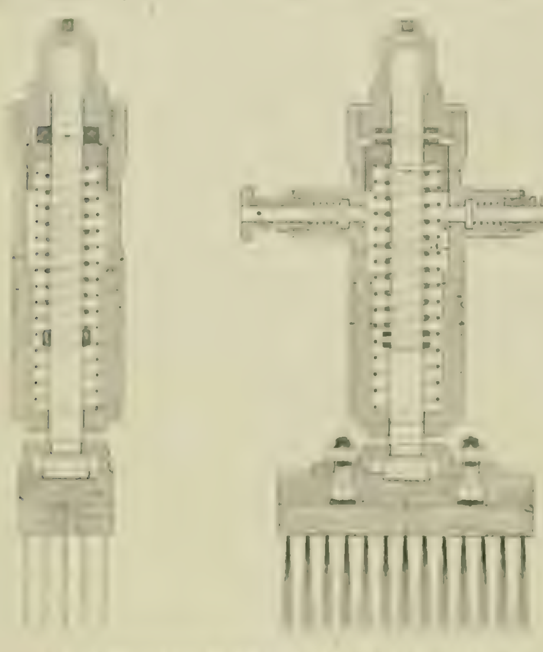


FIG. 1.—[illegible] CLEANER.

at 110th Street became a scene of pyrotechnic display that brought crowds to the vicinity to observe. Finally, all electric cars were withdrawn. While difficulty from sleet had been foreseen by the Manhattan people, and brush and sprinkler equipments ordered to meet an emergency, it appears that there had been delay in delivery, and but few [illegible] on hand. [illegible] they were put in place, but it was then found that the remedy they were supposed to furnish was inadequate. Only part of the traffic on the Sixth Avenue line, where the worst trouble was experienced, was being handled by electric cars, and the intervals between these was not sufficiently small to enable the brushes to keep the rail clear of ice.

The accompanying illustrations show the contact shoe of a Manhattan motor car and one of the brush equipments. Each car is to be equipped with four brushes or scrapers, and as there are four motor cars to each six-car train, this will give 16 brushes per train. In order that they may be applied automatically, the brushes are mounted on a piston in an air cylinder, and by the opening of a single cock the motor can control all simultaneously.

Among other equipments that had been ordered by the Manhattan Company to meet the same emergency are ten oil and salt water spraying machines. These consist of tanks to hold oil or salt water, which is delivered in an atomized form through a nozzle located just above the contact rail.

The difficulty from sleet has been encountered on all the older third-rail elevated systems, and while at times it has resulted in some disorganization of the traffic, no situation approaching the recent one

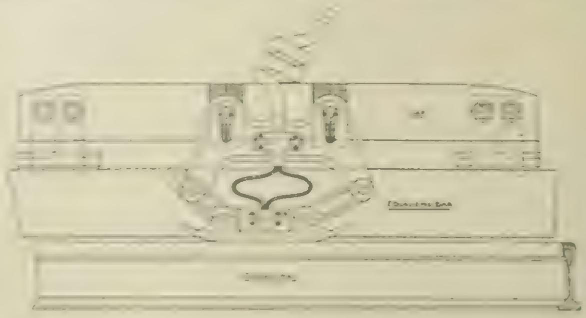


FIG. 2.—CONTACT SHOE AND HANGER.

in New York has developed. In Chicago, Boston and Brooklyn the cars are fitted with brushes, but main reliance against sleet appears to have been placed upon applications to the rail of oil in Chicago and Boston, and both oil and salt water in Brooklyn. It has also been found that if the rail is well oiled before ice has had a sufficient opportunity to form and adhere firmly, less difficulty is experienced in removing it with the brushes. In New York there appears to have been insufficient preparation for an emergency that was clearly foreseen, and lack of executive ability in meeting it when it arose.

It is fortunate that the capabilities of electric traction as applied to elevated railways had previously been thoroughly demonstrated in Chicago, Boston, Brooklyn, Liverpool, etc., as otherwise the recent experience in New York would have thoroughly discredited it. Owing to the shilly-shallying methods of the Manhattan in the past, and the extreme unpopularity of its management, the public has no confidence in its representations or competency; and if the fate of elevated electric traction had depended upon the Manhattan owners, these causes would probably "have held the art back for many years," to quote the language of one of the best-known transportation managers in the country.

International Congresses at the St. Louis World's Fair.

The president of the St. Louis World's Fair has announced the organization of World's Congresses, to be held in St. Louis during 1904. Howard J. Rogers, chief of the Department of Education, is to be the director of congresses. The Advisory Board to work in conjunction with him is as follows: Chairman, Nicholas Murray Butler, president of Columbia University, New York City; William R. Harper, president of the University of Chicago; R. H. Jesse, president of the University of Missouri; Henry S. Pritchett, president of the Massachusetts Institute of Technology, and Herbert B. Putnam, Librarian of Congress.

The duties of this Advisory Board will be more exacting than usually fall to the lot of advisory bodies. Upon their recommendations will be determined the number and extent of the congresses, the emphasis to be placed upon special features; the prominent men invited to participate, the character of the programmes, and the methods for successfully carrying out the enterprise. No effort will be spared to give the series of congresses at this exposition unity and connected purpose and make their published proceedings a valuable contribution to the world's literature.

A series of congresses has been an accompaniment of all recent international congresses, but they have always been disconnected, and rather incident to the exposition than related to it and supplementary to the exhibits. The work of the director and Advisory Board will be wholly given to constructing a co-ordinate department of the exposition which shall have an established scientific value and attract the attention of the practical scholars and experts of the world to St. Louis.

Ruhmer's Photoelectric Telephone.

By A. Frederick Collins.

THE ingenious experiments conducted by Prof. Alexander Graham Bell having for their purpose the transmission of articulate speech by means of a ray of light, have been recently enlarged upon to a degree little short of marvelous by Herr Ernest Ruhmer, of Berlin. The two great fundamental principles involved in the Ruhmer electro-optical telephone—or photophone, as Bell termed his apparatus—are based on the phenomenon of resistivity variations of conditionally modified selenium under the action of luminous waves, and the changes in the light-emitting qualities of an arc under the influence of a superimposed current.

One of the earliest types of arc transmitter and selenium receiver is shown in Fig. 2, and was first employed by Prof. Bell. It represents a beam of light, either from the sun or an arc lamp—although the latter is the more preferable form—which is caused to pass through a condensing lens *a*, where the converged rays fall on a concave mirror *b* of small dimensions. This mirror is fastened with exactness, to the center of a diaphragm—such as is used in an ordinary telephone transmitter; and placed immediately back of it is a mouthpiece.

An objective lens *c* for projecting the light to a distant receiving device completes the transmitting system, and it is at once obvious that an electric current plays no part in the propagation of the message, if we except the fact that light is itself of electro-magnetic origin.

The receiver differs from the transmitter in that it is strictly an electro-optical apparatus. Referring again to Fig. 2, let *d* represent a parabolic reflector of short focal length and having in its focal line a selenium cell *e*. Connected to the terminals of the selenium cell and in series with it is a single element *f* and a telephone receiver *g*.

In action, the apparatus is quite simple. When the diaphragm of the transmitter is caused to vibrate, there is a relative change in the amount and intensity of the beam of light reflected from the mirror and through the lens *c*. The light waves, so propagated, are received by the parabolic reflector, and here again the diverging light is brought to a concentrated point of great intensity, where it acts upon the photo-electric cell of selenium which, with every minute variation of the converged pencil of light, responds by a similar change in its resistivity properties to an electric current.

With the object in view of developing the experimental photophone of Prof. Bell into a wireless telephone having an application which should be of commercial value, Mr. Ruhmer has devoted much time to the experimental investigation of the speaking arc, the selenium cell and their combination as forming a completed whole.

Shortly after Prof. Bell concluded his experiments with the photophone in this country, Dr. H. T. Simon devised the speaking arc, that is, he found that by superimposing an alternating current set up in a secondary circuit by an undulatory current of a primary winding including in its circuit an ordinary telephone transmitter—on a direct current operating an arc lamp, that the emitted light varied proportionately. These variations of the volume and intensity of the flame, although the persistency of vision removes the possibility of the eye discerning these changes, are sufficiently great to impress either a selenium cell or a sensitive photographic film, and it has been ascertained that these changes are due to the combined influence of temperature deviations of the arc and the quantity variations of the light produced by it.

By causing a kinetoscopic film, such as is used in moving-picture machines, to move rapidly before the speaking arc, Ruhmer has succeeded in photographing these changes and in this way he obtained a continuous record of the different degrees of light representing articulate speech; and by passing this moving record of the voice before an arc light and a selenium cell in circuit with a telephone receiver the original sound waves are reproduced with very little distortion and with considerable distinctness, and thus a new form of phonograph results.

To employ the speaking arc and selenium cell for a wireless telephone, the combination Ruhmer has effected for long-distance

Fig. 1.—Ruhmer's Receiving Apparatus.

[illegible] the arc in the focal line of a parabolic reflector, the reflected light taking the form of a parallel beam, [illegible] The requirements for the production and reception of messages by means of the photo-electric telephone are numerous and depend quite as much on the transmitter as on the receiver. Among the more important factors of the former is the sensitiveness of the microphone, which determines the value of the undulatory alternating current which is to be superimposed upon the heavy direct current operating the arc lamp.

A transmitter of exceeding sensitiveness and requiring a minimum pressure, say six or eight volts, is quite superior to the less sensitive

[illegible]

one taking twenty-five volts. The nature of the arc must also be taken seriously into consideration and again the value of the luminosity best adapted to the sensitiveness of the selenium cell chosen; and after this the critical value of illumination must be carefully and constantly maintained if good results are expected.

Ruhmer has ascertained that for limited distances, say one or two kilometers, the results were best attained when 4 or 5 amperes of current under a pressure of 52 volts was used, but that for the transmitting speech over three or four kilometers, it was necessary to feed the arc with a current of 8 or 10 amperes, and if it was desired to increase this distance to five or seven kilometers a current of 12 to 16 amperes was the most suitable.

One might take it for granted on first thought that the larger the current consumed by the arc the better the results, but Ruhmer cites the following reason the values above given are best adapted which are based on Braun's investigation of the arc. In accordance with Joule's law, the heat developed is proportional to C^2r and the increase in heat produced by a greater current strength dC is proportional to $2Cr\ dC$ and therefore C or the current operating the arc.

It has been demonstrated that a selenium cell is considerably less sensitive to the variations of an intense illumination than when the light falling upon it is of a certain minimum value; and as a heavy current increases the luminosity of the field, the greater volume of light obtained avails the tests nothing, either in the elimination of distortion or loudness of speech, but if anything the reverse is more often the case.

After having evolved the elements constituting the transmitting apparatus so that the obstacles a beam of light encounters in its propagation through space, due to the inherent atmospheric changes, might be overcome or obviated to some extent, Mr. Ruhmer next applied himself to the subject of receiving these infinitely minute wave lengths. After having followed the transition of the sender devised by Bell through its successive stages when perfected by Ruhmer, it is interesting to review the latter inventor's work in adapting the selenium cell to long-distance wireless telephony.

Like the coherer used in wireless telegraphy, the selenium cell in [illegible] factured in their early history: that is, no radical change has taken place in the mode of making, but the development of each has been upon the basis of improvement rather than invention.

The evolution of the cell employed in the earliest form of the photophone, i. e., by forcing fused selenium between conducting wires forming a grid did not result in any marked increase of sensitiveness until it was developed by Ruhmer, who, in the course of his investigations, has tested many different selenium cells obtained from various sources. One made by the firm of Clausen and von Brouh, he considered particularly sensitive, a ratio of 10 to 1 having been established for it in resistivity changes, the maximum resulting from illumination and the minimum when obscured.

Another sensitive cell made by Giltay offered a resistance of 533,000 ohms in darkness, which under the decreasing action of 400 lux dropped to [illegible] ohms, but both the cells mentioned possess the disadvantage, according to Ruhmer, of having a high time constant in returning to their original resistance after the light is cut off. Added to this they do not operate well under the action of the shorter wave lengths of light, thus following closely the analogy presented by the metal filings coherer, for in both cases, after the drop in resistance has taken place, ten or twelve hours and sometimes a much longer period is required before the normally high resistivity is again reached.

Ruhmer therefore sought for some modification by which the resistance would reach its normally high value much more quickly—similar to a self-restoring coherer—and this he accomplished in the following manner. In the older forms of sensitive cells, the grid of conducting wires with its selenium filling was made flat, and when used with a parabolic reflector the converged light did not illuminate the cell uniformly. In order that the light might be distributed evenly over the entire surface of the cell, Ruhmer gives them a cylindrical form by duplexing two fine platinum wires wound parallel to each other on a glass tube 20 mm in diameter and 35 mm in length; the space between the wires is about 7/10 mm and the whole is then coated with the properly prepared selenium.

To prepare the selenium, it is necessary to melt the red powder, in which state it is primarily found, and apply the degree of heat needed to reduce it to a black, gummy mass when it becomes, virtually, an insulator.[1] It is in this condition that the amorphous selenium is applied to the platinum wires forming the cell when it is baked at a constant temperature of 200° F. for a period of twelve hours or longer; the next step is to anneal or gradually reduce the temperature when a crystallized form of the selenium results, having a characteristic gray color. It then assumes the most remarkable property of varying in resistivity under the action of light.

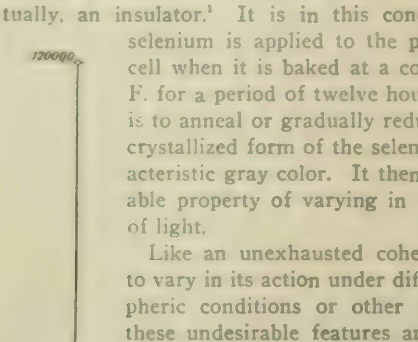


FIG. 3.—RESISTANCE CURVE.

Like an unexhausted coherer, a selenium cell is apt to vary in its action under different temperatures, atmospheric conditions or other disturbances. To exclude these undesirable features and to place the cell in the category of instruments of precision, it is enclosed in a second glass tube and a vacuum is formed by means of a mercurial air pump.

By carefully following every detail of the foregoing delicate processes, Ruhmer has not only increased the sensibility of the selenium cell and rendered it accurate in its responsive changes, but has obtained cells which respond instantly to every differentiation of light values. The properties of selenium were observed long ago, but until Ruhmer took up the work there seems to have been nothing definite accomplished recently. For instance, Sale found in 1873 that the drop of resistance was due largely to the red wave lengths, and Adams's observation showed the greenish yellow to be the most effectual, and, agreeing with these physicists, Dingler found that the violet and ultra-violet end of the spectrum produced but little effect.

But these observations do not appear, by any means, conclusive with regard to the Ruhmer cells, for his are especially sensitive to the shorter wave lengths, and in this they fulfill an important requirement for long-distance wireless telephony by the photo-electric method. For obtaining the resistance curve shown in Fig. 3, the receiving apparatus consists of a selenium cell arranged in the focal line of a parabolic reflector having an opening of 50 cm. The resistance of the cell in the dark was 120,000 ohms and when illuminated by a 16-cp lamp the resistance dropped to 1,500 ohms. The receiver proper is shown in the photograph, Fig. 1, and includes a pair of head telephone receivers wound to high resistance and having feeble magnets actuating very thin diaphragms.

The experiments were conducted by Ruhmer on the Wannsee and the Havel, a map of which is shown in Fig. 4. The arrows illustrate the direction in which transmission took place. The figures on the map correspond to the experiments in the order in which they were made. In every case, the transmitter was placed on the electric

[1] Das Selen und Seine Bedeutung fur die Electrotechnik von Ernest Ruhmer. Electrical World and Engineer, November 15, 1902, p. 708.

launch *Germania.* The first trial was made across the Wannsee in the daytime, a distance of 1½ km, when the air was clear. The second experiment took place in a heavy rain. This was also across the Wannsee, the distance being 1.6 km. An accident to the storage battery prevented tests to a greater distance.

On July 16, in the afternoon, when the sun was shining, another test made and proved entirely successful, articulate speech being reproduced clearly a distance of 2.3 km. As these tests exceeded in range the limits of the Wannsee it was determined to test the photoelectrical telephone on the Havel, where a greater distance could be obtained.

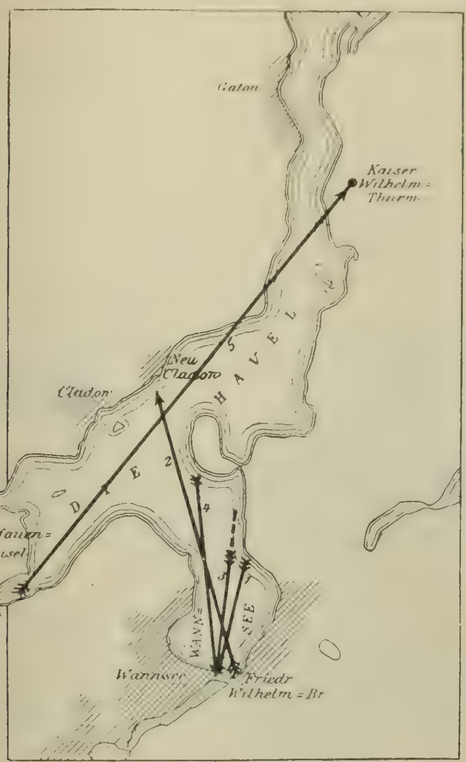


FIG. 4.—MAP SHOWING DIRECTION OF EXPERIMENTS.

On the evening of July 25 tests were made between the transmitter on the *Germania,* near Peacock Island, over a distance of 7 km, to the receiving station erected on an eminence at Kaiser Wilhelm Tower, Grunewald, and when the atmosphere was heavy and somewhat foggy. This ended the series of experiments, but I am informed by Herr Ruhmer that at subsequent tests he was enabled to transmit articulate speech a distance of 15 km, when it was received in a very satisfactory manner.

Some Notes on Illumination.

By Bassett Jones, Jr.

With all the discussion that has lately arisen over the measurement of light considered primarily from the standpoint of artificial illumination, it seems proper that some note should be taken of the various methods of lighting required under certain specific conditions.

It is, of course, obvious that with widely varying requirements there must be widely varying types of illumination, and it will be found that there is a certain type of illuminant best suited to each condition. Possibly as lying at the two opposite extremes, may be mentioned the source of light best suited to illuminate the open air freight yard, and that best suited to illuminate the book for reading.

In the first case we require the widest possible distribution of light at maximum intensity, and in the second case the softest quality of light attainable, and projected preferably in a single direction.

There is little doubt that among existing types of illuminants the arc lamp is best suited to our first condition, while for the second condition we find the green shaded oil burner justly popular.

Under all conditions of illumination the object sought is so to arrange the light source that its rays are only perceptible to the observer through their reflection from illuminated objects. This result is impossible save in a few special cases, but the nearest approach to it will be secured by making the elevation of the source such that its rays do not shine directly or horizontally into the eyes, and this requirement applies equally to outdoor and indoor lighting.

Where the area to be illuminated is extensive the units of light should be so distributed as to give the most even illumination compatible with first cost, and maintenance of equipment. Bright spots, as well as dark zones, should be as far as possible eliminated, and where, as in the case of the arc lamp, the body of the fixture casts a shadow directly below, the arrangement of lights should be such that one lamp throws light directly under neighboring lamps.

The great difficulty with the arc lamp is that its maximum rays are inclined toward the horizontal, and this, while widening the area of illumination, produces decidedly uncomfortable effects on the eyes, and often by its very intensity prevents the observer from seeing the objects illuminated. This drawback has been in some measure illuminated by the use of the enclosed arc, using ground glass or diffusing globes, but even here the high intrinsic brilliancy necessary to an efficient illumination over a considerable area, still leaves the subject in an unsatisfactory stage of development.

Where enclosed arcs with clear globes are used, the marked unevenness of the illumination is decidedly detrimental. It may be overcome to some extent by bringing the lamps fairly close together, so that the portions of the surface left dark by one lamp may receive the maximum value of illumination due to a neighboring lamp. Except in certain special cases such an arrangement would produce an extremely wasteful brilliancy, and would be far too expensive for consideration.

The fact still remains that the arc lamp as at present used for outdoor illumination is unsatisfactory from every point of view, but until an ideal substitute is devised with its maximum intensity thrown at the widest angle and equally grading off to a vertical illumination suitable for the height at which the lamp is hung we must be satisfied to stumble along our streets in alternate brilliancy and darkness.

At present the tendency seems to be toward horizontal arcs, but here the vertical rays are the strongest, and diffused light must be obtained by the use of ground globes with consequent decrease of efficiency from the standpoint of light actually received. The flame arc appears to produce very satisfactory results and will doubtless become a hard competitor of the pencil arc, so soon as its complicated mechanism has been simplified.

By suspending the horizontal or flame arc at a considerable height it is possible to extend the radius of illumination, but only at the cost of intensity according to the laws of inverse squares.

As a rule, the value of the intensity of illumination is the first consideration only in outside lighting. In this case the maximum value of light that can be obtained and spread over a given area per unit of energy expended is the guiding factor. As we have mentioned, for the lighting of large areas from a few centres of illumination the vertical arc without doubt best satisfies the condition.

For street lighting, where the value of the light obtained is sufficient to warrant the use of numerous sources of light in fairly close proximity to one another, and where the traffic is sufficiently heavy, a source of light throwing its rays downward and at the same time diffused toward the horizontal, is much to be desired. Even if such a lamp does not show as high efficiency rated in mean spherical candle-power as is shown by the vertical arc lamp, its effective illuminating power—its value as an illuminant of the roadbed—will make its use advisable over all other forms of light source.

As a matter of fact, there are on the market to-day two or more lamps that satisfy these conditions in a greater or lesser degree, and have the advantage of efficiency nearly if not equal to that of the open arc. Unfortunately, they are still more or less in an experimental stage, although the Nernst lamp has, we may say, become an established fact, and has even been applied to street lighting.

On the other hand, for country roads, and in streets where the traffic is light and where the effective value of illumination is of small consequence, we are justified in using the lamp that will give the maximum intensity of illumination per unit of energy expended, and will spread its light over a maximum area. The quality of light emitted is now a minor consideration.

Thus, while a [illegible] arc lamp throws a dark spot directly underneath, yet the total area illuminated sufficiently for ordinary purposes is far greater than the lamp throwing its maximum intensity of light in a vertical direction.

When we consider interior illumination we find that the conditions vary in an infinite number of ways. Usually no actual formulæ are applicable for the very strong reason that the taste and needs of the occupants of the room or building vary in most extraordinary and unexpected forms. The success of the lighting system must depend practically entirely on the judgment of its designer and on his ability to see things through his client's eyes. Private house lighting is particularly variegated in this respect, and often a dozen different types of illumination are required within the four walls of one building.

In the lighting of halls and auditoriums and enclosed spaces of large extent, the same considerations that apply to outdoor illumination will, in a great measure, determine the system installed. Sometimes, sad to relate, first cost is the first consideration and consequently the light-giving source must be centralized.

Whatever the type of light adopted, it is imperative to supply the general light from a source overhead, and no light-giving sources should be permitted to throw rays directly into the users' eyes.

Wall brackets, for instance, should be used only for purposes of decoration—exceptions being taken in the case of bureau and dressing table lights. The light from wall brackets should be killed by the use of colored shades or globes. Table fixtures similarly should be supplied with colored shades that will reflect the light so as to confine it within the surface of a cone, no part of which reaches to the users' eyes.

From a decorative standpoint center chandeliers give the most effective "style" to room illumination. Even here the drop of the fixture should not be great enough to disturb the eyes with horizontal rays. The light units employed should be as far as possible small and numerous enough to give a hemispherical form of light source with the flat upwards. Design of fixture and quality of illumination may clash, but the result should tend along the lines indicated.

For the best quality of evenly diffused light single small power lamps studded in the ceiling give a most equally distributed illumination, but is to be criticised from the standpoint of light and shadow. A room without contrast is a most uninteresting and uncozy affair.

It is readily seen from the above considerations that in most cases the "watts per candle," or the mean spherical candle-power, has little to do with the value of the lamp as an illuminant. The principal factor in selection of the lamp is its suitability for the case considered. Circumstances are frequently arising where a number of low candle-power lamps are used in preference to a few units of higher light-giving power, although the former are more costly in both power and maintenance.

It seems peculiar that while an 8-cp lamp used frequently if necessary, will give so much better a type of illumination, yet all our energies have been expended in increasing the efficiency of the 16-cp lamp—a unit too powerful for all uses but that of general illumination.

Of course, it is the duty of the engineer to see that his client gets the most efficient lamp suited to his requirements, but the effective illumination desired must be the first consideration.

British Association in Africa.

An interesting event will take place in South Africa in 1905 which will definitely mark that country's progress and development. According to a recent London dispatch, the British Association for the Advancement of Science has accepted an invitation from the British South Africa Company to hold its annual meeting in 1905 at Victoria Falls, on the Zambesi River, where a hotel will be erected for the accommodation of the visitors. The company has appropriated $25,000 to meet the expenses. It is said that the only time the British Association ever held a meeting outside of England was in 1884 when it met in Canada. The sessions at McGill University, Montreal, will be recalled by many electrical engineers, especially as they were followed by the Electrical Exhibition and Electrical Congress at Philadelphia the same year.

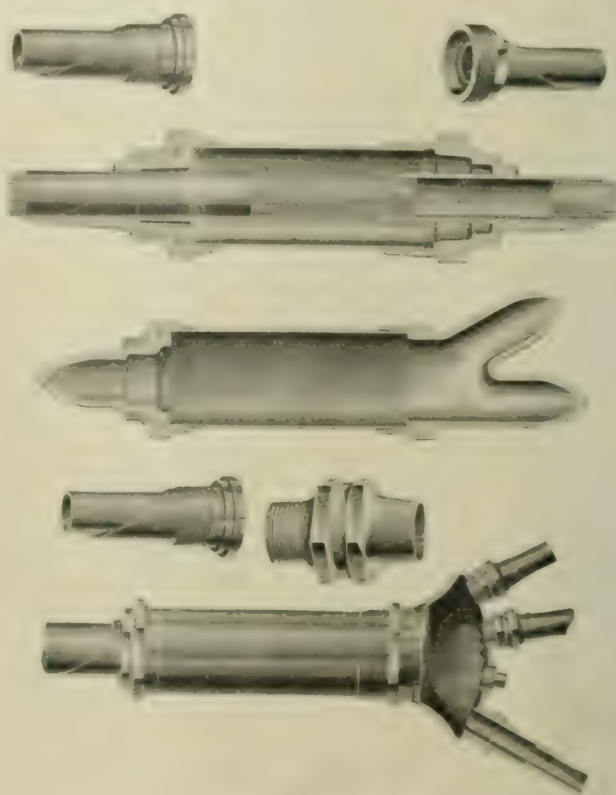
Telephone Cables—III.

By Arthur V. Abbott, C. E.

Pot Heads.

The pot head method is so simple as to require little mention beyond the instructions to be found in the "*Cable Specifications,*" except to emphasize the absolute necessity of employing as insulating material on the terminal wires some non-fibrous material. Examined under the microscope all silk, cotton or other similar material is found to consist of an agglomeration of fibres. each of which is a little tube. No matter with what apparent care wires covered with such material be boiled in, or saturated with, insulating compound, it is found practically impossible to seal *all* of the multitude of little tubes that can serve to conduct moisture to the paper of the cable. For the pot head terminal wires there is nothing better than okonite, though this is expensive and inflammable.

Formerly the only method of splicing or pot-heading cable has been to make a "wiped" joint. If this operation is *well done* it is perfectly satisfactory, for thoroughly soldered surfaces are absolutely moisture proof, but wiped joints are difficult to make under the most favorable circumstances, while on the top of a 60-foot pole, with a kettle of melted lead for a companion, or on the swaying platform of a boatswain's chair, the probabilities of poor work are much increased. Further, a wiped joint requires skilled labor in the shape of a *plumber* with all the objectionable concomitants of that somewhat unsavory trade.



Figs. 20, 21 and 22.—Terminals and Methods of Making Joint Splices.

A method of making joints splices and terminals has recently been brought to notice, designed to avoid these difficulties, and further furnishes a method of making connections that possess the incalculable advantage of always being accessible to inspection. Figs. 20, 21 and 22 shows the plan adopted, and are self-explanatory. The illustrations exhibiting this method as applied to a straight splice in Fig. 20, a Y splice in Fig. 21, and a pot head in Fig. 22. In general this device employs a sleeve supplied with special threaded ends, designed to supply a moisture proof joint. To the sheath of each cable a similarly threaded piece of brass tube is soldered, and the splice or pot head completed by connecting the tubes with the sleeve by the screw joints. As all parts are interchangeable all soldering may be done on the ground and the ends boiled out, leaving merely the screwing up of the nuts to be performed aloft. This plan is

certainly sufficiently promising to be worthy a careful experience test to demonstrate its ability to cope with practical conditions. Unfortunately the expense of the joint (about 50 per cent more than the wiped joint) is likely to be a serious handicap.

THE INSTALLATION OF UNDERGROUND CABLES.

To install underground cable would seem a very simple process—simply pull each piece into its duct; but experience has indicated some desirable precautions. By means of the fish wire placed in the duct, as described under "Conduits," a strong yet soft and flexible manilla rope is hauled through the duct, and by its aid a brush and scraper is pulled through two or three times to clear away all accumulated debris. The plan of greasing the cable has been often tried, but with poor success, for while a lubricant may aid in drawing *in* the cable, its presence causes subsequent dust and dirt to so impact the cable that drawing *out* is difficult or impossible. The cable reel is placed adjacent to one manhole, and the pulling appliance at the next one. This may consist simply of an old-fashioned winch, worked by man or horse-power, but a far preferable, better and more economical device is a steam or gasoline motor geared to a small hoisting engine. The rope from the pulling machine, whatever it may be, is now attached to the cable, and here particular care is necessary, as the pull must be carefully distributed to the sheath. The best plan is to use a brass tube, a foot or more long, but slightly larger than the sheath to which it may be soldered. The end of the brass tube is supplied with an eye to which the rope is attached, and thus the pull distributed evenly to the entire lead. When all preparations are complete the drawing is started and should proceed slowly, steadily and uniformly without interruption till the desired manhole is reached. It is sometimes customary to place at the reel one or more sheaves to guide the cable. With small sizes, when the sheaves can be made very large in proportion to the cable diameter, this is good practice, but with 2-inch or 2½-inch cable there is rarely enough room to work rollers of sufficient diameter, and it is preferable to have a gang of men guide and feed the cable into the duct, the mouth of which should be protected by a conical shield of leather. As far as possible it is desirable to order cable of such lengths as can be drawn from point to point in the underground system. The various pieces are then supplied by the manufacturers with sealed ends, and there is little or no waste in cutting. Splicing follows next upon drawing in, and in case a length is cut from a reel, it should be either spliced, or the cut end sealed immediately, for even a few hours' exposure of an open end to the damp atmosphere of conduit vaults will injure cable insulation.

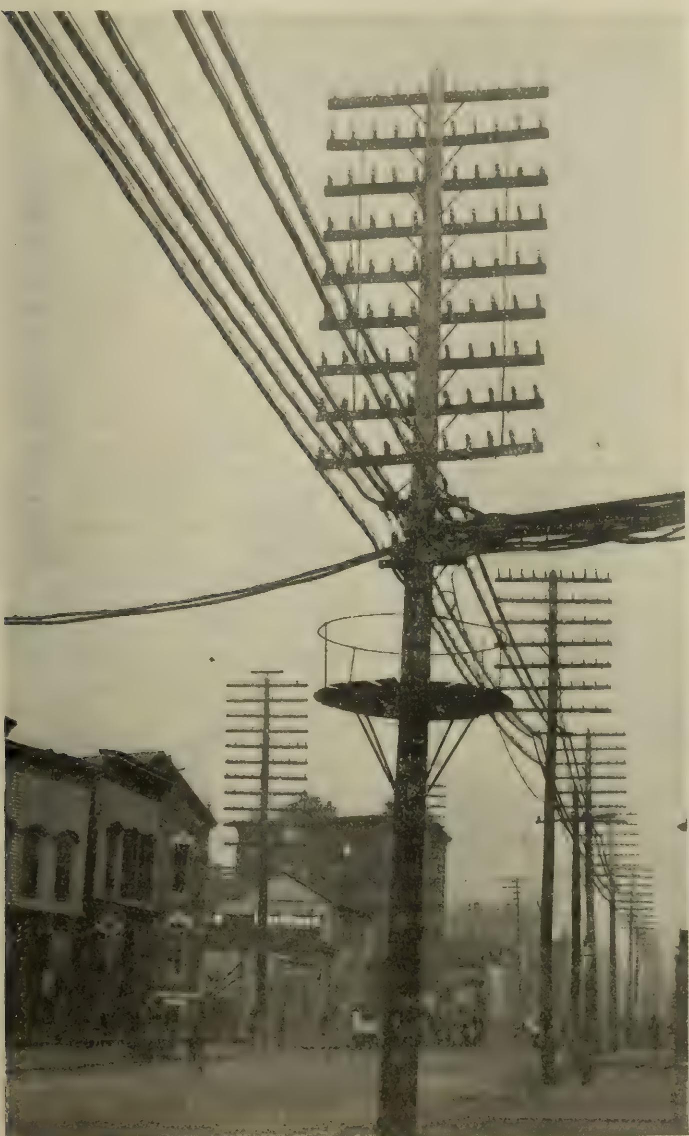


FIG. 23.—AERIAL CABLES.

FIG. 24.—HOUSE-TOP FIXTURE.

FIG. 25.—LONG SPAN OF AERIAL CABLES.

AERIAL CABLE.

The installation of underground cable is limited to drawing the cable into its duct. Aerial cable is suspended from pole lines; is necessarily placed in very diverse locations, and in far more exposed situations, hence the opportunity for "engineering" is much wider. Cable is far too frail to hang unsupported from pole to pole. It is customary therefore to run a wire rope ⅜ inch to ⅝ inch in di-

[illegible] a "messenger wire" or "strand," to which the cable is at frequent intervals, as often as 18 inches to 2 feet, attached.

The strand is attached to the poles in case of an ordinary open wire line as is indicated in Fig. [illegible], or in the [illegible] of a house top

FIG. [illegible]—[illegible] CABLE [illegible]

fixture, as in Fig. 24. By this method circuits may be carried over very long spans many hundreds of feet, as illustrated in Fig. 25. more cheaply and safely than by an other device.

When there are not more than two cables the strand is most conveniently supported by the method of Fig. 26, but if there are a greater number an angle iron cross-arm, bolted to the pole, is by far the best method, as is illustrated in Fig. 23. Hundreds of devices have been advanced for attaching cable to the messenger, a few of the more successful of which are shown in Fig. 27. The chief requisites are ease and cheapness of application; permanence, i. e., freedom from slipping or unhooking and no injurious action to the lead of the cable.

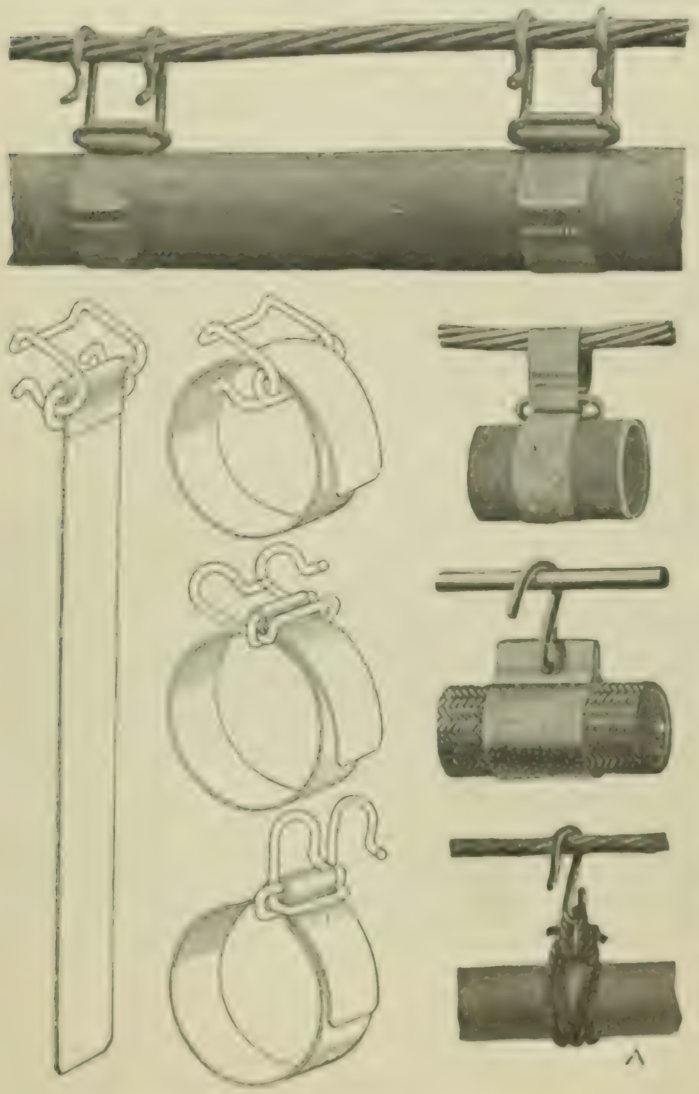


FIG. 27.—DIFFERENT STYLES OF CABLE HANGERS.

Few of the modern cable hangers meet these characteristics better than the old-fashioned marlin loop, shown at A, Fig. 27. Well-tarred marlin will last nearly as long as the cable. If the hook be closed there is little tendency for the cable to leave the strand; with each sway of the wind the slip nose hugs more tightly and rarely slips, and lastly this is one of the quickest and cheapest methods of application. Another plan of support is that of the "Spinning Jenny," as exhibited in Fig. 28. A split spool is clasped about both cable and strand, and then filled with marlin. When spool is hauled along, it lifts the cable close to the strand and lashes

FIG. 28.—CABLE-SPINNING JENNY.

it in place. Unfortunately, this plan is open to the objection that if the marlin gives way at any point the entire span is lost, and the cable precipitated into the street.

The weight of aerial cable is a very great addition to even the strongest pole line, and this form of wire plant should never be attempted unless the pole line be specially designed for the purpose. All corners and anchorages must receive special attention also and be designed to bear the extra stress inflected on them. For further details relating to cable construction the reader is referred to the "Cable Specification" to come later.

Opportunities in Italy and Sicily.

A correspondent traveling in Italy and Sicily writes us:

Italy, especially in its northern parts, abounds in powerful waterfalls; on the other hand, every pound of coal has to be imported, and, as a consequence, electricity is, in comparison with other continental countries, making greater progress in Italy than anywhere else in Europe. Even on the Island of Sicily, electricity is being more and more introduced. Though the electrical industry in Italy —I mean the manufacturing industry—is steadily growing, the imports of all kinds of electrical machinery, appliances and supplies are not only large, but continuously increasing. Germany and Switzerland get a good share of this trade. The United States is fairly represented, especially in northern Italy (Lombardy, Piedmont, Liguria, etc.), but there is very little, if any, American machinery to be found in the south of Italy, or on the Italian islands.

I think there is a good opportunity for the introduction of electrical appliances on the Island of Sicily for power, light and transportation. The sulphur mining industry offers an especially good field. I have visited quite a number of the principal mines and was surprised to see how electricity had made progress. There are, in Sicily, in the neighborhood of 650 sulphur mines, of which some 400 are being exploited. Of these 400 about 40 are worked by means of modern machinery, and these are, in the first place, the mines which offer a market for electrical enterprise. German and Swiss, and, to some extent, Austro-Hungarian firms, are doing a pretty good business in Sicily. When in Palermo I visited the Esposizione Agricola, where some space was devoted to agricultural and industrial machinery. The only American firms, represented with a few small exhibits, were the Enterprise Manufacturing Company, of Philadelphia; the Buffalo-Pittsburg Company, of Buffalo, and the McCormick Harvesting Company, of Chicago. Correspondence should be carried on in Italian or French; catalogues and all printed matter should be in either language. It would be waste of time to address these gentlemen in English.

Business in heavy machinery can be done direct with the mines, or by means of local agents. The latter are not easily to be found. German and Swiss manufacturers have their own offices in Italy. For the sale of small supplies for power, telephony, etc., electric novelties, lamps and so on, correspondence may be opened with Sicilian firms interested in such branches.

A French System of Train Lighting.

By P. Letheule.

THE system of train lighting which has been patented and experimented on by the well-known French engineer, Mr. M. F. Loppé, in the shops of Daydé & Pillé, at Creil, may be considered, in its broadest aspect, as a general solution of the problem which consists in regulating the terminal voltage of a dynamo under very large limits of speed. In its application to train lighting it assumes the use of this dynamo combined with a storage battery employed as will be described further in the latter part of this article.

The principle of the method consists in providing the dynamo with two field windings. The first winding is excited by constant current of a given value. The second winding is connected in shunt between the terminals of the machine. The ampere-turns of the two field windings of this machine are in opposition, so that the resultant magnetization depends upon their respective values and on the way the dynamo builds up.

1. If the dynamo is first built up under separate excitation alone it gives a difference of potential across the shunt field terminals which excites these fields, but which can never overcome the first and opposed magnetization due to separate excitation. Thus, if we run the dynamo with increasing speeds, the difference of potential at the terminals increases slightly, thus increasing the ampere-turns on shunt excitation, and consequently tend to oppose a further increase of voltage with an increase of speed.

If the dynamo builds up as a shunt machine, that is, without its separate excitation, the difference in potential will increase at first proportionately to the speed. If at a given speed we connect up the separate excitation and send through it constant current from a separate source, so that its ampere-turns have a lower value than the shunt ampere-turns corresponding to that speed the difference in potential will decrease. If, however, we increase the speed of the machine its potential difference will gradually decrease towards a certain value. For an infinite speed it will have a certain limiting value, and increasing speeds will gradually bring the potential to this value with a variation which may be made unnoticeable.

Again, considering the first type of dynamo in respect to its use for train lighting, the shunt ampere-turns increasing with the speed of the machine have a limited value which is the value of the separate ampere-turns. That is, the difference of potential between the terminals is limited to the value corresponding to this limiting value of shunt ampere-turns which cannot be exceeded even with infinite speeds, though infinitely increasing speeds may tend to demagnetize the machine and to lead to some trouble at the commutator, a difficulty which will be dealt with in the results of tests.

Now that we have stated the limit of voltage of this machine, we can investigate the variations of its terminal voltage at different speeds in making use of the following notation and equations:

Let A_c = the value of independent ampere-turns, which is constant.

A_s = the value of ampere-turns of shunt excitation.

a-t = ampere-turns.

The corresponding terminal voltage E is related, to the value of ampere-turns A_s; to the exciting current i; to the number of turns n, and to the resistance of the shunt winding r,

By the equation

$$A_s = n\, i = n \frac{E}{r}$$

where $\frac{n}{r}$ has a constant value which may be denoted by a.

Thus, $A_s = a\, E$. We can denote the maximum value of E by E_M. corresponding to

$$A_c = A_s = a\, E_M$$

whence

$$E_M = \frac{A_c}{a} \quad (1)$$

For a given speed, corresponding to terminal voltage E_M, the shunt a-t $= a\, E_M$, and the separate a-t $= A_c$; the resultant a-t $= A_c - a\, E_m$.

These resultant a-t are proportional to the corresponding difference of potential

$$A_c - a\, E_m = b\, E_m \quad (1')$$

whence

$$E_m = \frac{A_c}{a + b} \quad (2)$$

Thus, from (1) and (2) we get the ratio between maximum and minimum voltage:

$$R = \frac{E_M}{E_m} = \frac{a + b}{a} \quad (3) \quad = 1 + \frac{b}{a}$$

The ideal regulation would mean equality between E_M and E_m, which correspond to the maximum and minimum speeds of the dynamo. This, of course, cannot be realized, but we can arrange for this ratio R not differing very much from unity, which is to say $\frac{b}{a}$ as small as possible, which can be obtained by a convenient choice of the dynamo constants A_c, n, r, i.

By investigating this condition it is easy to see that the number of excitation turns and the loss in excitation will be very large. In fact, if at minimum speed we express the proportionality of flux to difference of potential, we write again equation (1')

$$A_c - a\, E_m = b\, E_m.$$

The ampere-turns of the shunt excitation alone would show a much higher difference of potential:

$$E_{sm} = \frac{a}{b} E_m \quad (4) \quad \text{derived from (1)}$$

The independent excitation alone would give a still higher difference of potential E_{cm}:

$$E_{cm} = \left(1 + \frac{a}{b}\right) E_m \quad (5) \quad \text{derived from (1) and (1')}.$$

Taking for instance, certain conditions of regulation, we can easily see that they lead to a very wide range of excitation. Suppose we wish to keep a voltage not increasing more than 10 per cent., which is represented by $\frac{b}{a} = 0.10$.

Equations (4) and (5) show that

$$E_{sm} = 10\, E_m \quad (4')$$

$$E_{cm} = 11\, E_m \quad (5')$$

The ampere-turns of independent excitation have to be eleven times higher than the ampere-turns which would give the same difference of potential in working alone, and the shunt ampere-turns excitation have to be ten times greater than necessary.

We can, in a similar manner, calculate the ratio of ampere-turns of both excitations corresponding to different given values of regulation. We have expressed them in the following table, as ratios of their value to the value of ampere-turns giving the same voltage at the same speed, taking this latter voltage as unity:

Given values of $\frac{b}{a}$	0.10	0.15	0.20	0.33	0.50	1.00	2.00
A. T. shunt excitation	10.	6.7	5.	3.	2.	1.	0.50
A. T. separate excitation	11.	7.7	6.	4.	3.	2.	1.50

The practical applicability of the method has been tested by the inventor in the shops, Daydé & Pillé shops, with a dynamo which was not built for this special purpose. It was a bi-polar machine normally running with shunt excitation and at 1,500 r.p.m., giving 107 volts with 10 amperes load. The shunt coils were simply disconnected and one of them was used for shunt excitation, the other one being connected for separate excitation.

The following are the potential differences obtained at speeds varying from 2,000 to 3,000 r.p.m.:

Table I. Readings with load:

r.p.m.	Terminal voltage.
3,000	20
2,400	19
2,000	18

Table II. Without load:

r.p.m.	Terminal voltage.
3,000	22
2,600	21.5
2,300	21
2,000	20.4

In testing, the separate exciting current was maintained at the con-

stant value of 0.5 ampere. The maximum difference of potential corresponding to a shunt excitation current of 0.5 ampere, this with a resistance of shunt exciting field of 48 ohms, is:

$$48 \times \tfrac{1}{2} \text{ ampere} = 24 \text{ volts.}$$

No sparking could be noticed at the commutator and there was no necessity to shift the brushes, although the dynamo had not been specially built for the purpose of the trial. Under load the armature reaction and ohmic resistance of armature gave a drop of about 2 volts, so that the load difference of potential was about equal to 24 — 2 = 22 volts.

This test, which was made for ascertaining the practicability, good running and safety of the system, seems conclusive, and points to satisfactory results.

It is always necessary to make use of storage batteries for lighting trains at stations. Moreover, as a dynamo has to be provided with

FIG. 1.—FIRST COMBINATION.

separate excitation, the separate exciting current may be obtained from a motor-generating set. Both of these arrangements have been patented by Mr. Loppé.

Three main dispositions of lighting are possible, which correspond to different conditions and cost. The first combination corresponds to the use of a battery for lighting and a second battery for separate excitation (Fig. 1).

The best disposition consists in taking two identical batteries which are interchangeable. A commutator can be used for changing over the batteries from one system to the other. This commutator is represented in *EE*. *CD* represents a maximum and minimum circuit-breaker which cuts off the dynamo when its electro-motive force is too low, and places it in circuit again whenever its terminal voltage is sufficient. When the terminal voltage is too low, the dynamo has one of its terminals disconnected from the corresponding terminal of the lighting circuit. This maximum and minimum circuit-breaker *CD* is therefore of the unipolar type, as seen from Fig. 1.

The second combination (Fig. 2) uses one battery only for lighting and a motor-generator set, *MG* for separate excitation. The motor *M* is shunt wound and connected to the terminals of the battery.

To assure a constant current in the separate excitation, it is necessary that the generator *G* shall produce a constant difference in

FIG. 2.—SECOND COMBINATION.

potential. As the variations at the terminals of the motor are small, the motor can be simply shunt wound.

The third combination, Fig. 3, is suited to installations requiring a good regulation, even at the stations, where the battery takes the place of the generator.

Then the battery is discharging and the discharge voltage is lower than the charging voltage previously applied. The lamps are here disconnected from the battery for the purpose of avoiding the variation resulting from the difference between charging and discharge voltage of the battery. They are connected to the generator *G*, which permanently feeds the lamps and the constant excitation *E*. This gives a means of compounding the dynamo, if necessary, against any variations of output, or speed. For variation of output the generator excitation may be compounded.

For the slight variation in speed due to the variations in battery voltage, the motor *M* may be simply shunt-wound, but running in the straight part of its saturation curve; or it may even be compounded for assuring constant speed under variable voltage. With these dispositions it is necessary to build a special dynamo *D*, though the regulation need not be so close as in the preceding combinations. The regularity, measured by $\frac{b}{a}$, may be made much larger and quite sufficient, if the motor *M* is compounded, and the construction is therefore much less expensive.

Special dynamos of the same kind have previously been used by other inventors, but they all appear to have made use of a shunt dynamo with an opposed series winding. In Mr. Loppé's system

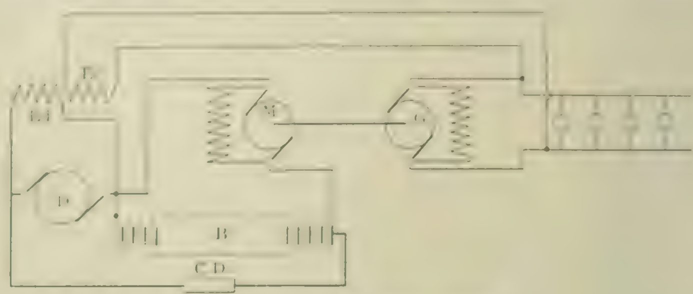


FIG. 3.—THIRD COMBINATION.

the separate winding produces the magnetization of the dynamo, against which is bucking a smaller opposite excitation from the shunt windings, a point much in favor of Mr. Loppé's system, as it leads to the use of a smaller battery. Indeed, in the other systems the series intensity increases with the speed, and the battery has to be of larger capacity, so as not to be deteriorated by the larger volume of current.

A Theory of Magnetism.

By Johannes Zacharias.

EIGHTY-TWO years have passed since Ampere published his theory of magnetism. During that time many widely different hypotheses have been formulated explaining the essence of electricity, yet to-day Ampere's theory is still the one most generally accepted. Most of us still incline to the explanation that a magnet is composed of molecules of steel, or in case of iron, of molecules of iron, which through the influence of the earth's magnetism, or of an electric current, become magnetized, so that two kinds of magnetism, positive and negative are present in each individual molecule. This influence causes the magnetic molecules to arrange or revolve themselves so that we have two resulting poles, as in a bar or horseshoe magnet, or others of like kind.

To the author it has been clear for many years (since the beginning of 1880) that this view and the duality of magnetism did not agree, and at a lecture delivered in February, 1882, he expressed the presumption that the magnetic phenomena are the result of pressure. This opinion resulted from the fact that the presence of pressure forces can be proved to exist everywhere in nature, as in the case of water, air and mechanical occurrences. Furthermore, philosophical reasoning has inclined the author to the opinion that gravitation, as in the case of weight, can only be due to pressure forces. Outside of magnetism and weight, the hypothetical attraction which we still ascribe to these two cannot be proved to exist anywhere in nature, and it is definitely known that a pressure is possible only because differences of pressure can be transmitted through any material or lever, so that all motion in nature is possible by this means only.

As a result of these reflections the author has come to the firm conviction that the origin of magnetism must be due to a pressure force. To prove this he has investigated during the past twenty years the magnetic properties of a straight electromagnet covered by means of an iron mantle or shell, one end of which was closed. The center of this magnet consisted of an iron core of the same length as the shell, while the space between the shell and magnet was occupied by a coil of copper wire. The author then studied the entire literature on the subject of the shell magnet and found that

the first construction of the same dated back to 1850 with the credit given to three inventors, Romerschausen, Guillemin and Fabre. The author immediately noticed that all writers on the subject claimed that a magnet of this description was bipolar. For instance, a recent writer, Prof. Silvanus Thompson, of London, on page 48 of his *"Der Electromagnet"* Halle, 1894, gives in Fig. 26 an illustration of a magnet of this kind and describes it as follows: "A magnet of the type as shown in Fig. 26 possesses at one end an inner pole, which is surrounded by a ringshaped pole of an opposite polarity."

If we compare this statement with another one made by Prof. Thompson, we will readily come to the opinion set up by the author. On page 26 of Prof. Thompson's *"Die Dynamoelektrischen Machinen,"* Halle, 1900, is as follows: "As long as we do not positively know what electricity is, so long will it be impossible for us to attain any definite knowledge regarding the nature of the current. But no electrician doubts this very important fact, that the magnetic forces which are present when a current passes through a wire are not present in the wire, but in the surrounding medium." The same almost is said by Prof. Thompson in the first English edition of his work, 1884, page 8. In these two quotations lies the whole point of the view and researches of the author. For, if the magnetic force has its origin outside of the electromagnet, *then in this case the origin must be due to pressure,* because even if the existence of the undemonstrable attraction is accepted, it will not hold, for the force is present not on the inside, but on the outside of it!

To prove the existence of this exterior force, the author studied the properties of the shell magnet very thoroughly, though by the employment of inexpensive and simple apparatus. The results of his investigations were published in the *Electrotechnischen Mitteilungen,* Halle, 1901. In the different papers published on this subject he shows not only all the different kinds of magnets and drawings of the different experiments as performed with them, but also five photographs are given, some taken in 1884, others in 1900 and 1901, which prove the absolute truth of these drawings.

In the course of the investigations it was learned that the sought-for pressure force increases disproportionately as soon as the straight electromagnet, as before described, is covered with an iron shell or mantle and supplied with an armature consisting of an iron cover so made as to close in the core and shell as tightly as possible. It is not the object to describe again all the experiments, and the author will simply briefly mention the most important phenomena to explain the questions here set up.

1. The shell magnet has at the open end, not as claimed in the literature on the subject, two poles, but is at this place unipolar, the upper rim of the shell showing no distinct pole.

2. The second pole of this shell magnet lies at the lower end and is so enclosed by the iron shell that it is very weak and has little external influence, and this starting from the lower end of the shell and continuing about half way up.

3. The investigation of the polarity could only be carried on by means of file dust figures, as a magnetized needle was not only unreliable, but showed two weak poles at the upper, open rimspace. These were no doubt due to the so-called earth magnetism.

4. By a suitable arrangement of the investigation it was proved that, when comparatively small holes were drilled in the base of the electromagnet, the force exerted on the armature would become disproportionately very small, although the so-called magnetic circuit between the core, shell and armature was not substantially decreased, these being still connected by a large amount of iron.

5. These facts can lead us to but one conclusion, that we are actually dealing with a pressure force as yet unknown, and till now thought non-existing.

From the above five statements we see the essence of electricity and of magnetism, not only in a totally different light, but one illuminating all the views regarding our observations of other natural occurrences up to the present time. The magnetic pressure on the magnet is dependent on the ether vacuum in the iron core (permeability), on the electrical energy in the coil winding, on the density of the ether in the bottom, in the shell and in the armature, as also on the area of the armature, and on the ether separation between the armature and the core and mantle; on the assumption, of course, that the essence of electricity depends on the ether.

The magnetism present in steel can be explained the same way. The same is dependent on the density of the material, on the cross-section of the material in reference to the pole area, and also on the electric currents flowing on the earth. In this case, as in that of the shell magnet, it is not very difficult to prove the existence of the pressure force.

This proof is dependent on the fact that we succeed in diminishing the pressure on the shell or steel magnet. The correctness of this conclusion is proved by means of well-known facts.

If we take two hemispheres, ground at the joints so that they are air tight (the so-called "Magdeburg Cups"), exhaust the air in them to about a quarter of an atmosphere pressure, hang them suitably so that they can be weighted till nearly the limit of their carrying power; if now they be placed in a suitable receptacle which can be exhausted to about a half atmosphere pressure, the weight suspended from the hemispheres will pull them apart, as the outside pressure can no longer support the lower hemisphere. The same result must follow if, as stated before, magnetism depends on pressure, and it is possible by means of suitable apparatus to reduce the pressure force around the magnet. Perhaps I may be accused of simply proving my theory by entering into a war of words and conceptions while the whole work is neither practical nor possesses a purpose. I am, however, almost ready to publish a nearly completed work showing the great extent of my discovery to the satisfaction of all; and that my discovery is not only of practical usefulness, but of great importance. I have positively proven that in the case of the shell magnet, two poles are *not* present at the upper end. I have also found (according to our present view) no completion of the circuit of the so-called lines of force on the upper part of the shell, although a magnetic circuit should exist. I have further proved that the shell increases the strength of the magnet 30 to 36 times that of a magnet without a shell. It has, therefore, been shown that considerable magnetic force is present, although the instrument is neither bipolar nor contains a magnetic circuit between shell and armature. Hence it can only be possible *that the magnetic force is a phenomenon due to pressure* and all our ideas and theories regarding magnetism must be newly stated.

If this presentation is overlooked, it might seem as if the above-discussed arguments must be evident to all. It required but one step and but one thought was necessary. By a system of logical reasoning we can arrive at the same result, yet in a way differing from that pursued by myself, namely by following the studies and investigations pertaining to the kinetic theory of gases, the wave motion and vibration of heat, light and electricity, etc. He who even then doubts that the magnetic force is nothing else than electric pressure, transmitted as wave motion, should recollect that not only have we determined the velocity and wave length of the different manifestations of energy, and we have ascertained the size of the active molecules, but that we have even measured them with accuracy. Wherever there is matter in motion, a force is present and work is done. The Röntgen rays prove this.

We know that light makes between 450 to 800 billion vibrations per second, the number depending on the color, and light is visible. Heat waves make about 500 billion vibrations per second and are not visible. The invisible electrical waves have even a larger number of vibrations, up to 80 thousand million, and we employ them in wireless telegraphy, or what perhaps would be more appropriate, wave telegraphy. Photography discloses to us the invisible ultra-violet rays, making 800 billion vibrations per second.

Between the viabrations of heat and electricity there is still an unknown sphere. And another beyond the hyperviolet waves. Much is still to be investigated.

We know that heat results in force and light does the same as is proven by Profs. Crookes and Lebedew. We no longer doubt that light, heat, electricity are due to the same kind of motion, and then should it be said that the electric waves do not result in pressure?

If, therefore, as has been done, we come to the same result by different methods, that the magnetic and likewise the electric forces are manifestations of pressure, we must conclude that this theory of pressure is not to be set aside, as has often been done before, but we must make further progress and advance it in all directions. This work of mine, therefore, deserves acceptance and claims appreciation.

I have also seriously considered whether I should attempt to oppose the existing opinions, deep grounded on scientific tradition, and openly proclaim that all thinkers and investigators since the year 1820, when Ampere announced his theory of magnetism, have erred. I am well aware of the responsibility that I assume in giving publicity to these statements.

The Production of Calcium and Strontium.

By H. Danneel.

It is well known that the metal calcium, which, in the electrical [illegible] and [illegible] occupies a position midway between aluminum and sodium, would be of immense value in the industrial world if it were less expensive. For reduction purposes when electrolysis cannot be employed and aluminum is too weak and sodium is too strong, sodium amalgam is used. The employment of this compound, however, has many disadvantages since organic mercury salts are easily formed and are difficult to remove. Furthermore, the use of calcium in organic chemistry would probably result in important scientific discoveries, if the price

FIG. 1.—ELECTRIC FURNACE.

of the pure calcium were not too high even for scientific researches, being only recently 18,000 marks (about 4,500 dollars) per kgm. The metal would also be of great value in the iron industry. To remove phosphorus, sulphur and oxygen from iron, aluminum is used at present; but only a few tenths of a per cent. of aluminum remaining in the iron will spoil it. This danger is removed when calcium is used, because the latter does not become soluble in the iron. Whether the presence of traces of calcium will affect the iron is not known, but this can be ascertained very easily. In any event the calcium will act more energetically on the impurities of the iron than the aluminum.

It is, therefore, not to be wondered at that many inventors and

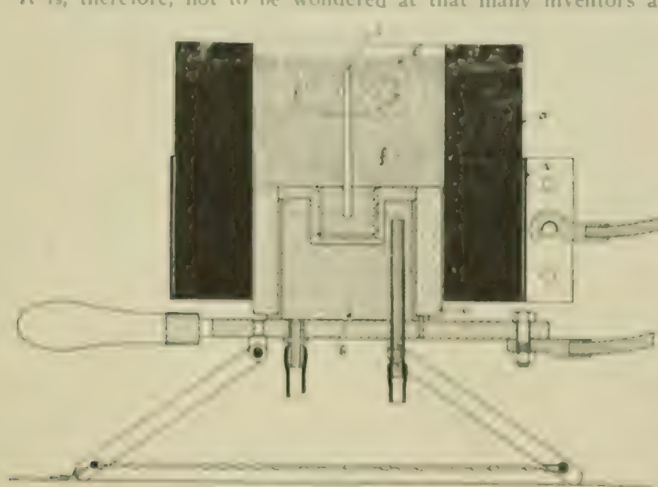


FIG. 2.—ELECTRIC FURNACE.

scientists have endeavored to produce calcium by a less expensive method. That attempts have been unsuccessful to accomplish this on a large scale is evidenced by the high price of the metal. Formerly calcium was obtained by electrolizing a diluted solution of the calcium chloride by using a mercury cathode and by liberating the mercury from the amalgam thus obtained by the application of heat. Aside from the fact that this method is complicated and, therefore, expensive, the calcium thus produced is never quite pure, as it always contains some mercury. Recently Moissan has obtained calcium from calcium iodide by electrolysis, but only very small quantities were produced in this way.

Prof. W. Borchers and Mr. L. Stockem have succeeded in constructing at the Institute for Electro-metallurgy at Aachen after many laborious and costly experiments, a furnace in which calcium can be easily produced from fused calcium chloride by means of electrolysis. If a small cathode and a large anode are used and the calcium chloride is brought to a slightly red heat, then the calcium collects at the cathode in the form of a spongy mass, which may be removed. If the mass is then dipped in petroleum, a spongy metal is obtained saturated with calcium chloride which contains, however, from 50 to 60 per cent. pure calcium. If the spongy mass is squeezed by means of tongs while it is still warm, the chloride flows out and a substance remains which contains 90 per cent. of the calcium metal. By excluding the air, the latter may be fused into a firm silvery white mass. By this process calcium may be produced for 3.60 m (90 cents) per kgm, or about 5,000 times as cheap as formerly. The apparatus shown herewith is constructed as follows:

The retort consists of a cylinder, *a*, composed of carbon rods joined together in stave fashion and held together by a metal ring, *r*. This cylinder forms the anode, and it is connected to the circuit by means of the ring, *r*. The cylinder is closed at the bottom by a cooler, *h*, which for simplicity also serves as the support of the cathode. The latter consists of an iron rod, *k*, placed in the center of the cooler, *h*. It is thus connected through the cooler to the negative pole. The cooler must, of course, be insulated from the anode by some fireproof material, such as the clay cylinder *i*, so as to prevent any leakage of the retort. A layer of fluorspar, *f*, is firmly packed on the bottom of it, which on account of its higher melting point, and on account of being cooled by the cooler *h*, generally remains solid during the operation of the device. Above this the fused mass of calcium chloride, *c*, is packed, and in order to start the fusion, the iron rod *K*, is connected with the carbon cylinder *a*, by several thin carbon rods, *w* which are embedded in the upper layer of calcium chloride, and through which the current is sent. The upper portion of the chloride thus begins to fuse, and by removing the carbon rods, *w*, at that time, the electrolysis is started.

By thus fusing the metal, there was obtained besides the pure metal, a red salt, probably CaCl. To obtain strontium was attended with more difficulty, because it separates in small fused spheres which easily rise to the surface and there re-unite with the anode chloride or escapes into the air. The apparatus, therefore, had to be so changed that the passing of a metal towards the anode was made more difficult. Strontium, like calcium, is a white metal as soft as lead. This apparatus was constructed as follows:

The cathode, an iron rod, was placed in the center of a large cooler only reaching into the cylinder to an extent that its upper end only

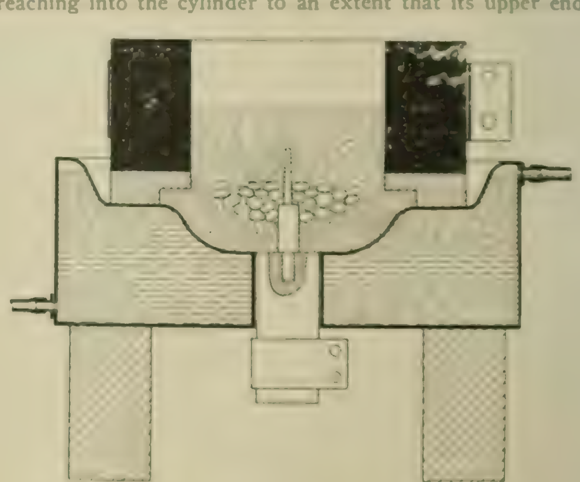


FIG. 3.—ELECTRIC FURNACE.

extended slightly above the lower surface of the carbon cylinder, which formed the anode. The other was supported, in order to insulate it from the cooler, in a ring of fireproof material, which in turn was placed on a recess in the cooler, as shown in the diagram. The diameter of the cooler was made larger than that of the carbon cylinder, so that during the operation of fusing a central depression was formed in the solid salt which constituted the bottom of the cylinder. The electrolytically liberated strontium settled in this hollow and was solidified from below due to the cooling. The strontium metal was found here, after the electrolytic action was stopped, in the form of spheres up to 1 cm in diameter.

The Armature Reaction of Alternators—VII.

By C. F. GUILBERT.

PREDETERMINATION OF LOAD CHARACTERISTICS.

In the previous article the general considerations relating to the predetermination of load characteristics were given, and the actual construction of such characteristics will now be taken up.

Assuming that Fig. 7 represents the armature characteristic (flux curve or curve of maximum useful induction) of an alternator, and let AB be the maximum useful flux corresponding to no-load and to a m.m.f., OA. If we accept the sinusoidal law with respect to the distribution of the transverse m.m.f. we can draw from the point A as a center a semi-circumference having a radius equal to the mean value of the transverse m.m.f. calculated by the preceding formula, and multiplied by $\frac{\pi}{2}$ in order to have the maximum of this mean value. The mean value is here considered with the object of simplifying the calculation of the transverse flux. Rigorously, the transverse reaction should be considered for various positions, for each of which should be found, as will be seen later, the values of transverse flux, which values can then be used to construct a curve of which the mean value will be that sought.

The semi-circumference corresponding to the center A can be regarded as representing the length of a polar step, and we can take off from each quarter of the circumference values equal to $\frac{b}{2}$. The m.m.f. in any point C of the polar arc is then obtained by dropping from that point a perpendicular such as OC' on OA. We then construct a curve of values of $C'F$ in function of the arc DC. If the intensity of the field in the gap were constant at no-load, as Picou assumes, this intensity would at load be represented by the curve HBF of Fig. 2. If this be not the case, it will be necessary to draw with BA as an axis and a maximum value, the curve representing the distribution of the flux, then take off points as F', F'', in such a manner that we will have $\frac{CF''}{CF'} = \frac{CF}{AB}$; or lower the points such as H', H'' with $\frac{IH''}{IH'} = \frac{IH}{AB}$ in order to have in $D'' P B F D'$ the distribution of flux after distortion.

If this surface is not equal to the surface $D'' P B Q D'$, but is smaller, the mean flux is reduced by the effect of the distortion, and to have its new maximum value it suffices, bearing in mind the ratio of the surface to its maximum ordinate, to drop the point B by the quantity $B B'$, such that the new surface representing the flux without distortion will be equal to the surface representing the flux after distortion.

The difference between the two parts to the left or the two parts to the right of the flux surfaces after distortion and without distortion but after reduction, will represent the transverse flux, which flux it is necessary to know for the calculation of the e.m.f. due to the transverse reaction. One can thus employ the curves of the points B', that is to say, the characteristic of undistorted the useful flux, to determine the number of ampere-turns $B B'$ (Fig. 1) necessary to be added to $O A$, in order to maintain the same useful flux after distortion. This curve is practically parallel to $\alpha \beta$.

It is to be remarked that if the portion α β, of the armature characteristic is a right line, distortion will cause no loss of mean flux. This obvious property in the case of a homogeneous distribution of flux in the gap is also true for any distribution symmetrical with the axis of the pole, as can be verified easily, the point, B, then being a center of symmetry of the curve α β.

The reduction of useful flux due to distortion and the transverse flux being known, there remains only a summary indication of the construction of the diagram for a given output, I, and the total phase angle ψ. For this purpose we can start from one of three points of view, as above implied, and according to the following assumptions:

1°. That the excitation be increased so as to maintain under load the same useful flux as at no-load.

2°. That the excitation be increased so as to maintain solely the flux constant in the field.

3°. That the excitation be simply assumed as constant.

Of these three alternatives the second (due to Picou) is the most convenient and necessitates the employment of partial characteristics of the armature of the field and of the circuit or circuits of dispersion of the armature and field. With the first and third alternatives, the total no-load characteristic is alone necessary, and the increase of the m.m.f. $C N'$ (Fig. 3) in the first case or the calculation of the useful flux, $C B'$, in the second (Fig. 6) will determine, as has been indicated in the consideration of the value r and in connection with the formula giving the direct reaction.

To facilitate the application of the second method, we will first recall a very ingenious graphical construction for the loss of useful flux by the effect of direct reaction, also proposed by Picou. We have seen in the first part of this article that if the flux is main-

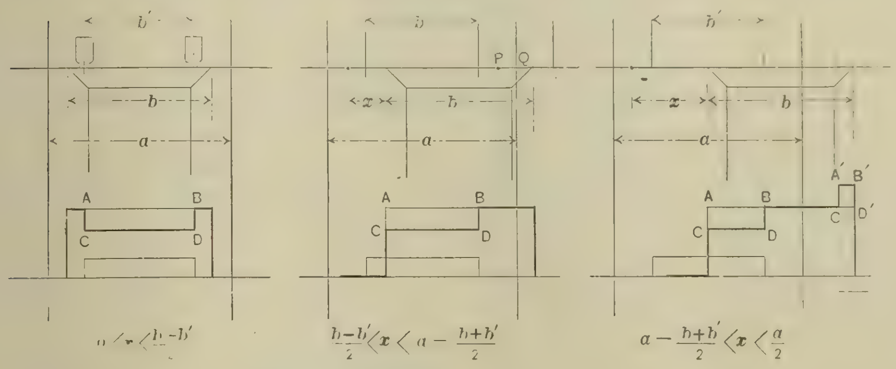


FIG. 1.

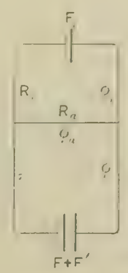


FIG. 2.

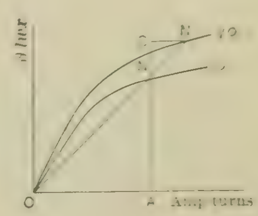


FIG. 3.

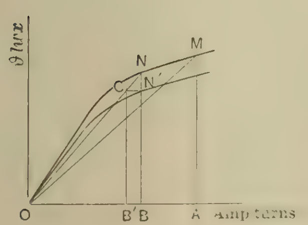


FIG. 6.

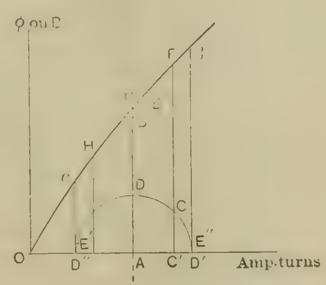


FIG. 7.

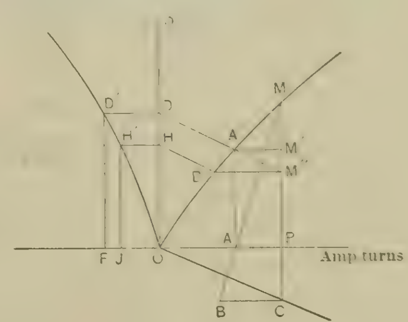


FIG. 9.

[illegible] in the field, the direct reaction reduced the useful flux by the quantity $\frac{F_i}{R_i + R_a}$, while at the same time necessitating an increase of the inducing m.m.f. by the quantity $\frac{F_i}{r}$. To obtain graphically the reduction of flux, consider (Fig. 9) the armature characteristic. The useful flux, $M\ P$, produced in the armature by the magnetic difference of potential, $O\ P$, is evidently such that the tangent of the angle $M\ O\ P$ is equal to the permeance, $P_i = \frac{1}{R_i}$ of the armature. Trace below and from the point O a curve representing the values of the field leakage flux in function of the ampere-turns. For a magnetic difference of potential, $O\ P$, between the pole pieces, the lost flux will be $P\ C$. From the point C draw a horizontal line equal to the direct m.m.f, F_i, and join $B\ M$, which meets $O\ P$ at A. From A raise a perpendicular $A\ A'$ until it meets at A' the curve, and from A' draw a parallel line, $A'\ M''$, to the chord $O\ C$. The reduction of the useful flux is $M'\ M''$, and the increase of the field m.m.f. to compensate for the transverse m.m.f. is $A\ P$. We thus have

$$A\ P = B\ C \times \frac{M\ P}{M\ C} = F_i \times \frac{\frac{1}{R_i}}{\frac{1}{R_i} + \frac{1}{R_a}} = \frac{F_i\ R_a}{R_i + R_a} = \frac{F_i}{r};$$

and $M'\ M'' = A\ P \times \frac{1}{R_a} = \frac{F_i}{R_i + R_a}$.

To take account of the field, it suffices to trace the characteristic of that part only of the magnetic circuit which is to the left; for the total flux to be developed being $C\ M''$, we have only to draw from M'' a line parallel to the chord, $O\ C$ to D, and then from this point a parallel to $O\ P$, to have at $D\ D'$ or $O\ F$ the m.m.f. necessary for the field. If we draw from M'' the parallel $M''\ B'$, and then from B' the parallel to $O\ C$ and finally from H the parallel, $H\ H'$ to $O\ P$, we see that to maintain a constant flux, $B\ M''$, in the armature at no-load and at load, it is necessary to increase the m.m.f.; first, by a quantity equal to $B\ M''$, then by a quantity $J\ F$, corresponding to the increase of field flux following the increase of dispersion. The sum $B\ M'' + J\ F$ is evidently equal to the value found above, $F_i \left(1 + \frac{r}{R_a}\right)$, increased by the ampere-turns corresponding to the variation of the reluctances r and R_i.

Independent Telephone Securities.

In a paper read before the meeting of the Interstate Independent Telephone Association, Mr. John W. Layne considered the subject of independent telephone securities. Capitalists of the East have been timid of independent telephone securities, by reason of being unable to comprehend the rapid growth and development of telephony in the Middle and Western States. Progress there has been much retarded for want of more capital for betterments, and to meet the increased demand for telephone service; hence the importance of better knowledge of telephone securities, and where to place them. His own experience, as well as information derived from other sources, led him to believe that the easiest way to float telephone securities is to enlist the aid of the local capitalists, using in this direction the same energy displayed in building up the business. By formulating a prospectus, showing both present and prospective financial conditions, surprisingly favorable results will be achieved. As an example of the value of such securities, the case of the Carthage, Mo., plant was cited, which has expanded from 220 subscribers to 2,250 in less than three and one-half years, and stock originally offered at par is now quoted at 300.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

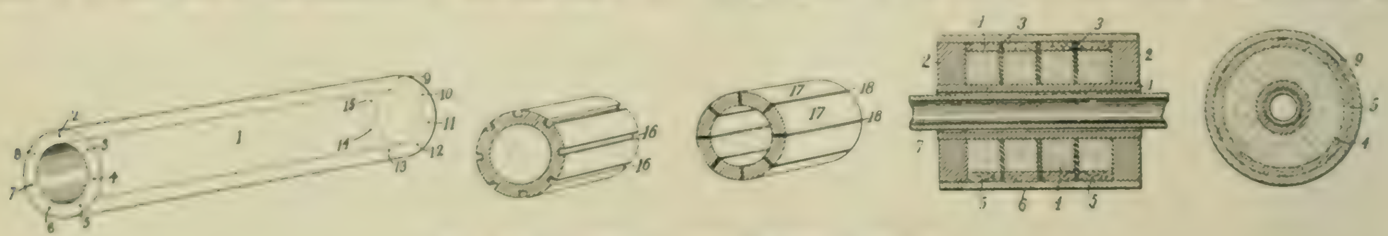
Electric Furnaces.

Mr. Henry Noel Potter, of New Rochelle, New York, has patented a number of electric furnace structures, all of the "tube" type, and all possessing features of especial novelty and interest. Mr. Potter's ingenious application of a non-fluxing and non-reacting jacket to furnaces of the Nernst type, depending upon the employment for a jacketing material of a single one of the mixed oxides which constitute the conducting body of the furnace, will be recalled. A jacket of this kind, being composed of a pure oxide, is substantially nonconductive; and being composed of the oxide which forms the chief constituent of the conductor, it is of course incapable of reacting therewith at any temperature at which the conductor itself is stable.

The present improvements are applicable either to Nernst furnaces, or to the older carbon tube type; they relate to means for securing an even heating effect in all parts of the tube; to the design of effective and permanent terminal connections; to constructions permitting free expansion of parts, both longitudinal and axial; to means for conserving the heat of the furnace; and to devices for strengthening the tubes and rendering such parts as are subject to wear readily replaceable.

Absolute uniformity, either physical or chemical, is scarcely to be expected either in the carbon tube or in one formed of dry electrolytes; hence an even distribution of the current, and an even heating effect, are seldom attained.

Figs. 1, 2, 3 show several forms of heating tube designed to equalize the heat effect. In Fig. 1 this is accomplished by the use of a plurality



Figs. 1, 2, 3, 4 and 5.—Potter Electric Furnaces.

of terminals, numbered from 2 to 15, arranged in opposed pairs, in conjunction with independent connections to the members of each pair; such connections may be from the separate secondaries of a transformer, or from ballast resistances in the several circuits from a common generator. Longitudinal partial divisions of the furnace tube, as shown at *16* in Fig. 2, effect the same result of restricting the current flow to definite paths; and the use of insulating or poorly conducting divisions *18* between conducting segments *17*, as in Fig. 3, is a further development of the same idea. From this construction to a conductor formed of a series of juxtaposed rods is but a step; this latter construction is, however, a part of the prior art.

Figs. 4, 5 show furnaces consisting of a carbon tube, *1*, carbon terminals, *2*, and a series of carbon collars, *3*; these collars surround the tube and prevent its distortion at high temperatures. The spaces between the collars are filled in with magnesia, *4*, and asbestos, *5*, and the whole is surrounded by tube *6*, which may be of glazed earthen ware. This furnace may be used with no parts other than above described, but it is preferred to provide an inner tube, *7*, which is rotatable and which may, if desired, be internally lined with magnesia. It is suggested that in this case the tube be made slightly tapering, in order that the magnesia lining may be slipped into place and adjusted in position to compensate for shrinkage.

Fig. 6 shows a device for mounting the tube to permit the furnace to be used in any position, and to allow for expansion of parts without interference with the electrical connections. In this construction *1* represents the carbon tube, *2*, carbon rings at either end, and *3*, *4*, metallic rings surrounding the carbon rings, *2*, and capable of being tightened by bolts, *5*, upon their beveled faces. These bolts, *5*, also secure the entire device to metal diaphragms, *6*, through which in turn the electrical connections to the external circuit, *10*, are made. A casing, *1*, and terminal plates, *8*, enclose the furnace, insulation, *9*, being interposed between the two. It will be seen that free longitudinal movement of the carbon tube is permitted by the elasticity of

the diaphragms, *6*, and that no change in dimensions or position will tend to reduce the efficiency of the electrical connections.

In 1889 Douglas Dixon suggested the following ingenious procedures for producing aluminum: Molten sodium chloride, rendered more fusible by the addition of sundry other alkaline chlorides, was electrolyzed, and the chlorine and sodium separately withdrawn. The chlorine was admitted to a chamber containing oxide of aluminum or this oxide admixed with carbon. Aluminum chloride was thereby formed, and being volatile at the temperature used, was brought into the presence of the metal sodium. Reduction occurred,

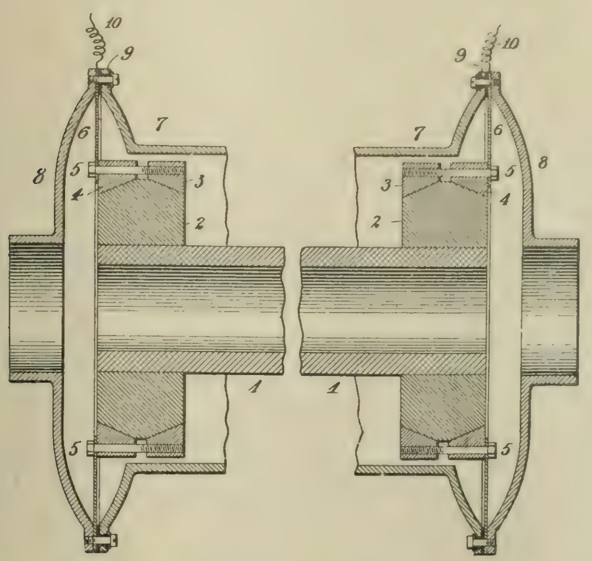


FIG. 6.—DETAIL OF ELECTRIC FURNACE.

the sodium chloride of the bath being regenerated, and the metal aluminum tapped off.

This period witnessed the rise of the Hall process, and it is needless to say that the method above noted did not enter the commercial field. It is curious to note, therefore, the recent issue of a patent to Giralamo Taddei, of Turin, Italy, for an apparatus designed for carrying into effect this very plan of operation. Taddei seems also to have developed the method quite independently, but it is highly improbable that better commercial success will attend the venture at this time.

Bids for Lighting Guayaquil.

Consul-General Thomas Nast transmitted from Guayaquil, November 12, 1902, just before his sudden death from yellow fever, translation of an advertisement by the municipal council, inviting tenders for lighting the city by gas or electricity. Mr. Nast said:

The tenders must be sent to the secretary, municipal council, of this city, not later than February 12, 1903, under sealed envelope. It is to be hoped that American capital will try to get the contract. The terms are:

1. The city to be lighted by gas or electric light, or by both, within limits provided for in the contract.

2. The lights to be located 3.5 meters (3.8 yards) above the surface and 1 meter (1.09 yards) from the houses' front (portales), and not be farther apart than 35 meters (38.1 yards).

3. Each light to be of 15.4 cp (international unit); at the intersection of the streets in the central part of the city, the lights to be of 80 cp, located at a height of 6 meters (6.5 yards).

In all cases, the lights used in the streets shall be arc lights.

4. The council guarantees that it will take at least 1,400 lights during eleven hours daily, also 50 lights of 80 cp—for which payment will be made monthly.

5. The municipal engineer and the inspectors of lights shall take the usual measures to test the quality of the lights in any part of the city.

6. The gas or electric conductors must be laid underground, and of the most modern system and size.

New Telephone Patents.

A few weeks since mention was made in these columns of a new type of insulator for telephone line wires by which the usual tie-wire was dispensed with. In the patent issue of December 9th a patent granted to Mr. Morton Harloe, of Hawley, Pa., describes another such insulator. In this insulator the usual petticoat, threaded hole and tie-wire groove are provided, but in addition three lugs project from the upper part of the insulator. Two of these lugs,

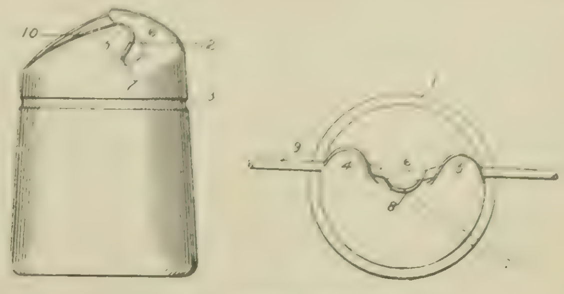


FIG. I.—HARLOE INSULATOR.

shown at *4* and *5* respectively in Fig. 1, arise from the same side of the insulator and incline to the right. The third lug shown at *6* arises from the opposite side of the insulator and is so inclined as to overlap and pass between the points of the lugs *4* and *5*. The manner of using the insulator is self-evident, the aperture *7* being the resting place of the line wire. From the figure it will be noticed that the lug *5* is considerably lower than lugs *4* and *6*, which feature is one of the chief novelties of the invention, facilitating to a great extent the insertion of the wire.

The next telephone patent of this issue is one entitled "electromagnet." This patent describes a type of electrical relay wherein the adjustment for different current values in the operating coil is obtained by changing the position of the pole face of the core instead of changing the position of the armature, as has been heretofore customary. The advantage of this arrangement lies in the fact that a constant contact clearance is maintained irrespective of the relay adjustment. The manner of applying the invention is well shown in Fig. 2, which is a sectional view of a telephone relay embodying this type of adjustment. This relay is designed to break the contact

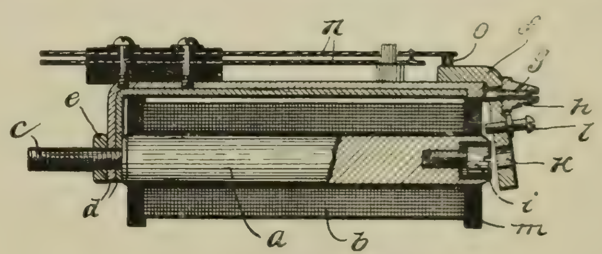


FIG. 2.—STROMBERG ELECTROMAGNET.

between two springs *n*, the upper of which follows the motion of the armature *f*. It is readily seen that any change in the position of the armature will affect both the normal and final positions of the upper contact spring, yet the air-gap, i. e., the distance between the pole face *i* and the armature *f*, must be varied to provide for the proper operation of the relay with different operating currents. This necessary adjustment of the air-gap is accomplished by recessing the core of the electromagnet and mounting therein an iron screw, the head of which serves as a pole face, and the position of which may be adjusted by a screw driver passed through the aperture *k* in the armature. Alfred Stromberg is the inventor of this device, the patent for which is assigned by him to the Stromberg-Carlson Company, of Chicago.

Again, the antiseptic mouthpiece is with us, but this time the attachment is purely mechanical, no chemicals being used. The new device is a holder for sheets of paper, and is applicable to all existing transmitters in such a manner that each user of the telephone may conveniently interpose a fresh sheet of paper between his mouth and that of the transmitter. Thus he is screened from infection within the transmitter and from infection from all other users. This attachment is the invention of Henry Baething, of Buffalo, N. Y.

A "Composite System of Electrical Transmission" is the subject

[illegible] granted to Prof. Frederick Bedell, of Ithaca, N. Y. In this patent Prof. Bedell proposes to use "commercial" lines for the [illegible] of constant potential "commercial" currents and of signalling currents. Under commercial currents may be included all currents both alternating and direct, adaptable for light and power work; and by signal currents is meant telegraph, telephone and both alternating and direct-current electric bell currents. Prof. Bedell states that he finds he must provide means for attaching the signal circuit to the constant-potential circuit in such a manner that the point of attachment will at all times be at equal potential, this not the potential as measured by a voltmeter, but the instantaneous values of potential. Thus the points of attachment of the receiving and transmitting stations for the signalling current must be so located that change of potential along the commercial line will produce equal effects upon them. Further, they must be so arranged that their changes of potential will be simultaneous. In other words, the potential changes of the two points must follow the same wave forms, these waves being exactly in phase.

The principle of the application of the signalling currents to commercial lines will be readily understood by those familiar with central energy systems of telephony, by a glance at Fig. 3. Here A represents a two-phase power line feeding one phase to circuit ab and the other to circuit $a'b'$. These circuits are feeding lamps at j and j' and an electric motor at Jx. Again, B is a direct-current source feeding the line cd. The double circle U may represent one telephone station, while v^1 v^2 and v^3 represent others upon the same circuit.

By means of the various devices shown, i. e., the split and accurately balanced impedance coils, resistance coils and the balanced

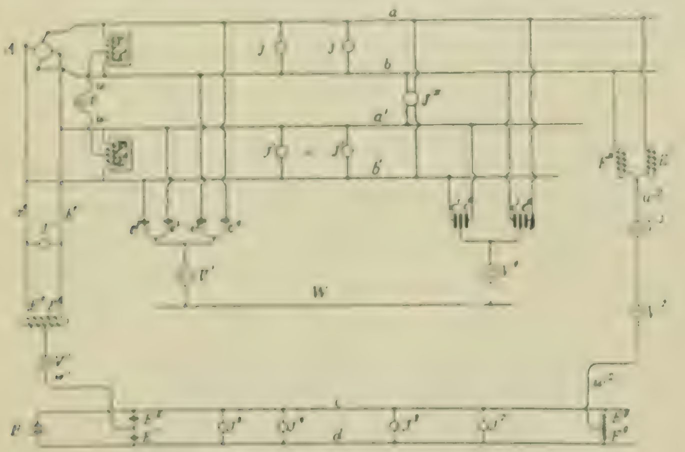


FIG. 3.—BEDELL SYSTEM OF COMPOSITE TRANSMISSION.

condensers, E E', E^2 E^3,—E^4 E^5, the signal circuit is attached to the constant-potential circuit; the line wires ab, cd and $a'b'$ in pairs, in parallel, and in that order, serving as the signal current conductor. Again, a second signal circuit may be maintained connecting the instruments U' V''', for which circuit the wire W is a return, while the line wires $aba'b'$ are used in parallel. Prof. Bedell also illustrates means for attachment to many other kinds of commercial circuits. He also describes means whereby such dangerous currents as would arise in the signal circuits through grounding or other accident to the transmission line, will be shunted around the signal instruments. For example, where the commercial current is alternating, and the signalling telephonic, a shunt, resonant to the power current but practically of infinite resistance to the telephone current, may be arranged around the telephone apparatus.

The inventor certainly appreciates the present day difficulties of accurate balancing of impeding devices, but suggests that methods will be forthcoming which will solve this heretofore insurmountable difficulty. The practical telephone engineer, will, however, certainly have his doubts. Some of the claims of this patent are very broad, one in particular being so constructed that if taken literally it apparently covers all existing systems of composition for the simultaneous transmission of telegraphic and telephonic signals.

The fifth and last telephone patent of the issue under discussion, related to an improvement in magneto bells. This improvement has three distinct features: First, the simplification of the armature adjustment; second, increasing the resilience of the hammer rod; and, third, the provision of an adjustment such that each blow of the hammer will have the maximum effect upon the gongs. The first of these is accomplished by rendering the armature-supporting plate flexible, and making all adjustment from one end, the other end being held permanently in position. The change in the hammer rod consists in forming in it a double spiral, the plane of the spiral coinciding with the plane of motion. Finally the adjustment of the hammer is effected by interposing a socket between the hammer rod and the armature within which socket the rod is longitudinally adjustable. This patent bears the number 715,683, and the improvements are the invention of W. E. McCormick, who assigns his rights to the International Telephone Manufacturing Company, of Chicago.

Changes in the National Electric Code.

In regard to proposed restrictive action on high-voltage circuits by insurance interests, we quote the following official report from the bulletin of the American Institute of Electrical Engineers as to the proceedings of its committee on National Electric Code, of which Messrs. Kennelly, Ferguson, Gossler, Perrine, Steinmetz, A. Williams and Woodbury are members. This committee, which has had repeated conferences with a committee of the Underwriters' National Electric Association for the purpose of formulating rules respecting extra high pressure lines says:

A joint report was prepared which was considered by the Board of Directors of the Institute at a special meeting called for that purpose on December 8th. The following resolutions were adopted:

Whereas, the American Institute of Electrical Engineers has used its best endeavors through its special committee to bring about a satisfactory understanding in regard to the formulation of rules for the regulation of the location and construction of "Extra High Pressure Constant Potential Overhead Lines," and

Whereas, its committee has in conference with the Special Committee of the Underwriters' National Electric Association considered certain rules for insertion in the National Electric Code; and

Whereas, it has come to the knowledge of the Board of Directors of the American Institute of Electrical Engineers that various electrical interests are opposed to the acceptance of said rules in their present form; and

Whereas, there has been insufficient time since the receipt of these rules in their present form to have them fully and adequately considered by its membership; and

Whereas, the Board of Directors has received telegrams and letters to-day from various prominent members and committees of affiliated electrical societies bringing forward new evidence and urging that official action on these rules be deferred until they shall have had an opportunity to present to the board their views and arguments, therefore, be it

Resolved, That the American Institute of Electrical Engineers, through its Board of Directors, withhold for the present any endorsement whatever of the proposed rules for insertion in the National Electric Code.

Resolved, That the president of the Institute be authorized to request the postponement of official action by the National Board of Underwriters on this matter until the American Institute of Electrical Engineers has been enabled to consider through its membership the new and important questions now raised in connection with the proposed rules.

On December 9th the president of the Institute and the chairman of the Committee on National Electric Code, appeared before the Underwriters' National Electric Association and presented the resolutions with an explanation of the position of the Institute. Upon motion of Mr. C. M. Goddard, chairman of the Conference Committee and secretary of the Underwriters' National Electric Association, that body acquiesced in the position taken by the Institute.

Telegraphic Facilities at Coronation Durbar.

A special dispatch from Calcutta gives some interesting details of the preparations being made at Delhi for the coronation durbar, which is to be held on January 1 next. The interest that is being taken in the great event is evident from the fact that a special telegraph office has been fitted up to accommodate 200 operators. There will be thirty emergency wires, with a working capacity of approximately 1,000,000 words per day.

Telephone Law in Ohio.

Mr. W. F. Lanbach, of the Akron, Ohio, Peoples' Telephone Company, read a paper at the recent Interstate Telephone Convention which gave an account of some of the legal restrictions imposed in Ohio on the telephone business. A case was cited where an Ohio court decided that a telephone company whose franchise had expired could not be ousted for declining to assent to an illegal condition embodied by a municipality in a proposed new franchise. After quoting Ohio statutes on the subject of right of way, Mr. Lanbach said that they would appear to accord telephone companies unlimited rights upon country roads so long as wires were sufficiently high to clear a load of hay, and the poles sufficiently removed from the wagon track. But it has been decided that the abutting property owner retains a right over the same; that a steam or electric road has rights paramount to a telephone company; and that every grant in derogation of the right of the public in the free and unobstructed use of the streets, or restrictive of the control of the proper agencies of the municipal bodies over them, or of the legitimate exercise of their powers in the public interest, will be construed strictly against the grantee and liberally in favor of the public and never extended beyond its expressed terms when not indispensable to give effect to the grant.

It was pointed out that in Ohio there are restrictions concerning the handling of messages. A telephone or telegraph company is required to receive messages from and for other lines, and from and for any individual; and on payment of its usual charges for transmitting dispatches, as established by the rules and regulations of the company, it shall transmit the same with impartiality and good faith, under a penalty of $100 for each case of neglect, or refusal so to do, to be recovered with cost of suit, by civil action, of the company forwarding or desiring to send the dispatch. Another law is that "When the person who sends a dispatch desires to have it forwarded over the lines of other companies, whose termini are respectively within the limits of the usual delivery of such companies, to the place of final destination and tenders to the first company the amount of the usual charges for the dispatch to the place of final delivery, the company shall receive the same and, without delaying the dispatch, shall pay to the succeeding line the necessary charges for the remaining distance; and the succeeding line shall accept the same and forward the dispatch in the same manner, as if the sender had applied to it in person and pay the usual charges; and for the omission so to do it shall be liable to take penalty, as provided above."

Mr. Lanbach referred to the recent Ohio law taxing telephone companies at the rate of one per cent. of their gross receipts. The gross receipts are defined as "the entire gross receipts (including all sums earned or charged, whether actually received or not) for the year then next preceding the first day of May, from whatever source derived, whether message, telephone tolls, rentals, or otherwise, for business done within this State of each office within this State (giving the name of the office) and the total gross receipts of the company for such period in Ohio from business done within Ohio."

Pro and Con of Interurban Trolleys.

In a recent issue of the *Wall Street Journal*, the financial possibilities of interurban trolley systems are discussed pessimistically as follows by Mr. A. A. Lisman, of Lisman, Lorge & Co.: "I call your attention to the following striking facts on the continuous flotation of interurban street railways, and the extravagant claims made on behalf of projects of this character.

"The average cost per mile of interurban traction, especially when the road proposes to do a freight business, is at least $18,000. Adding thereto the contractors' profit makes the minimum cost per mile of road $20,000. In order to raise this money, roads are generally bonded for $25,000 in 5 per cent. bonds. In other words, the fixed charges per mile of road are $1,250. To this must be added at least $150 a mile for taxes and legal expenses, not counting damage suits.

"Taking the New York street railway report as a guide it will be seen that the average earnings per mile of interurban traction are $3,400, and the average operating expenses are 55 per cent., which is very low. This equals $1,870. Add to this maintenance of way and rolling stock, and above all, maintenance of electrical equipment, say only $1,000 a mile (certainly ultra-conservative) for a term of say ten years. All projects of this kind in the State of New York show net earnings of not exceeding $530 a mile less taxes, as above, $380, against fixed charges of minimum $1,250.

"These figures are taken from official records and the only change made is the addition of very limited charges for maintenance of way, power and equipment. Only by leaving the latter charge out can interest be earned. As a matter of fact, therefore, the average interurban road from its very inception when charged with essential expenses for renewal of maintenance, shows a deficit of $800 a mile. Of course there can only be one end to this kind of thing. The next reorganization period this country will see will be the reorganization of interurban traction properties, and from all indications this period is apt to come even more quickly in traction properties than it will come in industrials."

To this, however, Mr. Alfred M. Lamar make a very interesting reply, in the course of which he says: "The facts as stated and reason given for foreclosures and reorganizations, it appears, are confined to the State of New York, and the experience of the roads confined to that limited territory. It is a well-known fact that New York is one of the most undesirable States in the Union in which to build this class of roads, and except in specially favored localities they should not be built.

"The statement that the gross receipts of interurbans in New York State amount to $3,400 per mile is doubtless correct, but it is a fact that the gross revenue of such completed roads in the States of Ohio and Indiana are now averaging $4,975 per mile per annum. Taking the New York average of $3,400 per mile, he charges 55 per cent., of $1,870 for cost of operating, $150 for taxes and attorneys' fees, $1,250 interest charge and $1,000 per mile 'for maintenance of way, rolling stock, and, above all, maintenance of electrical equipment.' A total of $4,270, or $800 above gross receipts. The cost of operating placed at 55 per cent., is ample, as there are many roads being operated for a much less figure, and this includes maintenance of every kind. So even in New York, the future of interurban electric roads is not as discouraging as he would have it appear.

"Heavy freight business is yet in its experimental stage, and clear-headed traction men are not now insisting upon undertaking that branch of the steam railroads' business. The package or express business has proven very profitable and the frequency of trains will cause this business to continually increase, though there are isolated cases where the conditions are such that it is manifestly plain that heavy freight business will pay handsomely. Of course, there will be in this business instances where unwise methods and plans of financing prevail to wreck the business, but where conservatively financed, substantially built, and judiciously managed, there is no class of investment to-day in America that promises a safer and more substantial return."

How to Deal With City Congestion.

Whether London or New York is the worst example of a city choked by its own traffic is, remarks the *New York World*, an open question. Whatever gives relief to the general condition of cram and jam of either metropolis is consequently of first-class interest to the other. London's fearfully congested state, in the opinion of the *Spectator*, can only be remedied by these radical reforms:

All wires and pipes must be sunk in tunnels into which workmen can go and work without interfering with overhead traffic.

All goods must be received and discharged from warehouses and shops either before or after the hours when street traffic is at full tide.

All heavy hauling must be done in motor cars of large size, and the horse as a draught animal must be banished from the streets.

Pedestrians on the streets must be greatly reduced in number not only by underground railroads, but by spacious subways connecting one central point in the city with another.

These are obviously the main lines along which New York no less than London must seek to make the tension of daily life less severe and the toils of locomotion less arduous. It is simply inconceivable that we shall forever go on enduring the horrors of bridge "crushes," L road and surface car sardine-packing, sidewalks made impassable by barricades of merchandise, and crossings that are only to be crossed at the peril of life and limb.

Letter Boxes on Trolley Cars.

It is [illegible] in Washington that Postmaster-General Payne is not going to have plain sailing with his experiment of placing letter boxes on the sides of street cars in cities, so that any one having a letter to post where haste in forwarding is important, can push it through a slot on the first street car he sees going toward the post office or the railway station. On every side it is admitted that the plan will add greatly to the convenience of the letter-writing public, especially in those districts in large cities where collections are comparatively infrequent. It would also reduce materially the work of the carrier force in every city post office.

But the labor organizations have begun to flood the Post Office Department with protests, and to appeal to Senators and Representatives to press their remonstrances upon the department. They complain that the use of the street cars as regular mail carriers will mean that striking employees of the street railway companies will not be able to obstruct the free movement of the cars without laying themselves open to punishment for interfering with the United States mails. A spokesman for the American Federation of Labor is said to have remarked:

"We shall oppose any proposition that looks to furnishing the protection of federal courts and troops to the operation of a private enterprise employing a large number of workingmen, under the guise of protecting the mails. The car companies have tried this before, but we have succeeded in tying them down to the use of certain special cars, appropriately labelled, and not permitted to carry any passengers."

Other schemes to improve service are also on foot. With the beginning of the year a number of entirely new devices in postal business will be tested. One is a new mail box, which is said to be the most perfect arrangement yet made to keep tab on letter carriers and collectors. The boxes will be arranged on a regular route and numbered. Each will be connected by a wire with an annunciator board in the main office and as the collector opens the box to take out the mail a bell will ring and an index on the board will tell the box that is open.

The electrical connections on the new box are so fixed that if the collector fails to open a box by reason of forgetting it or because it fails to work and he cannot get the door open, there is a wire which prevents his opening the next box in the series and the fact is also announced at the main office. This makes sure that the collector is doing his duty and that every box is opened at each collection.

There is a third novelty in the new system. In each box there is to be hung on the inside a telephone transmitter and receiver and, if at any time the collector should need to communicate with his chief at the office, he can do so, or the latter can tell from the annunciator just where he is and talk with him if necessary.

There will be also elaborate tests during January of the automobile as a vehicle for mail carriers and collectors.

London Underground Roads.

It is reported from London that all of the bills of the Underground Electric Railway Companies of London, Limited, have received the royal sanction, and this company, which has been fathered by the Speyer Brothers, of London, is in a position to carry out its undertaking as a whole. Work on Baker Street & Waterloo, the Brompton & Piccadilly and Great Northern & Strand roads, which have, under a recent bill, been consolidated, is being pushed rapidly, and 18 months should show these roads nearly ready for business.

The electrical equipment of the Metropolitan and Metropolitan District Railways is proceeding rapidly, and within a year these roads, known as the old underground, should be operated by electricity in a bright subway lighted by electricity, with good ventilation and frequent service in lieu of the smoky eight minute steam service of the past.

Of the total capital of $25,000,000 of the Underground Electric Railway Companies, 50 per cent has been called on the stock subscriptions, making $12,500,000 paid in. It is not expected to call the other $12,500,000 at the present time, but the increased cost of the building of the underground roads will be provided for by the sale of debentures and guaranteed preference shares, issued under the acts of parliament by the underlying operating roads. Of the above $12,500,000 paid in upon Underground Company stock the United States furnished about one-half and Boston furnished about one-half of the United States subscriptions.

A New Trolley Bridge for Greater New York.

Mayor Low has outlined the plans submitted by the commission of experts for the new bridge to span the East River and pass over Blackwell's Island, New York. The expert commission comprised Profs. Burr and Ricketts and Henry W. Hodge. Their plan, in effect, is to build a bridge 91 feet wide to take the place both of the original plan and of that submitted by Commissioner Lindenthal. The general arrangement will be very similar to that suggested by Commissioner Lindenthal, but it will follow the original plan of giving space for the trolley tracks to run in lanes of their own, so as not to interfere with wagon traffic. Four trolley tracks are recommended. The plan provides for sidewalks, so that in case of accident all of the passengers would be able to leave the cars and finish their journey across the bridge on foot. The two lines of L roads will run parallel to the sidewalks. The lower deck is to be arranged with two trolley lines on overhanging brackets, one outside of each truss, with two additional trolley lines inside the trusses. Then it is recommended that a roadway be built in the center between these two inside trolley lines.

CURRENT NEWS AND NOTES.

OLD CARS AS PARK SHELTERS.—It is noted that the Cardiff Town Council furnishes another example of the advantage of co-ordination between different municipal departments. As its tram cars get too old to stand the heavy demands made on them for traffic it proposes to use them, with a little suitable decoration and fitting up, as park shelters.

WIRELESS TELEGRAPHY IN MEXICO.—A correspondent in Mexico informs us that the Mexican government is establishing a system of wireless telegraphy between Guaymas, State of Sonora, Santa Rosalia, and other points on the peninsula of Lower California across the Gulf of California. The work is in charge of Otto Scheller, an engineer of Berlin, Germany. The Slaby system will be used.

ELECTRIC BILLIARDS.—A cable dispatch from Paris of December 13 says: The very latest thing in Paris toys is an electric billiard game. It is played on a diminutive table, which can be folded up into the size of a small workbox. The balls are made of compressed pitch. The cue is a penholder with a cork disc at the end, forming a small mallet. The cue is chemically prepared. In the center of the table is a plate formed of any material which can be easily electrified. The game consists in attempting to make caroms by counteracting the electric influence behind the tiny balls. A practical player may run up a series of caroms, but a novice will find it not at all easy. The game is fully entitled to be called one of skill.

MARCONI AT GLACE BAY.—A special telegram from Halifax, N. S., of December 13 says: The *Glace Bay Gazette* published a very pessimistic article on Marconi's wireless telegraphy work here, insinuating he has failed up to date in bridging the Atlantic. It is understood the difficulty is due to insufficient power. Messages are being exchanged, but not as successfully as had been expected, and in the hope of remedying this it is rumored they are putting in a lot more storage batteries. Marconi will not go on the *Carlo Alberto* to Venezuela if the vessel gets out of the ice, but will stay here. The price of wireless stock has dropped twenty points within a month. Insiders are optimistic that the system will be on a commercial footing by Christmas day, and account for the present rumors by Marconi's aversion to giving out any news until he has his plant thoroughly equipped and is ready to take the public into his confidence. Mr. Marconi, in reply to inquiry regarding the statement published in the Glace Bay newspaper says: "I do not consider it worth while to notice such apparently wilful misstatements as those referred to claiming that I had met with failure. They are an entire fabrication." In the meantime, the *Carlo Alberto*, the Italian warship placed at Mr. Marconi's disposal by the King of Italy, has been dispatched to Venezuela to press Italian claims in that quarter.

CASTNER MEMORIAL TABLET.—A memorial tablet to the late Hamilton Y. Castner was unveiled December 16 in Havemeyer Hall, Columbia University. Mr. Castner, who died in 1899, was an alumnus of the Columbia School of Mines, and the tablet erected was provided from subscriptions among his large circle of professional admirers.

PARIS AUTO SHOW.—The most important automobile exhibition ever seen in France is attracting a large number of visitors to the Grand Palais, Paris. The show is not only artistic, but is striking testimony to the importance of the industry. A car which attracts much attention uses a combination of petroleum and electricity and was made partly by Daimler and partly by Lohne, of Vienna. The power is conveyed directly to motors on the front wheels from a 28-hp Mercedes engine, which drives a dynamo. The advantages of this new car are said to be the complete absence of side-slip and the abolition of the chain and speed gear.

SUBMARINE BOAT TESTS.—The board of naval officers appointed to conduct the trials of the submarine torpedo boats *Adder* and *Moccasin* have submitted their report on the *Adder* and recommended the acceptance of that vessel after certain defects and unfinished work are completed satisfactorily. The board calls attention to the fact that although the trials fulfill the strict letter of the contract, they do not provide for any trial under service conditions at sea, and no prediction can be made "as to her behavior in even a moderate seaway." The report therefore recommends that when the remaining vessels of this class are tried, one of them should be given sea tests.

PROPOSED STATE LABORATORY.—A telegram from Schenectady, N. Y., of December 9 says: An important meeting of the New York State Electrical Laboratory Commission was held here yesterday afternoon. There were present State Engineer Bond, Harold W. Buck of Niagara Falls; C. P. Steinmetz, of this city, and State Architect Hines. Plans already submitted to the commission were approved and Messrs. Buck and Steinmetz reported on the amount of space needed for the electrical apparatus. The cost of the proposed buildings and equipment will be between $250,000 and $300,000. The buildings alone will cost in the neighborhood of $100,000. The commission decided to make a preliminary draft of its report to be presented to the Legislature at the next session of that body.

A GREAT TUNNEL FRANCHISE.—The Pennsylvania Railroad obtained on December 16 from the New York Board of Aldermen, by a vote of 41 to 36, the right to tunnel under the Hudson River to the Borough of Manhattan, to the projected terminal of the company below Thirty-fourth Street, between Seventh and Ninth Avenues, thence eastward under the East River to the Borough of Queens, to connect with the Long Island Railroad system recently acquired by the Pennsylvania Company. The company proposes to spend $50,000,000 on the improvement and in return for the franchise the company claims that the people of New York City will be given exceptional transit facilities with the aid of electricity. The fight for the passage of the tunnel franchise has been long and bitter.

KANSAS ASSOCIATION MEETING.—At the recent meeting of the Kansas Gas, Water & Electric Association, which was well attended, Mr. R. C. Maunsell, of Topeka, Kan., presented an interesting paper on the economy of adapting old central stations to modern methods. Another interesting paper was read by Mr. S. W. Sterrett, of Kansas City, Kan., entitled "Why the People Distrust Gas, Water and Electric Companies." Professor Lucien I. Blake also favored the Association with a lecture on "Some Recent Discoveries in Electricity." The following officers were elected: President, Jesse Shaw, Topeka, Kan.; first vice-president, W. T. Soden, Emporia, Kan.; second vice-president, C. R. Maunsell, Topeka, Kan.; third vice-president, J. D. Nicholson, Newton, Kan.; secretary and treasurer, S. W. Sterrett, Kansas City, Kan.; executive committee, R. C. Johnston, Lee Riley and J. C. Nicholson.

THE CHICAGO ELECTRICAL ASSOCIATION elected officers for next year at its meeting December 5: For president, Prof. P. B. Woodworth; vice-president, Peter Junkersfeld; secretary, W. B. Hale; treasurer, H. G. Dimick; auditor, DeW. C. Tanner; directors, W. J. Warder, Jr., C. W. Whitney, Albert Scheible. The paper of the evening was by Capt. A. D. Khotinsky, on the "Early Development of European Incandescent Lamps." Capt. Khotinsky was associated with Jablochkoff and Maxim in their pioneer work of thirty years ago. In 1873, he was awarded the Royal Engineers' Medal for the first practical incandescent lamp. His paper was an interesting review of some of the inside history of the early work on the incandescent lamp in Europe. The next meeting of the association will be Friday evening, January 16, 1903, at which time a lecture will be given by H. M. Brinckerhoff, on "Third-Rail Electric Railway Systems."

POTASSIUM CYANIDE FROM AIR.—Prof. Edmund O'Neill, of the chemistry department of the University of California, declares that he can produce potassium cyanide from the atmosphere at less than half its present cost. If he succeeds this will reduce the heavy cost of treating gold ore. Using simple apparatus, gas of petroleum or coal is mingled with the atmosphere, which is four-fifths nitrogen. Subject to the influence of an electric arc, the resultant is hydrocyanic acid. This, when treated with potash, rapidly yields potassium cyanide. The cost of materials is small and the requisite energy to produce the combination is also inexpensive. The process of producing potassium cyanide is, it is said, now so expensive that more than $2,000,000 is spent annually on imports of the chemical. Its use is so general that besides the amount imported eighteen factories in this country turn out large amounts of it yearly. Prof. O'Neill says he can produce it for five cents a pound. Under old methods it costs 25 cents a pound.

CABLES IN THE PACIFIC.—The Pacific cable, in connection with the Canadian Pacific telegraph lines, was opened for business on December 8. The Commercial Pacific Cable Company has filed with the Secretary of State of New York an amended certificate of incorporation covering extension of its lines from Manila to Shanghai. The company has a New York charter. The American shore end of the Commercial Pacific cable was successfully laid on Sunday last, December 14, at Ocean Beach, near San Francisco, in the presence of thousands of spectators. Among those present on this interesting occasion were President Clarence Mackay, George G. Ward and other officers of the cable company, Governor Gage, of California; Mayor Schmitz, of San Francisco, and a distinguished party of guests. Governor Gage delivered an address, and his little daughter Lucille christened the splicing of the cable. The cable steamer *Silvertown* is now on her way to Honolulu, paying out the cable as she goes along.

LETTER TO THE EDITORS.

The Size of Atoms.

To the Editors of Electrical World and Engineer:

SIRS: I am obliged for your comments (in issue of November 22) on my paper on the size of atoms before the Physical Society of London, and particularly for the sight of that blessed word "bicron." Bicron is good. Its rhythm would place it in two-time measure; but what will the philologists say? My slight upon the diameter of the sun will surely merit a lighter sentence. You seem to have acted from malice prepense, while I was chained down to hard and fast figures.

It is easy to understand that on your side there may be some objection to atoms being rather small, but not that anything can be too big, not even the necessary sphere of 1,000 sun diameters. We are not on familiar terms with the sun over here, but as a matter of ethics I think his personality might have been kept out of the question.

Why should I not take "convenient hypotheses"? This quality of convenience is an attribute of their natures—not my creation; you see, I just snapped them up unawares and caught them in a natural state. If an atom is not a sphere, what is its shape? Further, if we put a number of apples in a bushel measure, we predicate contact at their adjacent surfaces. Who says there is one set of physical laws for things large, and another set for things small? What happens to the unlucky mass which is neither large nor small? Does he work "on his own"?

I carefully guarded myself against the equality in size of the

hydroxel and hydrogen ions. The authors lead me to believe that [illegible] was hypothecated to remove from discussion a question which I propose dealing with in a subsequent paper. But whatever values we can reasonably attach to the elements of the problem, the result will be varied within very narrow limits only. I expressly stated in my paper that pending agreement on the value of the constants, the figure found, 114½ millions to the linear cm, was to be regarded as approximate only.

In the course of the discussion—I quote (in first person)—from the official report of the paper in *Nature*—Lord Kelvin said, "The value obtained by Mr. Ridout for the diameter of the hydrogen ion is almost exactly one-half of that which I have obtained for a molecule of hydrogen. The fact might be a coincidence. I have dealt with a sphere which would have the same effect as a double atom of hydrogen. While avoiding the assumption that atoms are hard and spherical, it is usual to treat them as such for the purposes of calculation."

What makes the coincidence the more remarkable is the fact that at the time I was not aware of Lord Kelvin's latest mathematical investigation, upon which his remarks were based.

You say in conclusion that the end is not in sight. This is welcome. It gives us prospect of many pleasant encounters in the future.

CLAPHAM, LONDON, England. H. V. RIDOUT.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Design of Direct-Current Dynamos.—MAVOR.—His presidential address to the Glasgow Local Section of the (Brit.) Inst. Elec. Eng. In a former paper he had suggested that the essential part of the dynamo is the region occupied by the armature conductors in the magnetic field, and proposed the name "active belt" for this region which is bounded by the principal surface of the armature, the surface of the core at the bottom of the slots, and the ends of the core. He pointed out that an examination of the dynamo in terms of the energy generated in this active belt shows that machines of widely varying size, output and speed, give a remarkably constant value in watts generated per cubic centimeter of active belt at unit velocity in unit field. S. P. Thompson later confirmed this from calculations of a large number of machines. 5 ergs per second, or 0.000,000,5 watt per cb. cm. at unit velocity in unit field may be pointed out as a safe load. The application of this method to machines of smaller size has, however, shown that this value must be subjected to considerable modification, the reason being that in the smaller machines the losses in the armature are relatively more important than in the larger sizes. In machines with armatures 24 in. in diameter and upwards, it appears that the output may safely be given in watts per revolution, i. e., a given carcass will give an output directly or nearly directly proportional to the speed of rotation of the armature. He calls attention to the rapidly increasing market for smaller machines and the special points to be taken into consideration in their design. He discusses at length the limit set by the temperature rise; it is customary to specify this rise at 70 to 90° F. above the temperature of the surrounding air; but on small machines this is an exceedingly uncertain standard. He gives a formula for the total watts generated in the winding of a dynamo or absorbed in the winding of a motor armature. It shows that the total output of the armature varies as the square root of the loss in the winding and directly as the speed. If the loss in the winding be relatively small, the output will, for practical purposes, vary directly with the speed; this is the case in large machines; in small armatures, on the other hand, the winding loss is relatively large; he treats this case graphically and shows that for every machine there is a maximum possible output for a given rise of temperature, and this maximum is at a definite speed of rotation. The conditions may be changed by various means; for low speed the total watts and the efficiency are greater with a deep slot and high inductions. The ratio between the iron and the copper can be adjusted to suit the conditions of work to which the motor is likely to be subjected. If, for example, it has to run constantly with a varying load from an outside supply, paid for by meter, the iron losses should be kept low and the copper losses high, whereas if the machine is to run at full load it should be designed to give the output under the most favorable conditions of combined iron and copper losses; attention to this point results in a very considerable saving in cost of working. Increase of core induction, slot depth, air-space induction, and tooth reduction, all have the same effect upon the output curve of a machine as increase in speed, and increase in slot depth produces by far the most conspicuous change. The iron losses decreasing with decrease in slot depth, a point is reached when the slot becomes too shallow to hold the wire, and a limit is reached in this direction; if the wire be outside the slot, the risk of eddy current loss must be taken into account; he is not in favor of enclosed machines. He finally gives a diagram showing the difference in output obtained with different design and maximum output obtainable from a given carcass at various speeds.—Lond. *Elec.*, November 14.

Murdoch and Mavor.—A communication by Murdoch on the hysteresis loss in armatures, and Mavor's reply.—Lond. *Elec.*, November 28.

Calculation of Direct-Current Machines.—KOSSOM.—An article in which he points out that the design of cheap and good machines requires the utmost attention to the danger concerning the details of the process of commutation; the e.m.f. of self-induction of machines is to be measured and in each case one should consider which value it may have. For this purpose he uses tables for the magnetic conductivity of the magnetic circuit which may easily be obtained by calculation and measurements. After the ends of a coil were separated from the commutator, the resistance was measured by determination of current and e.m.f. with direct-current, and afterwards the impedance with alternating current of 50 periods; for these tests the armature is removed from the magnetic field. He gives a table showing the results of such a test; by gradually enlarging such a table, one soon gets enough material for determining the self-induction for all existing slot dimensions; the proper choice of this value is the most important point of the calculation. For large machines with 550 volts between the terminals, Parshall and Hobart give this value at 8 volts, while Rothert considers 4 volts to be the normal value for similar machines. With the latter value the author has obtained good results for machines of small and medium size. It is necessary to hold the self-induction within moderate limits and to leave a part of the commutation work to the brush resistance; this part can naturally be the greater, the greater the voltage loss due to brush resistance. He recommends the following steps in choosing the dimensions of the armature: Determine approximately the dimensions from the usual formulas; then choose the magnetic flux and number of turns; determine the magnetic conductivity of the slots with the aid of the above empirical tables; calculate the self-induction and then change accordingly the number of turns and the dimensions; calculate again with the new dimensions, and definitely choose the self-induction with regard to the coil resistance and especially the brush resistance.—*Elek. Zeit.*, November 27.

REFERENCE.

Commutation.—ROTHERT.—The first parts of a full illustrated English translation of his German article on the theory of commutation.—Lond. *Elec. Eng.*, November 14, 21.

LIGHTS AND LIGHTING.

Mercury Vapor Lamp.—ARONS.—A communication referring to some points in an article by Recklinghausen on the Cooper-Hewitt lamp. The author claims that water cooling does not increase, but decreases considerably the danger of breaking. In his own investigations (made with the mercury vapor lamp several years ago) he fully recognized the great importance of the density of the mercury vapor. The relatively large resistance required can be diminished

if several lamps are used in series. He protests against considering "certain devices as the property of Hewitt," as he would like to hold the mercury lamp open to improvements without hindrance; it is for this reason that he himself did not take a patent for the underlying principle, namely a mercury vapor arc in a complete vacuum. He says that the lighting by a shock of high potential has been used for a long time, probably first by Herschel, in 1840; Arons also used it. The introduction of a positive iron electrode is not due to Hewitt; Arons used it. He finally adds that he does not want to belittle Hewitt's merit, but wishes to insure freedom to other experiments.—*Elek. Zeit.*, October 23.

POWER.

French Power Transmission.—An extremely long and profusely illustrated article on the hydro-electric plant near Grenoble, which supplies many plants along the industrial valleys of the Eure and the Morge. The plant contains five turbine-driven alternators, each of 1,350 hp, and two 150-hp sets for exciting. The alternators generate three-phase currents at 3,000 volts, the voltage being raised to 26,000 for transmission. Induction motors are used by the consumers at various voltages, according to the special conditions. The price of the hp-year is 150 francs ($30) for a day of 24 hours and 125 francs ($25) for a day of 12 hours.—*L'Ind. Elec.*, November 10.

French Waterpower.—An article illustrated by maps, on projects of utilizing the hydraulic power of the upper Drac River in the French Alps, where there are several available falls. The Ponsonnas fall is discussed at some length and it is estimated that the development of 20,000 hp would cost about 2,000,000 francs, or 110 francs ($22) per hp, if 10 per cent. is allowed for unexpected expenses. If only 9,000 hp are first developed, the expenses are reduced to 1,650,000 francs, i. e., 200 francs ($40) per hp, and the final development of the total power would require 550,000 francs, or 55 francs ($11) per hp, including the 10 per cent. for unexpected expenses.—*L'Eclairage Elec.*, October 18.

Mexico.—BRATMAN.—A well-illustrated article on the power transmission and distribution in the valley of Mexico. There are five hydro-electric stations with a total of 19 generating sets, each consisting of a turbine-driven, 225-kw, 440-volt, 2-phase generator; 22 transformers of 225 kw raise the voltage to 22,000 for the transmission lines. In the La Veronica station the voltage is reduced to 2,600 volts for distribution in the City of Mexico.—*L'Eclairage Elec.*, November 1.

TRACTION.

Manhattan Elevated Railway of New York.—An article on the rolling stock of this company, which has 1,286 closed cars and 96 open cars. Of the closed cars, 850 are motor cars; none of the trail cars is equipped with motors. The standard train consists of six cars, of which the first, third, fourth and sixth are motor cars; each motor car is equipped with two 125-hp motors controlled from the front car; with other lengths of trains there are always two motor cars for each trail car. Each electric heater carries three coils which are exactly alike; different gradations of heat can be secured by throwing one, two or three coils into service. The company is using a novel fuse made of a copper ribbon 7½ in. long, 1¼ in. wide and 10 mils thick; it has a hole in the middle ½ in. in diameter and carries about 300 amperes. The chief point in favor of a fuse of this kind is that it is absolutely reliable, and when it burns away only a very small part of the fuse burns, as the ribbon is flexible and the ends turn themselves back. A novel feature of the wheel on the motor truck is the extended hub on which the solid steel gear is pressed. In this way all tendency of the motor to break the axle by torsional strain is removed. Another novel feature of the equipment is the device for cleaning the sleet off of the third rail, which is a very important problem on third-rail railways. Each car is equipped with four steel brushes which are pressed down on the track by pneumatic means by the movement of a valve in the motorman's cab.—*St. R'y Jour.*, December 6 and *Int. Ed.*, December.

Worcester & Southbridge Street Railway.—A description of this road, which is one of the latest high-speed roads completed in New England, and connects the cities of Worcester and Southbridge, Mass. At the ends current is supplied from rotary sub-stations to the trolley wire. The transmission is at 11,000 volts, the power station being situated near the center of the road. The generators are double-current machines supplying both direct current at 555 volts and alternating current at 355 volts, approximately. They are of 400 kw capacity, having a speed of 115 r.p.m, giving 3,000 alternations per minute. The generators have given excellent satisfaction in this plant, it being possible to take nearly the total capacity of the machine from either the collector rings of the alternating-current side or the commutator of the direct-current side. There are two sub-stations, one at the Southbridge end of the line and the other at North [illegible] near Worcester. These are equipped with six 75-kw, oil-cooled, step-down transformers, and two 200-kw rotary converters. Each car is equipped with four 35-hp motors.—*St. R'y Jour.*, December 6 and *Int. Ed.*, December.

Paris.—An article giving some notes on heavy electric traction in Paris. Particulars are first given of the locomotives and third rail used by the Paris-Orleans Railway on a section 4 km in length between the Austerlitz station and the Quai d'Orsay station in Paris. The locomotives weigh 49 tons each, and each is equipped with four motors. The shoe is made of a lower wearing part of cast iron and an upper part of steel riveted to the lower part. The third rail is protected by a wooden guard. Insulators of beechwood which have been dipped in asphalt are used. The overhead conductor used in stations, track yards and other points where the insulation of the third rail is not considered desirable is illustrated: Some particulars are also given of the Paris-Versailles line owned by the Western Railway Company of France. This company made some experiments at first with compressed-air locomotives and then with electric locomotives. The latter are somewhat curious in construction, as the armature is supported on a hollow shaft, which is spring-supported from the car wheels. In some cases the motors are geared and in other cases gearless motors were used. The locomotives proved to be cumbersome and inefficient and the multiple-unit system is now in use.—*St. R'y Jour.*, November 15, and *Int. Ed.*, December.

Third-rail Traction in Italy.—A description of the power station and third-rail system of the railway between Milan and Porto Ceresio, in Italy. The company is planning to operate its line by water power, but in the meantime has installed a steam plant. The third rail is of the Vignole type weighing 45 kg per meter and bonded with flexible copper bonds of 200 sq. mm section. The shoe is of a novel type and has a very broad bearing surface, 317 mm x 254 mm, to clear a wooden guard which is placed over the third rail in the switch yards and at the stations; this guard is shown in one of the photographic views.—*St. R'y Jour.*, December 6, and *Int. Ed.*, December.

Three-Phase Motors for Traction.—NIETHAMMER.—A communication in which he claims that the polyphase induction motor with the ordinary connections heats with repeated starting more than a direct-current series motor in the same space; or in other words, given a direct-current locomotive built with so greatly intermittent service that its rationally chosen direct-current motors become very hot (150° C. and more); if polyphase induction motors would be introduced instead, they heat still more, if no artificial means for cooling are applied. He says, however, that he does not claim that the induction motor is generally inadvisable for traction.—*Elek. Zeit.*, November 27.

Ward Leonard Single-Phase Traction System.—GEIPEL AND LANGE. —A communication in reply to some critical editorial remarks recently noticed in the Digest. The Ward Leonard system provides for delivering the necessary current at a low voltage without any resistance in the main current, to do which it uses only a small current at the full voltage; the power required by the motors at the moment of starting is therefore small. They deny that the question is entirely one of fluctuation of power. With the Ward Leonard system the current rises gradually to a maximum shortly after starting and then falls gradually to the value required at full speed.—Lond. *Elec.*, November 28.

REFERENCES.

Polyphase Transmission of Traction.—An editorial on overdoing a good thing. A note of warning is sounded that polyphase transmission with converter sub-station is being installed in many cases where two or more direct-current stations can be operated cheaper.—*St. R'y Jour.*, November 29.

Overhead Wire.—HARVEY.—An article on the proper construction, inspection and treatment of the overhead wires for tramways.—Lond. *Elec. Rev.*, November 28.

Railway Working.—Tables showing the performance of the trains on the Liverpool Overhead Electric Railway. A diagram gives the current curve for acceleration of trains on this line under working condition.—*Elec. Rev.*, November 28.

Railway Signals.—A long and well-illustrated description of the "[illegible]" system of railway signalling.—Lond. *Elec. Rev.*, November 28.

WIRES, WIRING AND CONDUITS.

REFERENCE.

[illegible].—[illegible].—An illustrated description of some apparatus to be used in the wiring of house installations for the purpose of maintaining a good insulation resistance against the earth.—*Elek. Zeit.*, October [illegible].

ELECTRO-PHYSICS AND MAGNETISM.

Radio-Activity Apparatus.—[illegible] AND GEITEL.—A description of the apparatus used by them for studying the radio-activity of the atmosphere in places removed from physical or meteorological laboratories. In these measurements it is necessary to maintain the body to be "activated" for several hours at a negative potential of several thousand volts. To save the use of an induction coil or influence machine for this purpose, they substitute a dry pile of 6,000 couples arranged in 30 sets of 75 volts each, strung on ebonite rods, and enclosed in a metal case. When the pile is not in use, its discharge is retarded by disconnecting the sets and keeping the apparatus in a warm and dry room. It is, of course, necessary to control the potential of the pile by means of a high-potential electroscope; they use a Braun electroscope, but provide it with amber insulation and with an arrangement for drying the interior by means of sodium. A current cannot be taken from the pile, its only function being to keep the conductor at a potential of 2,000 volts. The pile will keep in good working order for several years if properly treated. It has been found satisfactory in the open air as well as in the moist air of cellars and caves, and can easily be renewed when worn out.—*Phys. Zeit.*, November 15; abstracted in Lond. *Elec.*, November 28.

REFERENCES.

Cathode Rays.—LAMOTTE.—An illustrated article describing experiments on the production of cathode rays by ultraviolet rays.—*L'Eclairage Elec.*, November 1.

Propagation of Röntgen Rays.—BLONDLOT.—A translation in full of his French paper in which he describes his experiments proving the speed of propagation of Röntgen rays to be equal to that of Hertzian waves or light.—Lond. *Elec.*, November 21.

A supplementary note in which he quotes some further experiments in support of his conclusion that Röntgen rays are propagated with the velocity of light.—*Comptes Rendus*, November 10; abstracted in Lond. *Elec.*, November 28

Influence of Metallic Screens upon Cathode Rays.—DES COUDRES.—An account of experiments in which he found that when cathode rays penetrate a thin metallic membrane like a Lenard "window" they lose in speed.—*Phys. Zeit.*, November 15; abstracted in Lond. *Elec.*, November 28.

ELECTRO-CHEMISTRY AND BATTERIES.

Thallium Storage Battery.—MARSH.—An article on a new storage battery which is interesting from a theoretical point of view, although the author does not believe it to be suitable for commercial use. After discussing the chemistry of thallium, he describes the preparation of the cell as follows: A cell containing sheet iron electrodes is filled with a dilute solution of thallous oxide, which is soluble in water, to which some potassium hydroxide is added to increase the conductivity. If a current is then sent through the cell, spongy thallium is deposited on the cathode and thallic oxide in a hard black coating on the anode; neither of these is soluble in the remaining solution. This represents the charged cell. During discharge the thallium and thallic oxide are changed back into thallous oxide. An interesting comparison is given between the principal features of the thallium cell and the lead cell. Thallium is very expensive, but this would not necessarily be prohibitive for its use in storage batteries. The principal difficulty seems to be that during charging it is very difficult to obtain compact, evenly distributed and adherent deposits. The cell is discussed in a separate editorial in which it is said that the solubility of an electrode may cause the failure of a battery for two reasons. The first refers to batteries with electrodes of two metals. If the electrode which is the cathode during discharge is soluble in the electrolyte, then its material may be deposited on the other electrode with resulting local action. The other reason why soluble electrodes are unsuitable for battery practice is that in charging it is impossible to obtain compact, evenly distributed and adherent deposits, as has been conclusively proved in practice with the lead zinc accumulator.—*Electrochem. Ind.*, November.

Electrolysis of Fused Caustic Potash.—LE BLANC AND BRODE.—An account of some experiments in which they continued their investigation of the electrolysis of fused soda and potash, recently noticed in the Digest. From their experiments they conclude with positiveness that it is impossible that by Castner's process in the presence of air, metallic potassium can be produced from pure, fused caustic potash, on an industrial scale. They think that Castner probably worked with fused caustic soda only, and that the impossibility of the production of metallic potassium by Castner's process is due to the fact that metallic potassium at that temperature is easily oxidized.—*Zeit. f. Elektrochemie*, October 23.

Electrolytic Bleaching.—An illustrated description of a new apparatus for producing bleaching liquids, the chief advantages of which are said to be cheapness of the product and simplicity. The salt solution flows down a sort of step-to-step arrangement of cells and at each step the electric current flows through it. The action of the new apparatus is said to be based primarily upon the fact that the salt solution is divided into thin liquid threads subjected to the action of the current.—*Elektrochem. Zeit.*, October.

Electric Furnace Processes.—DANNEEL.—Besides the processes already noticed in the Digest, the following, which have been worked out in the metallurgical laboratory of the Institute of Technology of Aix-la-Chapelle, are discussed. Preliminary experiments on the production of chromium, free from carbon, from chronic oxide, aluminium oxide, and carbon. Experiments of Stockem for producing cerium by electrolysis, the object being to utilize the waste materials of the gas incandescent lamp manufacture; cerium is best obtained from the fused chlorides, free from water; less favorable results are obtained with the reduction of the oxide; by the Goldschmidt reduction process cerium could not be obtained. Some experiments by Borchers and Dorsemagen on the preparation of red lead or minium from lead peroxide and lead oxide. Some notes on nickel refining, the modern "tops and bottoms" process being represented diagrammatically.—*Zeit. f. Elektrochemie*, September 25. (See this issue ELECTRICAL WORLD AND ENGINEER, p. 1002.)

Maxwell's Theory and Electrolysis.—PLATNER.—The conclusion of his mathematical article on Maxwell's theory of electricity and its importance for the theory of electrolysis. He arrives at what he believes to be a sufficient basis for the explanation of electrolytic phenomena without the use of any "fantastic hypothesis."—*Elektrochem. Zeit.*, September.

REFERENCES.

Sault Ste. Marie.—J. W. RICHARDS.—An illustrated article on the present situation and the prospects of electrochemical industries at Sault Ste. Marie, with a detailed description and critical discussion of the Rhodin process of electrolyzing a sodium chloride solution for the production of caustic soda and bleaching powder.—*Electrochem. Ind.*, November.

Low Temperature Researches.—DEWAR.—The first part of his presidential address to the Brit. Assn. This part deals with the history of the researches on the absolute zero point of temperature, the liquefaction of gases and continuity of state, and liquid hydrogen and helium. The importance of the subject for electrochemistry and physical chemistry in general is discussed in an editorial—*Electrochem. Ind.*, November.

Storage Batteries.—A continuation of a long serial on chemical and metallurgical industries at the Dusseldorf Exposition, deals with electro-chemical exhibits which were confined to storage batteries; those exhibited by various German firms are described.—Lond. *Eng'ing*, October 17.

Oxidation and Reduction Processes.—BODLÄNDER.—A long contribution to the theory of some technical reduction and oxidation processes. It seems to contain very valuable figures, but cannot be abstracted. At the end of the article the author gives the most important interpolation formulas for the free formation energies, relating to the oxidation of various substances.—*Zeit. f. Electrochemie*, October 30.

German Elektrochemical Patents.—An article giving some statistical data on the work of the German Patent Office in electrochemistry during the last ten years.—*Elektrochem. Zeit.*, October.

Pioneers of Electrochemistry.—The third part of this serial gives an account with portrait of the life and work of E. G. Acheson.—*Electrochem. Ind.*, November.

Units, Measurements and Instruments.

Determining the Efficiency of a Dynamo.—Ashworth.—An illustrated article on the following method for determining the mechanical power supplied to the generator from observations in the rate of change of the rotational energy of the armature under the conditions of full load. The machine is run at a velocity a little higher than the speed at which the efficiency is required and at which it is yielding full output; the driving power is then cut off suddenly and the rate of change of speed of the armature is determined as it slows down past the given speed. The rate of change of angular velocity at that speed measures the retarding forces, and hence the power to maintain the armature in rotation. This method may be used successfully with machines of the modern fly-wheel type. For determining the moment of inertia he plots two retardation curves, one for the armature by itself and the other for the armature loaded with a disc fly-wheel of known moment of inertia. He gives the numerical data of a test for determining the moment of inertia and its application for obtaining the efficiency of a dynamo.—Lond. *Elec. Rev.*, November 28.

REFERENCE.

Oscillographs.—Blondel.—A mathematical article, illustrated by diagrams, on the theory of oscillographs.—*L'Eclairage Elec.*, October 25.

Telegraphy, Telephony and Signals.

Transmission of Pictures to a Distance.—Dussaud.—A description of a new type of selenium cell for electric vision at a distance. The transmitter consists of a plane non-conducting surface divided into equal squares of 5 cm side. In each of these is placed a coil formed of an insulating core, upon which are wound two thin copper wires covered with a layer of selenium prepared in such a way as to give it the maximum sensitiveness. One of these wires is traversed by a feeble current of the order of those in a telephone. When the selenium is illuminated it acquires a conductivity varying with the degree of brightness, and thus communicates some of the current to the second wire. This works a relay and brings into action a lighting circuit containing an incandescent lamp at the receiving station. At the receiver there is another surface divided into squares and each square contains an incandescent lamp. These lamps, therefore, reproduce the intensity of illumination at the origin. He claims that by this process of analysis and recombination, images may be reproduced at a great distance.—*Comptes Rendus*, November 10; abstracted in Lond. *Elec.*, November 28.

REFERENCES.

London Telephone Exchanges.—An illustrated description of the Westminster and Kensington exchanges of the London Post Office, where arrangements are made for party lines.—Lond. *Elec.*, November 21.

Lightning Arresters.—Franke.—A long illustrated paper read before the Berlin Electrical Society in which he describes new lightning arresters for telephone lines.—*Elek. Zeit.*, November 27.

MISCELLANEOUS.

Ignition Devices.—Longbridge.—An illustrated paper on electric ignition devices in oil automobiles. He says that existing systems of electric ignition admit of improvements in two directions, in the automatic timing and in the "automatic consumption of current." He suggests using wedge-shaped contact pieces on a rotating disc and allowing the disc, under the direction of a governor, to have an in-and-out movement on the shaft, so that with increasing speed, the disc slides backwards, for instance, bringing the wider portion of the contact pieces under the brush.—Lond *Elec.*, November 21.

Typesetting Machine.—Reyval.—A well-illustrated description of a new typesetting machine, used in the office of a Paris newspaper. It is of interest here on account of the use of electric devices not only for operating the machine, but also for the transmission to a distant point, of copies made by this machine.—*L'Eclairage Elec.*, October 18.

Surface Electric Locomotives.

In designing electric locomotives for surface haulage, the restrictions of gauge, limitations of height, width, etc. and other conditions frequently necessitate special construction but the Westinghouse Electric and Manufacturing Company have fixed upon the following types as covering the principal requirements: Four-wheeled pedestal type, with platform, open canopy or inclosed cab; four-wheeled mining type, with cab at one end, with central cab, or with cab over all; eight-wheeled double-truck type, with platform, open canopy or inclosed cab; eight-wheeled double-truck freight or passenger-car type; double eight-wheeled type.

Any of the above four wheeled locomotives may be constructed with one or two motors. A two-motor equipment is generally preferable, permitting the use of all the adhesive weight for tractive purposes In case of accident to one motor, the locomotive is not helpless, but may be operated with the remaining motor. Eight-wheeled locomotives are usually equipped with four motors, but may be designed for but two, if desirable. Double eight-wheeled locomotives are two eight-wheeled locomotives coupled together, and may be operated separately. Other types are readily adapted to meet special conditions of service.

Fig. 1.—Eight-Wheeled Electric Locomotive.

Two of the above standard Westinghouse types are shown in Figs. 1 and 2, the former having eight wheels, four 50-hp motors, and weighing 34,000 lbs.; and the second, four wheels, two 10-hp motors, and weighing 13,000 lbs.

As the motors are of the well-known Westinghouse railway type,

[illegible] description of the details of the locomotives will be confined to the controlling and other circuit apparatus. Two types of control are commonly employed for electric locomotive service, namely, the "series parallel" (Fig. 3), and the "rheostatic" (Fig. 4). With the "series parallel" control, the motors are first connected in series with each other and with a resistance which is gradually cut out of circuit; they are then connected in parallel with each other and in series with a resistance which, as before, is gradually reduced to zero. Thus there are two efficient running positions, viz., "series," giving half speed, and "parallel," giving full speed. With the "rheostatic control," the motors are connected permanently in parallel and in series with a resistance which is gradually cut out of circuit; this gives only one efficient running position, the "parallel": all variations in speed must be obtained by throwing resistance into the circuit.

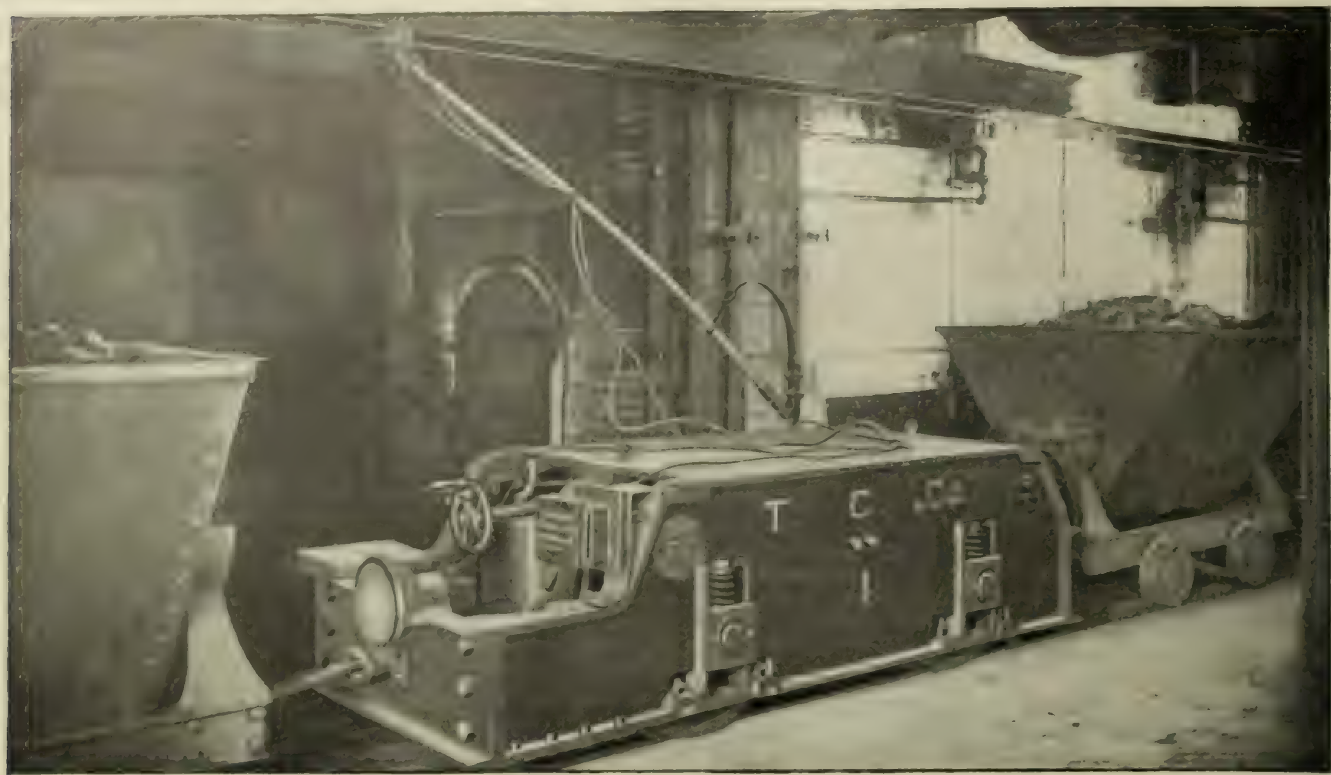


FIG. 2.—MINING LOCOMOTIVE.

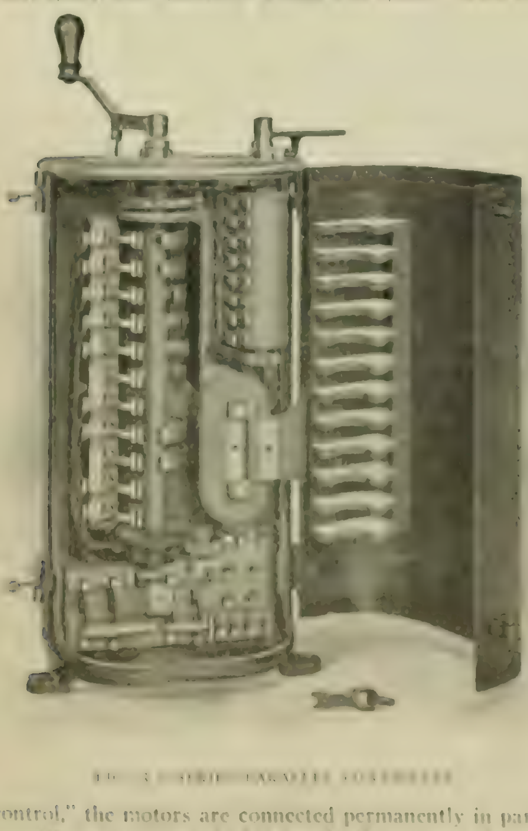


FIG. 3.—SERIES-PARALLEL CONTROLLER.

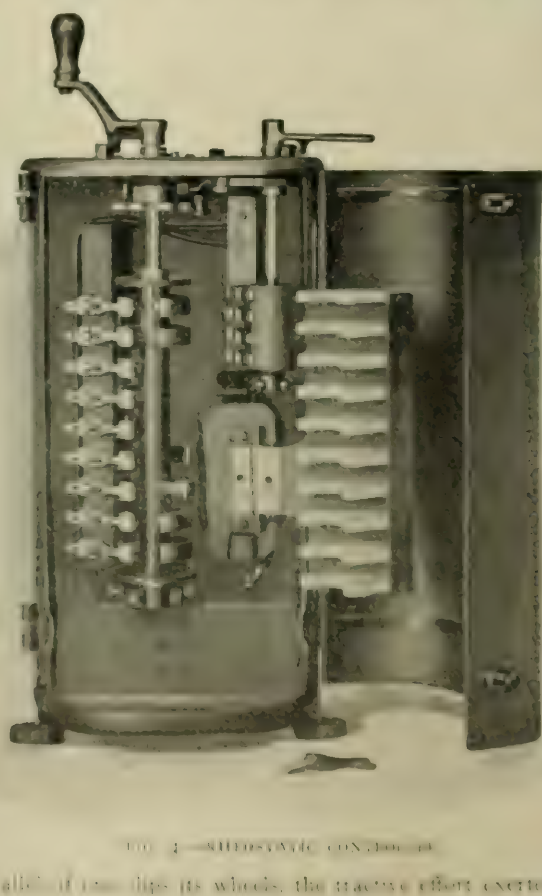


FIG. 4.—RHEOSTATIC CONTROLLER.

The "series parallel" control is the more economical, as less energy is dissipated in the resistance. For such work as yard shifting, however, the "rheostatic" is generally preferable, as the troubles due to slipping of wheels are reduced, owing to the fact that with two motors connected in series, if the wheels driven by one motor slip, the current through the other motor falls off, and the tractive effort exerted by it is consequently reduced; while with motors connected in parallel, if one slips its wheels, the tractive effort exerted by the other is increased, which tends, to a certain extent, to make up for the slip. Controllers of each type designed for handling two 500-volt, 50-hp motors are illustrated on the opposite page. In special

cases, a switch is provided with "rheostatic" control, by means of which the motors can be thrown in series if desired. Controllers are provided with a magnetic blow-out device, which reduces to a minimum the arcing at fingers and contacts.

Two standard forms of resistance are manufactured for locomotives—the "iron-clad cell" and the "grid" diverter (Fig. 5). The iron-clad cell diverter consists primarily of a strip of sheet metal wound in a spiral form on an iron cell with mica interposed between the layers. A number of these cells, mounted upon a section of insulated tube, are held together by lock nuts to form a column. This form of resistance has been in service for a number of years with marked success.

The "grid" diverter consists of a number of cast-iron plates mounted together in a frame, separated by means of mica washers, and so arranged as to give ample space between the grids for the free circulation of air. This form of diverter is very compact and durable, and is admirably adapted for out-door service. It is practically indestructible

An automatic railway-type circuit breaker is used, connected in the main circuit, which effectually protects the motors from dangerous overloads. Fig. 6 shows a 500-ampere circuit breaker of this type. The current at which the breaker will open the circuit may be varied by turning the milled nut, shown on the right-hand side of the case. These circuit breakers being provided with a powerful magnetic blow-out will open on the severest short-circuits which can occur with the voltage ordinarily employed for haulage work.

To protect the electric equipment from possible injury resulting from a lightning discharge, each locomotive is furnished with a Wurts' lightning arrester. Each arrester is completely enclosed in an inverted cast-iron box, with a lid on the bottom, thus preventing any possibility of moisture reaching the arrester. The case is carefully insulated from the arrester and from the ground trolley and connections

The trolley is designed to withstand heavy strains. The cast portions are of malleable iron, and the spring is of the compression type which has been found to be most satisfactory in service The

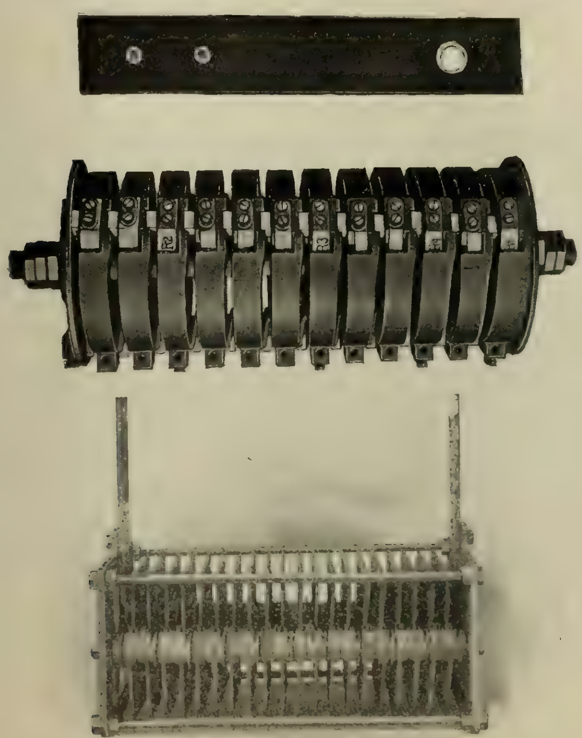


FIG. 5.—IRON-CLAD AND "GRID" DIVERTERS.

trolley automatically adjusts itself to the varying heights of the wire Where the current is large, a double tandem trolley is employed

In some industrial works the overhead trolley system is objectionable, either because of the multiplicity of switches sometimes necessary in the diversified transportation of a works' product, or because the use of an overhead trolley wire is not permissible. For such service, the Westinghouse electromagnetic switch system is applicable. No poles, overhead wires or troublesome switches are employed. Yards and buildings are free of all obstructions, the locomotive being supplied with current by cast-iron contact buttons. These are connected through electromagnetic switches imbedded in the track, to a feeder-cable laid along the track While in operation, all contact buttons are "dead," except those directly under the locomotive. It is impossible, therefore, for any one to receive a

FIG. 6.—CIRCUIT-BREAKER.

shock—a distinct gain in safety over the trolley system. Among other advantages to be mentioned are the facility with which freight cars can be drilled in yards and through buildings without turning the trolley whenever the direction of a locomotive is reversed, and the absence of the necessity for guiding the trolley through the multiplicity of switches usually found in factory yards and buildings—advantages amounting often to the use of electric locomotives where otherwise electricity could not be used.

The Moore System of Vacuum Tube Lighting.

As is well known, Mr. D. McFarlan Moore has been engaged for some years past in the development of vacuum tube methods of lighting, in which he has made some notable advances, due notice of which has appeared in these columns. A very interesting installation illustrative of his latest work has recently been on view at 50 Broadway, New York City. The ordinary office room there in which the Moore vacuum tube is installed measures 18 ft. 4 in. by 13 ft. 5 in. It is shown in Fig. 1. The ceiling is 11 ft. 9 in. in height. The walls of the room are buff-colored for a distance of 7 ft. 7 in. above the floor, and above that are white. The ceiling also is white. In addition the three doors and door trims are white.

FIG. 1.—ROOM LIGHTED BY MOORE VACUUM TUBE.

The floor is painted dark brown, with a rug having a brown and buff-colored pattern.

The vacuum light tube is 1⅞ in. in diameter and is run around the room supported by six side brackets at a height of 9 ft. 6 in. above the floor and at an average distance of about 13 in. out from the walls. The total length of the exposed vacuum tube is approximately 55 ft. The tube is in one continuous length and its terminals enter a box placed near the ceiling, which box, Fig. 2, contains a special

high-voltage transformer. Current is obtained from a motor generator set consisting of 3-hp. direct-current motor, direct-connected to a special inductor type alternator designed by Mr. Moore. The direct-current motor receives current from the Edison 220-volt

FIG. 2.—TRANSFORMER BOX AND END OF TUBING.

street circuits and runs at about 175 r.p.m. The alternator, as designed, gives 57,600 alternations (28,600 cycles) per minute, with a potential of between 40 and 50 volts at its terminals.

FIG. 4.—MOORE VACUUM BREAK VIBRATOR.

The wires from the alternator are led to the special transformer mentioned above, to which the tube is connected. This transformer has a ratio of 1 to 100, so that the potential delivered at

FIG. 3.—ROOM AND FOUNTAIN LIT BY MOORE TUBES.

the caps of the vacuum tube is approximately between 4,000 and 5,000 volts. The usual switches and rheostats are installed by which the light in the tubes can be controlled.

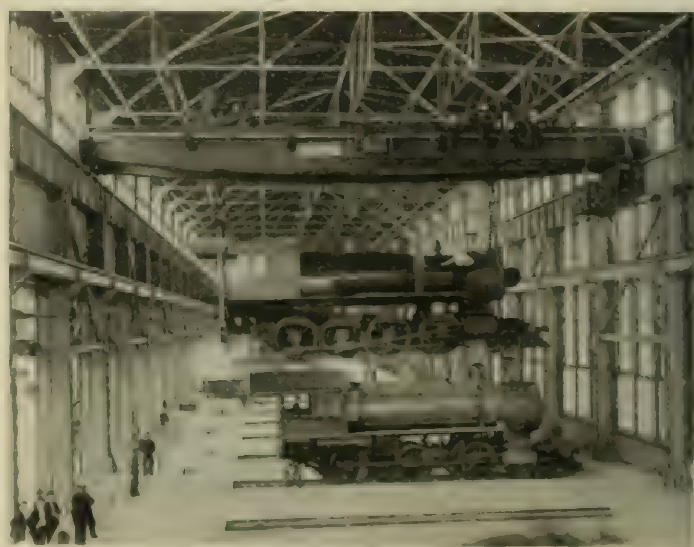
The tube shown in this room is built up from standard lengths of about 8 ft., which are joined *in situ* by simple and handy devices that Mr. Moore has worked out for the purpose, so that any length with any angle of bend can be made and run in a very few hours. As installed, and tested by one of the leading electrical experts whose report we have seen, good illumination is produced by the tube with 3.9 watts per candle, and brilliant illumination with 4.8 watts. Our own observation of the lighting is very satisfactory, the color being pure and cheerful and the diffusion perfect, as in a studio with proper north exposure in bright sunshine.

On the tables and sideboards in Fig. 1 are seen several devices, while on the walls are various signs. These are perhaps better brought out in Fig. 3, which shows a similar room, at the center of which a fountain plays, with light instead of water for its streams and jets. The different signs shown are operated by means of the special Moore vacuum break vibrator and coil shown in Fig. 4. The vibrator and coil are contained in the nickel-plated box, 8 in. high by 4½ in. in diameter over all. These vibrators are connected directly to the 110-volt Edison street mains that serve the office building, by means of the usual plug. They are extremely pretty and attractive, and, it would seem, might well be made a great advertising novelty, as well as a feature of spectacular displays of a kindred character. It is such work as this that makes one believe in the imminence of commercial vacuum tube lighting, toward which so much encouraging effort is now being directed.

Large Electric Crane in Railroad Shops.

The 100-ton, 5-motor electric traveling crane which has recently been installed by the Niles-Bement-Pond Company at the Collingwood shops of the Lake Shore and Michigan Southern Railway, is an interesting appliance. In the accompanying cut this crane is shown lifting an 80-ton, eight-coupled consolidation type locomotive. The crane is of the Niles standard design fitted with two 50-ton trolleys. The main hoist motors are each of 45 horse-power, and are capable of hoisting the full load at a speed of about 10 feet per minute.

The bridge motors traverse the bridge up or down the shop, which is about 530 feet long, at the rate of 150 feet per minute



100-TON CRANE.

with the full load, and 200 feet per minute with light load. The bridge which has a span of 65 feet 6 inches is of the company's standard box girder construction used on all its cranes, and is fitted with eight truck wheels running in heavy steel truck frames, which are securely rivetted to the box girders.

All gears on this crane are cut from the solid and run submerged in oil. Each trolley is equipped with the Niles improved automatic safety mechanical brake, which controls the load at all times, and an electrical brake mounted on the armature shaft which is "on" when the current is thrown off. The motors are designed especially for crane work, and are wound for 220 volts direct current. Each motor has its reversible controller and rheostat.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was stringent all through the week, the closing rates being 7 to 8½ per cent. for short dates and 6 per cent. for 6 to 7 months. Stock market conditions were disturbed during the week, resulting in heavy declines, quotations generally touching the lowest level of the year. At the close of the week, however, there was a rally. The decline was mainly due to high rates for and scarcity of time money and the renewed hardening of call-loan rates. Industrial stocks, headed by United States Steel, were very weak on general selling. All the tractions and electric securities receded, in common with the rest of the market. Brooklyn Rap. Tran. fell to 59¾, but recovered to 61¾ at the close, the net loss being 2½ points. Met. St. Ry. touched 135, closing at 137, a net loss of 2¼ points; Manhattan lost a like amount on the week's trading, closing at 144, ex-div. General Electric moved within 172 and 179, closing at 174¼, a net loss of 2¼ points. The fluctuations in the two Westinghouse issues were more violent, common closing at 191, a net loss of 9 points, and preferred 200, a loss of 6 points. Western Union closed at 88, being ¼-point off from the last quotation. Following are the closing quotations of December 16:

NEW YORK.

	Dec. 9.	Dec. 16		Dec. 9.	Dec. 16
American Tel. & Cable	88	89	General Electric	178	174
American Tel. & Tel	160	157	Hudson River Tel	..	..
American Dist. Tel	34	34	Metropolitan St. Ry	139¾	136¾
Brooklyn Rapid Transit	64⅜	61½	N. E. Elec. Veh. Trns	..	..
Commercial Cable	..	..	N. Y. & N. J. Tel	163	162
Electric Boat	22	20	N. Y. E. V. T. Co	10	9
Electric Boat pfd	37	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	3⅜	3	Western Union Tel	87¾	87¾
Electric Vehicle	3½	4	Westinghouse com	195	188
Electric Vehicle pfd	10	10	Westinghouse pfd	200	..

BOSTON.

	Dec. 9.	Dec. 16		Dec. 9.	Dec. 16
American Tel. & Tel	160⅛	159⅛	Western Tel. & Tel. pfd	98⅛	98
Cumberland Telephone	126	..	Mexican Telephone	2	1⅞
Edison Elec. Illum	..	..	New England Telephone	137	135½
General Electric	..	..	Westinghouse	..	93
Western Tel. & Tel	25	.	Westinghouse pfd	..	93

PHILADELPHIA.

	Dec. 9.	Dec. 16		Dec. 9.	Dec. 16
American Railways	..	..	Phila. Traction	97¾	97
Elec. Storage Battery	79	..	Phila. Electric	8⅛	..
Elec. Storage Battery pfd	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	9½	9⅛	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Dec. 9.	Dec. 16		Dec. 9.	Dec. 16
Central Union Tel	..	..	National Carbon pfd	97	98
Chicago Edison	..	175	Northwest Elev. com	..	..
Chicago City Ry	208¾	..	Union Traction	13½	..
Chicago Tel. Co	..	..	Union Traction pfd	45	..
National Carbon	26	..			

BRITISH WESTINGHOUSE.—The third annual report of the British Westinghouse Electric & Manufacturing Company, Ltd., for the year ending July 31, 1902, shows profits for the year, including the sum brought forward from last year, of £79,594 11s. 7d. Out of this an interim dividend of £23,257 16s. 4d. and debenture interest to the amount of £6,132 4s. 1d have been paid, and the directors propose to appropriate a further sum of £30,000, making a full 6 per cent. on preference shares. Of the £20,204 11s. 2d. remaining, £14,963 17s. 6d. has been written off for stamp duties and fees incurred on the formation of the company and the expenses connected with debenture issue, leaving a balance of £5,240 13s. 8d., which is placed to reserve account. The growth of the company's business is shown by the following figures:

Orders during the year July 31,				1899	£279,000
"	"	"	"	1900	547,000
"	"	"	"	1901	738,000
"	"	"	"	1902	932,000

and for the first four months of this year, viz., since July 31, 1902, the orders received exceed £825,000. This rapid growth of the company's business already necessitates an increase of capital and the directors will propose to the shareholders that an additional £200,000 6 per cent. preference shares of £5 each shall be created and to issue one-half of such shares at present. The company is in receipt of very large orders, all of which will now be executed at the Manchester works.

NEW YORK AND QUEENS LIGHTING.—The result of operations of the New York & Queens Electric Light & Power Company for the year ending August 1, 1902, were: Gross earnings, $[illegible]; operating expenses and taxes, insurance, discounts and bad debts, $140,6[illegible], maintenance, $2[illegible]973, total, $170,[illegible], net earnings, $137,-027; interest charges for year on all bonds outstanding, $116,775; surplus, $20,252. For three months ending October 31st the company's operations were:

	1902	1901		Changes.
Gross	$81,840	$74,345	Inc.	$7,495
Ex., tax. etc.	39,122	40,033	Dec.	911
Net	$42,718	$34,312	Inc.	$8,406
Fix. charges	29,375	29,012	Inc.	363
Surplus	$13,343	$5,300	Inc.	$8,043

The balance sheet as of August 1, 1902, shows a profit and loss surplus of $41,984.

DIVIDENDS.—Western Union Telegraph Company has declared a quarterly dividend of 1¼ per cent., being No. 137. It is payable January 15. A 1 per cent. dividend on the common stock of International Steam Pump, being the quarterly installment of the 4 per cent. dividend declared on that issue last spring, is payable January 2. The Columbus Edison Company has declared a semi-annual dividend of 3 per cent. on its preferred stock and a quarterly dividend of 4 per cent. on its common stock, payable January 2. The Twin City Rapid Transit Company has declared a quarterly dividend of 1¾ per cent. on the preferred stock, payable January 2, 1903. A dividend of $5 per share has been declared by the West Philadelphia Passenger Railway directors, payable January 1. Directors of the Philadelphia Union Passenger Railway Company have declared a dividend of $4.75, payable January 1. The directors of the United Railways Investment Company, of San Francisco, have declared a dividend of 1½ per cent. on the preferred, payable January 3.

MASS. ELECTRIC COMPANIES.—In 1901 the Massachusetts Electric Companies derived $777,841 in dividends from its sub-companies and "other income" brought the total income up to $819,158. The Companies' report will not show as large an income this year, but considerably more than sufficient to pay the 4 per cent. dividends on the outstanding Massachusetts Electric preferred stock, and during the present period of reconstruction this is all the management of the properties has cared to show. It has been estimated that it would require an expenditure of $10,000,000 to place the 800 odd miles of road in the Massachusetts Electric system in a position to be economically operated and show proper returns upon the invested capital. This plan is being systematically carried out, and it is estimated that it will require at least two years. During the past year the two leading properties of the Massachusetts Electric Companies carried 115,621,514 paying passengers and 2,112 cars covered 23, 436,247 car miles.

LOUISVILLE TROLLEYS.—It is understood the Louisville Railway directors will declare an extra dividend of 1 per cent. on the $3,500,000 of common stock in addition to the regular quarterly dividend of 1¼ per cent. and arrange for the distribution of $500,000 to $1,000,000 of new common stock to the old common holders at par, but with a payment of $50 a share to be credited to the stockholders out of the surplus. This will give the stockholders the new shares practically at $50, although the market price is 150. The money thus received will be used in building interurban lines, and it is understood a similar distribution of stock will be made every year for three years. The road's earnings are very large and equal to 10 per cent. on the common stock.

LONG ISLAND LIGHTING.—The Queens Borough Light and Power Company, which has a plant at Astoria, has absorbed the stock of the Hempstead Gas and Electric Light Company and it will take possession of that company's plant at Rockaway Beach.

TOLEDO-DETROIT TROLLEY.—The Toledo-Detroit Shore Line Electric road has been sold to the Grand Trunk and Clover Leaf roads for $1,500,000. The deal is said to enable the Everett-Moore syndicate to cancel all its obligations.

NEW JERSEY TROLLEYS.—The Interstate Railways Company has been organized, with a capital of $10,000,000, for the purpose, it is said, of acquiring and consolidating trolley roads of New Jersey south of Trenton.

Commercial Intelligence.

THE WEEK IN TRADE.—The retail distribution, according to *Bradstreet's*, now easily occupies the first position in the trade situation. During the week it was stimulated by colder weather and the advance of the holiday season. The latter caused it to expand largely. Wholesale trade is relapsing into the quiet usual at this, the stock-taking period. Building trades and other leading industries note a quieting-down usual at this season of the year. Great basic conditions, however, make for future prosperity. Railway earnings show an increase of 7.2 per cent. in November over the same month last year, thus marking a thirty-ninth consecutive monthly increase shown in the country's railways. The iron and steel industries alone show some symptoms of weaker prices for crude material, but this is stated to be more apparent than real, because demands for supplies are as pressing as ever and production has not, as yet, overtaken consumption. Heavier forms of finished material show no signs of weakness, fancy premiums being still paid on quick deliveries of plate and structural material. Two-thirds of the country's steel-rail production for next year has already been booked. In the copper market little change in the condition of affairs is noted. Various rumors were current of large purchases by consumers, but they were without foundation and had little effect upon the market. The last quotations were: Lake, 11.65c.; electrolytic and casting stock, 11.45c.; standard, 10.75c. The business failures for the week ending December 11, as reported by *Bradstreet's*, numbered 236, as against 185 the week previous and 233 the same week last year.

DEVELOPMENTS AT PORT HURON, MICH.—Mr. W. F. Davidson, secretary and treasurer of the Port Huron Light & Power Company, writes us as follows: Our company furnish lighting to about 150 well-built cottages located on the lake shore, five or six miles from our power house with an alternating, three-phase current, using single-phase for lighting. It is the writer's intention to investigate the feasibility of establishing in these cottages electric radiators or some heating device so that on cool nights and mornings they would be able to have heat, perhaps charging them what might be called a daylight power rate for the heat; at any rate, a low enough rate so it will be in the reach of people occupying summer cottages who come here from cities located in a warmer zone than this. This company is installing a 1,500-kw Curtis steam turbo-alternator, and the same is now being shipped from the General Electric (Schenectady) Works. We are having made for us by the Alberger Company, of New York, a surface condensing outfit to maintain 28 actual inches of vacuum continuously, and expect to demonstrate some fine economies with this outfit. We are also putting up independent building adjoining our large fire-proof power house, and will make this plant separate in every way from our present generating plant.

ELECTRICITY IN MINING.—It is stated that the coal companies in the Wilkesbarre region are adopting electricity as a motive power as fast as it is practicable. The latest is the Delaware and Lackawanna, which has made preparations to establish a power house at Hampton colliery in the Keyster Valley to furnish current to the sixteen collieries in that region for light and power. This departure will dispense with the services of about one thousand mules and an army of drivers and other employees. Oil lamps will disappear and light will be furnished by electricity. The cost of the plant will be $150,000. The Erie has also contracted to erect an electric plant at Old Forge not only to haul its cars and light its collieries by electricity, but also to run the hoists, pumps, drills, cutters and other mine appliances. The Lackawanna has for some time been experimenting with electrical drills and cutters in its Bellevue colliery and has found them to work in an eminently satisfactory manner. It has an electrical breaker at the Auchincloss colliery, Nanticoke, which has given the utmost satisfaction, and it is only a matter of a short time before electric breakers will be established throughout the company's entire system.

A 6,000-HP HYDRAULIC PLANT is to be constructed on the St. Joseph River at Twin Branches, between South Bend and Elkhart, Indiana, for the purpose of furnishing power for lighting and manufacturing use within a radius of 20 miles. The plant will be operated on a [illegible] ft. head. There will be six generators of 1,000-kw capacity each. Four of these machines have already been ordered from the Westinghouse Electric & Manufacturing Company, Limited. They will be of revolving field type, 13,200 volts, three-phase, 60-cycle, 120 r.p.m. Each generator will be operated by five horizontal shaft turbines of 48 inches each. These machines will be built by the Triumph Manufacturing Company, of Springfield, O. There are to be two 125-kw Westinghouse exciters, each direct connected to three 24-in. Triumph horizontal shaft turbines, 230 r.p.m. The Westinghouse Company will furnish the switchboard, which will be electrically operated by that concern's new type of oil switches. Sanderson & Porter are acting as contractors and engineers for the promoters of the St. Joseph enterprise—a New York and Western group of capitalists. The plant is expected to be in working operation next summer.

THE NEW YORK TUNNEL COMPANY was incorporated at Albany last week with a capital of $250,000. The New York directors are Herbert S. Brown, Shirly Onderdonk, Harold Nathan and Clarence S. Brown. John D. MacLennan, of Cleveland, is also named as director. This company will have, acording to Consulting Engineer William Barclay Parsons, the work of constructing a tunnel under the East River from Battery Park to Clinton Street, Borough of Brooklyn. This tunnel is the second section of the three the contracts for which have been let by the Belmont Company, now constructing the rapid-transit subway. The first section extends from Ann Street to Battery Park, and the third from Clinton Street, Borough of Brooklyn, to Atlantic Avenue, Flatbush. Mr. Parsons gave it as his opinion that the cost of constructing the second section would approximate from $4,500,000 to $5,000,000. The contract was let to Andrew Onderdonk. He is the partner of John B. McDonald in the Jerome Park Reservoir project.

THE CLEVELAND CLIFFS IRON COMPANY is about to install an electric power distribution system for operating mixers and blowers in its Gladstone (Mich.) plant. It has recently purchased from the Westinghouse Electric & Manufacturing Company two 75-kw, direct-current generators and eight 10-hp, direct-current motors. The Pioneer Iron Works, of Marquette, Mich., owned by the Cleveland Cliffs Company, will also be equipped with electrical apparatus, which will be used for the operation of mixers and blowers, as in the Gladstone plant. Apparatus recently purchased from the Westinghouse Electric & Manufacturing Company for the Marquette plant, includes ten 10-hp, direct-current motors and two 150-kw engine type generators to be direct-connected to two Westinghouse compound condensing engines. The company has also ordered a Baldwin-Westinghouse electric locomotive to be used for shifting cars in its yards.

MANUFACTURES now form one-third of the exports from the United States, a larger proportion than in any preceding year. The figures of the Bureau of Statistics for the ten months of the year for which data are now complete show that manufactures formed during that period 32.61 per cent. of the total exports of the country, while the highest percentaage in any preceding fiscal year was that of 1900, in which the exports of manufactures formed 31.65 per cent. of the total exports. In no other fiscal year have manufactures formed as much as 30 per cent. of the total exports. The figures of the ten months now available indicate that the total exports of manufactures during the calendar year 1902 will reach about $415,000,000, or more than in any preceding fiscal year, save in the exceptional year 1900, when the total was $433,000,000.

SHELBY ELECTRIC COMPANY.—Local daily papers at Shelby, Ohio, published recently the statement that the Shelby Electric Company was about to close a deal for the sale of its plant and business to the General Electric Company; the purchase price to be paid in three yearly installments and the factory to remain in the hands of the present directors during that period of time. General Manager J. C. Fish, of the company, has caused to be published a signed statement in which he denies that the General Electric Company made a proposition for the purchase of the plant. Certain other parties have offered to buy a block of the company's stock from some of the present stockholders.

THE MECHANICAL BOILER CLEANER COMPANY, Chicago, reports an order just received from the Cudahy Packing Company for seven cleaners, this making 65 cleaners installed in the plants of that company; also a duplicate order for 13 cleaners from the Fort Wayne Gas Company. The Mechanical Boiler Cleaner Company, owning all the Garrigus patents, and others, covering a floating skimmer, is doing a very large business with many of the best corporations in the country.

TELEPHONE WORK AT PIERRE, S. D.—The first underground cable system installed in the State of South Dakota is now being placed by the Capital City Telephone Co., of Pierre. Mr. W. S. Rowe, general manager, is quite busy making these extensive improvements. He is reconstructing the exchange and cabling all the central portion of the city. He is also installing an entire new central office equipment of the manufacture of the Eureka Electric Company, of Chicago.

TROLLEY FOR SOUTH AFRICA.—A certificate of incorporation of the Netherland Tramway Corporation has been filed at Bridgeport, Conn. The incorporators are Richard T. McKiniry and Charles T. Lark, of New York, and Louis B. Grant, of Brooklyn. The capital stock of the corporation is $3,500,000. It is said the corporation will operate tramways and other franchises in the Transvaal and Orange River Colonies, South Africa.

PRICE LISTS WANTED.—The Empire Manufacturing Company, of Franklinville, N. Y., have recently purchased the Citizens' Electric Light plant in that city. It is their intention to install a 100-hp engine and a 1,000-light incandescent dynamo. They want price lists, circulars and other trade literature.

EQUIPMENT FOR MONTEREY STREET RAILWAY.—Mr. A. W. McLimont, the chief engineer and general manager of the Monterey Street Railway Company, which concern, as previously noted in these columns, has acquired the existing mule tramways in the city of Monterey, Mexico, for ultimate conversion into an electric traction system about 70 miles long, when seen at the offices of the Federal Electric Company in the Washington Life Building, by a representative of ELECTRICAL WORLD AND ENGINEER, said: "In the first instance, 30 miles of lines will be converted into an electric road. The initial equipment of the power station will have a capacity of 1,350 horse power. It will consist of three 450 hp. cross-compound condensing Corliss engines, each for direct connection to 500 volt generators of 300 kw. capacity. The boiler plant will be in five units of 150 hp. each. In the construction of the track 60-pound T-rails and 70-pound girders will be used. For the present, the car equipment to be ordered will comprise 35 open bench cars and four freight cars. The cars will have double trucks. They will each be equipped with double motors of 38 horse power. They will also have air brakes. The trolley poles will be made of iron. The trolley wire will be No. 00. The power station and car house have been designed so as to permit of extensions. These buildings are now being constructed by the American electrical engineering and contracting firm of Mackin & Dillon, of Monterey. Steel beams, trusses, etc., will be used in their erection. Later on, we propose to install a storage battery system in connection with the power plant. No expense will be spared in making the road one of the most thoroughly modern and substantial systems. I am now getting estimates for equipment, etc., which I will take with me to Baltimore within the next few days for submission to Sperry, Jones & Co., who are financing the construction of the system, and the contracts will be let direct from Baltimore about the latter part of the current month. We hope to have the 30 miles of new road in active operation inside of 12 months."

SOME C. & C. ORDERS.—The C. & C. Electric Company, of 143 Liberty Street, New York, has secured an order from the Consumers' Ice Company, of Chicago, for a 125-kw engine type dynamo for both light and general power purposes. An order has also been received within the last few days for a 100-hp series-parallel equipment for operating a dock of the James Tregarthen Sons' Company, New York City. The Hall Signal Company, of Garwood, N. J., has requisitioned for an engine type dynamo of 40-kw capacity, which will be used for light and power. A fourth order has been obtained from the American Vulcanized Fibre Company, of Newark, Del., for a 50-kw belted dynamo. This machine will be employed for both light and power. Another repeat-order—the third—has been taken from the Smeeth Copper & Bronze Company, of Chicago, Ill., for a 40-hp motor to be utilized for power purposes. J. B. King & Co., of New Brighton, Staten Island, have called for two 7½-hp electric hoists. The C. & C. people will build the electrical portions. The Brooklyn Institute is to be supplied with two 18-hp slow-speed motors to be used for operating blowers. Other C. & C. contracts taken this week call for two 60-kw and one 40-kw generators for an apartment hotel now under construction up town, New York, and for one 50-kw and a 75-kw generator to be installed in a new Philadelphia apartment hotel. In both these instances the generators will be used for light and power. The Consolidated Dental Manufacturing Company, of New York City, has just ordered a 65-kw belt type dynamo for light and power use.

THE ELECTRIC CARRIAGE CALL COMPANY, 1402 Broadway, New York, has arranged for an installation of its system with the Hamburg-American Line, on the steamship *Deutschland*, for signalling at night at sea. Instead of numbers they are going to use letters which form the international code. This system for signalling will be visible five miles and will be the only system of its kind in operation. It is especially valuable on account of the record that is kept of all signals sent out by the perforated cards, which, after they are used, are dropped into a locked box, which is accessible only to those in authority. This system has been designed and supervised by Mr. Mortimer Norden, the general manager of the above-mentioned firm, which has also closed contracts with the Montauk Theatre, Brooklyn, Carnegie Music Hall, New York, and through its agent, the National Electric Supply Company, of Washington, it has installed four in that city.

700-KW PLANT FOR EASTON, PA.—The People's Light, Heat & Power Company's plant at Easton, Pa., is to be installed with a 700-kw equipment. The generators will be six in number—four of 150-kw capacity each and two capable of developing 50 kw each. These machines are being supplied by the Northern Engineering Company, Incorporated, of 95-97 Liberty Street, New York. There will be three engines furnished by the Harrisburg Foundry & Machine Works, of Harrisburg, Pa. Two will be of 400-hp capacity each and one of 175 hp. They will be of tandem compound type. Two of the larger generators will be direct connected to each of the larger engines. The boiler plant is to consist of three units of 300 hp each. This part of the contract has been undertaken by the Sterling Company.

ELECTRIC MACHINERY COMPANY.—This concern, of Minneapolis, Minn., was recently formed with a capital stock of $125,000, of which $110,000 has been paid in. It will continue the manufacture of electrical machinery as started and developed by C. H. Chalmers and J. T. Boustead. Several well-known lumbermen and flour manufacturers of the locality are interested in the enterprise. It is now building a 300-kw generator to be direct-connected to a Corliss engine at 100 r.p.m. This is the largest built by the concern so far, but it is equipping its shops to handle almost anything up to 1,000 kw.

MACHINE TOOLS FOR ENGLAND AND SOUTH AFRICA.—The Niles-Bement-Pond Company, of 136 Liberty Street, New York City, are receiving considerable orders for machine tools at present from England and South Africa. The demand from the first-named country is for new model turret lathes, thread milling machines and adjustable multi-spindle drills, manufactured at the Pratt & Whitney (Hartford, Conn.) shops of the company. The requisitions from South Africa chiefly come from Johannesburg and call for heavy machines—lathes, planers and boiler-making tools.

EQUIPMENT FOR ARLINGTON CELLULOID PLANT.—The Arlington Manufacturing Company has let contracts for the extensive electrical equipment of its celluloid plant now under construction at Arlington, N. J. The generators will be supplied by the General Electric Company. Sprague motors will be used. The contract for wiring has been undertaken by the Electrical Construction & Supply Company, of 27 Thames Street, New York. The switchboard, motor panels, etc., will be supplied by the Northern Engineering Company; New York offices, White Building, Liberty Street.

IMPORTATION OF COAL.—The bulletin of the New York Edison Company says: Probably the largest single cargo of coal that ever crossed the Atlantic, or any other ocean, is that of 8,525 tons just received by the New York Edison Company from the mines of Cardiff, Wales. This is one of several cargoes ordered by the New York Edison Company during the time of the strike, thus insuring against the possibility of coal shortage, however great the local famine." This is a good evidence of the far-sighted policy of the company's management.

MORE YANKEE CARS FOR SOUTH AFRICA.—The East London (South Africa) Municipal Electric Traction system is to be extended. The existing equipment was manufactured in the United States. The Jackson & Sharp (Wilmington, Del.) plant of the American Car & Foundry Company, for which concern Dutilh-Smith, McMillan & Co., 25 Broad Street, are the export managers, have just received an order for cars.

PUBLIC CONTRACTS OPEN.—Proposals are invited for the construction of water works and an electric plant by Springfield, Tenn., until December 15. H. T. Stratton is mayor. The public works department of Nashville, Tenn., will purchase two additional boilers for the electric light plant. Mr. Emmet Snipes, secretary commissioners, Searcy, Ark., will receive bids until December 26 for the installation of an electric light plant.

LARGE BRAZILIAN HYDRAULIC PLANT PROJECTED.—The St. John Del Rey Mining Company, a British capitalized concern, with head offices in London, which carries on extensive mining operations in Brazil, has acquired considerable water power in the vicinity of its properties with a view to the erection of a large hydraulic plant intended for the furnishing of power to operate low-grade iron ore in large quantities.

ANOTHER MEXICAN TRANSMISSION LINE.—German Roth & Company, engaged in extensive gold and silver mining operations in the district of Temascaltepec, State of Mexico, are about to let contracts for the construction and equipment of a hydraulic plant on the Rio Verde. Their concession permits of the utilization of 2,000 litros of water per second.

PENNSYLVANIA ELECTRIC RAILWAYS.—Superintendent Brown, of the Pennsylvania State Bureau of Railways, in his annual report, just made, criticises electric railway methods; says the various companies are overcapitalized; in fact, to twice their cost, and urges that New England's plan of supervising stock issues be adopted.

TO LIGHT CARTERET (N. J.) PHOSPHATE PLANT.—The International Phosphate Company's new plant at Carteret, N. J., is to be equipped with a 13-in. by 12-in. Harrisburg simple engine for direct connection to a 50-kw C. & C. engine type dynamo. This outfit will be used for lighting purposes.

THE STERLING ELECTRIC COMPANY, of Lafayette, Ind., has contracted to erect a telephone plant at Durban, a city of 100,000 inhabitants, in the colony of Natal, South Africa.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—[illegible] has been granted a telephone franchise [illegible].

SAN FRANCISCO, CALIF.—The Direct Line General Telephone Company, with a [illegible], has been incorporated. The directors are J. Finch, A. G. Andriano, W. T. Hess and others.

SAVANNAH, GA.—The Georgia Telephone and Telegraph Company is adding 200 new telephones to the local system.

AUGUSTA, GA.—The Southern Bell Telephone Co. has filed the necessary bond and received permits for beginning the work of installing its underground system of wires and conduits.

AUGUSTA, GA.—The city council has voted that the Strowger Telephone Company and the Bell Telephone Company be asked for bids, provided there is no contract with the Bell, for the city business. The bids will be called for the latter part of December. The Strowger Company has expended during the past few months $65,000 in various improvements.

MOSCOW, IDAHO.—Telephone lines will be built from Moscow to the outlying county. The mayor has the matter of bids and other work in charge.

KANKAKEE, ILL.—The council has granted a franchise to the Interstate Independent Telephone & Telegraph Company, a branch of the Illinois Telephone Company.

MOLINE, ILL.—The Independent Telephone Company will have its new Moline [illegible] ready to open for business about Jan. 1. About 450 telephones will be connected and ready for use by that time.

CHICAGO, ILL.—Thirty-nine persons and business firms have been allowed by Judge Tuley to become co-complainants in the suit brought by the Illinois Manufacturers' Association against the Chicago Telephone Company to enjoin the latter from charging more than the franchise rate of $125 a year for its service.

ELKHART, IND.—The Home Telephone Company, of Elkhart County, has decided to improve its plant at an expenditure of $30,000.

MARION, IND.—The commissioners of this (Grant) County have granted the Citizens' Co-operative Telephone Company, of Fairmount a franchise to operate lines throughout the county. By an agreement with the Central Union Company the new concern has the use of its lines to Marion subscribers.

LOGANSPORT, IND.—The Logansport Home Telephone Company gave a reception recently to hundreds of visitors, exhibiting the plant and explaining the working of the modern system. Managers of telephone companies from all over the country were present and many others who are interested in the business of telephones.

INDIANAPOLIS, IND.—The Louisville Home Telephone Company, with a capital of $75,000 represented in Indiana, principally in the city of New Albany, has complied with the State law by filing articles of incorporation and securing a license. The capital stock of the company, as represented in the two States, is $1,500,000.

KOKOMO, IND.—The Independent Telephone Company, of this city, has announced an advance in rates for private houses from $1.25 to $1.50 per month. This action is likely to precipitate a renewal of the rate war between the Bell and independent companies. The Bell Company has continually charged $1.50 per month for residences and in order to secure its hold has declared its intention to reduce the rate to $1.25.

TERRE HAUTE, IND.—The Kinloch Telephone Company, of St. Louis, Mo., has asked for a franchise for a long-distance line from the Illinois State line to Terre Haute. The company's line is completed to Casey, Ill., and the company wants to cross into Indiana and connect with the Citizens' Company at Terre Haute, thus establishing direct connection with the long-distance system of the independent lines through Indianapolis.

PETERSBURG, KY.—The Boone County Telephone Company will extend its lines to Bellevue and Rabbit Hash.

JEFFERSONVILLE, KY.—Representatives of the Louisville Home Telephone Company are endeavoring to organize an independent telephone company in this place. The Home Telephone Company has a franchise granted some years ago, but no work was ever done.

PORTSMOUTH, KY.—The Portsmouth Telephone Company is preparing to build lines to Springville, Fullerton, Malonton, Argentum, Lynn, Warnock and Tygarts Valley. At Warnock connection will be made with the Greenup and Grayson lines.

DETROIT, MICH.—The Tamarack Telephone Company is building two additional lines between Stockbridge and Dansville.

JACKSON, MICH.—The People's Telephone Company, of this city, has been taken over by the Citizens' Company, of Grand Rapids, and its name changed to conform to that of the latter.

MINNEAPOLIS, MINN.—Long distance telephone service was opened between this city and Winnipeg, Manitoba, on Dec. 2. The new lines run through Fargo, Grand Forks and Neche, the stretch from Neche to Winnipeg having been constructed by the Canadian company. The distance is 500 miles.

BUFFALO, N. Y.—The Independent Union Telephone Company has been incorporated with a capital of $[illegible].

TYRONE, N. C.—The Polk County Telephone Company, with a capital of $[illegible], has been chartered by Thos. C. Mills and others.

OTTAWA, OHIO.—The Farmers' Mutual Telephone Company has applied for a franchise in Ottawa and the petition is signed by over 300 people who will become subscribers.

CINCINNATI, OHIO.—Judge Smith has decided that telephone companies have the right to erect telephone poles in sidewalks on a permit from the city if there is no special injury to property owners in the way of cutting off light or air.

FOSTORIA, OHIO.—The farmers about Fostoria are making so many applications for telephones that the Federal Telephone Company can fill only about one-fourth of them. The company will extend its lines and enlarge its switchboard.

BOWLING GREEN, OHIO.—The Ticker Independent Telephone Company, reaching some twenty towns in the interior of the State, will build a line to connect with the long distance system of the Cumberland Telephone & Telegraph Company.

HAMILTON, OHIO.—The Hamilton Home Telephone Company has given a mortgage for $200,000 to the Cincinnati Trust Company to cover bonds of the same amount. A portion of the money will be used for the completion of the system. F. W. Hughes is president and F. W. Whitaker secretary of the company.

CLEVELAND, OHIO.—The gross earnings of the United States Telephone Company for the month of September were $27,006. Expenses and taxes were $14,660, leaving net earnings of $12,346. The monthly interest is $7,771, leaving surplus for stock of $4,576. At this rate the company is earning two per cent. on the stock outstanding.

MELMORE, OHIO.—Farmers of Melmore, Sycamore, Plankton, Poplar and Lykins have organized a company for the purpose of establishing rural telephones through the district. The main exchange will probably be established at Plankton. Graffton Baker, of Melmore, is president and Harvey Close, of Plankton, secretary-treasurer of the company.

BOWLING GREEN, OHIO.—The Federal Telephone Company has completed an examination as to the improvements necessary to place the exchange of the Wood County Telephone Company in first class shape. The capacity of the plant will be nearly doubled and lines will be extended to Rudolph, Portage, Mermill and other towns in this vicinity.

ASHLAND, OHIO.—The circuit court has granted a franchise to the Central Union Telephone Company to install its system in Ashland. The field has long been in the hands of the independent and the Bell Company has failed repeatedly to secure a franchise from the village council. The company was defeated in both the probate and common pleas courts.

CLEVELAND, OHIO.—The Cleveland Telephone Company is placing electric alarms on all pay stations. The alarm rings in the room of the person in charge of the building, in case an attempt is made to tamper with the contents of the toll box. The company has experienced great trouble from pay stations being rifled. The money lost is not large, but the telephone is usually thrown out of service.

CLEVELAND, OHIO.—H. R. Newcomb, chairman of the Everett-Moore banker's committee states that the syndicate is planning to pool the entire assets of the Federal Telephone Company and put up a collateral trust bond issue to fund all its debts. These bonds would likely be taken by some of the creditors of the syndicate for the money due from the Federal Company, and by the Everett-Moore syndicate itself for money which will be advanced to place the affairs of the company in good shape.

CINCINNATI, OHIO.—The Cincinnati Telephone Company has been incorporated with $50,000 capital stock to construct and operate lines between this city and Lebanon, extending through Hamilton, Butler and Warren Counties. An effort will also be made to establish an independent exchange in Cincinnati. Incorporators: Robert W. Seebaum, R. C. McCracken, Sheldon Browne, J. S. Nowotney and James P. Hughes.

PICKENS, S. C.—It is reported that the Southern Bell Telephone Company has purchased the local independent system.

CHATTANOOGA, TENN.—A franchise will likely be granted to Annie McElroy Brett for a new telephone system with the right to place the wires underground. The grantees guarantee that $100,000 shall be spent in the city within six months from the final passage of the ordinance. Mrs. Brett also owns systems in Detroit and in El Paso, Tex.

PARIS, TEX.—The Citizens' Telephone Company, of Paris, has increased its capital stock from $120,000 to $150,000.

ABILENE, TEX.—The Northwestern Telephone Company, capital $75,000, has been incorporated by W. G. McWright, D. M. Howard, G. R. Loveless and others.

McKINNEY, TEX.—The Roland Local Telephone Company, capital stock $5,000, has been incorporated by C. T. Lewis, C. H. Farnsworth, J. R. Coggins and others.

SALT LAKE CITY, UTAH.—The Utah Home Telephone Company has been granted a franchise in this city. The grant limits the rates to be charged to $48 per annum for business telephones and $30 per annum for residence instruments on individual metallic circuits.

OGDEN, UTAH.—The Home Telephone Company has petitioned for a franchise to install and operate a telephone line in Ogden. The Rocky Mountain Bell Telephone Company has asked the council to extend its franchise in accordance with the terms proposed in an application two months ago, and which was at the time rejected by the council.

NORFOLK, VA.—An injunction has been issued against the Hampton, Va., Telephone Company to prohibit the company from discontinuing its service in Norfolk in connection with the Southern States Telephone Company. This is said to be the beginnning of a long fight between the Bell Company and the local exchange.

ODESSA, WASH.—J. A. Willis, of Willis, Adams County, has applied to the town council for a franchise to operate a telephone system in this place.

CITY OF MEXICO, MEX.—A proposition to establish and operate an extensive system of telephones in the City of Mexico has been made to the municipal council by M. G. Ribson, general manager of the Mexican Gas and Electric Light Company of the City of Mexico.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Mutual Electric Light Company, which operates a steam plant in San Francisco, is now procuring estimates from manufacturers of steam engines and electrical apparatus for the equipment needed for the new power house which is to be erected at the corner of Stewart and Folsom Streets. The initial installation will probably consist of two 1,500-kw two-phase generators, each direct-connected to a horizontal automatic engine. Oil fuel will be used in the new station. The new underground conduit system will be thoroughly up-to-date and the present distributing system will be remodeled on changing from single to two phase.

SAN FRANCISCO, CALIF.—A. M. Hunt, of San Francisco, is engineer for the capitalists who intend to install a 10,000-hp electric power plant on the American River near Placerville, Cal. He has returned from an inspection of the water power sources. An interested party says that the reports that the plant would be installed in connection with the new company headed by H. H. Griffiths, which has commenced the construction on a new street railway system in Stockton are incorrect. It is possible that a 60-mile transmission line might be built to that place if there were a sufficient demand for electric power for railways or other purposes, but, at present, no Stockton railway company has any interest in this project. A large portion of the output of the initial installation will be required for running operations not very far from the plant.

BARNESVILLE, GA.—The city will soon be held on a bond issue of $6,000 for an electric light plant.

LEWISTON, IDAHO.—The electric light company is building a new station and will install a 500-kw Westinghouse generator. The company is expending about $50,000 in rebuilding its system in Lewiston.

PANA, ILL.—For the first time in two months the streets of Pana were lighted on the night of December 1. The lighting question has not been settled between the council and the light plant, but the lights were paid for by the manager of a place of amusement for the purpose of showing the people the way to the play that was given on that night. When the play was over darkness again fell over the city. At present there seems no prospects for lights.

EDWARDSVILLE, ILL.—The city council and the Edwardsville Electric Light & Power Company have at last arrived at an agreement in regard to a franchise for street and commercial lighting in the city. Since the expiration of the contract with the local company on October 14, the city has been in darkness, the authorities and company being unable to agree upon terms for an extension. The street lights were turned on December 9 by the company and will be continued, the franchise being given for a period of ten years.

INDIANAPOLIS, IND.—The Modern Light, Heat & Power Company, of Indianapolis, has been incorporated. The capital stock is $10,000. C. A. Johnson heads the board of directors.

MARTINSVILLE, IND.—L. K. Davis, of Indianapolis, has purchased the electric light and gas plant of this city. Both plants will be repaired and improved, and $50,000 worth of new machinery installed.

RICHMOND, IND.—The friends of the municipal electric-lighting plant which has been in operation here only a few months are well pleased with the showing made. They claim that as soon as the consumers can all be connected there will be an income sufficient to maintain the plant without the street lighting which is now done by a private company at an expense of $15,000 a year. When this is turned into its coffers the municipal plant will speedily pay for itself, they say.

ELKHART, IND.—Another legal battle for possession of valuable rights on the St. Joseph river has begun in the Federal Court between the St. Joseph Navigation Company and the St. Joseph and Elkhart Power Company. The latter company is constructing a dam at Elkhart for a large power station to generate electricity for factory use. The former company seeks to enjoin the construction of the dam on the ground that the river is navigable and that no consent has been obtained from Congress to dam the river.

PLATTSBURG, MO.—The Plattsburg Light and Power Company has been incorporated to supply electric light, power and heat, with a capital stock of $40,000. The incorporators are M. J. Trimble, Claude C. Funkhouser, Joel Funkhouser and Alice H. Funkhouser.

ST. LOUIS, MO.—The Mississippi Valley Trust Company filed a deed December 3, conveying to the Union Electric Light and Power Company a lot fronting on Lewis Street for $100,000. The sale was made several months ago and the site is now being improved with a light and power plant.

ST. LOUIS, MO.—Bids were opened at the meeting of the board of public improvements Dec. 9 for the construction of two municipal lighting plants—one at the city hall and the other at the insane asylum. The lowest totals make the cost of the city hall plant, if the lowest bids are accepted, $31,103 and of the insane asylum plant $10,860.11.

JEFFERSON CITY, MO.—In the Cole County Circuit Court recently Robert W. Ray, of Canton, filed a suit for an injunction against State Auditor A. O. Allen to prohibit that official from registering $10,000 of bonds issued by the city of Canton for the construction and operating an electric light plant. T. L. Durke and others are the plaintiffs in the suit. They contend that the special election which was held on September 23, and at which the proposition carried, was not legally held in that the ordinance was not signed by the mayor when the election was ordered, nor was notice given in newspapers as required by law. The petition also attacks the validity of the law of the last legislature which allows cities of the class of Canton to vote bonds for electric light and water works purposes and declares this law is in violation of the Constitution in that it has two subjects in the title, and for other reasons.

ELIZABETH CITY, N. C.—The Berkley Railway and Light Company has purchased the local electric light plant and proposes to construct an electric railway, light and sewerage system at once.

GERMANTOWN, OHIO.—The council has authorized the mayor to issue $8,000 bonds with which to enlarge the municipal lighting plant.

NORTH LEWISBURG, OHIO.—An electric light plant in this place is one of the improvements hoped for. There is an opportunity for such an enterprise.

FINDLAY, OHIO.—The Toledo, Bowling Green & Southern Traction Company will increase the capacity of its Findlay power station to provide more current for city lighting. The company has announced that it will spend $[illegible] in improvements to the lighting plant.

YOUNGSTOWN, OHIO.—The Youngstown Consolidated Gas & Electric Company is preparing to replace all the arc lamps in the city with new ones of the latest pattern. Four hundred lamps of the enclosed type will be purchased.

COLUMBUS, OHIO.—The Indianola Heating & Lighting Company has organized as follows: W. E. Swisher, president; W. H. Sharpe, vice-president; Paul De Long, secretary-treasurer. The above, with C. L. Kurtz, George L. Gugle, W. V. Baker and Joseph Slater, are directors.

OTTAWA, OHIO.—The Ottawa Electric Light Company has submitted to the town a proposition under which it will lease its plant. It provides that the town shall assume charge of the plant and pay a monthly rental of $200 for a period of ten years, after which the plant may be purchased by the town for $15,000. The matter is under consideration.

READING, PA.—Electricity will be introduced into the mills of the Reading Iron Company to provide power as well as light on a large scale. Plans for a large plant have been prepared.

BEAVER, UTAH.—It has been decided to build a large reservoir at Minersville canon for power and irrigation purposes. Senator A. B. Lewis, of Beaver County, has bought a large tract of land, finished preliminary surveys and will build a dam 64 feet high, giving a 154-ft. fall of water. Electric power is to be used for electric railways, light and manufacturing plants. Senator Lewis has applied for 4,000 acres of land to be reclaimed by irrigation and for the site of the plant. About 800 horse-power will be obtained.

RICHMOND, VA.—The Virginia Passenger and Power Company has bought machinery for 5,000 additional horse-power for its various power plants. The new power house will be completed by May 1.

ETTRICK, VA.—It is said that the power and manufacturing plant of the Ettrick Manufacturing Company will pass into the possession of the Virginia Passenger and Power Company as Geo. E. Fisher, of New York, the purchaser of the Ettrick plant which was sold under a deed of trust, is a large stockholder in the Virginia Passenger and Power Company, of Richmond. The price paid by Mr. Fisher was $66,100.

NEW CUMBERLAND, W. VA.—The New Cumberland light plant has been sold at trustees sale for $2,000 to Judge Campbell, Wm. Marquet, A. F. Wilkins and James Porter. The new owners will operate the plant and furnish light to the village.

MARTINTON, W. VA.—The Pocahontas Water, Light & Power Company has been incorporated with $25,000 capital stock by J. W. Price and others, of Martinton. The company proposes to furnish light and power in Martinton, Durbin and Barton.

TAMPICO, MEX.—A new electric light company has been organized at Tampico. It is composed of local capitalists.

AMECA, MEX.—A company of Mexican capitalists has been formed for the purpose of establishing an electric light plant in the city of Ameca, in the State of Jalisco. The power for the proposed plant will be derived from a waterfall situated on the Estanzuela hacienda, as noted in our issue of Dec. 6. The company has entered into a contract with the municipal authorities of Ameca to supply that city with lights.

THE ELECTRIC RAILWAY.

ROME, GA.—J. L Bass and R. A. Denny have gone North to complete financial arrangements for extending the electric railway to Lindale, a new village owned by the Massachusetts Mill Company.

COLUMBUS, GA.—On January 1 the Columbus Railroad Company will increase the wages of motormen and conductors from 12 to 13 cents per hour. A 10 per cent. bonus is also paid for good service and freedom from accident.

ANDERSON, IND.—The city council has extended the franchise of the Union Traction Company fifty years. The company has appropriated $100,000 for the building of new car shops in this city. The capacity of the power house will be increased two-thirds, the machinery having already been purchased.

SHELBYVILLE, KY.—The Louisville, Anchorage & Pewee Valley Railway has applied for a franchise to build its line through this place. Some of the grading has already been completed and contracts for other work are being placed. Percy Moore, of Louisville, is at the head of the company.

BALTIMORE, MD.—It is reported that the Chesapeake Beach Railway (steam) between Washington and Chesapeake Bay may be converted into an electric line. David H. Moffatt, of Denver, Col., is the owner.

VICKSBURG, MISS.—The Yazoo and Mississippi Valley Railroad is planning to install an electric light plant in the Vicksburg shops.

HIGH POINT, N. C.—It is reported that a company of outside capitalists will build a factory here next spring for the manufacture of trolley cars.

AKRON, OHIO.—The Northern Ohio Traction Company's railway department earned $52,310 during November, a gain of $13,304 over the same month last year.

CLEVELAND, OHIO.—The November earnings of the Elgin, Aurora & Southern Traction Company were $28,607, a gain of $6,068 over the same month last year.

[illegible]

[illegible] build a freight station at this point and a franchise has been granted for [illegible]

[illegible] Canton to Alliance and Sebring.

[illegible]

PORTSMOUTH, OHIO.—The Portsmouth Street Railway & Electric Light Company is preparing plans for a new power station. While the matter has not been definitely decided it is probable that the plant will be erected in the [illegible]

TOLEDO, OHIO.—The Toledo Railways & Light Company is erecting a new 5,000-hp engine built by the Allis-Chalmers Company. It is of the vertical cross-compound condensing type and is direct connected to a 2,000-kw Westinghouse generator.

ZANESVILLE, OHIO.—The Zanesville Railway, Light & Power Company, which has bought up the Zanesville Street Railway Company and the Zanesville Electric Company, has applied for a 25-year blanket franchise covering the grants of the former companies.

MARIETTA, OHIO.—The council has granted a franchise to the Parkersburg [illegible] to and over the new Ohio River bridge. The extension to the West Virginia side will be made as soon as possible.

TOLEDO, OHIO.—The United States Construction Company is offering [illegible] worth of the stock of the Toledo, Columbus, Springfield & [illegible] work for the road and desires to realize on a portion of the stock.

COLUMBIANA, OHIO.—The O. K. Oil & Gas Company is negotiating with [illegible] of the railway power house near this city with a view to using gas from the company's wells as fuel. The proposition is being considered with favor.

LEAVITTSBURG, OHIO.—A number of citizens have signed a petition asking the county commissioners to revoke the franchise of the Pennsylvania & Mahoning Valley Railway on account of the failure to operate cars over the Leavittsburg extension. The road is completed but the company claims it is being held up by a railroad crossing.

CARTHAGE, OHIO.—The village council has declined to grant a 25-year franchise to the Cincinnati Interurban Company except on a basis of 5 cent fare to Fountain Square Cincinnati and universal transfers from that point. The company will not consider the proposition. The citizens have organized to resist any attempt to lay the tracks at night.

CLEVELAND, OHIO.—Directors of the Aurora, Elgin & Chicago Traction Company have voted to pay the first dividend on preferred stock on December 17 of three per cent. The company will not be able to pay this wholly out of the earnings of the road, since it has been in operation only for a short time. The gross earnings for the month of November were $16,594.

TOLEDO, OHIO.—The Toledo, Ft. Wayne & Southern Railway Company will soon be incorporated in Ohio to build a line from Toledo to Indianapolis by way of Ft. Wayne, Huntington, Elwood and Marion. The promoters are D. W. Jones and L. A. Smart, of Cleveland, W. H. Ogan, Tipton, Ind., and Dr. J. F. Spaunhurst, of Indianapolis.

ATHENS, OHIO.—A new company has been formed to take over the franchise secured some time ago for a line from Athens to Nelsonville. The officers of the new company are J. T. Woodward, president and general manager; D. H. Siggins, vice-president; L. M. Riddlesperger, treasurer, and H. H. Haning, secretary. The first three mentioned live at Warren, Pa.

FINDLAY, OHIO.—Farmers in this county appear to have organized to make trouble for the Western Ohio Railway Company, which is preparing to build its line from Lima to Findlay. None of them will sell right of way except at a certain figure which, needless to say, is exorbitant. The company has decided to break the combination by bringing condemnation suits.

CLEVELAND, OHIO.—The Northern Ohio Traction & Light Company, which is to succeed the Northern Ohio Traction Company, has been incorporated with a temporary capital stock of $10,000, by J. R. Nutt, W. R. Whitney, H. J. Crawford, C. E. Sanders, and V. J. Terrell. The majority of the stockholders of the old company have agreed to the change, which will be effected De[illegible]

SANDUSKY, OHIO.—There is a report that the Sandusky, Bellevue, Monroeville & Norwalk Railway project will be revived in the near future. Considerable work of grading and building of culverts was done about two years [illegible] The new [illegible] to have ample capital to complete the road as originally proposed. The road [illegible]

[illegible] the city over the tracks of the Toledo & Maumee Valley Railway from Perrysburg. The new short cut will be 23 miles long and will touch the towns of Sugar Ridge, Dunbridge, Dowling, Lime City, and besides drawing from these towns the company will save about thirty minutes on the running time to [illegible]

[illegible] Mansfield, Crestline & Galion Railway. The entire line extends from Bucyrus to Mansfield, a distance of 35 miles. It will be bonded at $700,000 with stock [illegible] is now fully in operation and next year it will be connected with the Cleveland, Elyria & Western Railway by a connecting [illegible]

WELLSBURG, W. VA.—The council has granted a franchise through town to the Pan Handle Traction Company. The Wellsburg, Steubenville & New Cumberland Traction Company has applied for a franchise to enable it to build up the West Virginia side of the Ohio river to Holliday's Cave.

THE AUTOMOBILE.

AUTOMOBILE SCHOOL.—It is reported that a school is to be established in Philadelphia for instruction in the art of handling automobiles. A full and thorough course is to be given, at the end of which diplomas will be granted to students passing examinations.

AUTOMOBILE MAIL ROUTE.—What is said to be the first rural automobile mail route in the United States has been established between Portland and Pennville, Ind. It covers a distance of twelve miles. Patrons of the line are served twice a day, the machine making two trips each day. The government officials at Washington are interested in the experiment as it is expected that many automobile mail routes will be established in the near future.

NEW INDUSTRIAL COMPANIES.

THE ROSEMONT ELECTRIC TRANSMITTER COMPANY, of New York, has been incorporated; capital, $250,000. Directors: Herman Schwarz, Julius Rosenberger and A. H. Schwarz, New York.

THE INDEPENDENT INCANDESCENT LAMP COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $20,000. The incorporators are Harry M. Coudrey, Walter L. Gilliam, Walter Ennes, James A. Gerr and B. G. Tremaine.

OBITUARY.

MR. A. C. BARNEY, member of the street car manufacturing firm of Barney & Smith, of Dayton, Ohio, died recently of heart trouble at Monte Carlo, where he collapsed on arrival in the railroad station from Paris, while on a trip for his health.

MR. C. L. PULLMAN.—The death is announced of Mr. Charles L. Pullman, a brother of the late George M. Pullman, of sleeping car fame. He was himself an inventor of no mean ability and was well known in the electric street railway field.

CHARLES H. PINKHAM.—Charles H. Pinkham died in New York city last week after a brief illness. He was born in Salem, Mass., fifty-three years ago, and came to New York when seventeen years old. In 1888 he founded the Bank of Harlem and became its first president. This institution was later merged with the Hamilton Bank, 125th Street. He was at one time executive agent for the Equitable Life Assurance Society. At the time of his death he was general manager of the Bay State Electric Light, Heat and Power Company, with offices in Boston. Mr. Pinkham was a member of the Lenox Avenue Unitarian Church and of the New England Society, the Colonial Club, the Unitarian Club, and the Harlem Club.

MR. JOHN VAN HORNE, ex-vice-president of the Western Union Telegraph Company, died at his home in Pewee Valley, a suburb of Louisville on December 13, aged 75 years. He was born at Centreville, N. J., 1827, became an operator and rose rapidly in the early telegraph service. He was made president of the Southwestern Telegraph Company within the Confederate lines during the period covered by the Civil War. When the telegraph consolidation took place in 1866 under Western Union he became general superintendent of the Southern Division and a member of the board of directors. In 1878 he became vice-president. His latest work while connected with the Western Union Company was the charge of the Central Bureau, the Free Service Bureau, Electrical Department, Bureau of Statistics, etc.

PERSONAL.

MR. ANDREW CARNEGIE has returned to this country in good health and spirits, altogether recovered from his late illness.

MR. FRANK J. SPRAGUE is home from Europe, where he has been taking a brief vacation and studying the electric railway situation.

MR. A. FREDERICK COLLINS will deliver a lecture on "Wireless Telegraphy and Telephony" before the Brooklyn Institute, Jan. 23, 1902.

COUNT CORRADO EMO-CAPODILISTA, of Milan, Italy, is in the United States for the purpose of making a study of the electrochemical industry as developed here.

MR. J. W. PETERSON.—The Electrical Equipment Company, of Chicago, announces that J. W. Peterson has been elected president to fill the vacancy made by the withdrawal of Mr. J. Holt Gates.

MR. F. W. WILLCOX, of the General Electric Lamp Works at Harrison, N. J., is to lecture this week, on the 16th, in Brooklyn, N. Y., before the Modern Science Club, on the manufacture of incandescent lamps.

MR. J. CUSTANCE BENNETT, of London, England, who is actively connected with various electrical interests in that country, has been visiting the United States for some weeks past. He sailed for home this week to arrive Christmas.

MR. J. HOLT GATES has withdrawn from the Electrical Equipment Company, of Chicago, of which he was president, and will conduct business hereafter as J. Holt Gates & Company, with offices at 927 Monadnock Block, doing a contracting business.

MR. HENRY HOPKINS, superintendent of city street lighting at New Haven, Conn., has a neat little article in the local *Palladium* showing how valuable street lighting is, if efficient, in promoting the welfare and prosperity of a city and its inhabitants.

MR. FRANZ MEYER, Ph.D. has opened an office as consulting metallurgical and chemical engineer at 88 Broad Street, New York City. He will also make a specialty of negotiating the sale in this country and abroad of patents and inventions relating to the art.

MR. JOHN S. SEYMOUR, of Seymour, Seymour & Harmon, formerly U. S. Commissioner of Patents, has contributed to the current *Yale Law Journal* a pithy and most interesting article on patents, in which the subject is dealt with in a masterly manner.

MR. F. E. DRAKE, for two years past general manager of the Union Elektricitäts Gesellschaft, of Berlin, has just returned to this country after closing a very successful engagement. He proposes to stay permanently in this country, where he has a host of friends and many influential connections.

SENATOR O. E. HARRISON, of Greenville, Ohio, was in Chicago during the past week, during which time he visited the plant of the Stromberg-Carlson Tel. Mfg. Co. It is understool that Mr. Harrison is interested in an entirely new telephone enterprise about which more information will be published later.

MR. JAMES S. PEARCE has been appointed master mechanic of the Scioto and Cincinnati Divisions of the Norfolk & Western Railway Company, with headquarters at Portsmouth, Ohio. Mr. Herbert T. Herr has been appointed master mechanic of the Eastern General Divison, comprising the Radford, Shenandoah and Norfolk Divisions, with headquarters at Roanoke, Va.

MR. E. J. LAVENS, formerly connected with the General Incandescent Arc Light Company, will assume entire charge on January 1 of the panel board, switchboard and switch departments of the Bossert Electric Construction Company of Utica, N. Y. The development of this well-known business affords an excellent opportunity for the well-known experience and ability that Mr. Lavens is known to possess.

MR. J. J. RUTLEDGE, one of the largest and most successful operators in the Klondike is now in New York for the purpose of placing contracts for considerable machinery, including electrical equipment. Mr. Rutledge has been granted a concession by the Canadian government for the dredging of the entire length of the 40-mile river where gold was first discovered in the Klondike regions. He is a guest at the Hotel Manhattan.

MR. R. L. WARNER.—At the regular meeting of the New England Railroad Club, at the Pierce Hall, Boston, on December 9, a paper on "Electrically Driven Shops" was presented by Mr. Robert L. Warner, Boston sales manager of the Westinghouse Electric & Mfg. Co. Mr. Warner's paper was illustrated by a large selection of stereopticon views showing many examples of the application of direct-current and induction motors to the driving of machine-shops tools and other apparatus.

MR. W. MANDELICK, who was formerly connected with the Sprague Electric Company and was later private secretary to Mr. E. H. Johnson, has been for two years past with Mr. C. T. Yerkes in London and has now become secretary for the Yerkes underground traction interests in London. He is now spending a few weeks in this country at the holiday season and will return to London early in the new year. Mr. Mandelick is making very rapid advancement for so young a man, much to the pleasure of his many friends in America.

MR. CHARLES E. WADDELL, of Asheville, N. C., is on a visit to New York in connection with an important water-power electrical generating plant now being installed near Asheville. It is thought by those interested that in a short time the western section of North Carolina will become an important manufacturing region owing to the abundance of water power and availability of labor for textile mills. Mr. Waddell is also electrical engineer of the Vanderbilt Biltmore estate, the several electrical plants of which he has recently reconstructed.

MR. PHILIP W. MOEN has resigned as second vice-president of the American Steel & Wire Company. He graduated from Yale and entered the business after several years of study. He was made general superintendent and assistant treasurer and in 1891 he became general manager and treasurer, which offices he held until the Washburn & Moen Mfg. Company, with its $4,000,000 capital stock, sold out to the American Steel & Wire Company in 1898. Mr. Moen was made a director and third vice-president of the consolidation and afterward was promoted to second vice-president. He was manager of the Eastern division of the company's business.

MANDELICK-SQUIRE.—Miss Marie Antoinette Squire, the daughter of Mr. and Mrs. Levi Henry Squire, of New York City, and Charles Edward Mandelick, were married this week at All Angels' Protestant Episcopal Church, Eighty-First Street and West End Avenue. The ceremony was performed by the Rev. Dr. S. Delancy Townsend. Mrs. John H. Flagler, sister of the bridegroom, was matron of honor, and Miss Helen Maude Mabley, maid of honor. William C. Mandelick was best man, and the ushers were Henry W. Stackhouse, William J. Beggs, H. W. Abbott, and Clayton Mayo. A small reception followed the ceremony. The bridegroom has been for many years in the electrical field.

MR. C. H. MACKAY.—A telegram from San Francisco of December 12 says: The commercial bodies of this city have held a reception at the Palace Hotel in honor of Clarence H. Mackay and others of the management of the Commercial Cable Company who are to see the laying of the new cable to Honolulu. Governor Gage represented the State, and Mayor Schmitz was present on behalf of the municipality. G. G. Ward said: "The length of this cable will be three and one-half times greater than any Atlantic cable. When this shall be completed our system will reach from England and France to China, three-fourths of the distance around the globe. And I venture to predict that we shall be able to beat 'Puck's' prophecy of girdling the earth in forty minutes by sending a message from San Francisco to San Francisco in one-fourth of that time." Mr. Mackay was slightly hurt during the first attempt to land the shore end of the cable last week.

SUPERINTENDENT HESS, of the German Niles Tool Works, Berlin, is now in the United States. The report that the works had closed down is [illegible]. There was a strike [illegible] among the employees, but the matter has been adjusted and the plant is now in full operation again. The Berlin works acquired the German rights to manufacture the [illegible] of the Niles Tool Works, of Hamilton, Ohio, prior to that concern's absorption by the Niles-Bement-Pond Company. The plant is an exact duplicate of the Ohio works. In view of the general business depression throughout the German Empire the German Niles Works have been [illegible] various machine tools for prompt delivery [illegible] per cent. lower prices than those existing here, notwithstanding the machinery being subject to a 45 per cent. import duty. [illegible] been taken in the American markets so far. In England the German tools have met with better success. Vickers Son & Maxim having [illegible] a fair sized contract with the German concern.

EDUCATIONAL.

GRADUATE SCHOOL OF ENGINEERING AT THE M. I. T.—A graduate school of engineering research is to be established Oct. 7, 1903, at the Massachusetts Institute of Technclogy in Boston. Its object will be to stimulate and provide research in such branches of fine and applied science as relate to the various departments of engineering, covering work in civil, sanitary, mechanical, electrical, marine, mining and chemical studies. The school will be composed of a limited number of graduate students of marked attainments presumably qualified to engage in advanced studies and investigation and the staff will consist partly of professors and instructors of the institute, and partly of experts and authorities actually engaged in engineering enterprises. Problems of immediate and practical importance are to be studied as far as means and facilities allow. Thus, $5,000 per year for three years has been offered by a friend of the institute to be expended in the study of efficient and economical methods of dealing with the sewage of large cities. Also a testing laboratory for the investigation of the behavior of building materials under exposure to fire. Another fund of $500 for three years has been tendered for the investigation of Röntgen Ray apparatus, with a view for its improvement for the uses of surgery and medicine. The degree of Doctor of Engineering (Eng. D.) will be conferred upon members of the school who have been duly accepted as candidates for that degree upon a residence membership of two years and an original thesis upon some approved subject, based upon sustained study of a particular problem which has been advanced by the candidate's work.

Trade Notes.

THE ELECTRIC APPLIANCE CO., Chicago, is out with the announcement that it has in Chicago ready for immediate shipment the largest stock of weatherproof wires carried by any house west of the Allegheny mountains.

STERLING ELECTRICAL MFG. CO., of Warren, Ohio, has recently issued a neat little folder circular discussing tersely the benefits and advantages of its incandescent lamps; the text being accompanied by cuts to emphasize the points.

STROMBERG-CARLSON TELEPHONE MFG. CO. reports a great many inquiries regarding its new hook-switch, which it has recently placed on the market. It is now equipping all its telephones with this new style hook, illustrations of which have appeared in this paper.

THE UNITED STATES CARBON COMPANY, a New Jersey corporation with $400,000 capital stock has been admitted to do business in Ohio with office in Cleveland. Burton L. Foster is president. The company is the reorganization of the old company of the same name.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is distributing to the trade a new No. 9 D. & W. price list. This price list, which contains half-tone cuts of all D. & W. products, includes much new material not heretofore listed. Any prospective buyer can obtain a copy by addressing the above company.

THE CARPENTER MACHINE WORKS is the name of the successor to Hubbard & Carpenter, 93 Pearl St., Brooklyn, New York, whose vacuum pumps are so well known and extensively used in the electrical field. The new firm, headed by Mr. Thos. D. Carpenter, will increase the plant and continue to produce work of the same excellent quality that has given the old firm the good reputation it has always enjoyed.

THE WESTERN ELECTRIC COMPANY reports very gratifying results from its constant potential alternating arc lamp. This lamp operates on the repulsion principle and the favor with which the central station managers have received it, as well as the fact that a competing manufacturer has recently copied the details of its mechanism, are tributes to its intrinsic worth. The Western Electric Company will be pleased to quote attractive prices to prospective buyers.

D. & W. SPECIALTIES.—In a neat catalogue-price list just issued the D. & W. Fuse Company, Providence, R. I., displays in illustration a full line of non-arcing fuses and safety devices for alternating, power, railway, lighting, telephone and fire-alarm circuits. The list includes this company's indicating cartridge fuse, the indication of a blown fuse being the appearance of a burned spot in the center of a circle; service switches and boxes; subway boxes; fuse terminals, etc. The price-list gives the prices of every size in the different classes. This company's business is rapidly increasing, to better care for which it has recently enlarged its manufacturing plant to double the former capacity.

THE WESTERN ELECTRICAL SUPPLY CO., of St. Louis, has recently got out two very attractive catalogues of seasonable articles. One of them illustrates a most complete line of electrical toys and small motors and dynamos. While these are toys, they are perfect miniature reproductions of large apparatus, and are mechanically and electrically perfect in every detail. There has been an increase of the demand for this catalogue, and the line of material illustrated would certainly seem very meritorious. The company has also issued a new catalogue on miniature incandescent lamps and fittings, showing an especially fine line of socketless, series lamps, which can be used to great advantage in decorating rooms and trees for Christmas. It is mailed on application.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 9, 1902.

[Conducted by [illegible], Patent Attorney, [illegible] N. Y.]

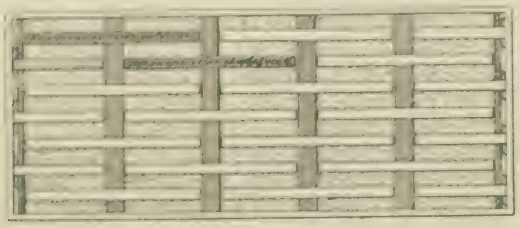
[illegible] [illegible] CONTROLLERS FOR ELECTRIC MOTORS; [illegible] App. filed [illegible] The [illegible] [illegible] by a [illegible] [illegible]

715,236. BOOSTER SYSTEM; G. Baehr, McKeesport, Pa. App. filed Feb. [illegible] A [illegible] with the armature of a shunt-motor whereby an increase in the load on the motor will cause a proportionate increase in the strength of the field of the generator.

715,265. THERMO-ELECTRIC PILE; A. Heil, Frankfort-on-the-Main, Germany. App. filed April [illegible] [illegible] that [illegible]

715,281. ELECTROLYTIC APPARATUS; Joseph Matthews, of Kings Heath, and William Davies, of Selby Park, England. App. filed March 29, 1901. An inner tank of perforated insulating material contains a revolving drum provided with a number of radiating arms passing through an outer surface of insulating material. The arms slowly carry the tin-scrap through the tank while it is being electrolyzed.

715,291. SYSTEM OF CONTROL FOR ELECTRICALLY PROPELLED VEHICLES; W. B. Potter, Schenectady, N. Y. App. filed April 8, 1899. The system comprises motor controllers operated by air pressure which is



715,413.—Storage Battery.

electromagnetically controlled and the arrangement is such that the controllers operate the motor circuits while the train is being driven and the brake circuit while it is being retarded.

715,299. ELECTRIC ELEVATOR; H. Rowntree, Chicago, Ill. App. filed Nov. 29, 1899. A push button system wherein the car can be automatically brought to any floor without interference from the operation of buttons at other floors.

715,313. PROCESS OF FORMING ELECTRIC CONDUCTING CABLES; R. Spaulding, New York, N. Y. App. filed May 3, 1902. The conductor is first formed into a tube by braiding together bare wires and is afterwards flattened, covered and given a rectangular shape.

715,327. RHEOSTAT; F. C. Watson, Philadelphia, Pa. App. filed April 2, 1902. A casing containing a number of lamps and a resistance coil, the latter having its convolutions projecting through an opening in the casing so that a contact finger can be moved across them.

715,329. RAIL CHAIR AND INSULATOR; W. D. Young, Baltimore, Md. App. filed Oct. 18, 1901. A chair for third rails having a dove-tailed opening for the insulator and side arms for supporting the guard rails.

715,332. ACCUMULATOR ELECTRODE; R. Alexander-Katz, Berlin, Germany. App. filed Aug. 31, 1899. Details.

715,334. ELECTRIC SAFE LOCK; J. M. Allen, St. Louis, Mo. App. filed June 7, 1901. A door without hinges or external handles is held in place by internal bolts controlled by electro-magnets. A handle in the form of a [illegible] magnet [illegible] to the front of the door at a certain point to complete the circuit of the internal magnets, which releases the bolts; the external magnet can then be used as a handle by reason of its sticking, to remove the door.

715,343. ACCUMULATOR; F. N. Blanc, Paris, France. App. filed Feb. [illegible] The support consists of Aluminum electroplated with copper and covered with metallic lead.

715,347. TELEGRAPH; J. E. Carney, Montgomery, Ala. App. filed May 27, 1901. Details of a non interfering box.

715,375. INSULATOR; M. Harloe, Hawley, Pa. App. filed May 9, 1902. (See page [illegible])

715,412. STORAGE BATTERY; L. Paget, New York, N. Y. App. filed Sept. [illegible] [illegible] is used as a filling between the plates on account of its being light and having great absorbent properties.

715,413. STORAGE BATTERY; L. Paget, New York, N. Y. App. filed Aug. [illegible] A [illegible] storage battery having plates extending [illegible] from one cell to another with the [illegible] conducting connection between the cells formed by the active material.

715,415. ELECTRIC TROLLEY WIRE HANGER; A. Palmros, Columbus, Ohio. App. filed Sept. 24, 1897. A bracket supporting a pair of shear [illegible] which grip the wire.

715,428. ELECTRICAL CONTROLLER; J. L. Schureman, Jr., Chicago, Ill. App. filed [illegible] A power switch [illegible] a [illegible] arrangement whereby the circuit breaking switch is moved a certain distance and then released to allow the resistance controller to move.

715,434. ELECTROMAGNET; A. [illegible], Chicago, Ill. App. filed Jan. 2, 1902. (See page [illegible])

715,455. SANITARY ATTACHMENT FOR TELEPHONE TRANSMITTERS; H. [illegible], Buffalo, N. Y. App. filed May 23, 1902. (See page [illegible])

715,505 and 715,506. ELECTRIC FURNACE; H. N. Potter, New Rochelle, N. Y. App. filed [illegible] (See page 1004.)

715,507. TUBULAR ELECTRIC FURNACE; H. N. Potter, New Rochelle, N. Y. App. filed Feb. 7, 1902. (See page 1004.)

715,508. ELECTRIC FURNACE; H. N. Potter, New Rochelle, N. Y. App. filed March 27, 1902. (See page 1004.)

715,509. END SUPPORT AND CIRCUIT TERMINAL FOR CARBON TUBE FURNACES; H. N. Potter, New Rochelle, N. Y. App. filed March 28, 1902. (See page 1004.)

715,511. SNAP SWITCH; H. E. Reeve, Brooklyn, N. Y. App. filed Feb. 12, 1902. Details of a pole switch.

715,528. FUSE BOX; M. R. Utley, Chicago, Ill. App. filed May 13, 1901. A box having a lining of installing material in which the fuse is mounted and having certain grooves and spaces to shed water.

715,537. COMPOSITE SYSTEM OF ELECTRICAL TRANSMISSION; F. Bedell, Ithaca, N. Y. App. filed March 20, 1900. (See page 1005.)

715,545. GENERATING ALTERNATING CURRENTS; C. S. Bradley, Avon, New York. App. filed June 22, 1896. (See Current News and Notes.)

715,546. GENERATING ALTERNATING CURRENTS; C. S. Bradley, Avon, New York. App. filed April 23, 1902. (See Current News and Notes.)

715,555. ELECTRIC SIGN; L. S. Crandall, Brooklyn, N. Y. App. filed Aug. 30, 1902. The sockets for the lamps can be filled by ornamental plugs to adapt the structure for a day sign as well as a night sign.

715,618. VENTILATED MAGNET COIL; W. Spencer, Jr., Schenectady, N. Y. App. filed May 23, 1902. A coarse helix with spaces between the convolutions, is wound next to the core to permit air to circulate therein.

715,625. PROCESS OF OBTAINING METALLIC ALUMINUM OR OTHER METALS BY ELECTROLYSIS; G. Taddei, Turin, Italy. App. filed July 17, 1901. (See page 1004.)

715,626. APPARATUS FOR OBTAINING METALS BY ELECTROLYSIS; G. Taddei, Turin, Italy. App. filed Dec. 13, 1901. (See page 1004.)

715,643. CARBON GUIDE FOR ELECTRIC LAMPS; W. J. Deming, Murphysboro, Ill. App. filed July 12, 1902. Details.

715,650. ELECTRICAL MASSAGE APPARATUS; O. A. En Holm, New York, N. Y. App. filed March 20, 1902. Details.

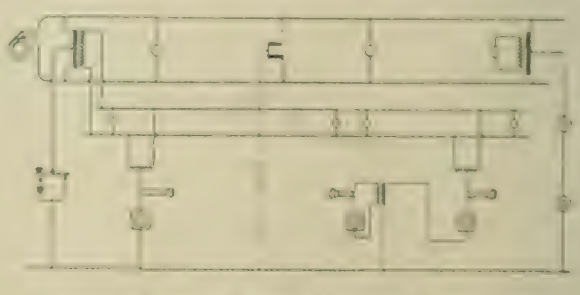
715,654. GRAVITY ELECTRIC BATTERY; A. M. Friend, Denver, Colo. App. filed June 8, 1901. A porous horizontal diaphragm is inserted between the upper and lower electrodes to act as a filter.

715,677. ELECTRIC ROLLER; C. J. Marius, West Hoboken, N. J. App. filed Feb. 6, 1900. A generator located inside of the roller supplies a current thereto while the roller is moved over the surface of the body in massaging treatment.

715,683. ELECTRICAL CALL BELL; W. E. McCormick, Chicago, Ill. App. filed Dec. 16, 1901. (See page 1005.)

715,684. ANODE; Frank McDonald, Johnsonburg, Pa. App. filed May 20, 1901. The anode comprises a tube or cup containing mercury, and a number of thin strips of platinum foil with one end sealed within the tube; a conductor enters the top of the tube.

715,686. ELECTRIC TELEGRAPH; T. D. Penniman, Baltimore, Md. App. filed Jan. 9, 1902. Intelligence is transmitted by sending over the circuit



715,537.—Composite System of Electrical Transmission.

a succession of impulses separated by spaces and substituting spaces for impulses and impulses for spaces in combinations to form the characters of a code.

715,689. ELECTRICAL SWITCH; C. D. Platt, Bridgeport, Conn. App. filed Aug. 19, 1902. The clips have V-shaped bases which fit into similarly shaped notches in the insulating block upon which the switch is mounted.

715,696. SYSTEM OF TELEGRAPHIC DISTRIBUTION; H. A. Rowland, Baltimore, Md. App. filed Dec. 11, 1901. A telegraph line having central stations at each end and one or more sub-stations from each central station which are connected thereto by a circuit relayed from the main line.

715,702. SYSTEM OF AND APPARATUS FOR CONTROLLING LIGHT EFFECTS; R. F. Spangenberg, New Orleans, La. App. filed Nov. 18, 1901. A machine by which the sliding colored screens can be manipulated by power to produce various effects for theatrical purposes.

715,714. TROLLEY FOR ELECTRIC RAILWAY CARS; L. E. Walkins, Springfield, Mass. App. filed Jan. 9, 1900. The trolley is hinged to the car and trails, so that it can raise and lower to compensate for inequalities in the conductor.

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NEW YORK, SATURDAY, DECEMBER 27, 1902.

CONTENTS.

ATLANTIC AND PACIFIC TELEGRAPHY.

Mr. Marconi, by dint of the steady persistence that alone enables genius to achieve great results, has now succeeded in transmitting wireless telegraph messages across the Atlantic, between the Canadian Government and King Edward, as well as between himself and the King of Italy. Nothing is lacking to the authenticity of the notable event. This December it is not possible for doubting cynics to challenge the deed as they did the transmittal of the "s" one year ago, or as they also did the existence of the "mythical De Sauty" in the grand old days of pioneer submarine cable work. We do not know whether Mr. Marconi so planned it or not, but to us it is an extraordinary coincidence that the very week that saw the landing at San Francisco of the shore end of the Commercial Pacific cable, and the very month that witnessed the completion of the British Pacific cable, should have recorded this splendid feat of sending etheric messages across the Atlantic. "Thus God fulfils himself in many ways, Lest one good custom should corrupt the world," and so the advance in electrical discovery and application goes on. With Mr. Marconi himself we are far from expecting to see the submarine cable annihilated as a means of communication. It is true that land telegraph lines were being run across Alaska and Siberia at the moment the Atlantic cable succeeded, and have never since been completed; but it would often have been an excellent convenience had they existed. When wireless telegraphy has worried through all the difficulties that still beset it, we may expect a great increase in transmarine telegraphy and a proportionate reduction not possible in the rates while submarine cables are the sole dependence. If 1902 had no further claim to remembrance, this wireless record of its closing month will forever signalize the date in the annals of our race and its civilization.

THE BATTLE OF THE ROADS.

A bill has been introduced in the United States House of Representatives authorizing the appropriation by the Federal Government of the sum of twenty million dollars to build good roads throughout the country. This measure, put forward by Mr. W. P. Brownlow, of Tennessee, a State whose roads are probably as atrocious as those of New York or Illinois, proposes that a Bureau of Public Roads of the Department of Agriculture shall have the spending of this money, co-operating with the road authorities in the various States to secure the beneficial result of furnishing the public with thoroughfares that shall not only be directly useful but shall serve as exemplars.

The proposal to spend so large a sum will naturally arouse criticism and provoke opposition, but it is certainly high time that every authority in the land was enlisted in the effort to improve these arteries of commerce and intercourse, just in the same manner as the River and Harbor bill, in spite of some errors, makes appropriations without which most of our ports and tidal ways would become unnavigable. To-day the French lead the world in automobilism, not because they are any whit superior to us in ingenuity and mechanical ability, but because their governments throughout an era of great steam railroad development have not allowed a superb highway system to degenerate. Hence in the remotest rural commune, the automobile has as smooth a path as on any of the Paris avenues radiating from the Arc de Triomphe. If ever the electric automobile is to succeed it will need better roads, and thus

[illegible] turers are touched by this proposed legislation. Such a striking measure of internal improvement should give us roads nearly as good as those over which Cæsar's legions swept easily from one confine of the Empire to another, two thousand years ago. Even if the sum proposed is not secured, it is reasonable to hope that the National Government will be enabled to join hands and forces, to some extent, with those who in New Jersey, New England and elsewhere are making straight and smooth the paths of the farmer and the automobilist. We are glad to know that that conservative but progressive body, the Automobile Club of America, is giving the measure its judicious and vigilant support.

THE THIRD RAIL AND SLEET IN CHICAGO.

The recent serious trouble experienced by the Manhattan Railway Company in New York with sleet on the third rail has aroused such apprehension in the minds of some people in regard to the advisability of third-rail electric traction for any heavy railroad work, that it is opportune to call attention to the fact that Chicago elevated roads are now troubled but little with sleet. It was several years before methods were evolved and apparatus perfected for successfully battling with what is probably the most serious difficulty a third-rail electric road has to contend with. Although sleet storms are not numerous in Chicago, they come occasionally with great severity. During the past three years there has been no storm that has seriously interfered with elevated traffic in Chicago.

The different companies do not entirely agree in the methods used, but the whole situation may be summed up by saying that plenty of brushes and scrapers are provided, and they are ready for use promptly during the entire season. One road uses steel wire brushes, bearing on the rail both in advance and in the rear of each contact shoe. These steel wire brushes have flat bristles, and will take care of any moderate sleet storm. The brushes are kept ready for use on each car, but, of course, are only brought in contact with the rail when necessary. Occasionally a sleet storm occurs which is too much for the brushes, and for an emergency of this kind the cars on this road carry steel scrapers, which are used in addition to the brushes. These scrapers are made of a single piece of sheet steel. Another elevated road in Chicago uses instead of brushes a scraper, which is somewhat in the nature of a brush, in that it has a back of cast iron, into which a number of steel plates corresponding to the bristles of a brush are cast. This scraper-brush rests on the third rail, being held down by a spring of considerable flexibility. Of course, the wear is rapid, but as they are not in service much of the time, that is of minor importance, in comparison to keeping the road in operation during a sleet storm.

Part of the trouble of the Manhattan Railway seems due to the use of a guard, or trough, in which the third rail is placed. One of the Chicago roads, when first adopting a third rail, put on a trough of this kind, but abandoned it because of the excellent space it formed for the collection of snow and sleet. Taken altogether, as we asserted last week, there is no ground for serious alarm about the practicability of the third rail in sleet storms. If the New York Board of Health would permit the removal of the guards on the Manhattan Railway short rail, it would no doubt facilitate the operation of the road in the sleet and snow storms very much. It is probably not far from a correct estimate to say that more lives would be lost indirectly in the city of New York in the course of a year through exposure during delays in the elevated traffic, caused by the presence of this third-rail guard, than would be lost through shocks or burns received by employees working on the structure. The frightful discomforts now endured by the New York public means sickness and death to many persons of feeble health. Of course, all overhead wires crossing the track would have to come down. They ought to be down, anyhow.

THEORIES OF MAGNETISM.

In an article which appeared last week Dr. Zacharias presented a particular magnetic theory, according to which magnetism is to be regarded as analogous to hydrostatic pressure. Moreover, it would appear that according to the views propounded, an iron shell enveloping a magnet intercepts the pressure in some manner, and produces remarkable phenomena. To judge by the concluding paragraph of the article, the author of the theory seems to be timorous of launching suddenly upon an unprepared world the violence of this revolutionizing conception. We hasten to assure him, however, that he need have no fear. If there be any truth in the hypothesis he suggests, it will not shatter the pinnacles of the temples of science; nor leave the esoteric world in sackcloth and ashes.

Furthermore, heretical as it may be, we do not see anything in the theory as stated in the article. In the first place, Ampere's theory of magnetism we believe to be a mere working hypothesis, and not a cardinal article of physical belief. We think that few persons, if any, believe that within the molecules of iron actual electric currents perennially circumambulate. But it is quite conceivable that in the atom of iron there are electrified ions performing mutual orbital revolutions about a common electric center of attraction, and such revolving ions would, according to existing theories—the experiments of M. Cremieu notwithstanding—be electrodynamically equivalent to small active electric circuits. In such a manner, Ampere's hypothesis might be promoted from the condition of an interesting mathematical speculation to that of a reasonable physical theory of inherent molecular magnetism.

In regard to the cylindrical electromagnet, in so far as its phenomena are correctly described, these phenomena are satisfactorily accounted for by the existing theory of the magnetic circuit. Some of these phenomena appear to be incorrectly described in the article. If the article is right, then it is of the greatest importance that the discrepancies should be revealed for the sake of experimental science, rather than for the sake of magnetic theory. But until adequate experimental proof is forthcoming, they seem to lie in a slough of inaccuracy. For instance, it is hopelessly inaccurate to say, as the article says, that the addition of the cylindrical shell in such a magnet increases the strength of the magnet from 30 to 36 times. The statement might be correct for the strength of some particular magnet and shell, at some particular distance, measured in some particular way. But one might just as well say that putting a man on a pair of stilts increased his height 1.53 times. Altogether, this "pressure" theory of magnetism has not sufficient weight to convince one.

THE UNDERWRITERS' ANNUAL MEETING.

The annual meeting of the Underwriters' National Electric Association was held in New York on the 9th of December, as already noted. This is the association which, with the aid and endorsement of various engineering institutions, has compiled and adopted the National Electrical Code. The Decalogue contains ten commands usually starting with the imperative "Thou shalt not." The National Code is an improvement, containing about four hundred commands, usually involving the injunction: "Thou must not." An aggregation

of four hundred must-nots is sadly depictive of human nature in connection with untrammeled electrical contracts and installations. An intelligent being arriving for the first time on this planet from another sphere, and reading the National Code, would be apt to become convinced of the utter depravity of electrical constructors. The pages of the code suggest the "eternal nay" of the universe as interpreted, during fits of indigestion, by Carlyle; or the mental attitude of the nursemaid, who told the child immediately beneath her orderly eye, to go out of doors to see what the other children were doing, and to tell them "they mustn't."

Nevertheless, it must be admitted, in all seriousness, that the musts and the must-nots of the National Electrical Code are essentially salutary and beneficent. Electric lighting, when properly introduced, is safer to property and person than gas or oil lighting, besides being more salubrious and convenient. But electric lighting carelessly introduced may be dangerous to property and to person. As long as a man builds himself a house far from his neighbors, and carries his own insurance, there is no desire on the part of his neighbors to dictate the conditions under which he shall install his house wires or fixtures. He may hang a naked arc lamp amid gauzy window curtains, or lead a 1,000-volt circuit through twin flexible cord conductors lashed to the gas pipes. But when he asks his neighbors to insure his house against destruction by fire, his neighbors have a right to declare that his premium for insurance shall be heavy unless he adopts approved fixtures and methods of wiring. It is inevitable that insurance shall necessitate the right to dictate the physical conditions under which the minimum rate shall be assessed.

Much, therefore, as the electrical contractor may resent the interference of the fire underwriters, yet it is better for him to accept the inevitable gracefully and to recognize in the interference a blessing in disguise. For the reduction of fire hazard in all electric installations by following prescribed methods, tends to accelerate the development and spread of electrical industry; while, obviously, the courting of the fire fiend by careless and cheap construction, tends to create apprehension in the public mind. Moreover, the public fear once aroused, with or without raised insurance rates, is far more blind, unreasonable, and difficult to allay, than the censure of the underwriters' experts. Consequently, the censure-dealing underwriter is really the guardian angel of electric enterprise unawares. Turn him ruthlessly out of the door and the municipal heeler armed with boss-bidden ordinances is likely to come in through the roof. The hostility that some central station managers evince towards the National Electrical Code and its framers is futile and must be nugatory in result. It is far better to join hands with the Underwriters' National Electrical Association for the joint purpose of encouraging the most widespread and safest plans of applying electricity in houses. Whenever a rule is unduly severe, it should be brought up under joint discussion for redress. But all reasonable rules should be enforced as far as possible.

Brakes and Braking.

The two Institute papers by Messrs. Parke and Keiley, respectively, form together an admirable compendium of the art of braking in theory and in practice. We could wish that the practical effect of bad track and worn brakes had been pushed to an experimental conclusion, but one cannot expect every condition to be taken up in a brief paper, and it is at least as important to know what is the best result that can reasonably be expected. Mr. Parke's paper is an excellent summary of the principles of braking in general with especial reference to the lapses from theoretical efficiency due to misplacement of the brake mechanism and to improper distribution of the brake pressure on the front and hind wheels of a truck. Mr. Keiley supplements this by an [illegible] actual performance of brakes on fast-running electric cars as found in ordinary electric railway practice. It has long been known that the effective braking of electric cars has proved very difficult, and the long succession of serious accidents which have appalled the public in the last year or two, has served to call forcible attention to the problem. Braking electric cars indeed is far more difficult practically than braking ordinary railway trains, by reason of the frequent necessity for emergency stops to avoid collision with the vehicles or persons excluded from ordinary railway tracks.

The fundamental principle of practical braking is to take up at the brake shoes all the energy possible without causing the wheels to skid. The moment skidding begins not only is the wheel damaged by flatting, but effective braking ceases; so that the art of efficient braking demands that the brake pressure should be kept at all speeds just below the point where further resistance to rotation would produce skidding. This practically means a gradual reduction of the pressure as the car slows down, a feature automatically secured in some of the latest types of air brakes and electric brakes, but very difficult to attain in hand brakes. Actual braking effects can readily though approximately be calculated from the known coefficients of friction between wheel and rail and wheel and brake shoe. This is done in Mr. Parke's interesting paper. It is there shown that in principle it should be possible by the use of sand in bad weather to reach a negative acceleration of just about one-fourth of gravity without skidding the wheels. Now in actual practice this figure is never anywhere nearly reached nor should it be, for it amounts to a reduction of speed of very nearly 5½ miles per hour per second. This is nearly double what is permissible on the score of safety to the passengers, so that we need not regret the evident failure to reach ideal conditions. To tell the truth, a word needs to be spoken on the dangers of too great acceleration both positive and negative, as anyone who has ridden much on some modern electric lines knows to his sorrow. It looks much as if any material increase in brake efficiency would have to be followed by putting the passengers into padded compartments.

Mr. Keiley takes up the practical side of the matter as applied to electric cars, and by a very ingenious apparatus secures accurate automatic records of the action of various types of brakes. In the paper the actual performance of modern hand brakes and of five varieties of power brakes are recorded, and the curves obtained are worth detailed study. Broadly considered, they show plainly that for speeds higher than eight or ten miles an hour, hand brakes are so ineffective that using them implies wilful neglect of the safety of passengers. At fifteen miles per hour a car weighing eighteen tons, loaded, required 150 feet to stop after brakes were signalled—a distance far too great for safety. The best power brakes would bring the same car to a stop in half the space. As between the various power brakes, there were rather large differences, but all were much better than the hand brakes. At low speeds, say eight miles per hour, the hand brakes were relatively better in performance, but were even then hardly adequate. The weakest point of all the brakes tried seemed to be ineffective distribution of the pressure as between front and rear wheels, and proper equalizing gear produced a great change for the better. Perhaps the most striking feature of the experiments was the demonstration of the general inadequacy of any and all braking arrangements to insure safety at the speeds now common on electric roads, unless the track can be kept free of obstructions. Heavy and fast-running cars must be treated along the lines that experience has laid out in practical railroading, irrespective of the motive power.

Exchange of Official Wireless Telegraph Messages Across the Atlantic.

Just a year after he jumped the famous signal "s" across the Atlantic in an experimental way from Poldhu, Cornwall, to St. John, Nova Scotia, Mr. Marconi has publicly succeeded in sending regular messages both ways. This feat will ever render memorable the year 1902 in electrical annals and may mark the definite beginning of wireless transmarine telegraphy as an enterprise. The work of a year ago has been fully recorded in these pages and more recently the work of Mr. Marconi at Glace Bay, Cape Breton, as well as on board the *Carlo Alberto* has been described and illustrated. The *Carlo Alberto* was placed at his disposal by the King of Italy and has been employed in experimental work off the Nova Scotian coast for some time, while the wire antennæ towers at Glace Bay have been under trial. These messages now noted are the first given out to the press, but it is understood that Mr. Marconi had already established all his methods and results before attempting such a veritable tour de force.

On Sunday, December 21, the following dispatch from Mr. Marconi, dated Glace Bay, N. S., December 21, was received at the office of the Associated Press in this city:

"I beg to inform you for circulation that I have established wireless telegraph communication between Cape Breton, Canada, and Cornwall, England, with complete success.

"Inauguratory messages, including one from the Governor General of Canada to King Edward VII, have already been transmitted and forwarded to the Kings of England and Italy. A message to the *London Times* has also been transmitted in the presence of its special correspondent, Dr. Parkin, M. P. G. Marconi."

At the same time, on Monday in London, the *Times* announced that it had received by post from Poldhu, Signor Marconi's receiving station in Cornwall, the following message, sent by wireless telegraphy, from the *Times's* special correspondent at Glace Bay:

"Being present at its transmission in Signor Marconi's Canadian station, I have the honor to send through the *Times* the inventor's first wireless transatlantic message of greeting to England and Italy."

Mr. Marconi also notified Lord Minto, Governor General of Canada, of the achievement and received the following acknowledgment by telegraph from Ottawa:

"Delighted at your message just received. Warmest congratulations on your splendid success. Minto."

Sir Richard Cartwright, Acting Premier, has cabled to England congratulating the British people on the new method of communication between the two countries. A special Marconigram was also sent from Glace Bay to the King of Italy, who immediately forwarded a congratulatory reply to Mr. Marconi.

Replies to messages sent by the Marconi system across the Atlantic were received at Glace Bay on December 22. The inventor was pleased to get one from King Edward VII, which read:

"I have had the honor of submitting your telegram to the King, and I am commanded to congratulate you sincerely on the successful issue of your endeavors to develop your most important invention. The King has been much interested in your experiments, as he remembered that the initial ones were commenced by you on the royal yacht *Osborne* in 1898. Knollys,
"Private Secretary."

The King's reply to Lord Minto's message, sent by wireless telegraphy, was received at Ottawa on December 22 by cable as follows:

"I am much interested by the wireless message which you have sent me and am delighted at the success of Signor Marconi's great invention, which brings Britain and Canada into still closer connection. Edward *R.*"

Mr. Marconi is quoted as follows in the *New York Sun* of December 23 as to his great feat:

"When did I first succeed in transmitting messages from Table Head to Cornwall? It was about a month ago. The first messages were all in code and were simply queries such as 'How is this?'

"We would have been in a position to transmit messages much sooner but for delays in obtaining machinery of all kinds. We are, as you can readily see, a good deal out of the world here, and often we had to send as far as Montreal for parts of machinery. This, of course, delayed us greatly. Even after the first message was sent a slight defect was found in one of the instruments and it required two days to remedy this.

"I cannot tell you definitely when we will have our stations ready for commercial purposes. All that is required here is a little organizing, which is merely a matter of a short time. Some time ago, however, the English Government, which controls the telegraph system of the United Kingdom, refused to make connections with the Poldhu station, and this, of course, will have to be done before we can do successful commercial business.

"It was rather amusing," said Marconi, "for us to read rumors of failure in the papers just at the time that our experiments were reaching successful conclusions. Yes, the *Carlo Alberto* sailed yesterday, but it was not before her object in being placed at my disposal had been accomplished and messages had been sent from her commander to the Italian Government during night before last.

"I will remain at Table Head for a short time and then proceed to the Cape Cod station, and from there to Cornwall, to make arrangements for opening for commercial purposes."

Mr. Marconi has sent a telegram to Premier Bond, of Newfoundland, setting forth the complete success of his experiments looking to the transmission of wireless messages between Cape Breton and England. He says he remembers with gratitude the encouragement he received from Newfoundland a year ago, and that he regrets the action of the Anglo-American Telegraph Company made it impossible for him to profit from the colony's attitude.

In his reply to Mr. Marconi, the Premier expressed the hope that when the charter of the Anglo-American Company expires, in April, 1904, Mr. Marconi will establish a fixed wireless station there.

The staff at present at Table Head are Marconi, R. N. Vyvyan, managing engineer for Canada and the Marconi company, and his two assistants, F. S. Stacey and F. Taylor, and two of Marconi's personal staff, P. W. Pagett and G. S. Kemp.

Important Electrical Combination in Germany.

Rumors have been current for some little time past as to a proposed combination of some of the leading electrical manufacturers in Germany, and note has been made of these reports in our columns. A cable dispatch from Berlin of December 22 now makes the following important announcement: The Allgemeine Elektricitaets Gesellshaft, with $22,125,000 capital in bonds, and the Union Elektricitaets Gesellshaft, having $85,000,000 capital, have reached an agreement amounting to a practical consolidation, the directors of each company being elected members of the board of the other, so that the management is identical, though the companies nominally remain separate.

The step is the result of the crisis in the German electrical industry. After the subsidence of the great boom in electrical companies it was found that the manufacturing capacity had far outrun the market's demands, hence various efforts had already been made to organize a combination after the method practiced in America. The Allgemeine took the lead in this effort, but in early negotiations found that most of the other companies demanded too high a rating in the proposed combination. The first offer was made to the Schuckert Company, of Nuremberg, which surprised the country last summer by announcing sensational losses through the shrinkage in value of its securities and plant.

The Allgemeine attempted to secure control of the Schuckert business through a group of great Berlin banks which back the Allgemeine. The banks contemplated effecting a practical combination of the two companies by extending financial support to the Schuckert. The negotiations came to nothing through the refusal of the Schuckert directors to accept the terms offered. The Allgemeine then entered into negotiations with the Union, which were conducted so secretly that the announcement to-day took the market completely by surprise, and its publication caused a rise in Electricals, Allgemeine gaining 6½ and Union 2⅓ points. The Union owns the Thomson-Houston patents for Germany and neighboring countries. The technical manager of the combination is an American, Mr. Louis Magee.

The combination's greatest rival, the Siemens & Halske Company, capitalized at $23,250,000, held its annual meeting to-day and declared a 4 per cent. dividend, against 8 per cent. in 1901. The company's report says of the combination that the Siemens & Halske Company is able to go on alone, but after the situation has cleared up a combination may seem feasible.

Experimental Test of the Pupin System of Long Distance Telephony.

By F. Dolezalek and A. Ebeling.

THE Siemens & Halske Company, assisted by the German Imperial Post and Telegraph Bureau, have made a series of elaborate experiments to ascertain the effect of the addition of inductance coils to telephone circuits according to the Pupin system, and the results obtained were so favorable that the Siemens & Halske Company decided to take up the European rights to the Pupin patents. The following investigations were made in order to obtain actual figures with which to test improvements upon which the invention is based.

The initial tests demonstrated, that with the same conductor, i. e., with the same expense, it is possible to telephone over a distance four times greater than is at present possible; and that it would be possible to establish excellent telephonic communication between cities as widely distant as Paris and St. Petersburg, Berlin and London. For shorter lines the use of the system involves, of course, a very considerable increase in economy.

Dr. Pupin has shown in his calculations that locally inserted inductance reduces the damping constant in the same way as a uniformly distributed inductance, when the distance between the inductance sources covers a fractional part of the wave length of the alternating current transmitted over the circuit. This fact is the essential point of the Pupin invention; the tests showed improvement of the speech transmission efficiency of a circuit through the introduction of inductance coils. It being possible to perform readily laboratory experiments with a cable, the Siemens & Halske Company made extensive experiments by this means. The results obtained were such as to encourage the repetition of these experiments on a practical scale.

Through the kind assistance of the German Imperial Post & Telegraph Bureau, who recognized the importance of experiments of this nature and showed great interest in the same, it was possible for the Siemens & Halske Company to perform two series of investigations, one with a cable between Berlin and Potsdam, and the other with an overhead circuit between Berlin and Magdeburg.

The cable between Berlin and Potsdam was manufactured by the Siemens & Halske Company, and laid several years ago for the Imperial Postal Administration. Its object was to relieve the poles between the two cities and take care of the suburban service. It is 20 miles long and consists of 28 double circuits of copper wire 1 mm thick. The copper conductors are insulated by the paper method customary with Siemens & Halske. The cable is laid as a ground cable between Potsdam and the city limits of Berlin, and for this distance it is armored with lead and asphalt. In the city of Berlin it is drawn through the network of conduits as a lead armored cable without asphalt covering.

Fourteen of the double circuits of the cable were placed at the disposal of the Siemens & Halske Company, for the purpose of the experiment. The other 14 were to remain in their original condition. This fact was of great importance for the experiment, as it enabled the investigators to make comparisons between an equipped and an unequipped circuit of same length and otherwise same conditions, with great facility. As the cable was not to be injured in any way, the inductance coils could only be inserted at the manholes. This condition limited the distance of separation. It was decided to use every second manhole, making the distance between induction coils about 4,000 feet.

Each coil had a resistance of 4.1 ohms, being the same for the sending as for the return wire, and an inductance of about .062 henry. The resistance of one mile of line, including coils, was about 37.8 ohms and the capacity had a value of about .059 microfarads per mile. These values give for the dampening factor, according to Prof. Pupin's simplified formula, .01.

The inductance of the normal circuits was measured by means of an alternating current of 900 p.p.s. and was found to be .0005 henry per mile. The resulting dampening constant of the normal cable was, therefore, .06 at 900 p.p.s. Hence, by the introduction of inductance coils the self-induction was increased two hundredfold and the dampening factor reduced to one-sixth.

With this large reduction of the dampening factor a great improvement in the speech transmission efficiency of the line was to be expected and was actually obtained. Comparing the two circuits of the Berlin-Potsdam cable, each 22 miles long, one equipped with the Pupin coils and the other a normal circuit, a most decided difference in loudness was noticed. With the unequipped line speech was not intelligible 20 inches distant from the receiver, whereas over the equipped line it was clearly heard at the opposite end of the room, a distance of 40 feet from the receiver. A Siemens microphone of the type installed on the Imperial post and two Helles cells were employed for these experiments.

There being at the disposal of the investigators fourteen equipped and regular lines, it was possible to increase the length of the line by joining several circuits. Joining 3 lengths of line in this way gave a circuit 66 miles long. Comparison of two circuits of this length, one with coils and the other without, gave results even more marked than when only 22 miles distance was talked over. While it was possible by means of the equipped line to clearly understand speaking even at a considerable distance from the receiving apparatus, the speech transmission limit was almost reached with the regular line.

Joining 5 lengths of cable gave a circuit 110 miles. A trained ear could just detect a sound from the receiver diaphragm connected with the normal circuit, while with the line containing inductance coils a very clearly intelligible transmission was possible.

Almost the same loudness was obtained over five lengths of equipped line 110 miles long as over one length 22 miles of normal line. Intelligible transmission was obtained even over thirteen lengths, or 286 miles of equipped line, but the volume of sound was very small.

An overhead line, between Berlin and Potsdam, of 2 mm bronze wire and of the same length as the equipped line was next compared with the latter. The loudness of speech in both circuits was very nearly the same. The state of the weather had some effect in varying the result a little, in clear weather tending to increase the loudness of the overhead circuit, while in bad weather it was the cable circuit which was the louder. This result deserves special notice, as it was possible by equipping a cable with the Pupin system to obtain the same results as with an overhead line 2 mm in diameter and four times the cross section. Theoretical calculations show that this result was to be expected.

The coil equipment was a very simple one. The fourteen coils were placed in an iron case and their terminals led to a manhole where they were connected to the different circuits of the cable. The cases were then filled in with insulating material.

The cable experiments having proved a success, the Imperial Postal administration then placed at disposal of the Siemens & Halske Company a 2-mm bronze wire overhead circuit, connecting the cities of Berlin and Magdeburg and about 93 miles in length. The service is divided between six intermediate stations. This line could be compared with a 3-mm bronze wire circuit, used for the direct service between Berlin and Magdeburg and about 115 miles long. Before the equipment of the 2-mm line, the distinctness of speech transmitted over this line was, of course, not as good as that over the 3-mm circuit. The 2-mm line was then equipped with the Pupin coils, this being done without interfering with the service. A coil of .6-ohm resistance and an inductance of .08 henry was introduced at a distance of every 2½ miles. Upon the introduction of inductance coils the speech transmitted by the 2-mm line was observed to be much louder than that transmitted by the 3-mm line.

The previously described experiments with speech transmission are qualitative in their nature. To ascertain, also, the amount of reduction of the damping resulting from the introduction of inductance, loaded and unloaded cables were measured by means of an alternating current of small intensity, but high frequency; these are the conditions which are present in a practical telephone circuit. For this purpose alternating currents of 900 and 400 periods per second and a few milliamperes were sent through the cable, and the received current measured by means of a sensitive mirror dynamometer.

It was difficult to duplicate the theoretically calculated conditions whereby only the transmitter is permitted to contain impedance, as the measuring instruments had a perceptible self-induction of their own. It was, therefore, decided to adapt the method as far as possible to practical conditions. Hence, the receiving instrument was given nearly the same impedance, 4 henry and 400 ohms resistance, as that of the microphone. Fig. 1 shows a circuit of observations at 900 periods per second. The initial current in this, as in all the other measurements, was 3.38 milliamperes. As ordinate were plotted the received currents in milliamperes; the length of the

cable in kilometers was the abscissa. Lengths over 32.5 km were obtained by joining together several conductors of the cable. This was, practically, [illegible] between the different conductors [illegible].

Referring to the corresponding curves (Fig. 1), the received current at the end of the line containing inductance coils had a larger value than that at the receiving end of the normal cable. Both curves show plainly the exponential falling off predicated by the theory. A single length of cable, between Berlin and Potsdam, 22 miles long,

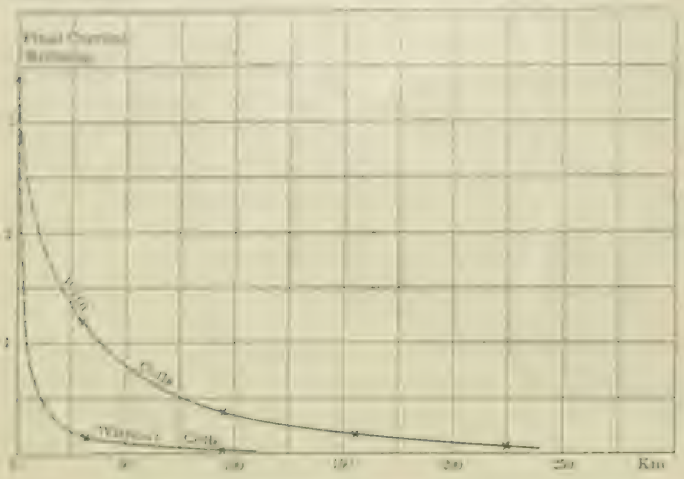


FIG. 1.—CURVES AT 900 P.P.S.

and equipped with the Pupin system, gave for the value of the receiving current 12 milliamperes; a similar normal cable .17 milliamperes. The received current of the former is thus seven times greater than the latter. According to the theoretical equation, the ratio between the receiving current of the Pupin cable and the normal cable rises extraordinarily in value as the length increases, so that with a length of 66 miles the speech transmission by means of a Pupin cable is forty-eight times better than with a normal cable.

The damping in case of the former with five lengths of cable is the same as with the latter, a result which agrees well with the experimental deductions. These results show the enormous superiority of the cable equipped with inductance over a normal cable.

Fig. 2 gives the results of analogous measurements at a frequency of 400 periods per second. The differences between an equipped and a normal cable are still considerable, although the damping in the normal cable is considerably reduced at low frequencies. Comparing Fig. 1 and Fig. 2, we see that the relation of the damping between frequencies of 800 and 400 p.p.s. of a Pupin cable is 1 : 1.6; of a normal cable, 1 : 6. The cable equipped with inductance coils transmits all sound waves approximately the same and this explains the exceptional clearness of the speech transmitted by this cable.

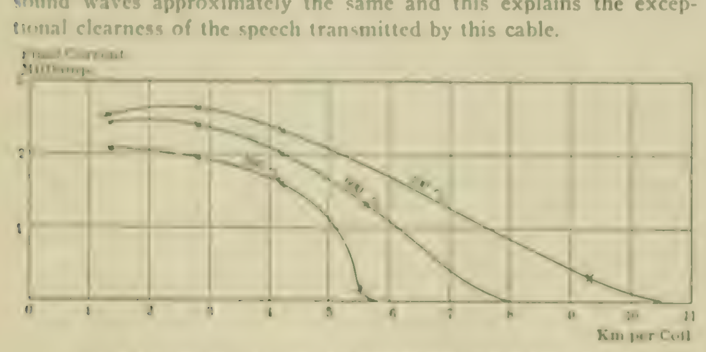


FIG. 3.—RECEIVED CURRENT AT END OF 17.4 MILE CIRCUIT.

The same method and instruments as employed on the cable were used in testing the 2-mm, 93-mile circuit between Berlin and Magdeburg. The circuit was tested before and after equipment. The initial current was again 3.38 milliamperes. The values of the receiving current at 900 p.p.s. are as follows:

93 miles long, 2-mm circuit, without coils..........	.53	milliamp.
do with coils..........	2.20	"
115 miles long, 3-mm circuit, without coils..........	.84	"

The experiments were performed with an insulation value for the lines of about 13.4 megohms per mile. By the introduction of inductance the value of the receiving current of the 2-mm line increased from .53 milliampere to 2.2 milliamperes, or fourfold, and thus considerably exceeded the value for the 3-mm line. The greater length of the 3-mm line is responsible for but a very small fraction of this difference. Naturally with longer lines, as was the result with cables, even far greater improvements can be obtained by the introduction of inductance.

To determine to what extent the current transmission is influenced by the insulation, measurements were made with insulations having different values. These showed that the insulation had a greater influence on the 2-mm line equipped with the Pupin system than on the 3-mm normal line, but even with its low insulation value of .62

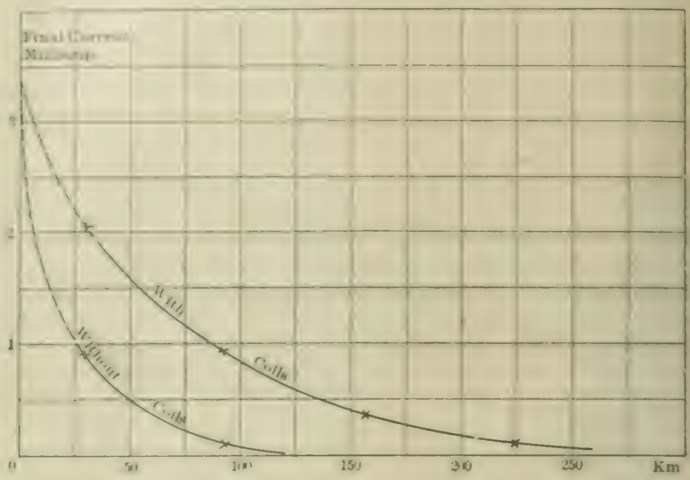


FIG. 2.—CURVES AT 400 P.P.S.

megohm per mile, the Pupin circuit was far superior to the 3-mm circuit.

From these measurements it follows that in long-distance transmission with the Pupin system it is possible to obtain, at least, the same efficiency with but one-quarter the weight of copper, or with the same weight of copper, to cover four times the distance.

The essential point of the Pupin invention is, as has been already mentioned, the fact that the added inductance coils are only effective in reducing the damping, when the distance between the coils covers a fractional part of the wavelength of the alternating current transmitted over the circuit. Increasing the distance between the coils brings in a reflection of the wave, while the damping increases rapidly and becomes even greater than that of the normal line.

Experiments on the effect of varying the distance of the coils were made with an ordinary paper insulated cable, 17.4 miles in length and having a copper conductor .8 mm in diameter. The alternating currents employed had frequencies of 980, 600 and 400 p.p.s. respectively. For all measurements the value of the inductance per mile was calculated, being 1.2 henry, and the capacity $C = .064$ microfarad. The resulting wavelengths in kilometers were as follows:

980 p.p.s., 12.9; 600 p.p.s., 21.0.

Twenty coils of .11 henry each were employed for the sending and

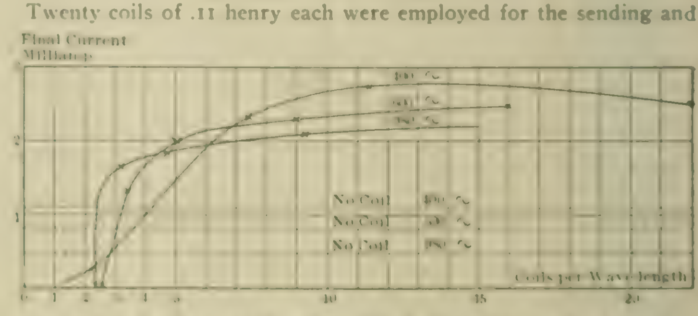


FIG. 4.—RECEIVED CURRENT FOR VARIOUS COILS PER WAVE LENGTH.

return circuit, and were distributed between 20, 10 and 5 points respectively. The total inductance was thus kept constant while the coil separation could be varied from 1.4 up to 10 km. The effective initial current was 3 milliamperes.

Fig. 3 gives the receiving current at the other end of the 17.4-mile circuit at the different frequencies, as a function of the distances between coils.

Beginning with a certain separation distance between coils, the values of the receiving current fall off rapidly, and the higher the frequency the more abrupt is the falling off.

With the distance between coils equal to 6 km and a frequency of 980 p.p.s., the alternating current was totally reflected. Even the most sensitive long-distance receiver was not able to detect any trace

of a sound. Alternating currents of 600 and 400 p.p.s. are completely choked when the inductance coils are separated distances of 8 and 10 km respectively. As the distance between coils increases, therefore, a successive filtering out of the different frequencies takes place. This was foreseen from the theoretical deductions.

Plotting the receiving current as a function of the number of coils per wave length the following results are obtained (Fig. 4):

Between 2 to 6 coils per wavelength, the received currents at all frequencies reduce to zero. With two coils per wavelength, therefore, we have reached a critical limit; a lesser number of coils will result in a complete choking out at all frequencies and hence make telephoning impossible. Concentrating the inductance at successive individual points gave very interesting results. Where properly inserted the inductances gave an exceptional clearness of speech; too large a separation of the coils resulted in a completely indistinct, confused noise.

These experimental tests demonstrate that the introduction of inductance coils into long-distance telephonic conductors in accordance with Pupin's invention, realize in practice the enormous effects indicated by theory; and as a consequence long-distance telephony is enabled to enter a new era of development. The problem of transatlantic telephony has through this invention become a possibility, even if the cost of an ocean cable of this kind be yet too high; and the technical difficulties accompanying the manufacture and laying of a submarine cable in great ocean depths with coils must be considered as exceptionally serious. But for the less considerable depths of the Mediterranean, North and Baltic Seas, the manufacture and laying of a Pupin cable presents no difficulty, so that there is nothing in the way of establishing direct telephonic communication between Berlin-London, Berlin-Copenhagen-Stockholm, etc.

December Meeting of American Institute of Electrical Engineers.

At the meeting of the Board of Directors of the American Institute of Electrical Engineers, held on Friday afternoon of last week, 52 associates were elected. At the regular monthly meeting two papers on railway braking were presented, notices of which appear below.

In introducing the papers, President Scott referred to the difficulty of the braking problems now being encountered in electric traction through the growing use of higher speeds and heavier cars. In electric service in elevated and underground city railways where stops are frequent and high schedule speeds are essential certain new elements have entered into the braking problem. Ordinarily brakes are for the purpose of facilitating traffic and preventing accident. The new feature of commercial value which has come into the problem is that of quick retardation. The run from one station to the next consists in acceleration, running at a sensibly constant maximum speed, and retardation. To increase schedule speed it is important to lessen the time of retardation as well as that of acceleration. This is a new demand. It presents a new point of view in braking problems which have not previously been of importance in regular service.

This is illustrated by the marked difference in schedule speed under average conditions such as prevail on the elevated railways of Greater New York between a low rate of braking and quick retardation. A change in the rate of retardation from 1 mile per hour per second to 3 miles per hour per second increases the schedule speed about 10 per cent. This effects a saving in time to the passengers of 10 per cent, and it reduces the number of trains required for carrying a given number of passengers by 10 per cent.

President Scott then gave a classification of brakes and described the main features of the different methods of electric braking, and pointed out the extreme flexibility of electricity in its application to problems of this kind; but the application of the braking effect in proper amount at the proper time and with a reliable method of control places very exacting requirements upon the designer of braking appliances.

In a paper entitled "Railroad Car Braking," Mr. R. A. Parke gave a sketch of the practical development of brakes in railroad service, which included an analysis of the results of investigation of brake-shoe friction; a definition of the requirements and limitations of brake efficiency in practice, and a consideration of the loss of braking efficiency through disturbance of the normal rail pressures by brake retardation, and the means of compensating for the same.

The paper discusses the data relating to friction, and gives formulas for calculating the several values necessary to be known in connection with braking. The design of a truck brake gear is briefly considered, and the conclusion arrived at that by the use of inside-hung brake beams, where sufficient inclination of the hanger links insures brake-shoe clearances through the action of gravity, both the expense and trouble due to the use of release springs is avoided. The latter portion of the paper is devoted to the magnetic brake, and the conclusion arrived at is that the efficiency of the magnetic brake under the various conditions of service is phenomenal, far exceeding that of any other brake for the retardation of trains; this, combined with the commercial advantage of dispensing with the use of trolley current, or any other means of heating cars, is considered to assure it a leading position in the railway operation of the future.

Mr. J. D. Kiely, in a paper entitled "Some Brake Tests and Deductions Therefrom," gives an account of braking tests with cars of from 15 to 25 tons weight (including passenger load) from speeds under 30 miles per hour. Full details of the methods of test are given, together with the formulas employed and the data obtained. A comparison of all the data, including costs, of several types of brakes showed that under certain conditions a very considerable amount per annum may be saved by the judicious selection of brakes. A practical result of the tests was the application of a system of differential levers to hand brakes, and another to power brakes; in the latter case the distance required to stop a car was reduced by approximately 18 per cent. through the use of non-equalizing levers applying to the front truck a braking pressure exceeding that applied to the rear truck in a certain predetermined ratio.

The discussion which followed was participated in by President Scott and Messrs. Mailloux, Stott, Lyford, Foster, Townley, Gotshall, Ries, Smith, Hammer, Franklin and Esty. The difficulty of laying down definite expressions to predetermine frictional effects was dwelt upon, especially by Mr. Mailloux and Prof. Franklin, the former as a result of a study of the practical data and the latter from a consideration of the nature of the phenomena entering. President Scott pointed out that the failure has been due to the application of mathematical methods without due consideration as to whether the assumptions they involved were justified by the nature of the phenomena. Mr. Townley cited a test made on the Boston elevated, where a three-car train running at a speed of 35 to 40 miles per hour had the emergency brakes applied with power lift on the motors; the result was that the train slowed down to 20 miles per hour and then maintained that speed, showing that with all the cars equipped it was not practicable to stop the train with brakes.

Mr. Townley favored placing the brake shoes of electrically equipped trains between the wheels, for the reason that with such an arrangement the brake-dust is thrown away from the electrical equipment, while with the brake shoes placed on the outside of the wheels. the reverse is true. Mr. Gotschall was of the opinion that more trouble will be experienced with the arrangement referred to than with outside brake shoes. He considered an explanation for the higher efficiency of the power brake is that it eliminates the motorman as a personal factor; hand brakes are set up a great portion of the time when power is on, while the motorman with power brakes throws off his power before setting the brakes. Mr. Parke, in reply to an inquiry, said that the experience of steam railroads is that inside-hung brakes are the most satisfactory. With high-speed brakes the shoes wear out somewhat more rapidly, but there has been no complaint of excessive shoe wear; it is true that such brakes introduce an additional piece of mechanism, but this requires very little attention. In reply to a question as to whether there was an increase of frictional effect incident to the use of the magnetic brake, Mr. Parke said that no attempt had been made to determine if the magnetism changed the coefficient of friction.

Mr. William Nelson Smith described some experiments which confirmed the statement that the pressure of the forward wheels on the brake shoes is greater than the pressure of the rear wheels. Mr. Hammer called attention to the use by Edison of a magnetic brake on his 1880 electric locomotive. Mr. Herman H. Westinghouse confirmed the views expressed that the problem of braking is an indefinite one, and with respect not only to the physical phenomena but the personal equation of the users of the apparatus. In the experiments with the Westinghouse brake this latter element is one of the factors receiving a full share of attention.

Storage Batteries in Electrical Supply.

By [illegible] D. Adams.

M[illegible] energy outputs and the efficiency of storage batteries determine their utility in systems of electrical supply. From these factors the investment in batteries per unit of their greatest load and the fixed charges per unit of their energy output may be determined. These important relations are better studied as they actually occur in existing systems rather than on mere assumptions of what could or should be done.

To illustrate the practical results that may be obtained with storage batteries, the following data as to their operation in a large system of electrical supply during a period of more than three years are presented. During the earliest of the three years in question a large part and during the two later years the larger part of the electrical output of this system was derived from water power. This fact is important because water power usually increases the utility of storage batteries, which may be used to deliver the energy of the night flow at times of maximum load. In the electrical supply system here considered the load was well divided between street and commercial lamps and stationary motors, but no electric cars were operated by it.

The battery in question consisted of 140 cells of standard make, and each cell had a capacity of 17,000 ampere-hours, giving a total of 2,380,000 ampere-hours' capacity. At an average discharge pressure of 2 volts per cell the battery thus had a capacity of 4,760 kw-hours. On a ten-hour rate of discharge the battery would deliver 476 kw, and on a five-hour rate 952 kw. On an average week day of each month during 1901 the maximum rates of battery charge and discharge, also the ratio of battery discharge at its highest rate to the maximum load of the electrical system were as follows: For the months of June and July the ratios of maximum battery loads to maximum station loads are not given because these loads did not nearly coincide in point of time.

	Maximum kilowatts battery charge.	Maximum kilowatts battery discharge.	Percentage of maximum battery discharge to maximum loads on the system.
January	390	520	19.1
February	240	970	39.2
March	280	240	14.2
April	330	300	17.0
May	330	300	17.4
June	200	200	....
July	150	200	....
August	210	440	27.1
September	360	270	15.3
October	360	400	16.2
November	240	330	13.5
December	340	340	11.9

The highest charging rate for the battery during the year was only 390 kw, corresponding to the battery discharge on a 12.2-hour rate. The highest discharge of the battery was 970 kw in February, amounting to a 4.9-hour rate. In the other months of the year the maximum rate of discharge was constantly above 9 hours, and for the greater part of the time above 14 hours. The battery thus worked much below its maximum capacity both in charging and discharging, a condition favorable to high efficiency. During the twelve months the highest load on the electric system for an average day was 2,840 kw, and of this load the battery capacity at a five-hour rate of discharge was 33 per cent., yet the battery actually carried only 11.9 per cent. of the maximum load. In February, when the battery carried 39.2 per cent. of the maximum load on the system, the discharge rate was 4.9 hours, and this percentage was the largest carried by the battery in any maximum load. In only one other month, August, did the battery carry more than 20 per cent. of the maximum load on the system. As a five-hour rate of discharge for a battery at the time of maximum load, is within the limits of good practice, it is notable that the battery in the present case reached this rate in but one month. The battery capacity being at command, but to a large extent not used during eleven months of the year, raises the natural inference that the station management found it cheaper to operate engines or water wheels and dynamo at the time of maximum load than to charge and discharge batteries. Service from the battery extended over the last three months of 1898, all of 1899 and 1900, and all except the months of June, July and December, in 1901. During this entire period the extent to which the battery has been used has been in general on the decline. Thus in the last quarter of the year of 1898 the battery discharged 103,800 kw-hours, during 1899 about three times and during 1900 a little more than twice this amount of energy, while the record for nine months of 1901 shows a discharge of only 165,487 kw-hours.

Year.	Months of Year.	Kilowatt hours battery discharge.	Percentage of battery discharge to total station output.
1898	last 3	103,800	7.6
1899	12	317,798	5.4
1900	12	222,355	3.0
1901	9	165,487	2.5

The decreasing extent to which the battery has entered into the operations of the electrical supply system is still further brought out by the percentages of battery discharge to total station outputs in kw-hours. Thus, in the last three months of 1898 the battery supplied 7.6 per cent. of the entire output of the system, in 1899 and 1900 the like percentages for the battery were 5.4 and 3.0 respectively, and during 9 months of 1901 the battery discharged only 2.5 per cent. of the entire station output for the same period.

Viewing the years of 1899, 1900 and 1901 as to percentages of battery discharges in each month, it seems that the extent of battery use has varied but little with the time of year. The decline in the monthly use of the battery extends with slight breaks from January, 1899, to December, 1900. Percentage of battery discharge to total kw-hours delivered by the system in each month.

	1899 Percentages	1900 Percentages	1901 Percentages
January	6.9	3.6	2.8
February	5.7	3.1	2.7
March	6.5	4.0	2.0
April	6.3	5.1	2.6
May	6.2	2.5	1.8
June	5.2	2.8	..
July	5.5	1.8	..
August	4.7	1.3	2.5
September	4.3	2.4	2.6
October	5.5	3.9	1.8
November	4.4	2.8	4.0
December	4.6	2.5	..

During 1901 the percentage of battery output shows no regular increase or decrease from month to month. In the three months of this year for which no figures as to percentage are given the battery is believed to have been in use, but the data of charge and discharge are not available. As far as can be learned, the decline in the use of this battery is due to no special circumstances, but simply to the idea that its employment to a greater extent would not pay. For the electrical supply system that includes the battery, the number of kw-hours delivered during 1901 was 1.4 times that delivered during 1899, so that the smaller use of the battery is not due to a decrease in the station output.

Efficiency of this battery, measured by the ratio of kw-hours of discharge to kw-hours of charge in each year, shows a material falling off during the period in question. For the last three months of 1898, when the battery was new, the efficiency was 75.6 per cent., but in the nine months of 1901 the efficiency was down to 64.6 per cent. This loss of efficiency is the more notable because of the moderate rates at which the battery was charged and discharged.

	Battery charge kilowatt hours	Battery discharge kilowatt hours	Battery efficiency
3 months 1898	137,200	103,800	75.6
12 months 1899	463,433	317,798	68.[illegible]
12 months 1900	318,470	222,355	69.8
9 months 1901.	255,824	165,487	64.6

From these figures it appears that the efficiency of the battery declined eleven per cent. during a little more than three years. At a price of $20 per kw-hour of rated capacity this battery of 4,760 kw-hours would have cost $95,200. During the year of 1900 the battery discharge was 222,355, so that there was 43 cents invested in the battery for each kw-hour delivered by it, on this basis of cost. Allowing 15 per cent. of battery cost for annual interest, repairs and depreciation, these charges would have amounted to 6.4 per kw-hour delivered by the battery during the year named. Facts similar to those stated here no doubt have a bearing on the failure of American central station to adapt storage batteries more rapidly.

The Problem of Small Station Reconstruction.*

By C. R. MAUNSELL.

The majority of central stations in Kansas, and in other States as well, have not paid the returns on the investments that were expected, and in a great many cases the reason has been that the machinery installed was not suited to the conditions of operation, and the lack of knowledge of the proper business methods. The usual scheme has been about this: The promoter of the plant first gets the idea that an electric light plant would pay well in his town; he talks the matter over with his associates, and they all agree it would; not one of them, however, knows anything about the business. The next move is to find out what the cost would be, and some supply house or manufacturer is asked to pay them a visit. The best salesman is sent; he knows very little about the operation of a plant, but can sell goods. His first effort is to find who knows what is wanted and who is to buy the equipment. When this is ascertained, he generally finds they want information more than anything else, and being a good salesman he gives them all he has; in other words, he lays out the plant, except the boilers and engines, as every one connected with the scheme knows just what is here required. In this part the most expert advice is necessary, as right here lies the success or failure in the lighting or power business. Having made a good guess at the start of a plant, let us see the results. The conditions are as follows, taking one small plant for an example:

The town has 5,000 to 7,000 population, and the city fathers have agreed to take 15 or 20 arc lamps at a rate paid by some other town, with water power to operate the machinery or other great difference in the cost of fuel.

The number of incandescent lights for commercial use have been decided as 1,000, all within an area of 2,500 feet from the site of the station; the residence supply has not been taken into account, as the salesman said this could be taken care of after the plant was started. No power load was considered as being a possible source of revenue, therefore the plant would only be in operation from 6 to 12 hours at the most. Anyone wanting a day service had to do without it.

We are now ready to build; the site is bought, a building is planned and built, and we are ready for the machinery. The mechanical man of the scheme selects one boiler of 100 horse-power capacity, one pump for feed water and, maybe, a heater. The engine is his next care. He knows nothing of steam as measured in pounds, so any old engine that is well recommended by the salesman will do.

It may be that coal costs $1.50 to $4 per ton, but the engine is the same in either case, for it must be a cheap engine, as capital is limited. The electrical salesman has found this out also, so he sells an alternating generator of high speed and an arc machine of as many lights capacity as he can get money for; no wattmeters are wanted, so the consumers can have all the light they can get while the plant runs.

The consumers have agreed to wire for the incandescent lights, so that expense is out of the way; but arc lamps may be wanted in stores, as every arc machine is sold with the full number of lamps included, the expense for wiring will be a small cost.

In short, the plant is completed and in operation; the engine man, boiler man and electrical man have their money and are gone. The mechanical man is left in charge; the plant apparently runs all right, and all are pleased with the new enterprise except the man with his money invested. He is anxious to know the results the first year, which soon passes, and he is called on for about 50 per cent more than he wanted to put in the plant, but he must go on or lose all, so he puts up or gets his friends to. But all this happened 10 years or so ago, and is forgiven, as there was no one who knew much about the business at that time.

Mr. Maunsell suggested that at this juncture a proper expert engineer be called in. In the plant cited above his first care would be the site for the station, then the electric machinery, which would serve all classes of service from one set of generators. Next, can steam heating be made to pay? This brings up the power supply, which means 24 hours' service to all, with increase of revenue from lighting customers, to say nothing of winds and fan business. He has decided heating can be made a success, and his boiler and engine must be selected for this service. Three new 75-hp boilers, suited for the water to be obtained and set from what experience has proven as the only proper way (in good brickwork on a foundation supplied with good draft); a pump with an injector for emergencies, with feed water heated to the boiling point.

The coal cost is $4 per ton, so the engine that is guaranteed to operate on the least pounds of steam per horse-power-hour is purchased; in this case, two 75-hp Corliss. As back pressure is carried in winter, the horse-power is rather high, but one engine will do the load in summer and mild weather, leaving you a reserve engine, which is a guarantee to the consumer that you mean to take care of him at all times, and he relies on you and gives you his power and heating business also, which enables you to make the necessary investments for such a plant, which is a credit to the town.

The next step is the generating machines. Two 60-kw direct-current at 250 volts is the selection, belted direct, and each with a wattmeter to give the amount of current made, so you will know how to sell it at different times of the day and night, by meter only, except to the city street lights, which are controlled from the switchboards in the station. The consumer will buy his arc lamps and pay for the wiring, if he can get current at living rates, should you put the proposition to him in the right way; the engineer will tell you how to do this.

A change from the first plant outlined to the last one would convince anyone of the economy in operation and the possible revenue to be obtained, in towns of 5,000 to 7,000 population, when it is considered that the last plant is earning a revenue every hour of the day and night, therefore, much more useful to the owners and public.

Taking an estimate of cost for each plant with the revenues and expenses, the above figures are given.

Plant No. 1.

Cost	$1[illegible]
Revenue, per annum	[illegible]
Expenses	4,800
Net	$1,[illegible]
8 per cent. net on investment.	

Plant No. 2.

Cost	$28,[illegible]
Revenue from lighting	9,[illegible]
Revenue from power, fans and day lighting	3,5[illegible]
Revenue from steam heating	5,[illegible]
	$17,5[illegible]
Expenses	11,[illegible]
Net	$6,500
23 per cent. net on investment.	

* Abstract of a paper read at the last meeting of the Kansas Gas, Water and Electric Light Association.

The Profitableness of Interurban Trolleys.

We have recently called attention to the brisk controversy over the profitableness of interurban trolleys, that has sprung up in the columns of the *Wall Street Journal*. The one contention is that such roads are over-capitalized; the other side is that their earning capacity is understated, and is not yet by any means fully developed. We have already quoted the arguments pro and con, and now add later ones:

Messrs. Tucker, Anthony & Co., who have built and managed more interurban properties than any other firm in New England, say in regard to this matter: "Mr. Lisman gives the cost of an interurban road, $18,000 per mile; it would be just as appropriate to say that a house costs $5,000. We could name roads that have cost $10,000 per mile, and others even up to $100,000 per mile; all depending upon the character of construction and the difficulties to be overcome. The modern high-speed interurban road of the middle West built upon a private right-of-way, 50 feet in width, is a very different proposition from the Eastern street railway with which the public is most familiar. The construction of these Western roads, with their 70 to 80-pound rails, 8-feet ties, steel bridges, etc., is in all

[illegible] as the standard steam road. The electric road has the additional cost of a very expensive overhead construction, and its frequent schedule requires a large number of cars for regular service, with an equal number of cars for summer use; these cars are usually 50 to 60 feet in length, costing the same as the best class used on the steam roads, and must all be equipped with expensive electric motors and air brakes. Added to all this cost is the power house and its equipment generally of the three-phase, high-voltage type, and its accompaniment of sub-stations scattered over the line. On such roads a regular schedule of 40 to 50 miles per hour is usually maintained.

"As to the earnings, there are, no doubt, all over the country undesirable roads in ill-advised locations and built by inexperienced people, but the interurban roads as a class should not be condemned on this account. Mr. Lisman gives the average earnings as $3,400 per mile. A study of the reports of interurban roads in the middle West will show that the earnings will average over $4,000 per mile of track, and in individual cases are, of course, very much higher. The net earnings will vary according to circumstances; it requires good judgment to locate a road, and also experience and ability to operate for the best results, and each proposition should be judged on its own merits. A study of the electric roads, for a period of ten years back, reveals a history of growth and prosperity that is almost fabulous, and yet the croakers of ten years ago were just as positive of coming misfortune as are the croakers of to-day. We think we could name some steam roads which will be much more liable to go into bankruptcy than the good interurban roads of the type we have referred to above."

In reply to his critics, Mr. A. A. Lisman, of Lisman, Lorge & Co., says: "The correctness of the figures submitted by me in an interview has been questioned as far as results obtained in the middle West are concerned. I, therefore, call attention to the following figures, showing that net results, after proper charges for maintenance of road-bed and equipment, are deducted from the so-called net earnings of Ohio Interurban Street Railways, and do not differ materially from those shown by New York State corporations pursuing a similar business. As examples might be cited the following properties, which are among the oldest and most prosperous in Ohio:

"The Cincinnati, Dayton & Toledo line of some 80 miles showed, in the year ending April 31, gross receipts of $353,000, operation expenses of $186,000, a net of $166,000, fixed charges of $175,000, showing a deficit of some $8,000. As operating expenses are charged with 52 per cent of the gross receipts, certainly no provision is made for maintenance of way and equipment. The expense of maintaining a motor car, including burnt-out armatures, repainting of car, replacing of trolley poles, etc., amounts to over $300.

"The Cleveland, Elyria & Western road, also running some five years, shows similar net results. The operating expenses in this case are 54 per cent of the gross earnings per mile (a 90 mile road), being at the rate of about $200,000 a year. Cleveland, Painesville & Eastern, on 42 miles of road, shows gross earnings of $144,000, and a net, after fixed charges, of $11,000, or less than $300 a mile.

"In this connection Mr. Cornelius Vanderbilt in this month's *North American Review*, comparing the earning power of interurban street railways with steam railroads, arrives at the same conclusion, that is, that maintenance of way and equipment of a street railway will amount in the end to about the same as for a steam road. My figure of $1,000 per mile would, therefore, seem to be even below a proper charge for these expenditures. This average charge for maintenance of way and equipment of roads east of Chicago amounts to fully $1,500 a mile. To put the whole question in a nutshell, it looks very much as if the capitalization for the last year or two of interurban street railways practicaly amounted to the issuing of new capital under the pretence of paying for extensions and improvements, but really for the purpose of paying for repairs and maintenance."

Continuing his discussion of the subject, Mr. Alfred M. Lamar writes: "In his second communication upon the question of interurban railroads, Mr. A. A. Lisman cites individual cases to sustain his position, and shows that one road is being operated for 52 per cent and another for 54 per cent of gross receipts. These figures confirm my contention that 55 per cent is ample for the cost of operating. He gives the gross receipts of the Cincinnati, Dayton & Toledo Traction Company as $353,000. The facts in this case are that this figure represents the gross receipts of the Southern Ohio Traction Company, now composing a part of the consolidation known as the Cincinnati, Dayton & Toledo Traction Company. The Southern Ohio Traction Company at the date of the receipts given operated from the heart of Dayton to College Hill, one of its suburbs and situated ten miles from Fountain Square, Cincinnati, a distance of 52 miles, owning side tracks and double tracks 79 miles. The receipts of this road were $6,788 per mile of road. Observe that I am not prognosticating as to what the future will be.

"The figure named as 'the expense of maintaining a motor car, including burned-out armatures, repairing of car, replacing of trolley poles, etc., amounts to over $300,' is, I think, too low. But I will again call his attention to the fact that such items do, and must of necessity, go into operating, for the reason that a road cannot be operated while its armatures are burned out, or trolley poles and cars out of repair. Mr. Cornelius Vanderbilt is cited as an authority upon the cost of maintenance to sustain his position, and he again says that the cost of 'maintenance and equipment of roads east of Chicago amounts to fully $1,500 a mile,' but does not say whether this refers to steam or electric roads.

"A few years ago a very able paper was read before the American Street Railway Association, in which the statement was made that the average life of a steam locomotive was ten years and that the average life of an electric motor was twenty-five years. The last statement was a mere estimate as at that time no motors had been in use for as long a time. All the wearing parts of a motor are interchangeable and are constantly renewed just the same as car wheels, and it is a fact that many of the first W. P. single-reduction motors put in use about 1892 are in use to-day, and show no signs of depreciation where properly cared for.

Chicago Meeting of the A. I. E. E.

The next Chicago meeting of the American Institute of Electrical Engineers will be held Tuesday evening, December 30, 1902, at the rooms of the Western Society of Engineers, in the Monadnock Block. The meeting will be held eleven days later than the New York meeting for December, in order that Chicago members may have opportunity to receive all the papers in advance. There is promise that some features special to the Chicago meeting will be brought up. As the subject, "Braking and Traction Brakes," is one of general interest, and as interest in the Chicago Institute meetings is being greatly revived, a large attendance is expected. Local Honorary Secretary R. H. Pierce, Manhattan Building, Chicago, can furnish those so desiring with advance copies of the papers and with further particulars in regard to the Chicago Institute meetings.

"Telephonitis."

A correspondent writing to the *New York Times* recently says: "In your edition of Sunday, December 14, you published an account of some modern maladies which have been discovered through the cleverness of the author of the article referred to. I was much surprised to find that in your "medical researches" you have not mentioned "Telephonitis," which is a widespread disease among business men in the down-town district; its first symptom is an irresistible desire to reach the telephone and to ring up "central." A person seriously affected by this treacherous malady, which, by the way, is contagious, will stand by a telephone for hours and call various numbers to the great discomfort of the telephone operator. Finally the person so affected will get into a frenzy, and in wild anger demand the "manager." When the manager, breathless, reaches the receiver, he will have to listen to the most serious accusations, which would justify him in discharging the entire force of the "central." The person who has telephonitis is remarkably always in the right, always gives the correct number, always has carefully listened, and the fact which makes his malady most unpleasant for himself and all others is that he can never get the party whom he calls up. In the first stages of this malady a slight electric shock from the receiver is generally sufficient, but while the disease is progressing the individual so affected gains in courage and impudence and manages to get a monopoly over the particular telephone in the office, which creates a revolution among his co-employes.. The only method to treat this unfortunate disease seems to be a large dose of "club-him" three times a day.

Telephone Cables—IV.

By Arthur V. Abbott, C. E.

OFFICE ENTRANCES.

To carry the underground wire plant into the central office it was customary to tunnel under the street, from the end of which the various ducts diverged. The sides and roof of the tunnel were provided with racks set about 3 feet center, on which the cable were supported. Such a method is shown in Fig. 29. Modern practice cheapens construction by omitting the tunnel, and continuing the underground conduits into the basement of the office building, or even in cases where the distributing board is placed on an upper floor the walls of the building are formed of hollow brick and the underground cable continues uninterruptedly to the wire chief's room. Whenever there are corners to turn either a manhole for the purpose must be built to give access to all cables, or else iron pipe bends, of about 5 feet radius, must be introduced into each duct through which the cable can usually be drawn.

Office entrances for aerial cable are as varied and numerous as there are exchanges. The most common method is to plant a distributing pole in front of the building to which all lines, both open wire and cable converge. Cable heads are placed here and all lines cabled and run through a hole in the building wall. A good example of this type of construction is shown in Fig. 30. A still more modern method, when the plant is entirely composed of aerial cable, appears in Fig. 31. In Fig. 32 an unfortunately far too common example is found. Up against the office wall any old pole is erected. To this all the circuits, cable, strands, and open wire run as best they may. The wire chief punches out a few bricks from the office wall and drags through the crevice a handfull of okonite to serve as office cable. Result, endless complaints. Yet this is a photograph from recent work of one of the Western Independent Companies that six months ago, in convention, voted that *"the maintenance of a telephone plant should not exceed 5 per cent per annum!"*

THE QUESTION OF ELECTROLYSIS.

Prior to electric railway days, telephones were universially provided with grounded circuits, but the return currents of trolley roads caused such lines to become unbearably noisy, and a long and bitter warfare was waged between the telephone interests and the street railways, with the view of forcing the latter to abandon the rail return. In this contest, the telephone companies were universally defeated, for it was impossible for a single industry to advance any just claim to demand the exclusive use of the earth as a return circuit.

Shortly after the victory of the street railways a number of cases of corrosion of water pipes, gas pipes, and the lead sheaths of telephone cables, made their appearance, that on investigation were conclusively found attributable to the electrolytic action of railway currents. Armed with this discovery, the telephone companies returned to the fray, and became almost hysteric in their assertions of the immediate and inevitable destruction that menaced all metallic underground structures. It was confidently asserted that every gas and water system in the country, together with the elevated railway structures and metallic foundations of modern buildings, was not only in danger of destruction, but that already incalculable injury had actually been inflicted. So plausible were these specious assertions, and so skillfully advanced, backed with scientific authority of weight, as to create at least a newspaper panic against the single trolley system. Continued investigation and wider experience proved that the alarmists had, to say the very least, grossly exaggerated the probable danger. The actual facts as they stand to-day may be summarized as follows:

First, when an electric current passes *from* the earth to a metallic body imbedded therein, there is no injurious action.

Second, so long as the current traverses the metallic body, no injurious effect is produced.

Third, when the current leaves the metallic conductor, and re-enters the earth, injury may, but does not necessarily take place.

Fourth, when injurious action does take place, it manifests itself as a corrosive pitting of the surface, and substance of the metal as exemplified in Figs. 33 and 34. Fig. 33 being a piece of lead service water pipe, and Fig. 34 a bit of the lead sheath of a telephone cable. This action results in a number of perforations of the metal, and may even spread so far as to cause a widespread destruction.

Fifth, a very small difference of potential between the metal and the earth (a hundredth of a volt) may be sufficient to cause an injurious action which will be cumulative, and will in time result in extensive destruction.

Sixth, it is easy to locate danger areas, and to provide protection by leading away the pernicious currents by some conductor that is not injured thereby.

Seventh, various metals exhibit very different degrees of sensitiveness to corrosion, lead being the most susceptible, wrought iron much less, while cast iron, particularly the hard white varieties, is frequently if not always immune.

Eighth, though the electric railways have been widespread operation for more than a decade, the gross injury so far discoverable, is of relatively small amount, and has been chiefly limited to the corrosion of a number of telephone cables, the perforation of lead service pipes, and small gas and water mains. A few isolated cases of injury to large mains, and the fall of a stand pipe at Peoria, Illinois, attributed entirely to electrolysis, are the only instances of capital injury on record, but the expert testimony in a suit brought to recover damages from the electric railway company of Peoria, leaves room for reasonable doubt as to whether the railway current was *solely* responsible for the collapse of the pipe, though undoubtedly it played a part therein.

Ninth, usually street railway companies have shown themselves keenly alive to the consequences of electrolysis and anxious to co-operate to any reasonable degree to secure the protection of underground structures.

So long as electric railways employ an uninsulated return, there will always exist the possibility of injurious action to underground metallic structures. As the lead sheath of telephone cables is particularly sensitive, and as even a minute perforation of the lead will destroy an entire section of cable, by the admission of moisture a frequent and thorough inspection of the underground plant is essential. This examination is usually accomplished by testing each cable in each manhole to see whether it is negative or positive to the surrounding earth, that is to say, whether the current is flowing *from* the earth *into* the cable, or from the *cable* into the *earth,* and the ease, rapidity and cheapness with which this examination can be made, warrants frequent repetition. A single inspector, provided with a helper to lift manhole covers, is all the force needed to examine many miles of cable per day. The inspector must be provided with a low reading voltmeter, reading in both directions from zero in the center of the scale. An instrument with a scale of about 10 volts on either side of the center, and capable of being read to 1-100 of a volt, is best suited to the purpose. From the positive terminal a flexible conductor made of good rubber-covered lamp cord, is extended to a pair of hand gas tongs, the jaws of which have been filed smooth. From the other terminal a similar flexible cord is carried to a light, sharp-pointed iron rod, three or four feet in length. The sheath of each cable to be tested should be thoroughly cleansed with a few strokes of emery paper, and then grasped with the gas tongs, thus insuring good contact of the positive wire. There is likely to be more difficulty with the negative pole in securing a good ground. If the vault has a sewer connection, the trap will usually be found full of water, and a good earth may be obtained by dropping the iron rod into it. In other cases, it may be necessary to get an earth by driving the rod between the paving stones into the ground, deep enough to reach moisture. It is inexpedient to ground on a neighboring water or gas pipe, as these structures are quite likely to be at a different potential from the earth, and so give readings leading to incorrect conclusions. When a proper earth is obtained, the voltmeter is observed, a deflection to the right, indicating that the cable is positive to earth, and one to the left that it is negative. Careful notes of the date, time of day, and designation and location of all the cables tested, should be made, as the electrical history acquired from repeated inspections, becomes of great value.

Telephone companies have at their disposal, in the wire network, ramifying throughout the entire territory served, peculiar facilities for ascertaining the electrical conditions of the earth. If each subscriber's line be grounded at the substation, and at the office, it is easy to measure the potential difference. This process is exactly analogous to that of the topographical engineer who, after running a series of levels over a country, can plot a map showing by contour lines the relative hills and valleys of the territory surveyed. Elec-

FIG. 29.—CABLE-SUPPORTING RACKS.

FIG. 31.—ANOTHER METHOD OF LEADING CABLES INTO OFFICE.

INSTALLATION OF TELEPHONE CABLES.

FIG. 30.—ONE METHOD OF LEADING CABLES INTO OFFICE.

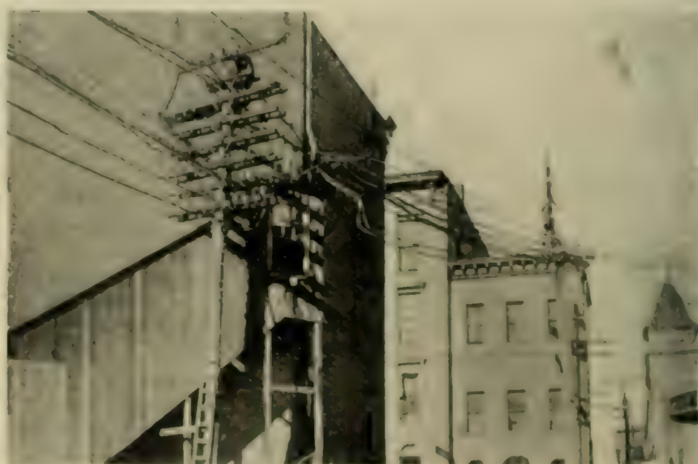


FIG. 32.—WHERE "BUGS" BREED.

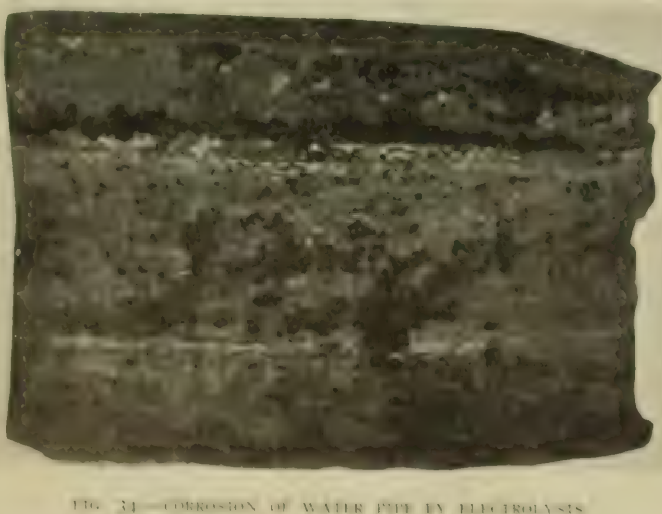


FIG. 34.—CORROSION OF WATER PIPE BY ELECTROLYSIS.

FIG. 33.—CORROSION OF LEAD CABLE-SHEATHING BY ELECTROLYSIS.

trical leveling is even more simple and quickly performed. To continue the analogy, the electrical leveler stations himself in the central office, and is provided with a voltmeter, one terminal of which is connected to a ground wire, while the other is supplied with a single cord and plug, fitting the jacks of the switchboard. The rod man proceeds to one substation after another, and from each calls up the office notifying the leveler to take a reading, at the same time grounding the subscriber's line. The leveler plugs the voltmeter into the subscribers' jack and reads, instantly obtaining the potential difference, or variation in electrical level between the office and the subscriber's station. In such a survey, the time consumed is chiefly that required by the rod man in going from one substation to another, for less than a minute at each is sufficient to call the office and secure a reading, so by having several rod men hundreds of stations may be tested per day with the utmost facility. As the locations of the substations are known, it is easy to plot on a good map the observed potential differences, and then lines drawn through all those of equal value from equipotential curves or electrical contours. Such an investigation may be termed an Electrolytic Survey. Fig. 35 shows the results of such an examination made by the writer in the city of Toledo, O. The contour lines are drawn at intervals of one volt, and show in the most salient manner the distribution of earth potential, and the gradual rise that takes place radially away from the power station of the electric railways. But these curves can teach a still more important lesson. As they are lines of equal potential, it is evident that any metallic conductor so located as to be essentially parallel to any equipotential curve will lie in a region where there is no electromotive force to cause a flow

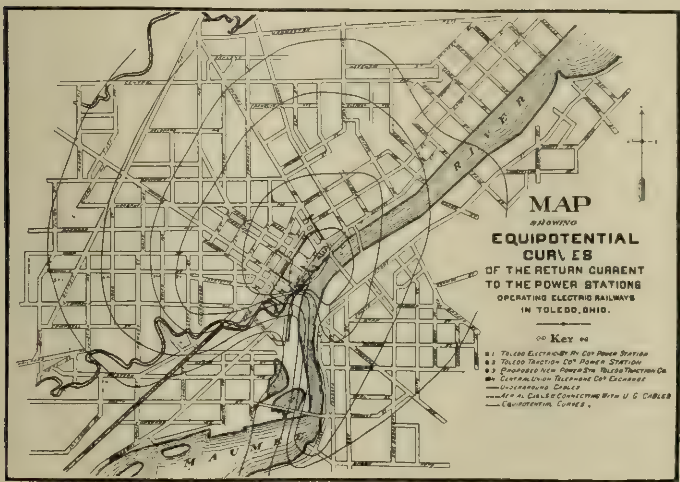


FIG. 35.—ELECTROLYTIC SURVEY OF TOLEDO.

of current, and consequently will not be subjected to any electrolytic action. On the contrary, if a conductor be so placed as cut the equipotential lines, current will flow from the regions of higher potential, to those of lower potential, and corrosive action may be expected, the amount of which may be roughly estimated by the number of equipotential lines cut or the steepness of the electrical gradient. To return to the analogy of the topographical map, if a stream were seen to cut a number of contour lines it could be confidentially predicted to be swift, rapid and full of falls, while if parallel to them, slow and sluggish. Though the electrical survey does not entirely take the place of manhole inspection, it presents a view so much wider, more comprehensive and prophetic that it is well worth its small cost. Nor is it sufficient to make a single examination and rest secure in the assumption that the electric potential is forever settled. Figs. 36 and 37 give the results of two electrolytic surveys made of the city of Chicago, one year apart, showing the very marked change in electrical conditions that took place during that interval. To be sure, the period embraced was one of very rapid railway development, so usually the change would be much less marked, but there is always growth of some kind, either new lines are built or old ones extended, or their loading increased; so that here, as in most other instances, eternal vigilance is the price of security, and a careful examination at least once a year should be made.

Having from the electrolytic survey and manhole inspection determined the various situations on the cable system that are in danger, or where there is a tendency for current to leave the cable sheath for the earth, the next step is a selection of a method of protection. *The current must not leave the cable sheath and pass into the earth.* This is the *only* requisite, and any device accomplishing this result will suffice. It is possible to attack the problem from either end; to prevent current from entering and passing along the cable, or to provide a good way for it to leave the sheath. The first method can be put in practice by insulating portions of the sheath that cut the higher equipotential curves, or those which are more remote from the railway power station. In many cases the simple expedient of cleaning out the manholes and ducts, lifting the cables off the wet floors of the vaults, and supporting them upon insulated pins, driven into the vault walls, will change many electric positive spots to electro negative ones and obviate further injury. Sometimes one or two breaks in the continuity of a long cable will prevent the current from following the sheath. Such breaks may be inserted without risk to the insulation of the cable,

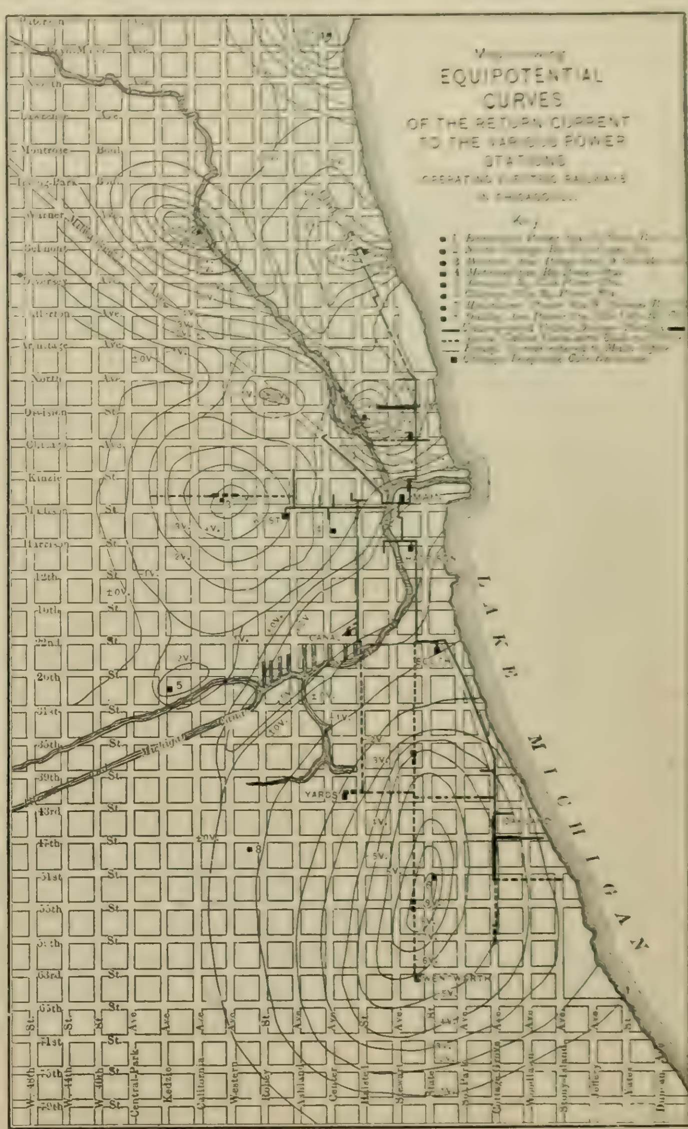


FIG. 36.—ELECTROLYTIC SURVEY OF CHICAGO.

by making "insulating joints" similar to the one illustrated in Fig. 38. This expedient is of special utility, when cables are partly aerial and partly underground.

The second plan consists in providing each danger spot with a supplementary conductor attached to the cable sheath of better conductivity than the earth. This is the "*supplementary return feed*" plan and is usually accomplished by attaching a copper wire of sufficient section to the cable and carrying the same to the railway track if well bonded, or to a railway return feed, or even in extreme cases, clear to the power station itself, and attaching it to the negative busbar of the switchboard. Such cases, however, in the present state of railway construction are rare.

If the current traversing the cable sheath is not large, and the length of the return feeds likely to be considerable, a good ground plate will afford protection. For this purpose a hole four or five

feet square should be made deep enough to reach a permanently moist stratum of earth. At the bottom a few bushels of coke will form, a good medium for delivering current to the earth, in which may be imbedded a lot of old rails, discarded car wheels, or any

FIG. 37.—A LATER ELECTROLYTIC SURVEY OF CHICAGO.

metallic scrap. This should be thoroughly tied together with plenty of copper wire, and connected to the cable sheath with an ample lead of copper. The ground plate acts to carry current from the cable to the earth, and diverts the electrolytic action from the sheath to the plate. That corrosion will there take place and in time destroy the ground plate, is unquestioned, but at reasonable expense, the

FIG. 38.—INSULATED BREAK FOR SHEATH OF LEAD-COVERED CABLES.

volume of the ground plate can be made so large as to last for many years.

A practical illustration of what the return feed expedient can accomplish may not be amiss. Turning to Fig. 37 a black line will be found extending on Halsted Street from Madison Avenue to Twenty-second Street. This represents a cable run which intersected a number of equipotential curves. Measurements in the various manholes, indicated the potential differences between the cable sheath and the earth, which when plotted yielded a curve something as shown in Fig. 39 at "A." By connecting the railway track to the sheath at

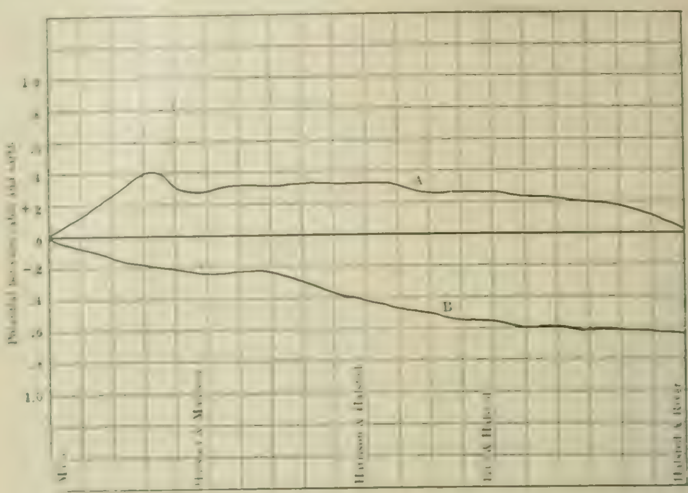


FIG. 39.—CURVES SHOWING POTENTIAL DIFFERENCES BETWEEN CABLE SHEATH AND EARTH.

several points, the electrical conditions were entirely changed to that shown by the line marked "B," indicating complete protection from electrolytic action.

More Tunnel Trolleys for New York.

It is announced that the New York and Jersey Railroad Company's tunnel, for which a franchise was granted by the New York Board of Aldermen last week, is to be used by the Erie and the Delaware and Lackawanna railroads to secure a direct connection with Manhattan by means of trolley or third-rail cars. The New York and Jersey Railroad Company was incorporated under the laws of the State of New York for the purpose of owning and operating the tunnel and railroad formerly owned by the Hudson Tunnel Company, and of constructing and operating a tunnel railroad in the city of New York to be connected with railroads in the State of New Jersey. The Hudson Tunnel Company was organized for the purpose of constructing a tubular tunnel under the North River to accommodate electric cars. After the company had expended $4,000,000 in construction work its workmen struck a rock about two-thirds of the way across the river on the New York side. It was deemed necessary to tunnel this rock. This work the old company never undertook, and the project passed from the public attention for the time being.

The New York and Jersey Company now proposes to complete the project. It is estimated that it will take $6,000,000 more to finish the tunnel and provide the proper terminals. The tunnel will enter New York at Morton Street and will run up Morton to Greenwich, thence along Greenwich to the block bounded by Christopher, West Tenth, Greenwich, and Hudson streets, where the terminal for Manhattan is to be located. The terminals for New Jersey probably will be at the Erie and Delaware and Lackawanna stations.

The Rapid Transit Board considered the proposed franchise on July 10, and by a concurrent vote of six of its members determined the locations and plan of construction of the railway, and also the terms of the franchise. It was decided that the company should pay the city a rental, which should be readjusted every twenty-five years. Under the terms of the franchise, the city is to receive 3 per cent. of the gross receipts of the company on that portion of the railway lines in New York for the first five years and 5 per cent. thereafter. Some regard these terms as even better than those arranged with the Pennsylvania Company. W. G. McAdoo, the president of the New York and Jersey Railroad Company, was assistant secretary of the Navy under President Cleveland.

Economic Operation of Electric Irrigation Pumps.

BY AUG. J. BOWIE, JR.

THE manner in which electric irrigation pumps should be installed and operated varies largely with the conditions of the case. The general considerations governing the installation of the same have been reviewed in an article by the writer, printed in the issue of the ELECTRICAL WORLD AND ENGINEER of August 9, 1902. The economy in the operation of these stations plays a very important part in the price of the water pumped. Poor management in this direction may fully double the amount which the water should cost. The location of the pump stations is important. As a rule, it will not pay to pipe the water or to convey it in any other channels but canals made in the ground, except for short distances. A canal is usually the cheapest conduit for the water which can be built, and will answer in most cases. This is a matter which may influence the location of the station to a great extent, as the canal must be at a sufficient elevation to be able to wet all the ground to be irrigated.

Where possible, it is well to have the stations located in such a manner as to be able to use the combined flow of several, in case a larger head of water should be desirable. Perhaps the most important point, however, is that the stations should be so located that they will be able to run continuously, night and day, for the whole year, and so obtain all the available water from each one. In that way the fixed expenses per cubic foot pumped may be greatly reduced. There is no reason why the station need be shut down at night, and thus the work of irrigation may go on continuously.

The stations should be so placed that the distance which the water must travel will be as short as possible. The main object of this is to minimize seepage and evaporation. Another reason, however, is that the ditches themselves hold considerable water and may have to be filled well up in order to raise the level of the water sufficiently to reach some of the land. Most of this water will be lost, and it may in some cases take several hours pumping to fill the ditches to a sufficient level to render the water available for irrigation. For this reason the ditches themselves should be as small as possible. However, on the other hand, there will be practically a limit to the size of the ditch, depending on the manner in which it is made. For example, if scrapers are used in building the ditch it will probably not pay to make the ditch so small that a scraper cannot work to advantage in it.

In the economic operation of irrigation pumping stations it is very important to reduce to as small a point as possible the loss by seepage. In some countries this loss may be so great that special means must be taken to obviate it, as the irrigation system may be a financial failure unless due precautions are observed. Among other means of avoiding undue seepage, some of the following methods may be employed:

1. Cementing ditches with a thin layer of cement. 2. Puddling the ditch. 3. Open iron conduits. 4. Iron pipes. 5. Wooden flumes.

While wooden flumes may be comparatively cheap to install, they are not naturally suited for use in this kind of irrigation, for the reason that in the natural course of events they will be constantly getting wet and then drying, with the result that they will soon rot and leak.

The conditions of the problem should be carefully studied before laying out any system of irrigation. The size of the checks (if that method of irrigation is to be employed) should be given due consideration. Some land it will not pay to irrigate simply on account of the great loss by seepage, not alone in the ditches, but also in flooding the checks. In fact, much land it will pay much better to abandon entirely than to try to irrigate it at a great expense.

The amount of water used in irrigation depends largely on the nature of the soil, the method of irrigation, the previous condition of the ground as regards moisture, as well as on the crop growing on the land. If the soil is very sandy and porous it will take a great deal of water. If there is a clayey subsoil near the surface this will cut down very materially the water required. Small checks take considerably less water per acre than large ones when irrigating with a given head of water. They require more attention, however, and they interfere with agricultural operations.

In irrigating for alfalfa, it is necessary to flood the entire ground with water. The amount of water required for an irrigation for the same will vary from about six inches to two feet. That is to say, in order to irrigate the land properly it will take a quantity of water sufficient to cover the ground to be irrigated to a depth of from six inches to two feet for each irrigation. The latter figure would be high; in general too high to pay for irrigation by pumps. Some land will take even more than this quantity, but such land it will pay to leave alone. Fruit trees are usually irrigated by running the water in furrows across the land, and hence it is unnecessary to wet the entire ground, thus resulting in a considerable saving in water.

The number of times it is advisable to irrigate per year depends on the rainfall and the climate. Thus, for example, where the rainfall is small, as it is in the southern part of California, it is customary to irrigate for alfalfa about four times a year.

Water for irrigation is commonly reckoned in acre-feet, an acre-foot being the quantity of water which will cover an acre a foot deep. A flow of a second-foot, that is, one cubic foot per second, will cover two acres one foot deep in a day of 24 hours. One second-foot rate of flow will cover 730 acres one foot deep in a year. That is to say, it will irrigate 182 acres of ground four times a year, provided each irrigation requires one acre-foot per acre. At this rate it will take a flow of 3½ cubic feet per second to irrigate a section. Owing to the loss in the ditches and canals and to the interruptions in the service, this figure will generally be materially increased in practice, particularly in the case where the water is pumped, and consequently only a comparatively small head used. One unit of the rate of flow of water, which is also in use in some parts of the country, is the miners' inch. This is a variable quantity having different values in different parts of the country. As commonly used in irrigation, a miners' inch, or an *inch*, as it is usually called, means a rate of flow of 1/50 second-foot. In irrigation stations of any capacity this unit is usually too small to be convenient, but in some parts of the country where water is very scarce and is almost worth its weight in gold, the inch becomes a unit of mammoth proportions. In a certain law suit in the southern part of California, one of the witnesses who was testifying in the case was asked the question of how much water was flowing in a certain place. He replied that there was a very large flow. When asked to be more specific and to state how large the flow was he replied that it was almost as much as two inches!

The question of attendance in the operation of pumping stations cuts a very important figure in the cost of the water delivered. Perhaps there is no subject in this connection on which there is a wider difference of opinion than on the amount of attention it is necessary to give to the operation of the pumps. For instance, some people who run pumps continuously, day and night, have as many as three different pump attendants for one 30-hp motor and pump, each man taking an eight-hour shift. The writer, on the other hand believes in the other extreme; that is to say, having one man look out for several pumps, visiting each pump in operation about twice a day. Provided there is a competent foreman there is no necessity for a pumpman to be a skilled mechanic, and any man of ordinary intelligence can give good service with comparatively little instruction. However, it is essential that the installation be made in as thorough a manner as possible, and that the station be kept in first-class running order. Simple automatic cut-outs should be provided to switch out the motor in case the current goes off for more than a few seconds, or in case the pump loses its priming. These should be made as reliable as possible. With proper care and attention to details, there is little likelihood that any serious accident will occur, the worst thing liable to happen being burning out a bearing or blowing a fuse. It is certainly cheaper to have a few such accidents happen than to pay for constant attention otherwise not needed.

The oiling devices should be as good as possible, self-oiling bearings being used where possible, so that in event of the attendant being unable to get to the station there will be no danger of the bearing going dry. On this account oil cups where they are used should be of ample capacity. The bearings should be dustproof, otherwise trouble is apt to ensue.

While skilled labor is not needed for the operation of stations, it is by all means essential that the foreman should be a thorough mechanic. On him will depend much of the successful operation of the plant.

The Kern County Land Company, with which the writer was connected, had 27 pumping stations for irrigation purposes. At each station there were two transformers, a 30 or 40 hp motor and a suitable centrifugal pump. Three pump attendants looked out for the operation of the stations. They were expected to visit each station in operation twice a day. To do so they had to drive from 20 to 30 miles a day. In a year's operation of these stations there were perhaps a dozen bearings burnt out, and in one or two instances the shafts had been cut at the bearings and had to be turned down. The total

[illegible] would not have been sufficient to have paid [illegible] for a [illegible]

[illegible] simple means of measuring the water should be provided. The pump attendant should keep a daily record of the output of the station. Perhaps the simplest means of measuring water in such cases is by means of a weir. This, it is true, adds somewhat to the head which it is necessary to pump; still, the extra head may be made very small, and it is usually preferable to have the discharge above high-water mark in the ditch so that the water in the ditch cannot back up into the station. The writer adopted the following method of keeping account of the stations. A fixed size weir was put in at each station. The crest of the weir was made of a strip of galvanized iron nailed to the wooden flume. The flume was long and large enough to reduce the effect of unequal velocity and velocity of approach very largely. A nipple passed through a hole in the side of the flume near the crest. A glass tube was set into an ell on the outside of the nipple and served to measure the head on the weir. A horizontal strip of wood was nailed on the side of the box at the level of the crest of the weir, so that a single measurement with a rule gave the depth of water over the crest of the weir. A suitable logbook was provided for each station. A table was printed in the back of the book giving the discharge in cubic feet per second for different heads. The pumpman thus had no calculations to perform and but a single measurement to make. No measurements of the flow of water were to be taken unless the pump had been in operation for at least a half-hour previously, as, of course, at first the flow is much increased, especially where the pit had filled up with water. Twice a month pressure and vacuum readings were taken on the pumps, and also readings of the level of the ground water when the pump had been shut down for some time.

At first sight it might seem superfluous to make much of a point of taking these readings. But, as a matter of fact, the information so derived is decidedly conducive to operating under better efficiency. The discharge from a centrifugal pump will vary from many different reasons. Wear in the running rings will increase the back slippage of water and decrease the output. A small leak in the suction side of the pipe or pump or in the stuffing box may admit sufficient air to affect materially the output. The discharge also depends on the level of the water in the wells and also on the amount of entrained air in the same. Sanding up of the wells will, of course, tend to throttle the water flowing into them.

By keeping an accurate record as above described, a very good idea may be obtained of the probable trouble causing a falling off in the suppiy of water. Besides, all such information is important for statistical purposes.

Where stations are to run with no one in constant attendance, it is especially advisable to keep them in the best of repair. It is by such means that accidents are avoided and the plant is kept up to its proper efficiency. With high-speed machinery this is particularly essential.

As to the best speed of centrifugal pumps, there is quite a difference of opinion. There had been in the past a tendency toward slow-speed pumps, and a decided feeling against running them at higher speeds. In electrically driven irrigation plants, induction motors are in common use, 30 to 40-hp motors being commonly employed for such purposes. These motors are 4-pole, 60-cycle machines, and consequently run at 900 revolutions per minute. At first the motors were belted to the pumps, the latter running about 400 revolutions per minute. Now direct-connected units are coming into general use.

The principal objections which can be urged against high-speed pumps are the vibration, if not properly balanced, and the more rapid wear of the running joints of the pump. One trouble with many of the pumps is that the shafts are too small. With larger, stiffer shafts and more careful balance the vibration can be largely avoided and the wear of the running joints also greatly reduced.

The advantages of high speed are twofold. In the first place the pump is reduced in size and is made both lighter and cheaper; and in the second place, the efficiency is improved, due to decreasing the friction on the sides of the runner. The power consumed in a surface of area, A, passing through the water with a velocity V feet per second is equal to fAV^3 foot pounds per second, f being the coefficient of friction. In the case of a pump runner, the expression given above would have to be integrated over the surface of the disc. It is thus apparent that when the speed of the runner is increased, while the peripheral velocity remains the same, the diameter of the runner must be decreased, which will, of course, decrease the friction at the same time, and hence make the pump more efficient. The smaller the capacity of the pump, the larger will be the relative percentage of friction loss to output; hence the greater the gain by increasing the revolutions per minute. Thus, within reasonable limits increase of speed of the pump is desirable and tends to render the pump more efficient, provided it is properly designed.

Of course, increase of speed does demand more careful balance of the running parts, and involves somewhat more wear and tear. The advantages, however, will in general outweigh the disadvantages. The most suitable speed for a centrifugal pump is not necessarily the most efficient one, and it will depend on the capacity of the pump and the lift. For example, a pump of large capacity and consequently large suction inlet, would require a lower speed and a larger diameter runner than a pump of smaller capacity, when operated under the same head. On the other hand, if two pumps were to deliver the same quantity of water at widely different heads, the pump with the higher head should be of larger diameter and of higher speed than the other pump, as it would probably be desirable to increase the diameter of the runner somewhat, in order to keep the speed within practical limits.

The idea is quite prevalent that the field for centrifugal pumps is limited to very low heads, and that for heads of moderate height they are hopelessly inefficient. This idea is due in part to tables published in engineering handbooks, which give a very erroneous statement of the true facts of the case. They largely exaggerate the facts, except as regards very small pumps. This will be apparent by considering the effect of running a given pump at different speeds.

Suppose at R revolutions per minute, the pump is designed to give a flow of Q cubic feet per minute under a pressure of P pounds per square inch. Let W be the horse-power required to drive the pump at this output. Suppose the speed of the pump is increased to R_1 revolutions per minute, let $\frac{R_1}{R} = K$. Then the capacity of the pump will be $K\ Q$ cubic feet per second, the pressure generated will be $K^2\ P$ pounds per square inch, and the horse-power required to drive the pump will be $K^3\ W$. The efficiency will be the same in the two cases, since all the energy losses will be multiplied by K^3. The relative angles of entrance and departure from the pump disc will also be just the same in the two cases. This, of course, means that to design a pump to deliver the same quantity of water at a higher head a smaller size pump, and hence one not so efficient must be used to attain a maximum efficiency. This would mean that very small pumps are very inefficient under high heads. But still, even for low heads such pumps would be inefficient, due to the large friction on the runner. Higher heads require stiffer casings and more wear on the running rings of the pump. However, simple means may be adopted to obviate in great part the effect of the latter.

Many pump manufacturers rate their pumps as having a certain capacity without stating the head against which the pump is to work. They sometimes furnish a table showing the speeds required for different size runners to give various heads, but do not specify the head under which the pump should deliver its rated capacity. Such rating is obviously wrong, as the capacity of the pump under conditions of maximum efficiency should vary directly as the speed of the runner, and is by no means constant.

The simplicity and cheapness of centrifugal pumps, as well as the fact that they can be direct connected to motors with excellent results, are what commend them particularly for use with electric power, even at somewhat lower efficiency than could be obtained from reciprocating pumps.

The actual cost of pumping water for irrigation will, of course, vary largely with the conditions of the case. The distance to ground water, the available capacity of the wells, the distance between stations, the number of stations operated as well as the percentage of time during which they are in operation, the facilities for making repairs, and last, though not least, the price of power, will all affect materially the cost of pumping water.

As a basis for comparison, certain assumptions will be made. Suppose the distance from the surface of the ground to ground water is ten feet and that in pumping the water is lowered 22 feet further in the wells. Allowing four feet additional for friction as well as for extra elevation of the water to get it into the ditches, gives an effective head of 36 feet. Assume the efficiency of the pump to be 50 per cent. Considerably higher efficiency than this should be attained when the pump is new and is pumping under favorable conditions. However, the wear in the pumps, the varying head, due to variations

in level of the ground water, and the entrained air in the same will cut down the efficiency of the pump, and 50 per cent. will be a fair figure in practice.

Assume that the pump will deliver a flow of 5 second-feet. This will call for a 40-hp motor. Suppose power distributed to the pump stations at high pressure, say 10,000 volts. Such a station should be installed complete for about $4,000, provided wells of moderate depth will furnish the desired water. If a number of stations are to be put in, they could be installed at a lower figure. Suppose one pump attendant is able to look out for six such stations. The annual expense of operation would be as follows:

Interest and taxes, 7 per cent. on $4,000	$280
Depreciation, repairs and renewals (10 per cent. on $4,000)	400
Attendance	180
Total	$860
Cost per station per day	$2.36
Cost per cubic foot per second per day	.47

The attendance includes the cost of horses for the pump man.

Assuming the cost of power to be $50 per horse-power year gives the annual cost of power $2,000 per pump station; cost of power per second-foot per day, $1.10; total cost per second-foot per day, $1.57.

Assuming that the pumps run only half the time, and that power is paid for at the above rate, but that charge is made only for the actual time the pumps are in service, we have:

Fixed and operating expenses per second-foot per day	$.94
Power per second-foot per day	1.10
Cost per second-foot per day	$2.04

The above figures refer to a 24-hour day.

Assuming power to cost from $50 to $100 per horse-power year, only that which is actually consumed being paid for at that rate; also assuming that the stations are run from 12 to 24 hours per day, the cost per second-foot per 24-hour day will lie between $1.57 and $3.14.

Assuming that one second-foot will irrigate two acres in a day, and that the land requires four irrigations annually, one pump station will irrigate 910 acres per year, and the cost per acre will be from $3.14 to $6.28 per year. Assuming that the crop is alfalfa and that the ground will grow a ton to the acre for each irrigation, the land will produce 4 tons of hay a year at a cost of from 79 cents to $1.57 per ton for the water. Individual plants will, of course, cost more to run for many reasons, but under the conditions assumed, and with cheap power and fair land the cost of water should not exceed $1.25 per ton of hay. Some land will produce as much as two tons to the acre for each irrigation.

So many conditions enter into the problem that it is simply impossible to make a statement of cost which will apply in general. The water supply, the depth from which it must be pumped, the nature of the soil, and the cost of power are the principal elements which affect the cost of pumping, and these are widely divergent in different cases. The seepage in the canals will often interfere seriously with the work which a station should accomplish, and will necessarily limit its field of operation.

The actual cost of pumping water for irrigation by the Kern County Land Company came well within the limits given above.

Western Union's Railway Circuits.

At Newark, N. J., on December 18, Judge Fitzpatrick, in the United States District Court heard argument on the rule to show cause why an injunction should not issue to restrain the Pennsylvania Railroad Company from removing or interfering with the Western Union Telegraph Company's wires along its system. By agreement similar proceedings in the United States Courts of Pennsylvania had been held up to suit the convenience of the lawyers who preferred to have the first test made in New Jersey. The telegraph company was represented by John F. Dillon, Henry D. Estabrook, and Rush Taggart, of New York, general counsel for the Western Union, and R. V. Lindabury, of this city. In behalf of the railroad company appeared James B. Vredenburgh and R. L. Lawrence, of Jersey City, and ex-Judge John G. Johnson, of Philadelphia.

Mr. Lindabury, after describing the contracts between the companies, said that the Western Union was negotiating for a new contract when, on May 14, it received notice from the Pennsylvania Company that the contract of 1881 would not be renewed, and that the company must vacate within six months from June 1 following. Subsequently, he said, the Pennsylvania Company accepted and receipted for rent for May and June, despite the fact that under the contract no rent was to be paid after six months' notice had been given. The acknowledgment of the rent, he said, voided the notice under the common custom of landlord and tenant, and the Western Union stood without any notice to vacate. But aside from that, he said, the Western Union was a Government agent, and could not be removed from the position it holds. It could only be made to pay a reasonable remuneration. He claimed that under an amendment to an act of Congress in 1866 all railroads are post roads, and therefore the Western Union had the right to occupy the right of way along them by paying a proper rental.

The Armature Reaction of Alternators—VIII.

By C. F. Guilbert.

The construction described in the previous article is that which the author used before knowing the one indicated by Picou, which we shall use again further on. We will now take up the construction of the diagram for load conditions and a given phase angle, ψ.

After having determined the part of the flux which the field should actually furnish, or the corresponding e.m.f., $O\ A$ (Fig. 10), and bearing in mind the view adopted, it suffices to drop on $O\ A$ a perpendicular $A\ B$ of a length equal to transverse flux calculated, as has been indicated, or to the corresponding e.m.f. Next is drawn a perpendicular to the direction of the current flow, a vector, $B\ C$, representing the e.m.f. of dispersion; then parallel to the direction of the current a vector, $C\ D$, equal to the ohmic drop, increasing it as is usual by the apparent augmentation of the resistance to take account of Foucault currents. The vector, $O\ D$, will then represent the value of the binding-post voltage and the phase. The necessary excitation is determined by summing the different m.m.fs which are required in the field to give finally a useful flux, $O\ A$, in the armature.

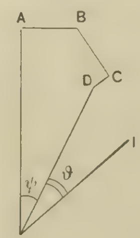


FIG. 10.

The only quantity remaining is e.m.f. of armature dispersion, and the calculation of these involves difficulties in arriving at a sufficiently exact result. This e.m.f. naturally depends on the form of slot teeth, their number per phase and pole, the exterior leakage and the total armature m.m.f. The armature e.m.f. can be separated into two distinct parts, one due to the actual self-induction of the armature winding and corresponding to the major part of the portions of the winding exterior to the armature.; the other corresponds to a fictive self-induction, due in reality to a decrease of the useful flux caused by the crowing toward the gap of the lines of force entering the teeth. By this is understood that the lines of force entering the teeth and constituting the part of armature dispersion flux under consideration come from the field and thus correspond to a real augmentation of the field dispersion aside from that already noted above, and which occurs in the gap and between the pole horns and core. In other words, this part of the armature dispersion, though in phase with the armature current, is in fact really to be credited to the field.

As a first approximation, it can be admitted that the dispersion e.m.f. is from 10 to 15 per cent. of the normal terminal e.m.f., according to the number of ampere-turns per centimetre of the developed armature per phase. This can be determined experimentally, for a given type, by unwinding, turn by turn, a test coil, and observing the voltage induced in the coil for the case of short-circuit, for example. On short circuit, in fact, the only flux passing through the armature corresponds solely to dispersion e.m.f. and ohmic resistance.

DIAGRAMS OF THE SECOND AND THIRD CLASSES.

The diagrams already given answer for the present rigorous technical demands, and will serve for the predetermination of load characteristics of alternators having quite high saturations both in

[illegible] many alternators are yet made having an induction in the teeth so small that with a reasonable gap the armature characteristic can be considered practically a straight line, it will not be without interest to give a simpler diagram applicable to such cases. The subject will be broached by a discussion of the diagrams of the second and third. The latter are ordinarily generalizations more or less complete of asynchronous motor diagrams such as that published in 1896 by Blondel. This was generalized by the author in 1897 for the case of a motor armature containing an inductance or capacity, and then applied to the case of alternators.

Whether this application is justified is doubtful, for reasons that follow. The asynchronous motor diagrams depends upon the fact that the resultant flux is produced by resultant m.m.f. of the armature and field. It appears to us that this assumes, which is true of the asynchronous motor, that the armature and field have not salient poles or, in other words, that the armature m.m.f. can, in every position with respect to the field, have effect on a magnetic circuit always identical with itself and comprising the field magnetic circuit. This amounts to saying that the direction of the field flux is not determined by the conditions of the design of the machine since it necessitates no visible separation between the field poles.

For alternators with separate pole, this is no longer true; the direction of the field flux axis is well determined in the core and in the frame, and it is only in the pole pieces, gap and armature that this direction ceases to be fixed. It results that in these parts alone can the composition of the m.m.fs follow the polygon of forces. This is also a consequence of the fact that the transverse and direct reactions are manifested together only in the pole pieces, gap and armature.

The permissible composition is thus only simply that of the difference of inducing magnetic potential between the two faces of the gap on the one hand and that of the difference of potential between the same faces due to the armature m.m.f.

If the armature is only slightly saturated, it is readily seen that we can combine the armature m.m.f. with the ampere-turns necessary for the gap and increased by a certain percentage to take account of the reluctances of the armature and the pole faces, supposed to be constant.

If we can assume that b is equal to a, the construction of the diagram becomes much more simple, for it no longer necessitates knowing the total phase angle, ψ, and consequently permits starting with the terminal voltage in constructing the complete diagram.

Let us assume that the terminal voltage is v, the current I, and that the angle between these is ϕ; we can then construct (Fig. 11) the voltage diagram by adding successively and geometrically to v the ohmic loss, rI, and the e.m.f. of armature dispersion. The resulting e.m.f., $O\ C$, corresponds to the useful flux in the armature, and we then lay down on the armature characteristic the number of ampere-turns necessary to maintain this flux at no-load, and, which should correspond to $O\ C$ by a suitable choice of scale for the ampere-turns. If we then draw from the point C a perpendicular $C\ D$ in the direction of the current and equal to F_i ampere-turns, the right line, $O\ D$, will represent the direction of the m.m.f. or of the field flux. If we decompose the flux, $O\ C$, in the direction of $O\ D$ and its perpendicular,

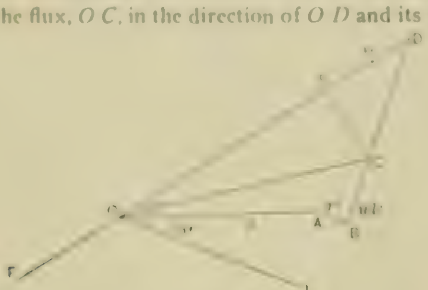


FIG. 11.

we will have in $O\ I$ the flux which, independently of leakage, will traverse the field, while $E\ C$ will be the transverse flux, the fluxes being here proportional to the differences of magnetic potential which produce them.

The vector, $O\ D$, represents the difference of magnetic potential between the pole horns, and it suffices to add thereto the m.m.f. of the direct reaction, $E\ D$, to have the total m.m.f. necessary to cause the useful flux to pass into the armature, and to balance the armature m.m.f. It is, in fact, easy to show, by reference to Fig. 9 (homothetic rectangles $B'\ M\ P\ A$, $B'\ M''\ C\ B$) that when the part $B'\ M$ of the characteristic $O\ M$ is a straight line, the point B' is on the same vertical as B; or in other words, that the m.m.f., $B'\ M''$, necessary to be added to the difference of magnetic potential between the pole horns, to maintain the same flux, $B'\ M''$, at load and no-load, is equal to F_i; the quantity $F\ J$ is then equal to $\frac{r}{R_a}\ F_i$. The field leakage is of the same phase as the flux in the core, and its value, $E\ H$, practically proportional to $O\ D$, should be added, *not* geometrically to the flux $O\ C$, as has heretofore been done, but to the flux, $O\ E$*. The resultant flux in the field is then $O\ H$. It is not, however,

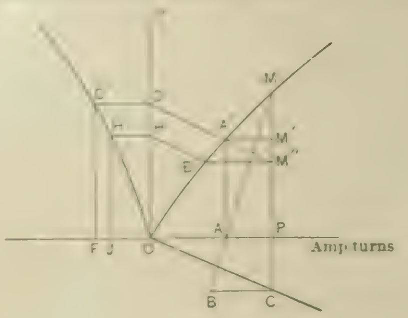


FIG. 9.

necessary to lay down this flux in the diagram, as the partial characteristic of Fig. 9 gives immediately the number of ampere-turns necessary to pass the flux, $M''\ P$ into the armature with the different leakages, including those due to the increase of m.m.f. necessary to compensate for the armature ampere-turns.

As can be seen, this diagram assumes only one thing, namely, that the armature characteristic is practically a straight line; the field can be saturated to any extent without effect on the exactitude of the method.

The considerations that have been set forth in this article are evidently not yet perfect, principally as concerns the manner of obtaining the value of the mean transverse flux, and that taking account of field magnetic leakage. With respect to this latter point of view, we have been obliged to admit that the field leakage are determined by the magnetic potential between the polar projections. In reality, this is only true for the part of the field magnetic leakage between the pole horns; the other part—that between the cores—depends upon a m.m.f. not possible to fix by direct calculations, but which may be approached by successive approximations.

However this may be, we believe that the formulas established and which have been verified with great care on a number of machines, particularly with respect to the predetermination of the short-circuit line, as well as the two diagrams given, may render some service to engineers engaged in the design of alternators. In a following article some numerical applications of the method and formulas will be given.

Statistics of Gas Apparatus and Supplies.

A recent bulletin of the United States Census Office gives the following figures as to gas apparatus in 1900:

Items	Gas and lamp fixtures.	Gas and oil stoves.	Gas machines and meters.
No. establishments	223	35	114
Capital	$10,009,230	$3,766,065	$4,605,624
Salaried officials	875	101	[illegible]
Salaries, total	$902,0[illegible]3	$231,436	$251,38[illegible]
Wage earners	7,642	2,471	2,167
Men	5,582	2,458	2,09[illegible]
Women	1,754	8	[illegible]
Children	306	5	10
Wages, total	$3,504,301	$1,138,442	$1,18[illegible]
Miscellaneous expenses	1,023,036	274,242	19[illegible]
Cost materials	5,013,507	2,501,568	1,943,7[illegible]
Value products	12,577,806	4,579,700	4,302,730

The total value of all manufactures as given in this revised and extended report is $13,014,287,498; cost of materials used $7,348,144,755, miscellaneous expenses, $1,028,035,611; salaries, $404,230,274, and wages, $2,328,691,254. This would leave a profit of nearly 20 per cent on the total capital of $9,835,086,909. There are also noted 19 firms making calcium lights; charcoal, 183; coke, 241,; electrical apparatus, 580; electrical construction and repairs, 1,162; fertilizers, 422; graphite refiners and producers, 11; manufactured ice, 775; lamps and reflectors, 156; matches, 22; petroleum refining, 67; plumbers' supplies, 174; plumbing, gas and steam fitting, 11,876.

* M. [illegible], whose diagram resembles the present one in the separation of the armature [illegible] from those of the field, makes also the same error as those who preceded him.

A Universal Patent Examination System.

A very interesting article on the value of inventions, the growth of the patent system, and the need of improvements in the methods is published in the *Yale Law Journal* for December, from the pen of Mr. John S. Seymour, United States Commissioner of Patents under President Cleveland. One notable point is dwelt upon, namely, the need of preventing so much duplication of work in authenticating the value of a new patent. Mr. Seymour discusses the "examination" system as follows:

Having now shown the beneficient tendency of patents when well grounded in view of all the prior art, and how they may become no better than the odious monopolies of Elizabeth and Charles I and the Bourbon Kings, when granted without anything new, and having shown that to grant patents without examination has resulted in England in the issue of 42 oppressive patents to 58 lawful ones, it amounts to a demonstration that the examination system must be installed wherever the patent system extends, and that in every country, more than eighty in all in the civilized world, where patents are granted, the same material must be collected that we have collected at Washington, that England is about to collect, that Germany and Sweden must provide, and that the equivalent scientific corps of hundreds of examiners must be organized into an effective body in every separate country, to work upon this material, first, to classify it, then to understand it, then to bring it to bear upon new applications as they are presented, thus manifolding scores of times the equipment and the work that is necessary for the grant of a single valid patent.

An American inventor who applies for a patent in England, after having obtained one at home, will have performed for him at the public expense the same search *through the same material* in order to grant an English patent that has already been made for him through the same material in order to apply for his patent here. If he should also apply for a German patent, the same search would be again repeated by the German officials over the same ground, and so it would be for Sweden, and so we may say it ought to be repeated in every other country where patents are granted. There is no escape from this except in co-operation between nations.

Having in our progress conceived the patent system as divested of many of its disfiguring features, we are now prepared to take one further but most important step in the perfection of the system, from which patents in several countries or in all countries may be granted upon one competent, exhaustive and thoroughly reliable search made in the one country where it can be made best, without burdensome expense, without delay or denial of justice.

Slight changes in the patent systems of the world would harmonize them to such a general regime. The innovation would be startling, but it would violate no principle, nor would it be comparable to universal legislation for the world.

To centralize scientific work that is already four times manifolded and is destined to be greatly multiplied is not visionary, because the system ought to exist. There may be no other governmental function open to this treatment, unless observations of the weather may be, and yet other analogies are found. The Postal Union has established joint action in the matter of foreign mail, and seals, the Behring Sea, Samoa, ocean cables, the open door, ships, missions, coaling stations, arbitration of international disputes, have been the subject of world legislation, or treaty.

We have a faint beginning in the International Convention concerning trade marks and industrial properties with its bureau at Berne in Switzerland maintained by many countries, including all the more important ones and our own, but its functions are limited to a few factors in the problem, and its equipment for the work here contemplated is inadequate.

The Hague Peace Tribunal, marking an epoch in civilization, placing Nicholas II of Russia and De Bloch in the foremost rank of philanthropists was the product of intellectual forces making for a rationally organized world. But this tribunal is only occasionally in action to prevent international ruptures and settle disputes after they arise, somewhat as electrical apparatus was, for more than a generation after Franklin, used merely to ward off lightning.

But the universal patent office could not only do quicker and better what the separate patent offices now do, but it would act continuously and affirmatively upon human affairs to give a constant stimulus to genius in every country, to benefit mankind at large by expanding and improving the industrial arts, and to weave thousands of silken threads to bind the nations together in an elevated and rationally guided daily life.

As matters now stand, the inventor of a machine or product or the discoverer of a new process may have a patent in every country of the world having a patent system upon paying the fees, which are in the aggregate burdensome even when but few out of the many are taken. Yet nothing is done to make sure of the validity of the patent except the search on the question of novelty and the decision on the question of invention, neglecting for the moment mere matters of form. One search being as good as eighty, and two searches on the same subject being useless, there must be a practical way in which the United States can share with others the use of its accumulated material. Two countries can act together, either by treaty or by passing the same law providing for joint action.

As the United States has been foremost in establishing the examination system and making use of the means by which valid patents may be granted and invalid patents withheld, it might fitly take the initiative in proposing joint action in the matter of patents, for example, with Canada our neighbor on the north, or with Mexico, or with the South American Republics, or with Spain, or with any country not likely on its own initiative to establish this costly machinery of its own, offering to investigate and pass upon the question of novelty and invention for every applicant whether desiring a patent in the United States alone, or in one or more or all of the foreign countries who should accept this offer of joint action and provide for carrying it out.

The rest would be the machinery for authenticating the patent by the signature of an accredited agent of such foreign country, or its present resident ambassador or minister.

Thus a patent issued by the resident ambassador at Washington countersigned by our Commissioner of Patents might by appropriate legislation be as valid and effectual in Mexico or Canada or Venezuela or Peru, supposing these countries united with us upon this plan, as though the patent were issued upon original proceedings in each of these countries.

Recent Electrochemical Developments.

By CLINTON PAUL TOWNSEND.

COMBINATION METHODS IN ELECTROMETALLURGY.

Mr. Alfred Dorsemagen, of Wesel, Germany, proposes to combine in a single operation the method of Acheson for the production of carbide of silicon and that of Cowles for the distillation of zinc from its ores. To this end he substitutes for the sand of the carborundum charge, the silicate of zinc; the metal is distilled over and collected, while the silicon unites with the excess of carbon to form carborundum which remains as a residue. This is the process claimed; the specification states, however, that zinc oxide derived from the dead roasting of blende, together with sufficient carbon for its reduction, may be merely added to the usual carborundum charge. In this case the curious proposition is offered to conduct simultaneously, in the same furnace, two independent and unrelated operations, neither of which is stated to modify the other in any manner.

It is seldom, indeed, that it is commercially feasible to combine independent methods in this manner. In the case mentioned it may be assumed that neither process modifies the other, and that therefore the sole advantage to be gained is a certain saving of heat due to the restriction of the radiation losses to the walls of a single structure. To counterbalance this gain is the obvious necessity for so constructing the carborundum furnaces that their walls and covers shall be impervious to the vapors of zinc; and considering that an effective zinc retort has long been a problem for metallurgists, the difficulties are seemingly somewhat disproportionate to the advantage derived.

In this case the operations are not incompatible, but in a sense the products are; the expense of the collection of either is vastly increased by the necessity for collecting the other. There are many

[illegible] may be mentioned the proposal of [illegible] for the simultaneous production of [illegible] the latter compound being formed [illegible] and the method of [illegible] by the addition of the latter metal to the usually impure [illegible] charge. Here [illegible] the object is to eliminate what may be regarded as an impurity, turning it instead to a useful product. As a further example may be cited the suggestion of De[illegible] for the simultaneous production of water glass and phosphorus by heating together sodium phosphate, silica and carbon in the electric furnace.

Such examples might be multiplied almost indefinitely, but it is probable that no more interesting combination process has been offered than the proposal, variously patented by [illegible], [illegible], Billaudot, Jacobsen, and perhaps others, that the manufacture of calcium carbide and phosphorus be combined in a single operation. According to this scheme, calcium phosphate is reduced by excess of carbon in the electric furnace, phosphorus being distilled and calcium carbide remaining as a residue. This plan is strictly analogous to that of [illegible], above referred to, and is probably open to the same objection of unnecessarily complicating the carbide furnace; it has also been found to be objectionable in that it contaminates the carbide with phosphide, thereby also contaminating the acetylene with gaseous hydrides of phosphorus.

The latest suggestion along these lines is in the patent issued jointly to Charles S. Bradley, Robert H. Read and Charles B. Jacobs and assigned to the Ampere Electro-chemical Company of New Jersey. In this case a virtue is made of necessity, and the product of the phosphate reduction is stated to be a "carbophosphide" of calcium. It seems to be in fact a mixture of phosphide and carbide, which may be crystalline, and which contains sufficient of the first-named compound to insure the liberation, by reaction with water, of a spontaneously inflammable mixture of gases, the predominant constituent being, of course, acetylene. For this compound certain uses, of a military and naval character, are suggested.

New Telephone Patents.

Telephony may be credited with no less than six of the patents issued on December 16th. Not the least interesting of these is one which, under the title, "Telephone System," describes and claims a novel design of induction, coil and receiver for common battery system subscribers' instruments. The novelty of design concerns the electrical features only, the primary winding of the induction coil being of higher resistance and of higher inductance than customary, while the secondary circuit embracing both the coil winding and the receiver has both these factors correspondingly reduced.

The reasons for these changes may be best understood by considering the induction coil as a transformer. With transformers, it is well known that when the secondary winding is on open circuit, that is, when no power is being used, the primary winding receives very little energy from the line. As the resistance of the secondary is reduced by the cutting into service of more and more lights or other apparatus, the primary current adjusts itself to supply the requisite power. This regulation of the primary current is due entirely to the fact that the two windings of the transformer so react upon each other that the impedance of the primary varies in an inverse ratio with the current or in a direct ratio to the impedance of the secondary circuit. Now with a telephone induction coil an exactly similar phenomenon takes place, and in the present invention this is utilized, the inventor making his secondary circuit resistances so low that the impedance offered to the telephone currents by the primary winding—which is in series with the line in a position to be effective in reducing the efficiency of transmission—is cut down materially, even though the resistance and number of turns of the primary winding are increased to compensate for the change of character of the receiver and secondary windings. The actual ratio of conversion of the new induction coil is 2 : 1, the windings both being of approximately eleven ohms resistance. The preferred resistance of the receiver is twenty-five ohms, obtained by using two fifty-ohm windings in parallel. The inventor of this system is Mr. W. W. Davis, of Chicago, the patent being assigned to the Stromberg-Carlson Company.

Another combined power and communicating system appears this week in a patent granted to A. M. [illegible], of Toronto, Canada. This system purports to be one whereby either telegraph or telephone communication may be carried on over the conductors of a direct-current electric light and power system while this latter is in operation. The claims of the patent are based largely upon the bridging of storage batteries across the power circuit at the central station "to aid in maintaining constant pressure * * * and to remove the effects of the imperfect commutation of the generator." The inventor seems to forget altogether, however, that these central station

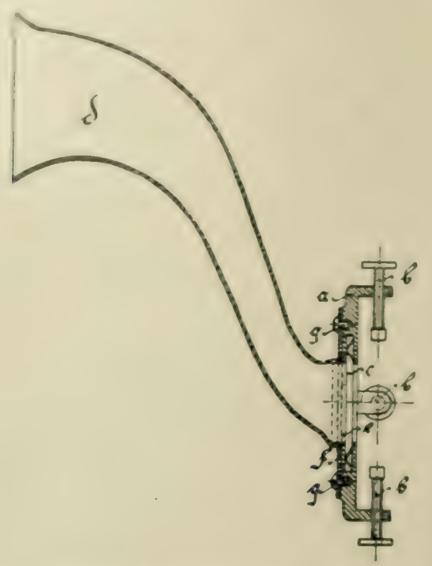


FIG. 1.—SCHOELER TRANSMITTER MOUTHPIECE.

batteries will not provide for the "effects of imperfect commutation" at the motor on the subscriber's premises or for the line wire resistance. As the telephone system described is rather crudely worked out, it does not seem worth while to give it detailed consideration.

Another patent in the same issue also related to the use of line wires for two kinds of transmission, but in this case it is not the simultaneous but the successive use of the wires which is provided for. The two types of transmission are telegraph and telephone signals, it being contemplated to arrange telephone instruments upon railway telegraph lines so that information may be properly reported from any station in the absence of a telegraph operator. Provision is made

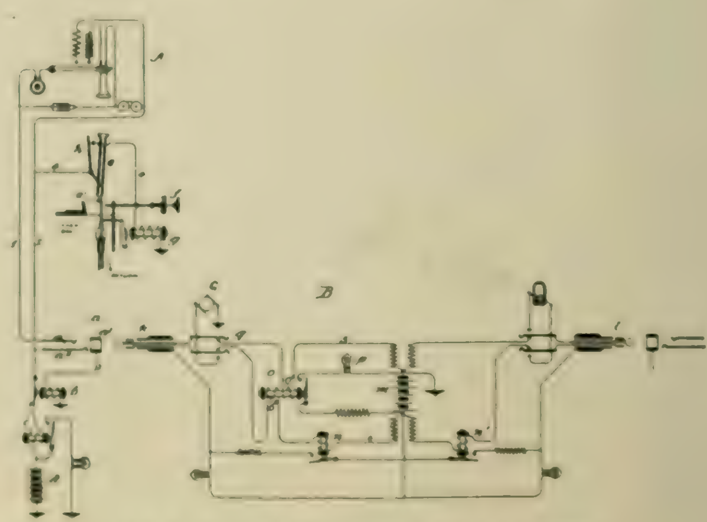


FIG. 2.—SCRIBNER SUPERVISORY SIGNAL SYSTEM.

for properly sending signals and for switching the line from one kind of apparatus to the other at any station, but as there is no telegraph busy signal and as the telegraph current exists upon the line during telephone conversation, it is interesting to consider what will happen if an operator at one station attempts to telegraph over the line while a telephone message is being sent from another, the unanswered and repeated telegraph signal calls being impressed forcibly upon the ears of the telephone users.

Fig. 1 shows a German idea of a convenient transmitter mouthpiece, being the subject of a patent granted to Arthur Schoeler, of Elberfield, Germany. The clamp *a* is adapted to clamp to the trans-

mitter and the crank-shaped mouthpiece may be rotated about the axis indicated in a manner to compensate for the varying heights of telephone uses.

Another mouthpiece patent is that of R. S. Willmarth, which bears the title, "Antiseptic Protector for Telephone Mouthpieces." The specified device is an absorbent, perforated disc, saturated with antiseptic solution and adapted to be secured in the front of the mouthpiece by means of a wire which engages notches at the base of the mouthpiece.

The sixth and last patent requiring consideration is entitled, "Supervisory Signal for Telephone Exchange Systems," and is granted to C. E. Scribner, of Chicago, and assigned by him to the Western Electric Company. Mr. Scribner's device is for use in connection with slot pay-station machines having coin-return attachments, and provides means whereby if a coin be removed from the slot during the completion of a connection, a signal light will notify the central office operator to cancel at once the call. Fig. 2 shows the means whereby this is accomplished, the action depending upon the contact at *h*, which is maintained as long as a coin is in the slot, and upon the differential winding of the relay *o* in the operator's cord circuit.

When a coin is in the slot the disturbing influence of the ground through the releasing magnet, *g*, at the pay station, is sufficient to unbalance the magnetic effects of the differential relay, allowing this to operate and show the signal *p*. When the coin has once been deposited either in the box by means of ringing current put upon the line by the operator, or in the return by means of the push button *f* in the hands of the subscriber, the balance in the relay is restored and the light extinguished.

Street Car Travel in New York State.

According to the statistics of the State Railroad Commission, during the fiscal year ended June 30, 1902, the surface and elevated railroads of the city of New York carried 924,754,211 original passengers; that is, passengers paying fares. Counting the transfers, the total number of passengers carried was 1,160,030,344. Figures are subjoined:

	Original.	Including Transfers.
Manhattan and Bronx........	625,547,434	802,154,809
Brooklyn	299,206,777	357,875,435

The original passengers riding on the cars in Manhattan were distributed as follows: On the street surface roads, 410,287,089; on the elevated, 215,259,345. There being no transfers on the elevated makes the total transfers on the street surface roads 176,726,464. These figures, when compared with those of the preceding year, show that the passengers carried decreased 7,895,446 on the street surface and increased 25,213,604 on the elevated. The decrease on the street surface roads of Manhattan and the Bronx was not in original passengers, but in transfers, as these figures will show:

	1902.	1901.
Original passengers	410,287,089	392,117,069
Increase	18,170,020	....

This year there are fifteen railroad companies operating in the territory of Manhattan and the Bronx, which is an increase of two companies over last year. The length of tracks operated by these companies is 216.491 miles, against 206.613 miles last year.

The surface and elevated roads of Brooklyn carried during the past year 357,875,435 passengers, including transfers. The original passengers numbered 299,206,777. There is no way to separate the elevated from the surface road passengers, for the report of the Brooklyn Heights Company makes no distinction. The lines of this company carried during the year 296,534,777 passengers, including transfers, and 240,394,676 original passengers. The increase in total number of passengers was 10,719,524. The statistics of original passengers for both years are:

	1902.	1901.
Original passengers	299,206,777	283,546,691
Increase	15,660,086	....

Eight companies operate the railroads of Brooklyn, which is unchanged from last year. The track mileage this year is 330.317; last year, 328.394.

These figures show that there were more than two millions of passengers carried on the cars of the several lines of railroads operating in Greater New York every day in the year. A great increase is going on at the present time.

Telephone Lines in Village Streets.

In New York State the Fourth Appellate Division has decided, by Justice Hiscock, that a telephone company has the right, with the permission and under the control of the authorities, to erect poles and string wires through the main street of a village of several thousand inhabitants, notwithstanding that the abutting property owners refuse to give their consent. The village in question is Salamanca, N. Y. The property owners there own to the center of the street. The defendant had no right to erect the poles unless their erection was within the limits of the public easement in the street, and it is settled that the ownership by a property owner of the fee to the center of a street does not give him the right to prevent any additional use of the street, provided such use is within the limits of the public easement. Justice Hiscock held that while a city street may be subjected to many purposes that would not be necessary or proper in a country highway, there was nothing to show —as no hard and fast line could be drawn—what class the Salamanca street came under. The Justice said: "In considering what are the proper limits of lawful public use of a street or highway, a natural and well-defined distinction has been drawn by the courts between rural or country roads and city streets. Passing upon the right of a telephone company like defendant to place its wires in a public street in a city, this court has fully held and decided that such right was within the limits of the public easement in a city street. In the classification of, and distinction to be drawn between, city streets and rural highways, the courts have treated village streets as more analogous and akin to the former than to the latter. Such conclusion is a natural one. No fixed and arbitrary line upon the subject of public uses and necessities can be drawn between the streets of a city and a village. The more populous the latter becomes the more extensive will be its public needs and the demand for public conveniences. In a smaller degree than in the case of a large city its streets will always, in the natural course of events, be subjected to greater public demands and uses than the ordinary rural highway."

CURRENT NEWS AND NOTES.

TROLLEY FOR LIMA, PERU.—A cable dispatch from Lima says: A company has been organized here and has petitioned the government for a concession to build an electric railway in this city.

AMERICAN RÖNTGEN-RAY SOCIETY at its annual convention in Chicago adopted resolutions in favor of the St. Louis Exposition, after hearing a statement from Prof. W. E. Goldsborough on the subject.

NAPOLEON AND ELECTRICITY.—The first sculptural assignments announced for the St. Louis Exposition are the heroic statues of Jefferson and Napoleon. The designing of the Jefferson statue, which is to be placed in front of the main entrance of the Education Building, is assigned to J. Q. A. Ward, and Daniel C. French will design the statue of Napoleon, which will be placed in front of the principal entrance of the Electricity Building on the opposite side of the main lagoon. The figures will face each other, Napoleon in the act of signing the transfer and Jefferson in the attitude of receiving it. It will be remembered that the Electricity Building at Chicago in 1893 had a fine statue of Franklin in front of it. The only association of Napoleon with electricity is that Volta explained to him the principle of his cell, since when electricity has been rapidly undoing all that Napoleon ever did in the way of mere physical conquest.

[illegible] which arrived recently [illegible] is reported to have [illegible] well [illegible]

FIRE AT RENSSELAER POLYTECHNIC INSTITUTE.—The [illegible] of the Rensselaer Polytechnic Institute at Troy, N. Y., was almost completely destroyed by fire on the night of December 13, the loss being [illegible]

AUTOMOBILE CLUB OF AMERICA will have its fourth annual dinner at the Waldorf-Astoria on Saturday, January 24, when several well known speakers will participate. A large attendance is expected. Mr. J. M. Hill is chairman of the banquet committee.

CHICAGO UNIVERSITY ENDOWMENT.—Mr. John D. Rockefeller has given another $1,000,000 to the University of Chicago, making a total of $12,400,000 donated to that institution by Mr. Rockefeller. Out of the new endowment it is expected that Dr. Harper, president of the University, will establish a school of technology.

NEW AIRSHIP.—A cable dispatch from Paris of December 20 says: A habitable airship seems to be the next project which French aeronauts desire to realize. Mr. Broet, a member of the Aero Club of France, has designed and is having constructed an airship which will have a room covered in with mica and furnished with couch, wardrobe and table. The airship will be lighted with electricity.

SEIZURE OF WIRELESS TELEGRAPH PLANT.—A significant act on the part of the French government is recorded in a press dispatch from Cherbourg, which states that the authorities have seized the wireless telegraph station erected there by a private company on the promontory. The seizure was made on the ground that the operation of the station is an infringement on the state monopoly of the telegraphs and endangers the national defence.

STRIKE OF TELEPHONE GIRLS.—A special from Des Moines, Iowa, says that the strike of the telephone operators there, which had been in progress about six months, has been settled by representatives of the company and of the Trade and Labor Assembly. The telephone girls are to be paid wages 15 per cent in excess of the Union scale, and all of the girls who struck are to be taken back to work. The company further agrees not to discriminate in any way against the strikers. The injunction suit to restrain the representatives of union labor from boycotting the company is to be dismissed.

PETROL ELECTRICS FOR ENGLAND.—A cable dispatch from London of December 18 says: The *Times* announces that the Northeastern Railway is about to try two autocars now being built at York. At one end of each car is a Napier petrol engine of 85 hp and with 4 cylinders, driving a dynamo generating electricity for two motors applying the power to the wheels. The cars are light, and each carries 52 passengers. The storage capacity is for 30 gallons of petrol, which will last 5 hours. It is proposed to work the new system experimentally on the crowded part of the railway between Hartlepool and West Hartlepool, which are not far apart.

A. I. E. E. LOCAL MEETINGS.—At the meeting last week of the American Institute of Electrical Engineers, President Scott announced that during the past month local meetings have been held in Chicago, Denver, Cincinnati and Pittsburg, and students' meetings at a number of the colleges. Prof. Esty referred to the interest manifested by students at Lehigh University, where three student meetings have thus far been held, in each case immediately after the New York meeting. The reading of the Institute papers was followed by discussions, and Prof. Esty spoke enthusiastically of the benefit to the students, and of their appreciation of the plan.

AMERICAN ELECTROCHEMICAL SOCIETY.—At the December meeting of the Board of Directors of the American Electrochemical Society, the following applicants were elected to membership: Dr. Leonard Paget, New York; Prof. Dr. Julius Wagner, Leipzig, Germany; R. W. [illegible], Stafford, England; Prof. Philippe A. Guye, Geneva, Switzerland; Leonard Wilson, Pittsfield, Mass.; Dr. William Dreyfus, New York; Charles J. Pretzfeld, Niagara Falls, N. Y.; August Eimer, New York; Dr. John Shields, London, England; Prof. D. McIntosh, Montreal, Canada; Dr. J. W. Walker, Montreal, Canada; Walter S. Landis, Bethlehem, Pa.; George P. Adamson, Easton, Pa.; Victor Engelhardt, Vienna, Austria; F. J. Machalske, Long Island City, N. Y.

A. I. E. E. IN CINCINNATI.—A local branch of the American Institute of Electrical Engineers has been formed at Cincinnati. The movement was inaugurated by Mr. F. G. Bolles and the first meeting held in the officers' dining room at the works of the Bullock Electric Manufacturing Company on Wednesday evening, December 17th. Eleven members were present, and after forming a temporary organization and discussing the different phases of the subject for some time, elected R. T. Lozier and L. E. Bogen as chairman and secretary of the permanent organization. It is the intention to discuss papers presented at the New York meeting, as this will be feasible, owing to the fact that the local meeting will be about three weeks later than the one held in New York. Mr. Bolles handed in ten new applications for membership and stated that at least ten more would probably be secured before January 12th, the date of the next meeting.

NEW TYPE OF ALTERNATOR.—Two patents issued December 9 to Charles S. Bradley describe a new and interesting type of alternator, which is self-exciting and particularly adapted for high speeds such as are incident to direct-connection to steam turbines. The armature, if such it may be called, is of the squirrel-cage type. As shown, the field is of the ring type with a continuous winding. This winding is tapped at three equidistant points by leads from three condensers in parallel; and at three other equidistant points by the three mains of the working circuit in case three-phase currents are desired. The capacity of the condensers is so chosen with respect to the field inductance as to give the condenser circuit a definite rate with respect to frequency. The periodicity of the generated current is a differential of two speeds—one of which depends upon the speed at which the armature is driven and the other upon the resonant rate established by the condenser circuit. Consequently the speed of the prime mover is the sum of the speeds of the rotary field established respectively by the condenser and driven element, and therefore particularly suitable when the prime mover is a steam turbine. By making the condenser circuit adjustable, the frequency can be very simply varied.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—Miss H. Billings, assistant secretary of the National Electric Light Association, sends us the following additional list of new members enrolled since November 1, making no less than 180 since the Cincinnati meeting: Franklin Falls, N. H., Franklin Light & Power Company; Lambertville, N. J., Hunterdon Electric Company; San Francisco, Cal., the Standard Electric Company of California; Victor, Colo., Pike's Peak Power Company; Phoenix, Ariz., Phoenix Light and Fuel Company; San Leandro, Cal., Suburban Electric Light Company; Lewiston, Idaho, Lewiston Water and Power Company; Hillsboro, Ill., Hillsboro Electric Light & Power Company; Saginaw, Mich, Bartlett Illuminating Company; Ann Arbor, Mich., Washtenau Light & Power Company; Marshfield, Ore., Marshfield Lighting Company; Fort Smith, Ark., Fort Smith & Van Buren Light & Transit Company; Oneida, N. Y., Madison County Gas & Electric Company; Idaho Springs, Colo., the Cascade Electric Company; Idaho Springs, Colo., the Consolidated Gem Mines Company, electrical department; Southampton, N. Y., the Southampton Electric Light Company; Paris, Texas, Paris Light & Power Company; Prescott, Ariz., the Prescott Electric Company; Grand Forks, N. D., Grand Forks Gas & Electric Company; Phoenixville, Pa., Schuylkill Valley Illuminating Company; Wausau, Wis., Wausau Electric Company; Port Huron, Mich., Port Huron Light & Power Company; Paducah, Ky., Paducah City Railway; Brandon, Vt., Neshobe Electric Company; Binghamton, N. Y., Binghamton Light, Heat & Power Company; Helena, Mont., Helena Light & Traction Company; Dover, N. J., Dover Electric Light Company; Suffield, Conn., Village Water Company; Thomasville, Ga., Thomasville Electric Light & Gas Company; Keeseville, N. Y., Keeseville Electric Company; Chelsea, Mass., Chelsea Gas Light Company; Santa Fé, N. M., Santa Fé Water & Light Company; Alpena, Mich., Alpena Electric Light Company; Unionville, Conn., the Union Electric Light & Power Company; Peekskill, N. Y., Peekskill Lighting & Railroad Company; Columbus, Kan., the Columbus Electric Company; Pittston, Pa., Citizens' Elec-

tric Illuminating Company; Vergennes, Vt., Vergennes Electric Company; Brunswick, Me., the Brunswick Electric Light and Power Company; Portland, Me., Consolidated Electric Light Company of Maine; Litchfield, Conn., the Litchfield Electric Light & Power Company; Lexington, Mass., Lexington Gas & Electric Company; Ontario, Cal., Ontario Power Company; New Lisbon, Ohio, the New Lisbon Gas Company; Aylmer, Quebec, Hull Electric Company.

LETTER TO THE EDITORS.

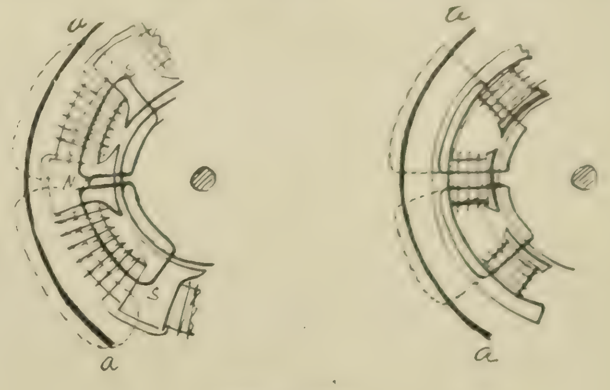
Increasing Output of Motors.

To the Editors of Electrical World and Engineer:

Sirs: Several months ago, while testing some small induction motors of my own make, I observed that the power output the motors were capable to yield was increased by removing the sheet iron cover around the stator coils. Some few words about the construction and winding of these motors will aid to understand the explanation that has occurred to me concerning the influence of the iron cover.

The motors are designed for an effective output of one-half horse-power on 104-volt, 60-cycle, single-phase circuits. The stator is 9 inches outside diameter; longitudinal breadth of iron, 4¾ inches; inside diameter of stator ring, 5 inches; rotor outside diameter, 4 31-32 inches; air-gap, 1-64 inch; slots in the rotor, 37, nearly closed, for No. 2 brass wires short circuited at the ends; slots in the stator, 36 open. A four-pole winding in ring fashion is used in the stator, the coils passing outside the stator and through the slots at the inside. The sheet-iron tube covering the stator coils is made 1-32 inch in thickness, and receives 11¼-inch diameter, leaving an air-gap all around the iron in the stator of 1⅛ inches.

A satisfactory explanation of the influence of the iron cover is the probable increase in the magnetic leakage due to its situation in the stray field around the stator coils. A sheet zinc cover has no influence at all upon the output. This influence of the iron cover will exist only in ring-wound stators. In drum-wound stators the cover will exert, if any, a favorable influence. Two simple analogies, with well-known types of direct-current magnet frames (Figs. 1 and 2), will require little



FIGS. 1 AND 2.

explanation to show that any magnetic cover or shield, *a a*, in Fig. 1, will decrease the flux linked with the armature, while in Fig. 2 there will be a very small action, and this in a favorable way. If we have in mind the direction of the m.m.fs produced by the windings, the analogy between Figs. 1 and 2, and ring and drum-wound stators, respectively will be plain.

LIMA, PERU. A. GRIEVE.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Experiments with Synchronous Converters.—THORNTON.—A long and fully illustrated abstract of a paper read before the Newcastle section of the (Brit.) Inst. Elec. Eng. on some experiments made with two small direct-current dynamos used as converters; both were two-pole, ring-wound machines, one of 9 kw, and the other of 5 kw. In order to avoid disturbances due to irregular driving, the first was driven from a battery of accumulators; both machines were excited directly from the accumulators. The two machines were connected on the alternating-current side by cables of negligible resistance in such a way that they could be used either as single or three-phase converters. The direct current furnished by the second machine was absorbed by means of a liquid resistance. Ammeters and voltmeters were arranged to read the currents and voltages on both continuous and alternating-current sides of both machines, as well as the currents in their shunts; a wattmeter was used to read the power in the alternating-current circuit. A double oscillograph was used to give the curves of current and voltage. The results of the tests are tabulated and also shown in diagrams; there is also a table showing the interesting curve forms obtained with the oscillograph. The two machines were started without load and the load was thrown on gradually; if the load was thrown on suddenly, the second converter started surging and was liable to fall out of step. In the first set of experiments the field of the first converter was kept constant, while the field of the second was varied; and, afterwards, the second was kept at constant excitation, and the field of the first was varied. In these experiments which were made with single-phase current, the efficiency of the combination is higher, when the power factor is highest. The variations of efficiency is nearly proportional to the squares of the current on the alternating-current side, showing that the variation of the copper losses is the cause of the loss of efficiency. Discrepancies between the observed and calculated losses in the converters led to an investigation of the disturbing effect of the armature reaction on the field in the magnet frame; the second machine being compound wound, its series winding was used as an exploring coil to show the variations in the magnetic flux. In the discussion which followed, Holmes pointed out that this paper represented the study of dynamos from a new point of view, viz., the actual observation of the magnetic flux; if an armature is out of balance or contains a faulty coil, changes go on in the field magnets; he has frequently observed a rise of voltage in the field coils of multipolar machines when an armature is out of balance.—Lond. *Elec.*, December 5.

REFERENCE.

Non-Synchronous Alternating-Current Machines.—ZIEGENBERG.—Continuation and conclusion of his long illustrated serial the first parts of which have already been noticed in the Digest. He discusses the motors of Latour and Heyland, which have been repeatedly noticed in these columns.—*Elek. Anz.*, October 23, 30.

LIGHTS AND LIGHTING.

REFERENCE.

Train Lighting.—An illustrated description of Kull's electric system of train lighting.—*Elek. Anz.*, November 6.

POWER.

Dust Destructors and Electric Stations.—WARING; APPLEBEE; AND THOMLINSON-LEE.—Three communications referring to Goodrich's recent paper on this subject. Waring thinks that from a combined arrangement of electric plant and refuse destructor, no beneficial results whatever accrue in the long run to either the electric plant per se or to the tax payers in general. The only exceptions ars such isolated cases in which the steam generated from the destruction of the refuse cannot be made use of for such purposes as mortar-mixing, pumping, grinding up material for flag-making, etc. Applebee thinks the combined electric plant and refuse destructor has come to

[illegible] of an ordinary form provides only a fraction of the total heat required; but in many places that [illegible] supplying traction to [illegible] hours per day, the fraction [illegible] be a most important one. Thomlinson-Lee urges that in the [illegible]me for a destructor there should be built and erected, [illegible] conjunction with the same, mortar mills and a flag-making plant, in order to utilize the clinker and residue; this plant would give the destructor plenty of work in generating steam for its own use. "The unfortunate engineer who is saddled with the management of a combined electric lighting and refuse destructor plant will learn that, after about 18 months' working of his precious destructors, the whole of his [illegible], if he can give it, will be required for the [illegible] the furnaces and the very many undesirable [illegible] to keep them going."—Lond. *Elec.*, December 5.

REFERENCES.

California Power Transmission.—A profusely illustrated description of the Northern California Power Company's transmission.—*Jour. of Elec.*, December.

Niagara Falls.—DUNLAP.—Illustrated articles on the new plant of the Canadian Niagara Falls Company.—*Sc. Am.*, December 6; *Eng. News*, December 11.

TRACTION.

Stationary Traction Storage Batteries in Italy.—DE CHRISTOFORIS.—An abstract of a paper read before the Italian Ass. Elec. Eng. He states that where the third-rail system is applied to traction work on main lines, the use of storage batteries at the station is almost a necessity. The Milan-Varese electric railway, which is equipped with the third-rail system, is taken as an example; it is 31 miles long and power is obtained from four sub-stations to which power is transmitted from a steam central station 6½ miles distant from the railway line, where water power will be utilized in future. The voltage of transmission is 12,000, and at the sub-stations the current is converted by means of transformers and rotary converters into direct current at 650 volts. The regular trains, consisting of a motor car and a trailer, are run at a speed of 56 miles an hour, taking 600 amperes at starting and 400 amperes during an average run at normal speed; it is intended to run five trains per hour each way for 18 hours. The storage batteries have been designed to permit of the switching off of one of the rotaries, and to furnish all current above the average load; the reserve is then constituted by the second rotary and the transformers. The battery also takes up all the fluctuations of the load and furnishes, alone, the necessary current to all the trains during a period of not less than one hour in the event of an interruption of the primary current. Each of the batteries at the sub-stations has a total capacity of 1,500 to 2,500 ampere-hours for a one-hour discharge rate. The use of the batteries at the sub-stations allows the central station to work under the average load throughout the whole day, and owing to this 1,400 kw of generating sets are saved. It is expected that the use of storage batteries will increase the efficiency of the entire plant by at least 11 per cent. From the saving of coal at the power stations, the author concludes that the cost of the batteries will be saved in two years.—Lond. *Elec.*, December 5.

New England Road.—A description of the trolley line between Concord and Manchester, recently installed by the Boston & Maine Railroad. Power is purchased at 10,000 volts and 3-phase alternating and is converted to 550 volts direct-current, for use on the trolley wire. Aluminum feeder cables are used for direct-current distribution. The cars are each equipped with four 160-hp motors with multiple-unit control. Single cars are generally used, but with heavy traffic trains of two or three cars are operated with one motorman.—*St. R'y Jour.*, December 6, and *Int. Ed.*, December.

Standards for Traction.—HERT, BIGGS, CONNETTS, NEWMAN, LUFFIN.—The report presented at the meeting of the American Street Railway Association in Detroit in October, accompanied by a number of valuable drawings. The committee recommends that the Association adopt as a standard for either a T or girder-rail, the form of rails shown in a diagram, the height of rails to be governed by the character of the pavement required in the municipalities and the weight of the rail to be not less than 70 lbs. for T and not less than 90 lbs. for the girder rail per yard. In the matter of motors, it was the opinion of the committee that the time had not yet arrived to recommend a standard form or design. The committee, however, recommended standards for axles, journals, journal boxes and other features, details of all of which are presented in the cuts and cover a wide range of equipment for cars up to 50 tons. The committee also recommended a steel-tired wheel and cast chilled wheel and gives the dimensions for different classes of service. Standard forms for a brake head and brake shoe are also recommended. Considerable attention is given to the subject of hauling cars. The committee recommends "a supplementary return in addition to the usual practice at the present time in all congested sections crossing all special work in the vicinity of the power plants." The subjects of "standard overhead construction for high-speed city and suburban service, including trolley wheels," and "car bodies for city and suburban service, including ventilation, also the question of oval roof," were not reported upon, but it was recommended that these subjects be given special attention during the coming year.—*St. R'y Jour.*, November 15, and *Int. Ed.*, November.

REFERENCES.

Jungfrau Railway.—SIDLER.—The first part of a well-illustrated description of this well-known three-phase Swiss railway.—*Zeit. f. Elek.*, November 30.

Provision for Snow Storms.—CONWAY.—A paper read before the New England Street Railway Club on the equipment and the organization for properly handling cars during snow storms, as done by the Old Colony Street Railway, of Boston.—*St. R'y Jour.*, November 29, and *Int. Ed.*, December.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Transformer Hazard.—Some editorial notes on a paper by Low on this subject, which has already been abstracted in the Digest. The class of transformers which might well be relegated into separate fire-proof buildings apart from power houses, embodies all large high-tension transformers, which are connected to pole-line circuits, or transformers which are so connected to other transformers that in the event of trouble to one transformer, the energy of other transformers, or of the generating station, can be centered in it, furthering its destruction. The short-circuiting of a high-tension transmission line and the burning out of a sub-station transformer, are two troubles which are ordinarily indistinguishable to the operator in charge of the generating station. The oil transformer is said to be the most perfect appliance in all the category of electrical machinery; when properly installed it will go through a station fire more nearly unscathed than any other piece of electrical apparatus. Concerning proper installation, it is suggested to erect the transformer on a foundation as solid as those built for engines, to equip them with water coils for cooling and to feed these water coils from an exterior source of supply; to place the transformers in heavy wrought iron cases, so covered with heavy caps as to be water tight; and then, if one chooses to do so, it will be a further desirable precaution to place them in a separate building. Above all, they should be kept off wooden floors and out of buildings which, when burning, will upset them and pour out their oil.—*Jour. of Elec.*, November.

REFERENCES.

Middle Wire.—An article illustrated by diagrams, on the installation of bare middle wires in three-wire systems.—*Elek. Anz.*, October 16.

Electrically Operated Appliances.—HOLBERTON.—A paper read before the Pacific Coast Gas Association. He recommends the use of electric appliances for controlling valves, etc., in gas plants.—*Jour. of Elec.*, December.

Electrical Experiences.—LEITCH.—An article, illustrated by diagrams in which he describes some experiences made by the engineer of the electric installation of a department store.—*Power*, December.

ELECTRO-PHYSICS AND MAGNETISM.

Conductivity of Pressed Powders.—STREINTZ.—An account of a continuation of his researches on the conductivity of metallic oxides and sulphides in powdered form and under pressures equal to those which gave a quasi-metallic coherence on platinum black and other substances. As a general rule, compounds having a light color, such as white, yellow, red or grey, conduct badly, and most dark powders conduct well, which is in accordance with the electromagnetic theory of light. On the other hand, a number of powders of a dark color are non-conductors. No compressed powders were discovered which could be classed both among metals and among electrolytes; in fact, truly electrolytic conduction was not found in any powder.

Only such powders were conductors at the ordinary temperature as could be brought to a state of metallic lustre and hardness without the use of a binding medium; such bodies possess a positive temperature coefficient. There is, for all these compounds, a temperature of transition from a low to a high conductivity. If any oxide or sulphide is a good conductor, the next higher oxide or sulphide is a still better conductor.—*Ann. d. Phys.*, No. 12; abstracted in Lond. *Elec.*, December 5.

Demonstration of Electric Oscillations.—ZEHNDER.—A description of some simple lecture arrangements for demonstrating the experiments of Feddersen, Paalzow, Hertz and Lecher. Feddersen's condenser discharges may be shown by means of a simple rotating mirror; a cylinder of dry wood or ebonite has a mirror inserted in a depression, in front of which and with its axis parallel to that of the cylinder is placed the spark gap of the condenser, and in front of that, again, a lens which projects the spark upon a translucent screen. The revolution of the cylinder makes contact and discharges the condenser at the instant this image is projected by the mirror through the lens on to the screen. Paalzow's experiments are demonstrated by means of a vacuum tube 62 cm long and 3.5 cm wide placed next to the poles of a horseshoe magnet separated by 12 cm. With a small spark gap in the condenser circuit or without any spark gap, a single refraction of the spark path is obtained, and with a large spark gap the other phenomena described by Paalzow, such as a double refraction is obtained corresponding to discharges in both directions. The successive discharges are separated on account of the heating of the air in the spark gap, which drives the discharges upward and separates them in a vertical plane.—*Ann. d. Phys.*, No. 12; abstracted in Lond. *Elec.*, December 5.

REFERENCES.

Loss of Radio-Activity.—CURIE.—An account of an experimental investigation of the loss of radio-activity by radio-active bodies. He finds that the loss of radio-activity follows a certain rather simple law.—*Comptes Rendus*, November 17; abstracted in Lond. *Elec.*, December 5.

Zeeman Effect.—FAERBER.—A paper on the reduction of the results of Runge and Pascher's magnetic separation of spectrum lines, to absolute measure and on similar problems.—*Ann. d. Phys.*, No. 12; abstracted in Lond. *Elec.*, December 5.

Photo-Electric Action of Salts.—ELSTER AND GEITEL.—An account of an experimental investigation of photo-electric dispersion, i. e., the expulsion of negative electrons during the illumination of a charged surface.—Lond. *Elec.*, December 5.

Hall Effect and Thermo-Electric Power.—VON AUBEL.—An account of experiments in which he confirmed Ettinghausen and Nernst's relation between the Hall effect and the thermo-electric properties of metals. He studied an alloy of bismuth and antimony and a fused mixture of bismuth and sulphide of bismuth.—*Comptes Rendus*, November 10; abstracted in London *Elec.*, November 28.

Photo-Electric Currents.—VON SCHWEIDLER.—An account of an experimental investigation of the photo-electric potassium cell of the type described by Elster and Geitel.—*Phys. Zeit.*, November 15; abstracted in Lond. *Elec.*, November 28.

ELECTRO-CHEMISTRY AND BATTERIES.

Hypochlorite of Soda.—WALKER.—An article describing a cell for the electrolytic production of hypochlorite of soda. It consists of a semi-cylindrical carbon-lined wooden vat, acting as anode, and a wooden cylinder as cathode, covered with lead and revolving in the vat within an inch of the surface of the carbons; the solution of salt fills up the space between; the electrolyte hardly becomes heated at all and thus no other reactions are produced and no chlorates are made. Preferably the apparatus is worked at the bleaching plant, where the solution is at once used in the bleaching vats, as it is not practicable to store and ship the hypochlorite. No other chemical is required in the bleaching vat, as the hypochlorite rapidly gives off its oxygen when it comes in contact with the pulp or textile fabric and passes back to common salt again. One of the great advantages over bleaching powder is that no insoluble precipitate is formed; for this reason and because chlorine has been found to be too strong for this purpose, it has been impossible to use bleaching powder in whitening high-class linen. A brief reference is made to the fact that the addition of sulphuric acid to the hypochlorite solution releases chlorine, and it is said to be probable that this would be a better source of chlorine for chlorination than bleaching powder, and at any mine where fuel, water and salt are obtainable such cells might be erected for the direct production and use of chlorine both in treating gold ores and in leaching low-grade copper ores.—*Eng. & Min. Jour.*, November 22.

Production of Metallic Calcium.—ARNDT.—A brief illustrated paper referring to Borchers and Stockem's method for the electrolytic production of metallic calcium, recently described in the Digest. He states that the same result may be obtained in a simple apparatus. He uses a coated iron crucible, a carbon rod as anode, and a thick iron wire as cathode. He obtained metallic calcium in larger, well-fused pieces, which could be easily hammered and filed. The analysis of a piece thus produced showed 99 per cent. of calcium and 1 per cent. of silicum, no iron or aluminum being present.—*Zeit. f. Elektrochemie*, November 13.

Testing of Alloys.—SIRKS.—A description of an electrolytic method suitable for testing alloys for industrial purposes, which is considered superior to the usual methods. The specimen is made the anode in an electrolytic cell, with copper as a cathode; direct current at 4 volts is used; the electrolyte is water with six drops of dilute sulphuric acid per 100 cc. Since the etchings are much more pronounced in this method than in the simple acid etching, it is not necessary to polish the specimens; smooth filing suffices. It is thus possible to etch out individual crystals of the alloy, showing a definite and invariable proportion of the constituents. These crystals are the product of a chemical reaction between the constituents which has a profound influence upon the mechanical properties of the alloy.—*Proc. Roy. Akad.*, Amsterdam, September 27; abstracted in Lond. *Elec.*, November 14.

Standardization of Methods of Chemical Analysis.—BLOUNT.—A paper in which he draws attention to the growing demand for standardization in general. The arbitrary methods in use for the examination of water, milk, oils, foods, manures, etc., should be standardized, but true analytical processes, such as the determination of all elements and most inorganic and many organic bodies, cannot be; he advocates conferences of specialists in different branches of analysis for the discussion of methods, though not for the promulgation of rules. —Lond. *Eng'ing*, November 7.

Electrolysis of Silver Nitrate.—It is generally said that silver nitrate becomes acid during electrolysis, yet Rodger and Watson found that the acidity of the bath diminished. This apparent contradiction has been explained recently by Leduc as being due to a difference of the conditions. With platinum electrodes in a sufficiently concentrated solution, a brown solid, containing a higher oxide of silver, is formed with simultaneous formation of nitric acid, when the bath has a certain concentration; when a sufficient concentration is reached, this reacts on the compound forming oxygen. He finds that corrosion or solution of the cathode deposit does not take place.—Lond. *Elec. Eng.*, November 7.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—Continuations and conclusion of the summary of wireless telegraphy patents of recent years.—Lond. *Elec.*, November 21, 28. In a long editorial the whole summary is discussed. The series of patents is said to show two points, namely the better understanding of the behavior of electrical oscillations on wires and the entire absence of any essential improvement in syntony. The magnification of the Tesla apparatus is said to be the chief novelty in the Fleming-Marconi patents; the essential features of the apparatus, regarded as a mode of radiating energy, being unmodified in method and remaining unchanged in principle. That Marconi now uses longer waves than formerly is a step in the right direction, as longer waves travel farther than short ones. This is said to have been overlooked by Blondel. Marconi's success began when he discarded high-frequency vibrators, such as the Righi oscillator, and when, by adopting the vertical wire, he commenced to use great wave lengths. In the case of air-wire systems in general, it is not altogether the mere height of the vertical radiator, but also the length of wave which it yields, that is responsible for the success of the elevated conductor. Concerning Fessenden's system, it is asked whether even under the most favorable circumstances, the different effects used by him are not extremely small; experiments alone can answer this question; "for the present Prof. Fessenden is to be congratulated on tackling the problem of wireless telegraphy in a refreshingly novel manner." The system of Lodge and Muirhead is said to be rooted definitely in accurate knowledge of the principles of the subject. It is finally pointed out that perfect syntony,—without

[illegible] —Lond. *Elec.*, December 26.

[illegible] when small distances [illegible] for the antennæ. The [illegible] electric constant, and [illegible] the electromagnetic rays upon a distant object, need not be very large [illegible] diameter suffice for waves 20 cm long, and signals can be exchanged over several miles. At the receiving station a similar lens is used; in fact, the apparatus is practically a heliograph employing invisible instead of visible light. The dark rays have the advantage of secrecy and of not being intercepted by fog or by non-conducting solids. Mountains are an obstacle, but this can be overcome by a series of relays. The direction of the arriving waves can be clearly distinguished to within a degree, and many simultaneous messages may thus be received and separated. Messages may also be sent out [illegible] in [illegible] directions. It appears that a clear path through the air without intervening bodies is necessary, just as in heliography.—*Phys. Zeit.*, November 1; abstracted in Lond. *Elec.*, December 5.

MISCELLANEOUS.

Some Limits in Heavy Electrical Engineering.—SWINBURNE.—The first part of his presidential address to the (Brit.) Institution of Elec. Eng. He remarks that the progress of electrical engineering has been so very fast lately that we may be a little apt to have vague views of what we can and what we cannot do electrically. Dynamo and transformer design is now well understood, but "we must not say that because we can buy efficient dynamos and order accurate instruments that we need have no technical knowledge. Quite otherwise, we must understand dynamos as before, also measuring instruments; but we must also understand steam engines, gas engines, fuel questions, financial matters, parliamentary matters, tramway matters, railway engineering and very soon railway management. All these are the work of the electrical engineer. No one man can be a complete electrical engineer; but each of us ought to know one subject well, and a large number of allied subjects fairly well." Concerning theory and practice, he says that the "theorist" and the "practical man" are both ignorant of "half science." To be an engineer one must know both branches. "There is nothing superior about knowledge which is not yet applied. It is mere raw material; it may be useful when worked up, and it is valuable when it is worked up, but only because it may be worked up. * * * * The sort of tacit assumption that an engineer can never be a 'scientific man,' while a 'scientific man' can teach the engineer his business, cannot fail to annoy the engineer, and this feeling of annoyance is largely the cause of a great deal of opposition to technical—that is to say, really scientific education." He then begins to discuss the limitations of "heavy electrical engineering." He first points out the small likelihood of there being any practical utilization of the energy of the tides. Concerning the generation of electrical energy from water power, he thinks people generally attach a too exaggerated value to it, because "as a rule, a water power is not where it is wanted industrially." Even electrometallurgical and electrochemical plants do not depend upon water power, but may use steam and earn profits. He then discusses the prospects of "carbon cells," which he believes to be impossible devices. The reprint of the complete address is to be continued. From some editorial notes it appears that the rest of the address deals with the following subjects: Advance in steam engine design must be sought at the low-temperature end of the cycle, and a two-fluid engine offers a possible solution; but he thinks that the large gas engine is likely to oust the steam engine for large powers in the near future, and, with cheap gas, the two-fluid engine will not become necessary. In dynamo and transformer design we are near finality, and battery improvements seem almost to have reached a deadlock; but in cable insulation there is still a field for scientific application of inventive talent. In electrical illumination much remains to be done, whether it be in discovering a more direct way [illegible] the readily available forms of electrical energy into electromagnetic radiation of the desired wave length, or merely in [illegible] our existing electric lamps. The address is concluded with paragraphs on electric railways and electrolysis.—Lond. *Elec.*, December 5.

Electric Production of Sleep.—LEDUC.—A description of sôme improvements in his former method of producing sleep electrically. With 10 to 30 volts, and with currents interrupted 150 to 200 times per second, the inhibition of the cerebral hemispheres could be brought about in animals, thus producing sleep and a general anæsthesia. The procedure had the disadvantage of producing at first contractions and convulsions, raising the pressure of the blood, provoking the evacuation of the bladder and the intestine, and momentarily stopping respiration. These disadvantages are largely reduced by introducing into the circuit an inductionless resistance allowing the operator to attain the necessary intensity gradually in three to five minutes. This method requires a preliminary introduction of the maximum e.m.f., but this should be made as low as possible. When the e.m.f. is then gradually raised to the necessary figure the animal passes gently and gradually, without a movement of defence or of flight, without a cry, and without any change in the movements of respiration or heart action, from the waking state into a quiet and regular sleep, with absolute anæsthesia. The dog at first bows its head as if sleepy, sits down on its side, and eventually goes to sleep without having given the least sign of fear or pain.—*Comptes Rendus*, November 17; abstracted in Lond. *Elec.*, December 5.

New Books.

A GRAPHIC METHOD FOR SOLVING CERTAIN QUESTIONS IN ARITHMETIC OR ALGEBRA. By George L. Vose. Second Edition. New York: D. Van Nostrand Company. 62 pages, 29 illustrations. Price, 50 cents.

This little book is No. 16 of the "Van Nostrand Science Series," and is like all the other numbers of this series in mechanical make-up. The subject matter is interesting and well presented in elementary form. Most persons who have never read any literature on this subject have no conception of the very great facility with which certain classes of problems, some of them quite complicated, are solved by ruling a few lines on ordinary co-ordinate paper. To all such persons who desire an introduction to the method, we can recommend this book.

MECHANICS-PROBLEMS. By Frank B. Sanborn. New York: *Engineering News* Publishing Company. 155 pages, 62 illustrations. Price, $1.50.

The author's purpose is to introduce certain classes of problems not found in the ordinary text books, in addition to the kind ordinarily found therein. In this he seems to have succeeded, the variety of the problems being somewhat extensive. The book is in three sections: Work, Force, Motion. The author believes, with some others, that this is the natural order. There are 500 problems propounded, the solutions of a few being given, but the greater part are intended for the student to work out unaided. The author's purpose was not to write a text book (as he says in his preface), but to produce a book that would take the place of the hectograph or cyclostyle sheets, which many instructors now find it necessary to prepare and issue. For this purpose we think the book well adapted.

BOOKS RECEIVED.

TRANSACTIONS OF THE AMERICAN ELECTROCHEMICAL SOCIETY. Philadelphia: The American Electrochemical Society. 274 pages; illustrated.

ELECTRICAL DICTIONARY, ENGLISH, GERMAN, FRENCH. By Paul Blaschke. Leipzig: S. Hirzel. 226 pages. Price, 5 marks.

JAHRBUCH DER ELEKTROCHEMIE. Berichte uber die Fortschritte des Jahres 1901. By Dr. W. Nernst and Dr. W. Borchers. Halle a. S: Wilhelm Knapp. 725 pages, 226 illustrations. Price, 24 marks.

ISOLIERMATERIALIEN UND WARME (KALTE) SCHUTZMASSEN. By Eduard Feltone. Leipzig: A. Hartlebens. 320 pages, 38 illustrations. Price, 5 marks, 30 pf.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: January 23d, 1903, "Telephone Exchanges"; February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa.

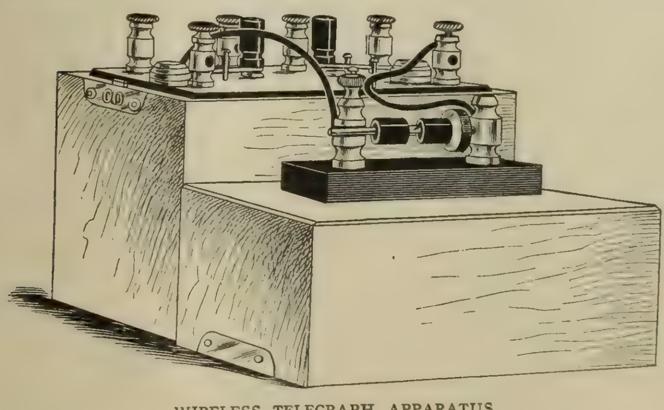
THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York.

Long Distance Wireless Communication Without Tuning.

To one acquainted with the technique of wireless telegraphy, some of the recent work at the De Forest Wireless Telegraph station at Coney Island is interesting. On Sunday, December 7, the operators there on watch for the Hamburg-American liner *Deutschland* picked up the boat at a distance of 60 miles. The *Deutschland* carries a Slaby-Arco system, but arrangements have been made with the Hamburg-American Company, whereby this steamer communicates with the De Forest wireless station on approaching and leaving New York.

On December 11 the Coney Island station caught messages from the American liner *Philadelphia* until that vessel was six hours from port, the last message being received perfectly when the boat was 100 miles distant. The *Philadelphia* is equipped with Marconi apparatus, and the boat was overheard calling up the Babylon station, and later the Sagaponack station. On several occasions the Coney Island De Forest operators have listened to the Sagaponack station calls, over a distance of 80 miles. The remarkable part of this reception is that no transformer, "jigger" or tuning device whatever was used at the Coney Island station, merely the simple aerial conductor, consisting of two stranded copper cables 210 feet in height. As far as known, 20 to 35 miles has been the greatest distance recorded for successful transmission without a "jigger" in connection with the receiver, and the fact that these messages were received so successfully without this adjunct speaks well for the extreme sensitiveness and reliability of the De Forest "responder," or anti-coherer.



WIRELESS TELEGRAPH APPARATUS.

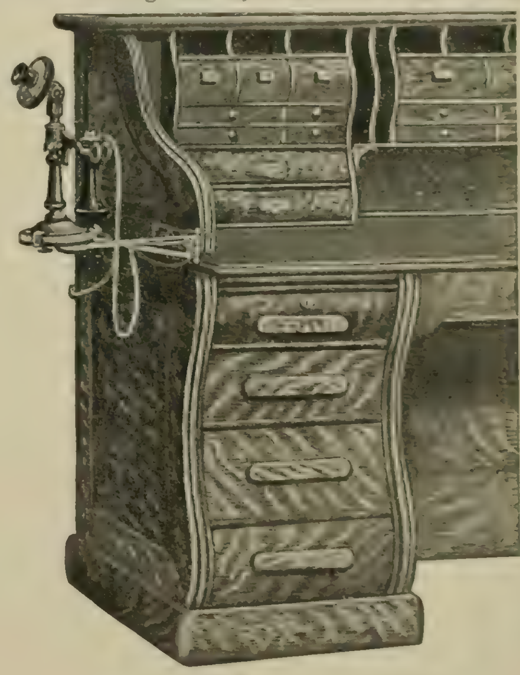
While the steamship *Deutschland* is in dock at Hoboken daily communication is maintained with the De Forest station on the roof of the Chesebrough Building, No. 17 State Street, New York City, notwithstanding the miles of metal warehouses, steel-frame buildings and shipping lying between. This was not, however, possible until the De Forest "responder" replaced the regular coherer on the *Deutschland* station.

The Providence *Journal* has decided to establish wireless telegraph communication between Block Island and Newport. The cable connecting the island has worked very unsatisfactorily for a long time, and the *Journal* estimates that, as a news-getting agency, as well as a commercial carrier, and as affording an excellent shore station for communication with passing vessels, the Block Island wireless plant will be a good investment. De Forest wireless apparatus will be employed throughout. As there is no electric power at either point, the alternating current required by the De Forest transmitter will be generated by a 2½-hp Secor kerosene engine at each station, driving a special 60-cycle generator. The outfits are identical, in fact, with those which the United States Signal Corps used so successfully during the war manœuvres last fall.

The fishing steamer "J. S. Warden," which leaves this port for deep-sea fishing, now carries a De Forest wireless telegraph outfit, and the fishermen are kept in constant touch with the Coney Island station. As New York business men frequently take a day's outing on board, it has become the custom to send out stock quotations, keeping those interested in touch with the market. This has been found to be an attractive feature. The Government stations at Fort Wadsworth, S. I., and Fort Hancock, Sandy Hook, have been completed and turned over to the United States Signal Corps by the De Forest Company. Colonel H. C. Dunwoody, Chief Signal Officer, Department of the East, who has felt a keen interest in the plan to replace the faulty cable between the forts, and who was largely instrumental in bringing about this improvement, has charge of the two wireless telegraph stations.

New Desk Telephone Bracket.

A neat and convenient form of desk telephone bracket has been put upon the market by the De Veau Telephone Manufacturing Company, of 27 Rose Street, New York City. It is made to fit on desks as shown in the cut, or so that it may be attached to the under side of the projecting desk board. It is furnished either in oxidized copper or in full polished nickel. It is so arranged that it will adjust to any size desk base and hold it firmly, owing to the bracket having adjusting screws. After the desk set is placed in the holder and tightened up, there is a thumb screw that takes up all play and holds the desk set firmly. All three lugs are adjustable. The bracket also permits



TELEPHONE BRACKET ATTACHED TO DESK.

of the desk set being swung completely around against the side of the desk. When the desk set is not in use it has a decided advantage, of not taking up any desk room and being entirely out of the way.

The bracket is formed of two separate arms, insuring great strength. The hinge base is made very wide, insuring a long bearing for the pin. This bracket will absolutely not work loose, rattle or shake. It is not made of malleable iron, so that it will not break, but on the contrary is very tough. It is fitted with cord eyelets which prevent the cord from getting twisted or tangled up.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Towards the close of the week time money was decidedly easier, being offered on Friday as low as 5½ per cent for six months. The rates are 6 per cent for sixty to ninety days, and 5½ a 6 per cent for four, five and six months. The stock market was stronger and fairly active, speculative sentiment being much relieved by the announcement that in case of stringency in money the New York banks would furnish a pool of $50,000,000. The announcement that the United States Steel Corporation had acquired the Union Steel Company—a very valuable property—accounts, in part, for the considerable improvement in the steel stocks. Amalgamated Copper was rather quiet, although in common with most of the other industrials, it shared to a certain extent in the stock market's advance. Tractions were also favorably affected, and all closed with substantial net gains. Brooklyn Rapid Transit closed at 64½, after falling to 59¼—a net gain of 2¾ points. Metropolitan Street Railway made a net gain of 2¾ points, closing at 139¼ ,which was ½ point below the highest quotation of the week. Manhattan made a gain of 2⅝ points, closing at 146⅛. The electrics, with the single exception of Westinghouse, closed on the upward turn, General Electric making a net gain of 3¼ points, closing at 176 ex-div. Westinghouse common closed at 193, which is a net loss of 3 points, and Western Union at 87⅜, a net gain of ⅞ point. There was a good amount of trading in all the electrics and tractions. American District Telegraph closed at 36½, being 2 points below the last quotation. Folowing are the closing quotations of December 22:

NEW YORK.

	Dec. 16.	Dec. 22.		Dec. 16.	Dec. 22.
[illegible]	[illegible]	[illegible]	General Electric	174	178
[illegible]	[illegible]	[illegible]	Hudson River Tel		
[illegible]	[illegible]	[illegible]	Metropolitan St. Ry	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	N. J. [illegible]		
[illegible]			N. Y. & N. J. Tel	162	160
[illegible]	[illegible]	[illegible]	N. Y. [illegible] Co.	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Tel. & Tel. Co. Am ...		
[illegible]	[illegible]	[illegible]	Western Union Tel	[illegible]	[illegible]
[illegible]	4	[illegible]	Westinghouse com	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	Westinghouse pfd	—	202

BOSTON.

	Dec. 16.	Dec. 22.		Dec. 16.	Dec. 22.
American Tel. & Tel	[illegible]	[illegible]	Western Tel. & Tel. pfd	[illegible]	[illegible]
[illegible]		[illegible]	Mexican Telephone	[illegible]	2
[illegible]			New England Telephone	[illegible]	[illegible]
[illegible]		[illegible]	Westinghouse	[illegible]	[illegible]
[illegible]		[illegible]	Westinghouse pfd	[illegible]	[illegible]

PHILADELPHIA.

	Dec. 16.	Dec. 22.		Dec. 16.	Dec. 22.
[illegible]			Phila. Traction	[illegible]	[illegible]
[illegible]		[illegible]	Phila. Electric	—	[illegible]
[illegible]		[illegible]	Pa. [illegible] Vehicle	—	
[illegible]	[illegible]	[illegible]	Pa. Electric Vehicle pfd	—	

CHICAGO.

	Dec. 16.	Dec. 22.		Dec. 16.	Dec. 22.
[illegible]			National Carbon pfd	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]		
[illegible]		[illegible]	[illegible]		[illegible]
[illegible]			[illegible]		[illegible]
[illegible]		[illegible]			

BOSTON INTEREST IN TELEPHONY.—With regard to the continuing interest of Boston in the telephone industry, the Boston News Bureau says: Boston National banks and Boston trust companies were never stronger than to-day, their loans were never before in so impregnable a situation, their deposits never so well protected. Boston may not have expanded as have New York, Pittsburg, Cleveland and Canada the past five years, but she has solidified in a most unprecedented manner. She has kept her Bell Telephone and her Calumet & Hecla shares as assured banks of wealth for years to come. She has sold her Montana to the Amalgamated at $100 per share, she has sold her Chicago, Burlington & Quincy at $200 for the strongest mortgage upon the northwestern prosperity she should get, she has recovered millions by the rise of Atchison and exchanged her common shares for preferred and bonds. New England has parted with the management of Union Pacific, which its capital and enterprise originally constructed, but she has still very many millions to show from Union Pacific investments. She has likewise recovered many millions more in General Electric, Westinghouse and other electrical enterprises. She has sold her Boston & Albany for a perpetual guarantee at the highest price and at increased returns over previous dividends. She has accepted guarantees upon her Old Colony, her Providence and her Fitchburg Railroad shares, garnered millions from Alton and from her Northwestern Railroad shares; has sold her Canadian coal and iron interests at profitable prices to her aspiring northern neighbor, solidified her electric railway systems in and around Boston and now rests financially with only two problems to solve, the solidification of her local gas interests and the developments of the telephone field of the country. The latter should be field enough for the investment of one city, and no other city can show in its possession an investment field the equal of the telephone, for solid and sure, although moderate, returns. New England may well sell her railroad, her electrical and her coal interests at the present high prices and keep the telephone field as capable of almost limitless scientific expansion.

CONSOL. LAKE SUPERIOR CO. appears to have been in some unexplained trouble which caused a heavy decline in its stock last week in Philadelphia, with the result of deferring the regularly declared dividend of 1¾ per cent., and the floating of a loan of nearly $2,0000,000, in large part through Speyer & Co. and the Morton Trust Company, of New York. The company is the result of the merger in 1901 of the American Lake Superior Company and the Ontario Lake Superior Company. Its authorized capital is $82,000,000 common and $35,000,000 preferred 7 per cent. stocks. Of the common $67,000,000 is outstanding and of the preferred $27,000,000. The company owns the Lake Superior Power Company, which operates a 20,000 hp. plant at Sault Ste. Marie, Ont., and the Michigan Lake Superior Power Company, operating a 60,000 hp. power plant at Sault Ste. Marie, Mich., noted in these pages recently. It also owns the following additional properties: The "Gertrude" nickel mines, in the Sudbury nickel range, Canada, from which a nickel steel is made that is taken, up to 250 tons daily, by the Krupp Gun Works, under a five-year contract; the "Helen" iron mine, in which are said to be 30,000,000 tons of iron; a contract with the Province of Ontario, by which the company became the owner of a grant of timber equivalent to 1,000 square miles of virgin forests; the Tagona Water and Light Company, supplying water and light to the town of Sault Ste. Marie, Ont.; the Algoma Central Railway Company, the Algoma Central Steamship Company, the Algoma Central Telegraph lines, the Algoma Commercial Company, and the big Algoma steel plant. So far as can be seen, the company has excellent assets and good prospects.

NEW JERSEY INTER-STATE ROAD.—The Inter-State Railways Company, with an authorized capitalization of $10,000,000, has obtained a charter from the State of New Jersey. The new company is to merge all the street railways in the State and to operate a fast electric line between New York and Philadelphia. It is also rumored that the Pennsylvania Railroad is behind the company in an effort to prevent its lines being paralleled by an electric line or to control the electric line when it is in operation. Another rumor has it that the Pennsylvania organized the company in connection with its New York tunnel plans. Other rumors connect the company with the operation of the trolley tunnel under the Hudson. None of these can be verified nor can any line be obtained as to the promoters. The incorporators of record are Frank B. Housel, William F. Eidel and George B. Martin.

EVERETT-MOORE TELEPHONE.—It is stated that the end of the year will see the street railway affairs of the Everett-Moore syndicate straightened out, but that their Federal Telephone Company's matter is still unfinanced. The company owes between $3,000,000 and $4,000,000, and has about $7,000,000 par value in stock and bonds in sixteen telephone companies. It is thought that the Federal's equity over and above its debts is about $1,000,000 and can be materially increased by developing subsidiary companies. This company will be financed by a bond issue against the assets of the Federal, the bonds to be taken by the Everett-Moore syndicate and by some of the larger creditors. The syndicate will put between $500,000 and $750,000 in new money in the proposition for the purpose of development work.

MARYLAND TELEPHONE.—Negotiations are said to be pending for the acquisition of the Maryland Telephone Company by the same syndicate which recently purchased the stock of the United Electric Light and Power Company, of Baltimore.

DIVIDENDS.—The Westinghouse Machine Company has announced an increase in the annual dividend rate from 6 to 10 per cent. The Westinghouse Air Brake Company has declared the regular quarterly dividend of 2½ per cent., and an extra one of 3½ per cent., payable January 10. The directors of Hall Signal Company have declared the regular quarterly dividend of 1½ per cent. on the common, payable January 1. United Power & Transportation Company, of Philadelphia, declared a dividend of $1 per share, payable January 20. The directors of Metropolitan Street Railway, of New York, have declared the regular quarterly dividend of 1¾ per cent., payable January 15, from the rent guaranteed by the Interurban Street Railway under the lease. The directors of the Otis Elevator Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable January 15. The Bell Telephone Company, of Philadelphia, has declared a dividend of 2 per cent., payable January 24, as registered January 17. The directors of the American Telegraph & Telephone Company have declared a regular quarterly dividend of 1½ per cent. and an extra of ¾ per cent. In Philadelphia the directors of the Electric Storage Battery Company have declared the regular quarterly dividend of 1¼ per cent. on the preferred stock and 1¼ per cent on the common stock, payable January 2. The regular quarterly dividend at the rate of 5½ per cent. per annum has been declared by the Cincinnati Street Railway Company. The directors of the North Chicago Street Railroad have declared the regular quarterly dividend of 3 per cent, payable January 15. The directors of the Cincinnati Gas & Electric Company have declared the regular quarterly dividend of 1 per cent.

WESTERN UNION.—The Western Union Telegraph Co. issues the following statement for the quarter ended Dec. 31, the figures for the current year being partly estimated, while those of 1901 are actual:

	1902.	1901.		Changes.
Net revenue	$2,100,000	$1,858,318	Inc.	$241,682
Bond interest	252,550	244,000	Inc.	8,550
Balance	$1,847,450	$1,614,318	Inc.	$233,132
Dividend	1,217,010	1,217,010		......
Surplus	$630,440	$397,308	Inc.	$233,132
Previous surplus	11,528,617	9,812,557	Inc.	1,716,060
Total surplus	$12,159,057	$10,209,865	Inc.	$1,949,192

The actual returns for the Sept. 30 quarter were: Net revenue, $2,247,174; bond interest, $252,550; balance, $1,994,624; dividends, $1,217,010; surplus, $777,614; previous surplus, $10,751,003; total surplus, $11,528,617. The executive committee has recommended the declaration of the regular quarterly dividend of 1¼ per cent., payable Jan. 15.

CONN. RAILWAY AND LIGHTING.—The Connecticut Railway & Lighting Company reports for the fiscal year ended June 30 as follows: Gross income from railway, $1,113, 778; electric, $279,136; gas, $204,470; total gross income, $1,615,384; operating expenses for railway, $616,723; electric, $188,938, and gas, $130,639; total expenses, $936,301; net earnings, $679,083; taxes and miscellaneous interest, $107,180; net applicable to bond interest, $571,903; interest on funded debt, $426,556; balance, $145,347; less extraordinary expenses incurred in betterments to lines, cars, and plants, $57,534; surplus, $87,813. Secretary and Treasurer Lewis Lillie says that the railway department receipts of the year show an increase of 8.5 per cent. over the corresponding period of the year previous. The proposed extensions planned by the company will make about 27 miles of new track, with turn-outs, for developing new territory, which it is expected will very materially increase the gross receipts and net earnings of the company. The increase in electric sales shows 10.6 per cent. over the previous year. The increase in gas sales shows 16 per cent. over the year ended June 30, 1901. The company is operated under the management of the United Gas Improvement Company, of Philadelphia.

AMERICAN RAILWAYS BONDS.—It is announced from Philadelphia that Messrs. Bioren & Co. and Messrs. E. C. Miller & Co. have exercised their option of purchase of the remaining $700,000 of the American Railways Company convertible 5 per cent gold bonds. These bonds were offered for subscription by them to banks and bankers in the city and elsewhere, which subscriptions, closing on the morning of the 20th inst., very largely exceeded the amount of the bonds offered. In view of the existing conditions in the money market, the ease with which these bonds were placed is surprising. The proceeds of the sale of this loan will pay off the existing indebtedness of the American Railways Company, which was incurred by reason of the construction of the Chicago & Joliet Electric Railway Company. This road is already showing a profitable return upon its construction cost.

CHICAGO STREET RAILWAY MERGER.—It is reported that a new move by the street companies of Chicago is proposed to avoid the renewal of their franchises and to overcome the twenty-year limitation. The idea is said to be to bring about a merger of all the street railway lines of the city by lease or otherwise, and operate them under the protecting privileges of the Chicago General Railway Company's charter, which still has forty years to run. This plan was brought to light in connection with a legal opinion on the subject by John N. Jewett, an attorney, and one of the best known authorities on railway corporation matters. Other lawyers of high standing are said to have coincided with the opinion of Mr. Jewett that renewal of the franchises was not absolutely necessary.

TROLLEY RECEIVERSHIP.—At Kingston, N. Y., on December 20, on the application of Assemblyman John Hill Morgan, of Brooklyn, Justice Betts, in the Supreme Court, appointed Joseph A. Duffy, of New York City, receiver for the New Paltz and Poughkeepsie Traction Company, in an action brought against it by the Franklin Trust Company, of Brooklyn, to foreclose a mortgage. The receiver's bond was fixed at $40,000 The traction company operates an electric road which crosses the Poughkeepsie Bridge.

FORECLOSE ON DETROIT TELEPHONE COMPANY.—The Central Trust Company, of New York, which holds a trust mortgage on the property of the Detroit Telephone Company, to secure an issue of $600,000 worth of bonds issued by the telephone company on June 23, 1896, has, according to a dispatch from Detroit, filed a bill in chancery in the United States Circuit Court seeking to foreclose the mortgage, alleging default of interest. The Detroit company is alleged to be insolvent.

PROVIDENCE (R. I.) LIGHTING.—The consolidation of the Providence Gas Company and the Narragansett Electric Light Company by the Rhode Island Company, controlled by the Widener-Elkins syndicate, of Philadelphia, is reported still under consideration. Nearly $5,000,000 is involvd. The syndicate now controls nearly all the traction companies within sixteen miles of Providence.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports of trade received by the mercantile agencies are of highly favorable character. Wholesale trade seems to be taking on a quieter aspect as the stock-taking season approaches. In retail lines, it is noted that holiday-buying is for a rather more expensive grade of goods than ordinarily experienced. "There are, of course," says *Bradstreet's*, "some drawbacks, such as unsettled weather or bad roads at the South, the coal shortage at the East, and the continuance of the railway congestion at the West, affecting the movement of coke, bituminous coal, and general freight, but, taken as a whole, the mercantile community contemplates the approach of the end of the year with complacency and satisfaction." Railway earnings thus far reported for December exceed last year's by 4.2 per cent, and those of 1900 by 10.4 per cent. The iron trade presents a quiet surface, but some important changes are taking place. "The passing of control of large independent mills into the hands of the Morgan interest unquestionably makes for stability in the department of wire, tin-plate and sheets," says *Bradstreet's*. Very heavy buying of cars and other rolling stock for the new year is in evidence, and liberal orders for plates, wires and structural materials for 1903 delivery are also noted. Practically the entire rail output of the country for next year is already sold, and new business and urgent buyers are compelled to go abroad. In copper there was an effort to create the impression that prices had advanced, but actual conditions do not warrant the acknowledgment that such was the fact. Lake is quoted on the Metal Exchange at 11.65c.; electrolytic and casting stock, 11.45c., and Standard, 10.75c. There was practically no business transacted on the New York Exchange. The business failures for the week ending December 18, as reported by *Bradstreet's*, aggregated 225, as against 236 the week previous, and 262 the corresponding week last year.

LONG ISLAND FIRE ALARMS.—The criticism which the Queens County Grand Jury passed upon Fire Commissioner Sturgis last June, after the disastrous fire at Rockaway Beach, has stirred him to action and he is pushing along the fire alarm system in the borough of Queens with rapidity. Thirty-five boxes will be installed in the Woodhaven district at once and a like number in Ozone Park and Aqueduct. Though $47,000 had been appropriated for the purpose, the Fire Department made no effort to equip the borough with a fire alarm telegraph system until the Grand Jury took up the matter.

[illegible] r, and a monthly [illegible] o. For the three [illegible] 140, so that November [illegible] not without encour- [illegible] twice exceeded, and that slightly, in the [illegible] The [illegible]

[illegible]	[illegible]	October	[illegible]
[illegible]	[illegible]	November	39,504,416

[illegible] FOR BREWERY.—The Elwell-Parker Electric Company, of Cleveland, Ohio, through the Northern Engineering Company, has just been awarded a contract for two generators and several motors intended to be installed for light and power purposes in Ebhling's brewery, 156th Street and Amsterdam Avenue, New York City. The equipment will consist of two generators, each of 62½ kw, 275 r. p. m. They will be direct connected to 13-inch by 12-inch tandem compound engines, to be supplied by the Buffalo Forge Company, whose New York address is 39-41 Cortlandt Street. The motors will be ten in number, aggregating in all 97 hp. There will be one of 20 hp, 650 r. p. m.; one of 15 hp, 675 r. p. m.; four of 10 hp, 750 r. p. m.; two of 7½ hp, 825 r. p. m.; one of 5 hp, 1,500 r. p. m., and one of 2 hp, 1,700 r. p. m. The Elwell-Parker Company will also furnish one 60-kw, 275-r. p. m. dynamo for direct connection to a New York Safety engine, and a 40-kw, 275-r. p. m. dynamo to be coupled to New York Safety engine for the Ivy Courts Realty Company, 210 West 107th Street, New York City. This outfit will be used for lighting purposes.

HAINES & NOYES COMPANY.—Announcement is made that the Haines & Noyes Company, of Chicago, has become affiliated with the Couch & Seeley Company, telephone manufacturer, Boston, Mass. The Haines & Noyes Company will in the future be the Western department of Couch & Seeley, with offices in Chicago. All prices will be f.o.b. Chicago for Western selling, and a large stock will be carried in that city. The Couch & Seeley Company is the largest and oldest independent telephone manufacturing company in the East, and its apparatus is too well known to comment upon. The Haines & Noyes Company has been in existence but a little over two years, but it has built up a large business and has become well known throughout the telephone trade. All communications or orders from the West, including the Western part of Canada and Mexico, will be directed to the Haines & Noyes Company, Western department of the Couch & Seeley Company, 153-157 South Jefferson Street, Chicago, while all communications and orders in the East should be directed to the Couch & Seeley Company, Boston, Mass. This affiliation should prove a strong and important factor in the independent telephone field.

MEAD MACHINERY FOR WESTERN PLANTS.—John A. Mead & Co., of Rutland, Vt., whose New York offices are in the Bowling Green Building, have taken a second contract for the installation of coal and ash handling machinery in the South Chicago plant of the Commonwealth Electric Company, of Chicago, for which concern Sargent & Lundy, of Chicago, act as consulting engineers. The contract calls for two equipments, each capable of handling 70 tons an hour. This machinery is to be used in connection with the second and third units, which the Commonwealth people are about to put in. The plant before completion will have fourteen units in all. The Mead Company has also taken a contract from the Cincinnati Gas and Electric Company, which is considerably adding to its equipment for coal and ash handling machinery to take care of 45 tons of material hourly. The additional boiler equipment has been ordered from the Sterling Company. Sargent & Lundy are the consulting experts also for the Cincinnati plant.

ST. LOUIS CONTRACTS AWARDED.—At a special meeting of the committee on the president's department of the Board of Public Improvements held last week, contracts were awarded for the installation of electric lighting plants at the City Hall and Insane Asylum. The Westinghouse Electric & Manufacturing Company got the contract for the lighting apparatus at the City Hall and the Chase Engine Manufacturing Company got the contract for the engines at the City Hall. Their bids were $[illegible] and $[illegible], respectively. The contract for the conduits at the City Hall was awarded to the Abbott-Gamble Construction Company, whose bid was $4,900. The contract for the electrical apparatus to be used at the Insane Asylum was awarded to the Frank Adams Electrical Company, whose bid was $5,689, and the contract for the engines at the same place was awarded to Brownell & Co., of Dayton, Ohio, whose bid on that work was $3,330.40.

SOME BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio, through its New York manager, Mr. Paul Bigelow, has secured within the past few days a number of substantial contracts for engines to be used in lighting, power and general industrial plants throughout the country. The Binghamton (N. Y.) Light, Heat & Power Company has ordered a Buckeye simple engine for direct connection to a 350-kw General Electric generator. This outfit will be utilized for lighting purposes. The E. M. Brown Paper Company, of Rock City Falls, N. Y., has requisitioned for a 125-hp simple engine to be belted to a generator for lighting use. A similar engine to be used for a like purpose has been ordered by Bernhard Meiners, Erie Basin, Brooklyn, N. Y. The Danbury & Bethel Power Company, of Danbury, Conn., has called for a 300-hp Buckeye cross compound engine for direct connection for power purposes, to a generator of 200 kw capacity.

BALL ENGINE ORDERS.—The McPherson Water & Electric Works, of McPherson, Kan., have recently purchased from the Ball Engine Company, Erie, Pa., a 125-hp engine arranged for direct connection to two General Electric generators. The United States Coal Company, Dillonvale, Ohio, is installing two 300-hp Ball engines, which are to be used for electric mining. The Osgood Light Company, Osgood, Ind., has recently placed in operation one 125-hp direct-connected engine furnished by the Ball Engine Company. The American Car Company, St. Louis, Mo., has recently placed in operation a 100-hp direct-connected unit. The Ball Engine Company furnished the engine. The Arkansas & Texas Consolidated Ice & Coal Company, Marshall, Texas, has recently purchased a 200-hp Ball engine for electrical purposes.

THE UNION RAILWAY COMPANY, of New York City, is about to build a large sub-station at West Farms, for which it has purchased from the Westinghouse Electric & Manufacturing Company a large amount of apparatus, including three 1,000-kw, three-phase rotary converters, with starting motors, self-cooling, oil-insulated transformers and alternating-current and direct-current switchboards. The transmission will be at 6,300 volts and 3,000 alternations. The alternating-current switchboard will be equipped with the new Westinghouse oil-break, electrically-operated switches. The Bayard Street station of the Metropolitan Street Railway Company, of New York City, is also being equipped with these switches.

SOME PASS & SEYMOUR EXPORT ORDERS.—Pass & Seymour, of Solvay, N. Y., through its New York manager, Mr. W. Brewster Hull, has recently succeeded in securing several fair-sized contracts for its specialties to be shipped to various foreign countries. An order has been obtained through the Markt & Struller Company, 193-4 West Street, New York City, for a considerable number of fusible and fuseless rosettes for shipment to Mexico. The Western Electric Company has sent in a large order for sockets and rosettes to go to Australia. Among large domestic orders received within the last few days is one for several big transformer cut-outs to be shipped to the Kuhlmann Electric Company.

CLEVELAND ELECTRIC PLANT BEING EXTENDED.—The Cleveland Electric Illuminating Company, of Cleveland, Ohio, is letting contracts for a large extension to its plant. The orders are being placed through Mr. Robert Grindsley, the general superintendent. John A. Mead & Co., of 11 Broadway, New York, have been alotted a contract for coal and ash machinery capable of handling 70 tons an hour.

TROLLEY FOR PORTUGUESE AFRICA.—A cable dispatch from London says: "Macartney, McElroy & Co., of London, have obtained a contract for the construction of electric tramways at Lorenzo Marques, Portuguese East Africa. The value of the contract is $500,000." It is understood that American apparatus is to be supplied.

CONTRACT PENDING FOR CUBAN ELECTRIC PLANT.—H. J. Reilly, the consulting engineer of Trinity Place, New York City, will shortly call for estimates for a 300-hp plant, which is to be erected in Caniajuanti, for the purpose of lighting that Cuban town.

AFTER BIG JAPANESE CONTRACTS.—The American Trading Company, Broad Exchange Building, Broad Street, is figuring on some important contracts for the equipment of Japanese street railway and lighting systems.

STUART-HOWLAND COMPANY, Boston, has recently taken the exclusive New England agency for the line of electric lighting specialties manufactured by the Geo. Cutter Company, Chicago.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended December 13: Argentine Republic—99 pkgs. material, $3,091; 33 pkgs. machinery, $1,305. Brussels—1 pkg. material, $5. Brazil—51 pkgs. material, $1,173; 4 pkgs. machinery, $326. Bremen—1 pkg. material, $69. British East Indies—12 pkgs. material, $751. Berlin—2 pkgs. machinery, $130; 1 pkg. material, $150. British Possessions in Africa—56 pkgs. machinery, $6,021; 2 pkgs. material, $74. British Guiana—42 pkgs. material, $786. Birkenhead—295 pkgs. material, $900. British West Indies—8 pkgs. material, $167. Copenhagen—1 pkg. machinery, $162; 200 pkgs. material, $150. Central America—78 pkgs. material, $702; 11 pkgs. machinery, $1,277. Cuba—41 pkgs. material, $687. Dutch West Indies—8 pkgs. material, $142. Genoa—1 pkg. machinery, $50; 16 pkgs. material, $400. Glasgow—36 pkgs. material, $1,518; 41 pkgs. machinery, $9,950. Hong Kong—9 pkgs. material, $132. Hamburg—16 pkgs. machinery, $1,662; 277 pkgs. machinery, $8,812; 104 pkgs. material, $10,939. Havre—19 pkgs. material, $567; 3 pkgs. machinery, $610. Japan—106 pkgs. material, $9,724; 29 pkgs. machinery, $4,914. London—150 pkgs. machinery, $3,770; 102 pkgs. material, $6,906. Liverpool—223 pkgs. machinery, $15,977; 91 pkgs. material, $4,336. Leicester—1 pkg. machinery. $227. Mexico—11 pkgs. material, $149. Manchester—49 pkgs. machinery, $3,434; 2 pkgs. materiala, $450. Newfoundland—2 pkgs. material, $75. Nova Scotia—15 pkgs. material, $192; 2 pkgs. machinery, $112. Philippine Islands—2 pkgs. material, $291. Rotterdam—3 pkgs. machinery, $784. Southampton—6 pkgs. material, $255. Stockholm—1 pkg. material, $55. San Domingo—22 pkgs. material, $403. Uruguay—18 pkgs. material, $304. U. S. Colombia—24 pkgs. material, $876. Venezuela—2 pkgs. material, $68.

NEW METHOD OF TREATING COPPER ORES.—A process is claimed to have been perfected for the treating of copper and other sulphite ores, which, according to experts, will bring about almost as great a revolution in the art of metallurgy as did the invention of Bessemer in the manufacture of steel. It will permit of the opening up of hundreds of low-grade copper mines throughout the country, which are now lying dormant because of the hitherto prohibitive cost of operation. The new method is the invention of former Superintendent Knox, of the East Pittsburg Gas Company, controlled by Mr. George Westinghouse. Mr. Knox has been working on the system for some years past at the instance of Mr. Westinghouse, who has already, it is said, invested over $2,000,000 in the process and in the acquisition of low-grade mines in New England and along the Soo. The Knox process does away with the preliminary roasting of the ores, which not only is an expensive treatment, but one which kills all vegetation within seven or eight miles of the smelters. Patent papers taken out describe the invention as a method for separating copper from copper matte, in which the iron and other metals exist largely as sulphides, which consists in melting the matte oxidizing iron and sulphur of the matte by forcing air into contact therewith while in a molten state, thereby generating heat sufficient to maintain the mass in a molten state, causing the formation of iron oxysulphides under such conditions that substantially no silicate of iron is formed and in separating the copper therefrom by causing it to remain quiescent a sufficient time to separate by gravity. Extensive operations are now being conducted under the supervision of Mr. Knox at Copper Fields, Vermont. The concentrates are being shipped to the Westinghouse Works.

SOME A. D. GRANGER COMPANY ORDERS.—The A. D. Granger Company, White Building, 95 Liberty Street, has been awarded a contract for three 11-inch by 12-inch horizontal automatic Skinner engines for direct connection to 50-kw Crocker-Wheeler generators, which are to be installed in Church, Dodge & Co.'s new office building at Troy, N. Y. The Granger Company has also taken an order for a 16-inch by 18-inch Woodbury horizontal automatic engine for direct connection to a 100-kw General Electric generator, and for a 14½-inch by 16-inch Woodbury horizontal automatic engine for direct connection to a 75-kw General Electric generator. These machines are to serve for light and power purposes in the Y. M. C. A. building, Twenty-third Street, New York City. The Hebrew Orphan Asylum, at 138th Street and Amsterdam Avenue, New York City, is to be installed with two horizontal automatic Skinner engines, one 12-inch by 15-inch, and the other a 14½-inch by 15-inch one, direct connected to 50-kw and 75-kw General Electric generators, respectively. This outfit will be used for lighting purposes. A Woodbury engine, 8 inches by 12 inches, has been ordered for direct connection to an Elwell-Parker generator, of 25 kw capacity, for light and power use in the plant of Scheuer & Co., Paterson, N. J.

EQUIPMENT FOR N. J. SILK FACTORY.—The North American Silk Company, of West New York, N. J., has just placed contracts for equipment which will be employed to furnish electric light and to operate looms and other machinery. A 37½-kw generator, 325 r.p.m., direct-connected to a 7-in. by 3½-in. by 10-in. tandem compound engine will be installed. The generator will be built by the Elwell-Parker Electric Company, of Cleveland, Ohio, and the engine will be furnished by the Buffalo Forge Company. There will also be three Elwell-Parker motors of 7½ hp each, 825 r.p.m., and one 5-hp motor, 900 r.p.m.

STEAM AND ELECTRICAL EQUIPMENT COMPANY, of Conestoga Building, Pittsburg, report the sale recently of a 300-kw street railway generator direct connected to a 16 by 30 by 42 Wetherill tandem Corliss engine, one 24 by 42 Corliss engine of 300 hp and one 72 by 16 steam boiler, Russell make. The company are now representing the Cosmopolitan steam condenser, with which they state engines are being operated condensing with less consumption of water even than was needed to run engines, high pressure. They have some special literature on the subject.

SOME ROTH MOTOR ORDERS.—Roth Bros. & Co., of Chicago, and 95-97 Liberty Street, New York, have secured a contract for seven motors to be installed for general power purposes in the silk mills at Paterson, N. J., of the Benjamin Eastwood Company. There will be one 10-hp, 800 r.p.m., two 7½-hp, 1,250 r.p.m., two 5-hp, 1,550 r.p.m., and two 2-hp, 1,650-r.p.m. machines. An order has also been received from the General Manifold Company, of Franklin, Pa., for one 10-hp, 800 r.p.m., two 5-hp, 900 r.p.m., and four 2-hp, 1,100-r.p.m. motors to be used for power.

CARS FOR THE RAPID TRANSIT SUBWAY.—Important contracts for cars for the New York Rapid Transit Subway road were awarded last week. Five hundred cars have been ordered and contracts for 300 more will be determined on shortly. The St. Louis Car Company got a contract for 200, and the Wason Manufacturing Company, of Springfield, Mass.; the Jewett Car Company, of Newark, Ohio, and the John Stephenson Company, of Elizabeth, N. J., were allotted contracts for the building of 100 cars each.

GASOLINE ENGINE LIGHTING PLANT.—The Northern Engineering Company has secured a contract for a gasoline engine and dynamo outfit, with switchboard, etc., complete, to be installed for lighting in the residence of Mrs. G. A. Hobart, widow of the late Vice-President Hobart, at Paterson, N. J. The plant will have a capacity for 100 lights. The engine and dynamo will be built by the Merrlam Abbott Company, of Cleveland, Ohio.

THE NEW YORK CENTRAL RAILROAD has made a contract with the General Electric Company and with Westinghouse, Church, Kerr & Co. for the installation of steam engines and alternating current generators for the Weehawken Station on the west shore of the Hudson River, opposite New York. The company is expending some $50,000 on its electric plant there.

RAILS AND TIES FOR THE SUBWAY.—The Cambria Steel Company, of Johnstown, Pa., has taken a contract for 3,750 tons of contact rails for the New York Subway. One hundred and twenty thousand ties have been ordered from Robert R. Sizer & Co., Coffee Exchange Building, New York City.

ELECTRO-PNEUMATIC CONTROL.—A Pittsburg dispatch states that the Brooklyn Elevated Railway has awarded a contract to the Westinghouse Electric & Manufacturing Company to equip all the new cars with the Westinghouse electro-pneumatic multiple unit control.

ST. JOSEPH RIVER POWER.—Mr. C. R. Chapin, of Chicago, has secured a legal decision in favor of his rights over power from the St. Joseph River, against contestants from Berrien Springs. Mr. Chapin has already spent large sums on the development at Berrien Springs, and proposes to push matters.

NEW SUBMARINE BOATS.—Among the bills introduced in the United States Senate last week was the following: By Senator Platt (Conn.), authorizing the construction of submarine torpedo boats, cost not to exceed $1,000,000.

SUPPLIES FOR JAPAN.—H. Becker & Co., Curtis Building, South William Street, New York, has secured a large order for electrical supplies for the Tokio Street Railway Company. The Ceneral Electric Company will fill the order.

WESTINGHOUSE MICA PLANT.—The Westinghouse Electric and Manufacturing Company will, it is stated, open a plant near Detroit, Mich., for the purpose of preparing mica for use in making electrical machinery.

PITTSBURG LAMP DEAL.—The entire plant and business of the Pittsburg Incandescent Lamp Company, Pittsburg, has been purchased by the Pittsburg Electric Lamp of Company, of Braddock, Pa.

General News.

THE TELEPHONE.

[illegible], FLA.—[illegible] telephone system, just completed, has [illegible] instruments in operation and [illegible] of wire. It includes the [illegible] exchange and [illegible] of [illegible], Pearl City, [illegible] and [illegible].

[illegible]—The [illegible] Bell Telephone Company will erect a new exchange here.

QUINCY, ILL.—The [illegible] Telephone Company has applied for a franchise in this place.

[illegible], ILL.—The [illegible] Telephone Company will build a telephone line from [illegible] to [illegible].

[illegible], ILL.—A telephone line from this place to Lena is projected. Mr. [illegible] of Pearl City, is interested.

[illegible], ILL.—The [illegible] Bell Telephone Company has changed its name to [illegible] Telephone Company.

[illegible], ILL.—The [illegible] Telephone Company has been incorporated with a capital of [illegible] by [illegible] A. A. [illegible] and F. A. Warner.

[illegible], ILL.—The Mutual Telephone Company, of Montgomery County, has been granted a franchise by the board of supervisors to build its line in the county.

KANKAKEE, ILL.—The council has granted a 25-year franchise to the [illegible] Independent Telephone and Telegraph Company, a branch of the Illinois [illegible] Company.

CHICAGO, ILL.—The Illinois Telephone and Telegraph Company has applied to the [illegible] for a permit to extend its conduits through a large [illegible] of the West Side, which, by its ordinance, it is permitted to [illegible].

[illegible], IND.—The Nine-Mile Telephone Association, of Allen County, has [illegible] with a capital stock of [illegible]. The incorporators are [illegible], of Ft. Wayne; T. P. Harbor, of Sheldon and J. [illegible] of Nine Mile.

BORDEN, IND.—The Daisy Telephone Company of Borden, Clark County, has been [illegible] with $2,000 capital stock. Among the incorporators are: William [illegible] M. Gray, Charles F. Gray, Benjamin F. Stalker, William Stone and William Rosenberger, all of Borden.

KOKOMO, IND.—The Bell Telephone Company in its fight against the local independent concern has reduced residence rates to 50 cents a month. The home company promises to meet the cut and may offer a 25-cent rate. When the Bell Company had a [illegible] here the residence rate was $2.

INDIANAPOLIS, IND.—The proposition to debar from membership in the [illegible] Telephone Association all companies granting concessions or accepting favors from the Bell Telephone Company is not meeting with favor from a number of Indiana cities. These cities want but one system and want that system open to connection with all outside exchanges, whether [illegible] by the Bell or independent companies.

EVANSVILLE, IND.—The Cumberland Telephone Company has filed suit in the Federal Court at Indianapolis asking for an injunction against the city to prevent it from destroying the property of the company. The company's franchise has expired and the authorities have ordered the company to remove its poles [illegible].

INDIANAPOLIS, IND.—The Board of Safety is advertising for bids for telephone service [illegible] departments for [illegible] and the rivalry between the two [illegible] is quite spirited. The contract amounts to [illegible] dollars and the bids are usually very low. In some of the city offices both telephones are used, but the fire department houses have [illegible] with only one line. The new company had the contract last year.

MUNCIE, IND.—The Anderson and Elwood exchanges of the Delaware and Madison County Telephone Company are now in operation and the exchange at Alexandria is ready to open. When the extension is completed Muncie will have communication with the leading cities and towns of Indiana, Ohio and Michigan. The company now has contracts for [illegible] telephones, which are being installed at the rate of 50 a day. The entire system will be in operation by January [illegible].

[illegible], IA.—[illegible] of Sioux City, and [illegible] have been granted a telephone franchise in this place.

[illegible], IA.—The [illegible] and Augusta Telephone Company has been incorporated with a capital of [illegible].

[illegible], IA.—The Farmers and Merchants' Telephone Company, of [illegible], has been incorporated by [illegible], Jr., A. H. [illegible], Thomas [illegible], H. A. [illegible], J. H. [illegible], M. McGregor and [illegible]. The capital is [illegible].

DES MOINES, IA.—The strike of the operators of the Bell Telephone Company [illegible] was settled on Dec. [illegible] by representatives of the company and of the Trade and Labor assembly. The telephone girls [illegible], and all of the girls who struck are to be taken back to work. The company further [illegible] against the strikers. The injunction suit to restrain the [illegible] from boycotting the company is to be dismissed.

BOWLING GREEN, KY.—The new Independent Telephone Company will erect an exchange in this city.

[illegible], LA.—The business men of this place have organized a telephone company.

HART, MICH.—The local telephone company, which is operated in Oceana and [illegible] improvements. To-day telephones are in a great many [illegible] years ago not a farmer had any communication with the towns except as he might hitch up his horse and drive to any point.

KANSAS CITY, MO.—The Kansas City Home Telephone Company has bought a lot on [illegible] Avenue and will, in the near future, begin the erection of a handsome and modern telephone building.

ARLINGTON, NEB.—The Arlington Telephone Company has increased its capital stock from $5,000 to $10,000.

TAMORA, NEB.—The farmers of this section have organized a mutual telephone company and will build lines in three directions.

YORK, NEB.—The stockholders of the Consolidated York County Independent Telephone Company have elected the following directors and officials: Captain George Holdeman, president; C. N. Beaver, vice-president; J. M. Bell, treasurer; Edwin Bell, secretary and manager; George Holdeman, Alfred B. Christian, W. L. Kirkpatrick, J. B. Erwine of Waco, Dr. Straight of Benedict, J. M. Bell and C. N. Beaver, directors. The new company starts out with a paid-up capital of $20,000 and has a network of wires over the north and northeast part of the county. It is a consolidation of the York Telephone Company, the Waco Telephone Company and the Benedict Telephone Company.

HOPKINTON, N. H.—The Hopkinton Telephone Co. has decided to extend its line from Contoocook to West Hopkinton.

BASKING RIDGE, N. J.—At Basking Ridge recently a fine for breaking the State game laws was inflicted over the telephone and duly paid to the nearest officer by the culprit.

ROCHESTER, N. Y.—The Rochester Telephone Company is putting in a line which will be equipped with apparatus that will accommodate forty telephones on one line.

ALBANY, N. Y.—The Columbia Telephone Company, of Hudson, has been incorporated, capital $50,000. Directors: Benjamin F. Case, Canton Center, Conn.; J. H. Bidwell, Collinsville, Conn.; E. C. Getty, Hudson.

TROY, N. Y.—The Eastern New York Telephone and Telegraph Company has entered into a five years' contract with the Rensselaer Telephone Company for connection with its toll lines. The connection with Troy and the Rensselaer Company's entire territory will be in operation about Jan. 1.

COOPERSTOWN, N. Y.—A telephone war in earnest is on between the Central New York Bell Company and an independent company. The village is becoming a network of wires overhead and tall poles line both sides of the principal streets. One of the opposing companies has offered to install telephones and give six months' service free to its subscribers. Both companies claim to be gaining ground daily.

DAVENPORT, N. C.—The Providence Telephone Company, a rural exchange, is building lines to Waxhaw, Matthews and other points.

WHITEVILLE, N. C.—The Columbus Telephone Company has increased its capital stock from $10,000 to $20,000. A number of toll lines are operated by this company.

WARSAW, N. C.—H. L. Stevens is president of the Duplin Telephone Company which has begun work on a line from Clinton to Magnolia, N. C., where connection will be made with the Bell Company.

VERMILLION, OHIO.—The new independent telephone exchange at this place is now in operation. It has 139 subscribers.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company has fitted up a hospital adjoining its exchange. A trained nurse, Miss Edna L. Tuttle, is in charge.

NEW PHILADELPHIA, OHIO.—The Tuscarawas Telephone Company now has 2,500 telephones in operation and operates six exchanges, including New Philadelphia, Canal Dover and Uhrichsville. The annual meeting will be held in January.

OXFORD, OHIO.—The Oxford Telephone Company has completed a connection with the farmers' line controlled by Ezra Bourne and is now affording service throughout a large district including Bath, Brookville, Mixerville and Springfield. The switchboard is being enlarged for the new service.

FOSTORIA, OHIO.—Farmers in the neighborhood of this city have asked that the lines of the Fostoria Home Telephone Company be extended throughout the district. Estimates are being prepared for an extension of the switchboard to take care of these people. The company is controlled by the Federal Telephone Company.

YORK, PA.—The United Telephone and Telegraph Company is building a new line from [illegible] to [illegible].

SUMTER, S. C.—The Bell Telephone Company is seeking a franchise to establish long distance service here and also a local exchange in October, 1903, when the exclusive franchise of the Sumter Telephone Company expires.

MEMPHIS, TENN.—The East Tennessee Telephone Company is building a line from Memphis to Bowling Green.

ASHLAND CITY, TENN.—It is said that a number of leading business men will soon organize a telephone company and put in a local exchange. The system will be [illegible] to a number of outside cities.

MOUNDSVILLE, W. VA.—The National Telephone Company is building a line between this city and Wheeling.

RACINE, WIS.—The Citizens' Telephone Company, of Racine, has incorporated with a capital stock of [illegible].

WEST SALEM, WIS.—The West Salem Telegraph and Telephone Company has changed its name to La Crosse County Telephone Company and transferred its headquarters to La Crosse.

FOOTVILLE, WIS.—The Footville Telephone Company of the village of Footville, capital stock [illegible], has been incorporated by S. W. Lacey, A. E. Aspinwall, J. Meehan, F. W. Snyder, Walter Honeysett and W. O. Howell.

ELECTRIC LIGHT AND POWER.

MONTGOMERY, ALA.—After a 30 days' test of the electric current from the water power at Tallassee, on the Tallapoosa River, 35 miles from here, the consolidation of the Montgomery Light and Power Company and the Tallassee Water Power Company has been effected, the new name being the Montgomery Light and Water Power Company. The river can supply 5,000 horse-power, and the local steam plant 3,000. The present consumption is about 2,500. The steam plant here is not operated, but available if the water power fails for any reason.

COLUMBUS, GA.—Engineers are making preliminary surveys at the Clapp factory site near Columbus for developing a fine water power. A dam 54 feet high will be erected to furnish power for an electric railway, electric light, etc.

MASCOUTAH, ILL.—The Mascoutah Light Company will increase its capital stock from $5,000 to $7,500, and will construct a local telephone system, for which a franchise has been granted by the city council.

DAVENPORT, IA.—The Davenport Gas and Electric Company will install a 600-kw. alternator, to be driven by a 1,000-hp. engine; also three Brush 125-arc light machines.

HARRODSBURG, KY.—This city has voted $18,000 electric light bonds.

LAUREL, MD.—The Laurel & Seaford Electric Light Plant Co. has increased its capital from $20,000 to $50,000.

SPRINGFIELD, MASS.—The Montague Electric Street Light and Power Company has been formed, with a capital of $2,000. Electricity will be generated by the water power controlled by T. F. Harrington.

COLUMBIA, MO.—A contract has been awarded by the University to J. W. Wilson, of St. Louis, for the construction of an addition to the University power-house. The recent addition of several new buildings to the University group made this improvement necessary.

CLARENCE, MO.—The proposition to increase the indebtedness of the city $10,000 to erect an electric light plant carried at the election held Dec. 16. This is the fourth time the city has voted upon the proposition. The ordinance provides for the issuance of $10,000 in five twenty-year bonds, at 5 per cent.

SYRACUSE, N. Y.—The Baldwinsville Heat and Light Company has been formed with $100,000 capital, the directors being William F. Morris, Jacob Amos, John T. Wilkins, E. C. Munroe, Windsor Morris and Robert Rose.

GALION, OHIO.—A proposition is before the city council to issue bonds for the repair of the electric light plant, which will amount to between $10,000 and $15,000.

CLEVELAND, OHIO.—The Pennsylvania Railway Company is preparing to erect an electric power plant on its docks at Cleveland. It will operate ore conveyors.

MEDINA, OHIO.—The Medina Electric Light, Power & Heating Company, formed some time ago to take over the plant of the Medina Electric Light Company with a view to enlarging the plant and heating the town, has failed to consummate the deal.

DALLASTOWN, PA.—An electric light plant, to cost $5,000, will be built at Dallastown.

YORK, PA.—The York Haven Power Company has a force of men engaged in stringing its line of wires from the York Haven plant to York, Pa. As the plant will not be in operation for a year, the wire will be kept charged with a 1,000-volt current supplied by the Edison plant. The purpose of charging the wire is to prevent its theft.

LEHI, UTAH.—The Utah Sugar Company is erecting a power plant on the Bear River to cost $150,000, installed in two units of 2,000-hp. each. The first 2,000-hp. has been contracted for to the Utah Light and Power Company, which will build its own line and connect at Ogden. Thomas R. Cutler is general manager.

SNOHOMISH, WASH.—One of the boilers at the city water works, which furnished power for the electric light plant, exploded recently, killing one of the electricians and doing much damage to the apparatus. The city was without electric light and water until repairs could be effected.

BARABOO, WIS.—The Baraboo Gas and Electric Light Company has changed its title to Baraboo Lighting Company.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The United Railroads Company will begin operating the new line to San Mateo early next year. Three sub-stations will be maintained which are to be supplied from high tension lines. Each will be equipped with one 750-kw motor-generator. One corner of the new 16,000-hp power station on Bay Street is under roof, and the first unit of the new plant is being erected. Chas. C. Moore & Co. are installing the Babcock & Wilcox water tube boilers having a combined capacity of 8,000 horse-power with a complete oil-burning system. The first 4,000-hp unit, consisting of two 1250-kw 13,000-volt generators direct-connected to one Union Iron Works engine, may be ready for operation in January.

FLORENCE, COLO.—A franchise has been granted to Thomas Robinson, of this city, to build and operate an electric railway.

CRIPPLE CREEK, COLO.—Deeds conveying right of way to the Cripple Creek and Pueblo Railroad Company have been filed and simultaneously articles of incorporation. The purpose of the corporation is to construct a 33-mile railroad connecting the gold camp with Pueblo. The road will be constructed in the district through a system of underground tunnels, and the motive power used in the tunnels will be either electricity or compressed air. Thomas B. Casey, of Boston, is the president of the company; J. R. McKay, of Chicago, treasurer.

VINCENNES, IND.—The Western Indiana Traction Company, of Vincennes, has filed incorporation papers. The capital stock is $100,000 and Edgar H. DeWolf, of Vincennes, heads the board of directors.

INDIANAPOLIS, IND.—The county commissioners have granted a franchise to the Indianapolis, Lebanon & Franklin Traction Company enabling it to cross highways in the county. The road will be built on private right of way.

INDIANAPOLIS, IND.—The stockholders of the Indianapolis Street Railway Company will, on Dec. 29, vote on a proposition to lease that company's lines to the Indiapapolis Traction & Terminal Company for 30 years. Upon approval of the proposition the stock of the Terminal Company will be increased to $50,000,000.

FT. WAYNE, IND.—The Ft. Wayne Street Railway system and several lines leading out of the city has been purchased by the McCulloch interests. This purchase is said to mean the ultimate consolidation of these properties with the McCulloch interests which already control 450 miles of interurban lines in the State.

MAYSVILLE, KY.—The Bluegrass Traction Company, Maysville, Ky., will probably erect a power house at either Lexington or Paris. The company is to construct a trolley line 23 miles in length from Maysville to several surrounding towns. John Duley, president of the Board of Trade, is interested.

LAWRENCE, MASS.—The Lawrence and Methuen Street Railway Company has purchased a large lot of land at Methuen and will build a new power house.

MIDDLEBORO, MASS.—The extension of the Middleboro, Wareham & Buzzard's Bay Street Railway through to Sandwich is assured. The Selectmen of that town have granted the company's petition in preference to that of the local company, the Cape Cod Street Railway. An extension of the Sandwich line is contemplated later to the Vineyard Sound shore at Cotuit, thence to Hyannis, Dennis, Harwich and Chatham.

ALBION, MICH.—The Jackson-Battle Creek Traction Company will erect large car barns and repair shop in this city.

CAMDEN, N. J.—The Monterey Electric Railway Company has been incorporated here; capital, $1,500,000; incorporators, Leroy W. Sperry, Baltimore, Md.; Edward F. Mass and Simon J. Block.

JERSEY CITY, N. J.—The Puget Sound Electric Railway has been incorporated by Preston Player, Nathan H. Daniels, Jr., Howard L. Rogers, Henry Reed Hayes, George C. England, Waldo E. Forbes, Alvah K. Todd and Gardner Rogers, of Boston, and Louis B. Dailey, of Jersey City.

NEW YORK, N. Y.—The State Railroad Commission has authorized the Union Railway Company of New York to use the overhead trolley system in extensions of its lines on several streets in the Borough of the Bronx.

ROCHESTER, N. Y.—The Penn Yan, Keuka Park and Branchport Electric Railway Company has been compelled to suspend operations, owing to its inability to secure a supply of coal. This is the second time this road has shut down from this cause.

NEW YORK, N. Y.—It is reported that the Manhattan Railway Company has leased, or is about to lease the Yonkers line of the Putnam division of the New York Central Railway. According to the report the line is to be equipped with the third rail system and express trains are to be run through from the South Ferry, Manhattan, to Getty Square, Yonkers.

COLUMBUS, OHIO.—The interurban railway people are planning to build a belt line around Columbus for use of both steam and electric roads entering the city.

WAPAKONETA, OHIO.—The Western Ohio Railway Company is planning to build an extension from Minster to Greenville and right of way is being secured.

CANFIELD, OHIO.—The Youngstown & Ohio River Railway Company, represented by Max P. Goodman, of Cleveland, has secured a franchise for its line through town.

NEW PHILADELPHIA, OHIO.—The Post Office authorities have established mail service on the cars of the Tuscarawas Traction Company between Canal Dover and Uhrichsville.

DEFIANCE, OHIO.—The city has granted a franchise to J. Morgan, trustee for the People's Rapid Transit Company, which proposes to build a line from Toledo to Greenville through this town.

CLEVELAND, OHIO.—The Lake Shore Electric Railway is making surprising gains in its earnings. The gross passenger receipts for November were $40,862, an increase of 48.9 per cent. over the corresponding month last year.

PORTSMOUTH, OHIO.—The Portsmouth Street Railway & Light Company has placed a contract with the Westinghouse Elec. & Mfg. Company for the equipment of its new power house. The company will build an extension to Hanging Rock.

COLUMBUS, OHIO.—The Franklin County commissioners have granted an extension of six months for the completion of the line of the Scioto Valley Traction Company. The original franchise required that the road be placed in operation Jan. 1, 1903.

TOLEDO, OHIO.—The Toledo, Fostoria & Findlay Railway Company is about to close a contract for the construction of its Fostoria-Toledo extension. It is understood that a New York engineering concern will secure the contract for building the 35 miles of road.

COLUMBUS, OHIO.—The Columbus, New Albany & Johnstown Railway Company is preparing to extend its line from Gahanna to New Albany and Johnstown. Contracts will be closed in the near future. The company will purchase new rolling stock and may decide later to build a power house.

CLEVELAND, OHIO.—W. D. Young, one of the chief promoters of the Lorain & Eastern Railway Company, announces that construction work on the line will start by January 1. The road will run from Rocky River, seven miles from Cleveland, to Lorain and Elyria. It is claimed right of way has all been secured.

WARREN, OHIO.—[illegible] County commissioners have notified the Pennsylvania & Mahoning Valley [illegible] Company [illegible] to [illegible]. The road [illegible] bound to the [illegible].

CINCINNATI, OHIO.—[illegible] Georgetown & Portsmouth Railway [illegible] will be operated by [illegible] have not been completed.

CLEVELAND, OHIO.—[illegible] of the Cleveland, Elyria & Western Railway Company and the [illegible] & Southern [illegible] Company [illegible] recently [illegible] of the properties [illegible] the Cleveland & Southwestern Traction Company. The [illegible] will be [illegible] by the stockholders [illegible] to be held January [illegible]. The new company will [illegible] Gas & Electric Light Company.

CLEVELAND, OHIO.—[illegible] of the Detroit United Railway met in this [illegible] per cent. on [illegible] capital stock. The usual quarterly dividend of one per cent. was declared. The directors voted to spend [illegible] per cent. in improvements, chiefly in rolling stock and equipment. The Sandwich, Windsor & Amherstburg Railway Company, the majority of whose stock is controlled by the Detroit United, will issue a [illegible] per cent. mortgage for [illegible] to provide for the extension of the road to Amherstburg.

TOLEDO, OHIO.—The Toledo & Maumee Valley Railway Company and the Toledo, Waterville & Southern Railway Company have consolidated under the name of the Maumee Valley Railways & Light Company. The capital stock of the new company is [illegible] and bonds to the same amount will be issued. The new officers are R. H. Baker, president; E. J. Bechtel, vice-president; Wm. H. McLellan, secretary, and Charles T. Munz. The property is owned by the [illegible] syndicate and it is operated by the same management as the Toledo Railways & Light Company. It is understood that the company is going into the electric lighting business with a view to illuminating Maumee, Perrysburg, Waterville and other towns in the valley.

CLEVELAND, OHIO.—It is [illegible] that within sixty days work will start on the construction of the proposed interurban freight station which will be located on Erie Street on property which has been held by the interurban companies for more than a year. The station will be operated by the Suburban Depot Company, interested in which are the Cleveland Electric Railway Company, the Cleveland City Railway Company, the Eastern Ohio Traction Company, the Northern Ohio Traction Company, the Cleveland, Painesville & Eastern Railway Co., the Lake Shore Electric Railway Co. and the Cleveland, Elyria & Western Railway Company. With the exception of the Eastern Ohio Traction Company the business of [illegible] is operated by the Electric Package Company. While the station will be devoted almost wholly to freight and express business there will be waiting rooms for the accommodation of travelers.

COLUMBIA, S. C.—A movement is on foot for the building of an electric railway to [illegible], S. C., a distance of 35 miles.

NASHVILLE, TENN.—An interurban electric railway to Clarksville is being discussed. Application has been made for a franchise by T. N. Watson, who is said to be backed by Clarksville capital.

DALLAS, TEX.—The municipal commissioners of this city have refused to confirm the ordinance passed by the city council authorizing the consolidation of the different street railway systems of this city into the Metropolitan Street Railway Company, which was recently organized by Stone & Webster, of Boston, Mass., with a capital stock of $4,500,000. Mayor Caball says that even should the ordinance have been approved by the commissioners he would have vetoed it.

SALT LAKE, UTAH.—Permanent surveys for the Coeur D'Alene and Spokane electric railway have been completed. The road will be 32 miles long.

RICHMOND, VA.—At a meeting of the directors of the Richmond and Petersburg Electric Railway Company, held in Cleveland, Ohio, F. Sitterding, of Richmond, was elected president and L. C. Spencer, secretary and treasurer.

MONTEREY, MEX.—It is reported that the Baltimore, Md., syndicate which recently acquired the Monterey street railway systems is also negotiating for the purchase of the street tramways of the city of San Luis Potosi, Mexico, and that the deal is likely to be consummated. The Baltimore syndicate has [illegible] the lines of the [illegible] Street Railway Company in Monterey. The latter company operated an extensive system of road connecting the center of the city with the depots and principal manufacturing concerns. The work of constructing the power house, preliminary to converting the company system into electric lines and the building of extensive new lines is now in progress.

LEGAL.

NERNST LAMP IN GERMANY.—[illegible] is made in a recent issue of the *Zeitschrift [illegible]* of a recent action in regard to the Nernst lamp in the courts of Germany. It says: "In the patent suits instituted against the company relative to Nernst lamps, the Imperial Court has reversed the decision of the patent office against the first Nernst patent, and has reinstated this patent to its full extent; the costs of both proceedings to be borne by the complainant." In this case the complainant was [illegible], of Berlin. The first Nernst patent in Germany is the broad one referring in general to the use of conductors of the second class heated by an outside source as a preliminary, and maintained in incandescence by the passage of current.

NEW YORK STREET CAR TAX.—The Appellate Division of the New York Supreme Court has handed down a decision in a number of cases brought to compel various railroad companies in the city to pay a tax of $50 per year on each car owned by them. The cases vary somewhat in details, but in general the Metropolitan Street Railway Company is held responsible for the payment of the tax, as being the lessee company. The city brought a number of suits some time ago to collect the tax, on which some of the companies are in arrears for years. Other suits [illegible] but the Corporation Counsel wished first to have it settled which company was responsible, the original or lessor companies, or the lessee. Under the present decision the Metropolitan will have to pay the back tax, which amounts to many thousands of dollars—that is, unless the latest transformation of the Metropolitan into the Interurban Company makes still further litigation necessary.

SUIT ON A TELEPHONE DIRECTORY.—A damage suit, involving a new and novel question, has been instituted in the district court at Houston, Tex., by Anna Ezell, against the Southwestern Telegraph and Telephone Company. Plaintiff asks for [illegible] damages for alleged injury done her good name for which she asserts the defendant company is responsible. She alleges in her petition that on July 15, 1902, she and defendant company had an agreement by which the latter was to place a telephone in her residence which she alleges was done, and that the defendant company was also to furnish her with a telephone directory with her address printed therein as 715 Travis Street, but instead of having her address printed as she had directed it was printed as a number on Texas Avenue. This number on Texas Avenue which was printed in the directory as her address had been for many years, the plaintiff alleges, occupied by notorious public characters and was so generally known by the public; plaintiff further alleges that she became a subject of much ridicule and also of many unpleasant remarks and comments from her acquaintances, which, though, perhaps, meant in a spirit of levity, were upon a repulsive subject and caused her to suffer great humiliation and annoyance, shame and disgrace; that she was slighted and shunned by acquaintances, who feared others who did not understand the real facts in the case would think that they were associating with a woman of bad repute; that defendant company failed to comply with her request that her address be corrected and the telephone directory issue containing the erroneous number be called in.

NEW INDUSTRIAL COMPANIES.

THE PULVERIZED COAL STOKER COMPANY, of New York, has been incorporated with a capital stock of $500,000. The directors are A. A. Day and G. W. Giddings, of Brooklyn, and A. A. Low, of Manhattan.

THE AMERICAN ELECTRICAL SPECIALTIES COMPANY, of New York, has been incorporated with a capital stock of $50,000. The directors are James Jones, Jr., and Julius Silverman, of New York.

THE CHAMBERLAIN LAKE TELEGRAPH AND TELEPHONE COMPANY, of Greenville, Me., has been incorporated, with a capital stock of $10,000. L. B. Folsom is president, H. M. Shaw treasurer.

THE FUSE-WIRE AND MANUFACTURING COMPANY, of Buffalo, N. Y., has been incorporated by Arthur A. Dana and W. H. Crosby, of Buffalo; E. A. Sperry, of Cleveland; H. E. Goodman, of Chicago, and G. B. Smith and F. H. Field, of Brooklyn.

PERSONAL.

MR. T. L. LYMAN, manager of the asbestos department of H. W. Johns-Manville Co., New York, sailed on Dec. 20 for Havana, Cuba, where he will remain about two weeks for the benefit of his health.

MR. L. W. STANTON, the telephone engineer of Cleveland, was a welcome visitor at the Chicago office of ELECTRICAL WORLD AND ENGINEER last week. A great deal of professional work in his field is opening up.

MR. C. H. DALE, president of the Peerless Rubber Manufacturing Company, has been elected president and general manager of the Mechanical Rubber Company, which thus secures an executive of great force and ability.

Mr. B. F. VREELAND, of Denver, Colo., dealer in Idaho red cedar poles, of which he is shipping a considerable quantity east, made a visit to Chicago recently, attending the Interstate Telephone Convention and looking after other interests.

MR. C. C. BADEAU, formerly with the Wagner Electric Manufacturing Company, of St. Louis, has opened an office in the Frick Building, Pittsburg, in behalf of the Cutler-Hammer Manufacturing Company, of Milwaukee, to represent its electric controlling devices.

MR. WILLIAM COALE, the energetic treasurer of the Sterling Electrical Mfg. Co., of Warren, has been a recent visitor to the East and was in New York City last week. He finds that the demand for the Sterling "Special" incandescent lamp shows no sign of lessening.

MR. O. W. BRAIN, the electrical engineer of the New South Wales Government, who has been on this side for the last week or two securing data in connection with the proposed extension of the Sydney City and Suburban Tramways plant, left New York this week, en route for San Francisco, from which place he will sail for Australia on the "Sonoma," Jan. 8.

MR. LAMBERT SCHMIDT, the well-known telephone manufacturer, and his wife were seriously injured in a trolley smash up at Weehawken, N. J., last week. They were returning home from the theatre when three cars that had broken loose from a freight train on the Erie Railroad smashed into the trolley car as it crossed the tracks. About forty persons were hurt in the collision.

DR. H. P. PRATT.—The office of X-ray Expert and Electrical Diagnostician of the Law Department of Chicago has been created and will be filled by Dr. H. Preston Pratt. In his letter tendering the position to Dr. Pratt City Attorney John E. Owens says: "This office has become necessary on account of numerous attempts at fraud through the evidence of X-ray and electrical so-called 'experts' in claims against the city for personal injuries.

MR. LEWIS NIXON, discussing battleship problems in the *World's Work* for January, says: "I have no doubt that soon electric influences will be projected and that the metal work of an enemy's guns may be able to transmit shocks to those serving them. The most important factor we have at present to influence the future navy is the submarine boat. It is a peculiarity of this new addition to our fighting force that its influences will be outside itself. By that I mean that so far

as the submarine boat is concerned it is at the very outset a practically perfect craft. Such changes as will be brought about by its enrollment in the navy will be in the conditions to which it is opposed."

MR. FRANK HEDLEY, who has been general superintendent of the Lake Street and Northwestern Elevated railroad companies, Chicago, has resigned to become general superintendent of the underground system of the Interborough Rapid Transit Company of New York. Mr. Hedley, now 40 years old, is descended from an English family that was among the first to be connected with steam and locomotive engineering. His grand-uncle, William Hedley, was the designer and builder of the first traction engine ever constructed in England. Mr. Hedley came to this country in 1882 and entered the Erie Railroad shops as machinist. In 1893 he took the position of superintendent of motive power with the Lake Street Company. He will be a welcome addition to the electro-technical circles of New York City.

MR. HORACE L. HOTCHKISS has transferred his membership in the New York Stock Exchange, and intends to retire from active business, after forty-five years in Wall Street. In 1867, in connection with Mr. E. A. Calahan, the inventor of the stock quotation system, Mr. Hotchkiss organized the Gold and Stock Telegraph Company, of which he was the treasurer, and materially aided in placing that company on a high plane of prosperity. In 1871 he was one of the incorporators of the American District Telegraph Co., and a director and the treasurer for several years. The firm of Hotchkiss & Burnham opened at the Fifth Avenue Hotel the first uptown branch office connected by private telegraph lines for public patronage in connection with their Stock Exchange business. This enterprise on the part of this young firm was considered at that time quite an innovation on the staid methods of conducting the stock brokerage business. Mr. Hotchkiss is congratulated on his retirement by a great many old friends in the telegraph field.

Trade Notes.

THE FISHER ELECTRIC COMPANY, Toledo, Ohio, has increased its capital stock from $10,000 to $25,000.

ELECTRIC HEATERS.—American Electric Heater Company, of Detroit, have made a change of address to 17-19 Spencer Street, that city, in order to secure larger and better facilities for the production of its goods.

ARC LAMP TALK.—"Twenty Chapters of Reasonable Arc Lamp Talk" is the title of a neat little booklet just issued by the Electric Appliance Company, Chicago, which is selling agent for the Adams-Bagnall arc lamps. A copy can be had by sending a postal card.

ELECTRIC BRAKES.—A company has been organized by George F. Campbell, Col. Glen Goss and Gustav DuWeilis, of Cincinnati, Ohio, and Joseph E. Dowling and John Drake, of Dayton, for the manufacture of a new electric brake for traction cars. A factory will be located in Dayton.

FIRE IN LAMP-BULB WORKS.—The plant of the Fostoria Glass Specialty Company was destroyed by fire recently, entailing a loss of about $50,000. The company manufactured bulbs for incandescent lamps and the stock was largely controlled by the Fostoria Incandescent Lamp Company. The insurance was about $17,000.

POWER PLANTS OF THE PACIFIC COAST.—A special reprint of the paper read by Dr. F. A. C. Perrine before the New York Electrical Society, description of the great transmission systems of California, has been issued. It includes illustrations of the great [illegible] plant and [illegible] other illustrations. It is bound in boards, [illegible] in. Price, [illegible], postpaid. The book is issued by the Stanley Elec. Mfg. Co., [illegible] Broadway, N. Y. City.

CHAIN BLOCKS.—One of the most useful devices around a factory or generating station is a chain block for handling heavy pieces of apparatus, etc. The Yale & Towne Manufacturing Company, 9 Murray Street, New York, makes a very complete line of chain blocks for quick service in handling materials, and these devices are described and illustrated in a pamphlet recently issued by the company. These chain blocks are of the differential, triplex and [illegible] types for occasional use, general use and constant use and best economy, respectively. The triplex chain block is made in lifting capacities up to 20 tons.

TOOL SHARPENING AND GRINDING.—With the title, "A Treatise on Sharpening and Grinding Milling Cutters, Reamers and Other Tools," the Cincinnati Milling Machine Company has issued a handsomely illustrated and printed pamphlet which will be found of much value to those interested in the subject. Following a page of general directions are two extensive clearance tables, and then come many pages of specific instructions for almost every possible application in machine sharpening and grinding. At the head of each of these pages is an excellent half-tone showing the setting of the machine, and below are the necessary instructions and cautions in concise form. Both in conception and execution the pamphlet is a creditable specimen of the type of trade literature which also contributes to the technical literature of an art.

McGUIRE RHEOSTATS.—The McGuire Mfg. Co., 122-132 North Sangamon Street, Chicago, has just issued a neat and instructive catalogue with regard to its well-known rheostats. It is well illustrated and shows a great variety of rheostats, motor starters, speed regulators, dynamo field regulators, theatre dimmers, etc. The motor starters are intended for automatic release, overload release, etc., and are of the button contact or segment contact types, as desired, with knife switches, blow-out fuses and other accessories, in the various needed combinations. The same variety is offered in speed regulators, simple, compound, etc. A neat class of dynamo field regulators is also made, in a wide range of capacities. Then there are theatre dimmers, organ regulators, etc. The pamphlet includes also some excellent connection diagrams, and gives full data, prices, etc. Mr. McGuire stands ready also to build such apparatus to specification.

OUR ROADS ASTONISH FOREIGNERS.—The development of passenger transportation in the United States astonishes all foreigners. Edwin A. Pratt, a representative of the London *Times*, was making some investigations recently at the Grand Central Station, with a view to writing a comprehensive article on American railroads. His inquiries developed the fact that the New York Central has eight passenger trains a day between New York and Chicago, and when he learned that the distance is 980 miles he remarked that it is a marvelous thing. He was still further astonished to find that four of the eight trains make the 980 miles in twenty-four hours, and that one, the Twentieth Century Limited, goes the distance every day, in either direction, in twenty hours. His amazement grew when he was informed that the westbound Twentieth Century Limited carries only Chicago passengers, and will not take a passenger for any other point. He remarked that his people would be equally astounded on learning these facts.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 16, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

12,064. REISSUE: MOTOR CONTROLLER; G. E. Krause and A. L. Bolen, Indianapolis, Ind. App. filed Nov. 4, 1902. A plurality of electrical resistances forming part of the motor circuit, of a pair of terminals for each of said resistances, and means for changing bridging connections between said terminals whereby the resistances may be placed in series or any number of said resistances placed in parallel with the remaining series arranged resistances.

715,741. INTERCHANGEABLE DIRECT AND ALTERNATING CURRENT ARC LAMP; M. H. Baker, East Liberty, Pa. App. filed March 11, 1902. The clutch mechanism is mounted on a non-vibratory flexible support.

715,797. ELECTRIC ARC LAMP; J. A. Heany, Philadelphia, Pa. App. filed Apr. 7, 1902. The dash pot is constructed to retard the upward movement of the feed mechanism and only a portion of the downward movement.

715,798. INSULATING METALLIC SURFACES OR WIRES; J. A. Heany, Philadelphia, Pa. App. filed April 10, 1902. (See Current News and Notes.)

715,813. INSULATED RAIL JOINT; W. E. Karns, Parkers Landing, Pa. App. filed June 10, 1902. Rubber insulation is vulcanized to the abutting surfaces of the joint.

715,817. COMMUNICATION WITH THE AID OF ELECTROMAGNETIC DEVICES; I. Kitsee, Philadelphia, Pa. App. filed June 19, 1897. The idea is to alternately energize, by means of negative waves, one or both rails of a track in opposite directions and receive such waves at a suitable distance by a receiving apparatus.

715,821. DRIVING MECHANISM FOR MOTOR VEHICLES; J. Ledwinka, Chicago, Ill. App. filed Feb. 10, 1902. The motor frame is secured to the fixed axle, the armature extending through a hollow hub and gearing with the drive wheel.

715,827. RHEOSTAT; F. Mackintosh, Schenectady, N. Y. App. filed May 22, 1901. Resistance coils are supported between two parallel open-work frames.

715,875. HIGH POTENTIAL INSULATOR; G. H. Rupley, Schenectady, N. Y. App. filed June 13, 1901. Two concentric tubes of insulating material with a filling of insulating material, such as oil, between them.

715,878. SWIVELING TRUMPET FOR TELEPHONES; Arthur Schoeler, Elberfeld, Prussia. App. filed April 7, 1902. (See page 1044.)

715,901. CONTROLLING ELECTRIC ARCS; E. Thomson, Swampscott, Mass. App. filed April 12, 1902. (See Current News and Notes.)

715,917. OUTLET OR JUNCTION BOX; M. F. Whiton, Hingham, Mass. App. filed April 17, 1902. Sheet metal caps are held in place in the openings of the box by clips.

715,920. ELECTRIC BATTERY; D. H. Wilson, Chicago, Ill. App. filed April 30, 1902. The carbon element consists of two cups integral with each other, separated by a space and opening in opposite directions.

715,930. TRANSFORMER FOR POLYPHASE ALTERNATING CURRENTS; E. Ziehl, Berlin, Germany. App. filed June 20, 1902. The cores have two long sides connected by intermediate bridge pieces. The coils for each phase are placed half on one long side and half on the other and between two bridge pieces.

715,941. COIL TAPING MACHINE; W. H. Bangs, Atlanta, Ga. App. filed April 11, 1902. Details.

715,975. CONTROLLER FOR ELECTRIC MOTORS; E. R. Carichoff, East Orange, N. J. App. filed Aug. 1, 1901. A spring is compressed between each notch and released suddenly to give the required quick movement.

715,976. ROD COUPLING; P. Carolan, Cleveland, O. App. filed Aug. 4, 1902. Details.

715,983. TROLLEY WHEEL; L. Chroninger and J. E. Adams, Findlay, O. App. filed May 21, 1902. A spiral track is formed on cones on each side of the wheel to conduct the wire into the central groove in case it becomes displaced.

715,999. TELEPHONE SYSTEM; William M. Davis, Chicago, Ill. App. filed June 17, 1901. (See page 1044.)

716,[illegible]. APPARATUS FOR COMMUNICATING SIGNALS THROUGH SPACE; L. De Forest, Chicago, and E. H. Smythe, Freeport, Ill. App. filed July [illegible], 1901. (See Current News and Notes.)

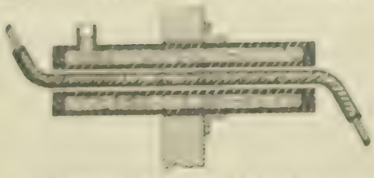
716,[illegible]. WORKING ZINC AND SUBSTANCES CONTAINING SILICIC ACID IN ELECTRIC FURNACES; [illegible], Germany. App. filed August [illegible], 1901. (See Current News and Notes.)

716,[illegible]. ELECTRIC HEATER; [illegible], Schenectady, N. Y. App. filed April 24, 1899. The resistance consists of a flexible [illegible] into a series of [illegible] coils and a [illegible] around the coils of [illegible].

716,[illegible]. STORAGE BATTERY; A. [illegible], Chicago, Ill. App. filed May [illegible]. [illegible] are applied to the plate to act as stiffeners.

716,[illegible]. AUTOMOBILE; J. [illegible], Chicago, Ill. App. filed Jan. [illegible], 1902. The [illegible] of the motor is made integrally with the axle and on the end of the latter [illegible] the wheel.

716,[illegible]. ELECTRIC RAILWAY; W. [illegible], Schenectady, N. Y. App. filed April [illegible]. A plurality of sources of current, a supply circuit, a control circuit and means brought into action by the control circuit for connecting the supply [illegible] with any one of the sources of current.



716,[illegible].—High Potential Insulator.

716,[illegible]. COMPOUNDING DYNAMO ELECTRIC MACHINES; E. B. Raymond, Schenectady, N. Y. App. filed Oct. 31, 1896. The combination with [illegible] a shunt transformer, a series transformer shunted by a [illegible], and a circuit connecting the secondaries in series, with their [illegible]tive forces in partial opposition.

716,[illegible]. ELECTRIC MEASURING INSTRUMENT; R. H. Read, Schenectady, N. Y. App. filed May [illegible]. Comprises a current carrying spiral [illegible] in a magnetic field and arranged to give a deflection by a change of shape of the spiral under change of currents.

716,110. VACUUM PUMP OR EXHAUSTER; T. A. Rose, London; W. A. Gwynn, Walthamstow, and A. M. Barnes, London, England. App. filed April 16, 1902. A [illegible] of magnetic material is moved by an external magnet.

716,113. DRIVING MECHANISM OF MOTOR CARS; A. Schmid, Havre, France. App. filed Jan. 28, 1902. Engine, dynamo, motors and controller, all mounted on the same vehicle.

716,[illegible]. ELECTRIC RAILWAY; E. A. Sperry, Cleveland, O. App. filed [illegible]. A traction rail engaged by suitable spur-wheels, also serves as the "third rail."

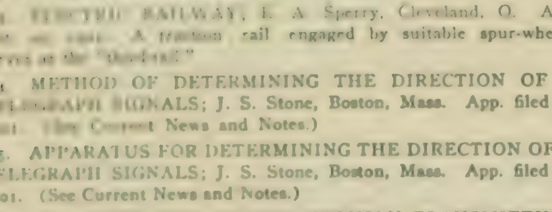
716,134. METHOD OF DETERMINING THE DIRECTION OF SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. (See Current News and Notes.)

716,135. APPARATUS FOR DETERMINING THE DIRECTION OF SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. (See Current News and Notes.)

716,136. APPARATUS FOR SIMULTANEOUSLY TRANSMITTING AND RECEIVING SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. (See Current News and Notes.)

716,137. METHOD OF SIMULTANEOUSLY TRANSMITTING AND RECEIVING SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. (See Current News and Notes.)

716,145. TROLLEY CATCHER; A. Thode, Hamburg, Germany. App. filed Sept. 25, 1902. A spring drum arrangement for winding up the trolley cord.



716,[illegible].—Communication with the Aid of Electromagnetic Devices.

716,155. ELECTRIC CABLE; J. H. West, Berlin, Germany. App. filed Sept. [illegible], 1901. A zig-zag strip of paper having notches in its edge in which the wires are carried.

716,178. RAILWAY SIGNALING SYSTEM; H. Bezer, New Rochelle, N. Y. App. filed Nov. 25, 1898. Improvement in a signaling system devised to force the action of the armature which determines the giving of a danger signal, also the removal of effects of sparking, also provision for setting the signals at danger in case of disarrangement of the circuit or apparatus.

716,179. RAILWAY SIGNALING SYSTEM; H. Bezer, Kingsland, N. J. App. filed Dec. 6, 1899. A modification of the preceding invention.

716,182. CARBOPHOSPHID OF CALCIUM; C. S. Bradley, Avon, N. Y., and R. H. Read and C. B. Jacobs, East Orange, N. J. App. filed April 20, 1898. (See Current News and Notes.)

716,186. COMBINED TELEPHONE AND TELEGRAPH SYSTEM; Charles E. Buell, Camden, N. J. App. filed Feb. 26, 1902. (See page 1044.)

716,189. MOTOR CONTROL SYSTEM; [illegible] Case, Schenectady, N. Y. App. filed June [illegible], 1901. A motor controller consisting of a group of independent elements arranged to control both the direction of rotation and the speed of one or more motors, each of said elements comprising a single set of contacts [illegible] the motor circuit and means for actuating the same.

716,193. DYNAMO ELECTRIC MACHINE; O. F. Conklin, Springfield, O. App. filed [illegible]. Fan blades on the armature shaft drive air through radial spaces between the coils.

716,200. CONTROLLING ELECTRIC MOTORS; M. W. Day, Schenectady, N. Y. App. filed [illegible]. A combined magnetic and friction brake for electrically [illegible], comprising connections for putting the motor on short circuit when the supply circuit is broken, a brake-releasing coil in series with the motor, and an auxiliary brake-releasing coil in shunt to the armature.

716,203. WIRELESS TELEGRAPHY; L. De Forest, Chicago, and E. H. Smythe, Freeport, Ill. App. filed Sept. 1, 1900. (See Current News and Notes.)

716,206. INDUCTANCE COIL; F. Dolezalek, Halensee, Germany. App. filed July 19, 1902. The core consists of small iron particles moulded together with insulating material and the coil is made up of fine wires bunched together and surrounded by a common sheath of insulating material.

716,216. END PLAY DEVICE FOR ROTARY MACHINES; H. Geisenhoner, Schenectady, N. Y. App. filed June 14, 1901. A rotary cam adapted to engage the revolving element at one limit of its end play and a cushion co-operating with the cam to assist its lateral thrust on the movable element.

716,222. RHEOSTAT; J. L. Hall, Schenectady, N. Y. App. filed June 27, 1901. A swinging frame carrying a magnet is adapted to lock the arm at any position of its movement and automatically release whenever the current fails.

716,252. ELECTRIC BRUSH; R. D. Laughlin, Ravenna, O. App. filed May 10, 1902. A laminated brush composed of alternate layers of carbon and plumbago.

716,278. COOLING DYNAMO ELECTRIC MACHINES; H. G. Reist, Schenectady, N. Y. App. filed June 26, 1901. A tubular frame having deflecting wings therein to direct air through all parts of the frame.

716,293. SUPERVISORY SIGNAL FOR TELEPHONE EXCHANGE SYSTEMS; C. E. Scribner, Chicago, Ill. App. filed April 1, 1901. (See page 1044.)

716,301. SIGNALING; R. C. Spaulding, Montclair, N. J. App. filed Jan. 29, 1902. A signal device consisting of a simultaneously operated horn and electric flash light.

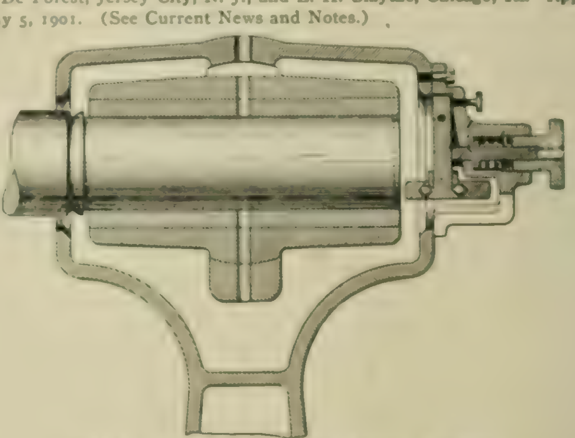
716,302. COMBINED TELEPHONE, TELEGRAPH, ELECTRIC-LIGHT AND POWER SYSTEM; Alexander McMartin, Toronto, Can. App. filed July 12, 1901. (See page 1044.)

716,306. PROCESS OF ELECTROLYTICALLY PREPARING MEDALS AND ALLOYS FOR LITHOGRAPHIC PURPOSES; O. C. Strecker, Cologne, Germany. App. filed April 19, 1900. (See Current News and Notes.)

716,311. ELECTRICAL CONDUCTOR; E. Thomson, Swampscott, Mass. App. filed May 23, 1902. (See Current News and Notes.)

716,329. ANTISEPTIC PROTECTOR FOR TELEPHONE-MOUTHPIECES; Robert I. Willmarth, San Francisco, Cal. App. filed Feb. 13, 1902. (See page 1044.)

716,334. METHOD OF COMMUNICATING SIGNALS THROUGH SPACE. L. De Forest, Jersey City, N. J., and E. H. Smythe, Chicago, Ill. App. filed July 5, 1901. (See Current News and Notes.)



716,216.—End-play Device for Rotary Machines.

716,345. COMPOUNDING DYNAMO ELECTRIC MACHINES; E. B. Raymond, Schenectady, N. Y. App. filed Oct. 31, 1896. The method of regulating a main circuit, which consists in applying to a secondary circuit in series two alternating electromotive forces, one dependent upon the voltage of the main circuit, and one upon the current in the main circuit, the two electromotive forces being dephased by an angle greater than a right angle, and compensating by the variation of current in said secondary circuit for the variation of electromotive force in the main circuit caused by shifting of phase of current in said circuit.

716,355. METHOD OF REGULATING MULTICIRCUIT GENERATORS; H. H. Wait, Chicago, Ill. App. filed May 5, 1902. The method of preventing undue sparking in multicircuit generators under conditions of unequal load on the different circuits, which consists in maintaining the electro-motive forces in the short circuited coils at their proper values by varying the components which produce these electromotive forces, to compensate for the changes caused by the unequal distribution of the armature reaction.

716,356. REGULATING MECHANISM FOR MULTICIRCUIT GENERATORS; H. H. Wait, Chicago, Ill. App. filed May 5, 1902. Details.